

wholly impossible, to estimate their relative importance in producing a fatal result, and where a new method is in question it is always well to be cautious in ascribing dangers to it on theoretical grounds. Scopolomorphine has now been so extensively used that it is possible to estimate its relative safety with some degree of accuracy. Faust,²⁷ Rinne,²⁸ and Neuber²⁹ have reported fatalities, and American observers have added to the number, while more recently Schoemaker³⁰ and Sick³¹ have also discussed the question. Neuber, in an elaborate paper, puts the figures as follows: scopolomorphine, 1 in 4762; chloroform, 1 in 2060; ether, 1 in 5930. These are fairly reliable figures, as they have been worked out from a very large number of published and unpublished cases, but it is obvious that a large number of cases of so-called deaths under anæsthetics are never reported and are therefore not available for statistical purposes. With regard to the opium combinations, many of the reported cases are not wholly reliable. Schoemaker's case, in which a patient died after an injection of a quarter of a grain of scopolomorphine, is one of those. With regard to pantopon, I know of only one fatality, and it is very doubtful if that can be ascribed to the drug, since there was apparently no necropsy. The patient died the day after the operation in coma; the anæsthesia had apparently been normal throughout. It is generally agreed that death in cases of scopolomorphine anæsthesia is due to the morphia. The symptoms, which come on a few hours after the operation, are those of opium poisoning—sleep, deepening into stupor, supervening in coma. With pantopon the picture would probably be similar, and the treatment would be on the lines of an ordinary case of morphia intoxication. It is just as well, therefore, to bear in mind that, according to Rigopoulos,³² atropine is not of much use in such a condition, but that early intravenous injections of a fairly strong solution of potassium permanganate hold out the best chance of saving the patient. During the administration the size of the pupils does not afford much indication of the depth of anæsthesia when pantopon is used; they are usually contracted, reacting faintly to light, but when much oxygen is given they may remain comparatively large with an equally faint reaction; the conjunctival reflex is hardly ever lost with pantopon. The safest guide to the anæsthetist in this as in most other methods remains a careful attention to all details, especially the cutaneous capillary reflex, and the condition of the breathing though the latter may be almost inaudible and imperceptible in some patients during an apnoic period when oxygen is used.

My thanks are due to Dr. E. Michels for allowing me to make use of some of his cases, and to Dr. A. Oberstadt, the house surgeon, and Dr. G. Dorner for information with regard to the after-history.

Buckingham-street, W.C.

A NEW METHOD OF ADMINISTERING NITROUS OXIDE, WITH OR WITHOUT OXYGEN, FOR PROLONGED DENTAL OPERATIONS.

BY NORMAN S. HEEGAARD WARNER.

THE apparatus used is shown in the accompanying woodcut, and consists of the following parts.

A special form of inhaler, which I call a *naso-oral inhaler* and which has two separate parts—a nose-piece and a mouth-piece. A metal attachment is adjusted so that two rubber tubes are in connexion with the ordinary "gas bag." These tubes pass one each side of the patient's head, and are joined to a hollow metal T-piece, which rests against the forehead. The vertical or lower part of the T-piece has a wider bore, and is joined to the top of the nose-piece by a short piece of rubber tubing.

²⁷ Faust: Deutsche Medizinische Wochenschrift, 1910.

²⁸ Rinne: Deutsche Medizinische Wochenschrift, 1910.

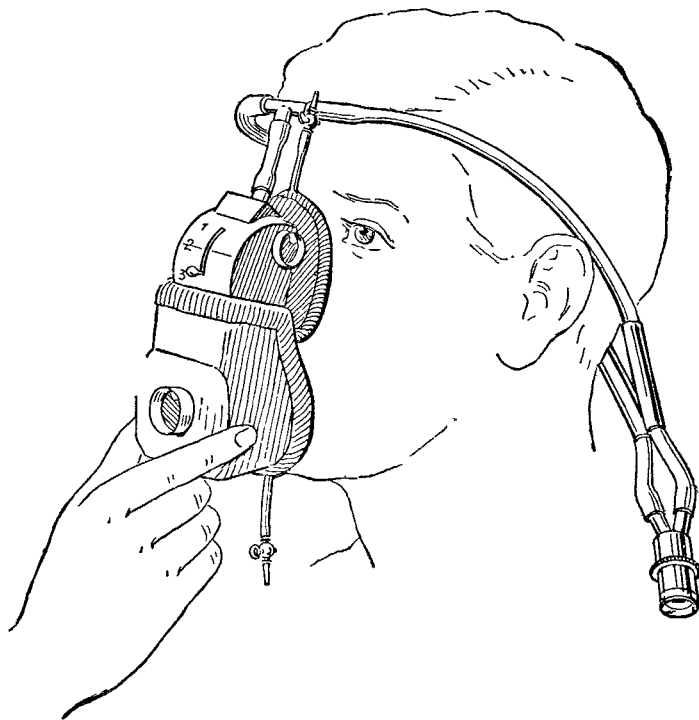
²⁹ Neuber: Surgical Congress, 1909.

³⁰ Schoemaker: Deutsche Medizinische Wochenschrift, 1910.

³¹ Sick: Loc. cit. ant.

³² Rigopoulos: L'Action Antagonistique du Permanganat de Potasse vis-à-vis de la Morphine, Thèse de Genève, 1905. See also Hancock: Zeitschrift für Experimentelle Pathologie und Pharmakologie, Band vii. Lindemann: Ibid. Bendersky: Comptes Rendus de la Société de Biologie, 1904. Engelmann: Centralblatt für Chirurgie, 1902.

The nose-piece is so made that it takes up the minimum amount of room (so as not to get in the way of the operator), and at the same time has the maximum width for its apertures. Running down the centre is a sliding plate (the regulator) which can be adjusted to the following positions, so that (1) the supply of gas is immediately cut off and air simultaneously admitted; (2) gas is admitted only to the nose; and (3) gas is admitted to the nose and mouth (as shown in the illustration). In the lower part of the nose-



piece is a rectangular opening, which, however, is not shown in the illustration, as it is covered by the upper part of the mouth-piece, thus indicating Position 3. This opening serves a double purpose: (i.) admits air, provided that the mouth-piece is removed and the regulator is in Position 1; (ii.) communicates with the mouth for the passage of gas, when the mouth-piece is in place and the regulator at Position 3 (vide illustration).

An expiratory valve is on either side of the nose-piece. Nose-pieces can be obtained fitted with or without pneumatic rubber cushions, though the former is advised, thus ensuring a better fit round the bridge of the nose. Coming off from the smooth facet of metal, just in front of the nitrous oxide tube, but not shown in the woodcut, is a short metal tube for the oxygen attachment. This tube is closed at its upper end by means of a metal cap, to prevent the escape of nitrous oxide when the oxygen attachment is not in use.

The mouth-piece needs no special description other than the illustration. It is supplied with an expiratory valve in the centre, and a pneumatic rubber pad or cushion round its sides. The rubber pad is essential in the case of the mouth-piece. Both the rubber pads can be easily removed for sterilising purposes.

I.—When used for the Administration of Nitrous Oxide without Oxygen.

The connexions having been made, as already described, the gas-bag filled, and the patient ready with mouth-prop in position, the nose-piece is adjusted with the regulator at 1—i.e., the patient is breathing only air through the nose-piece.

(a) In the case of normal patients.—A few words of encouragement and instruction should be given the patient as to breathing through the nose. After a few inspirations of air, when he should have become accustomed to the inhaler, and when he is seen to be breathing normally the valves on the stopcock of the gas bag are thrown out of action (as they are unnecessary, there being valves on the nose-piece), and the regulator is then turned to 2. At this point the mouth piece is put in position, which is, so that its upper border lies between the lowest part of the slot in which the regulator slides, and the upper border of the rectangular opening, which admits air. It is important that a gentle but constant pressure be exerted on the bag, to force the gas through the tubes, otherwise the patient is apt

to strain on inspiring, and hence suffer from feelings of faintness on recovering from the effects of the gas. Also, due to the fact that the pressure of the gas is greater than atmospheric pressure, the inadvertent entrance of air is prevented. If the patient is recovering from the anæsthetic during the operation the pressure should be increased until he is again well under the influence of the gas.

There are several forms of bag compressors on the market, all more or less after the same principle. One that I have found work admirably is the steel-spring compressor that was designed by Mr. J. F. Trewby, house anæsthetist at the Royal Dental Hospital of London, and used by him at that hospital. Another steel compressor—one that is cheaper but equally efficient—is the one designed by Mr. F. Coleman, assistant dental surgeon to the Royal Dental Hospital of London. Thirdly, the gas-bag could be compressed by an assistant; but if one is unobtainable the anæsthetist should use his own arm or hand. The last mentioned can be managed quite well after a little practice.

The most scientific and preferable method, however, is to use a special form of gas regulator, which can be joined to the gas cylinder, and which obviates the necessity of using a gas bag. Connected to both cylinder and gas regulator are nine coils of thick copper wire, beneath which is a small metal stand, on which rests an ordinary spirit lamp. This little lamp when lighted heats the copper wire, two or three minutes only being necessary to produce gas at body heat, provided an average pressure is exerted. Fixed to the top of this gas regulator is a fine screw adjustment, by means of which any desired pressure can be obtained. If this regulator is used the gas bottles will be found not to freeze, as is often the case if a great number of gas patients are treated in immediate sequence.

Usually in from 45 seconds to a minute the mouth-piece can be removed, and the dental operation started. There is no need to "push the anæsthesia" to the end of the third stage, as is done with the ordinary face-piece, but the operation can be proceeded with at the beginning of the third stage of nitrous oxide narcosis.

Best signs indicating the stage in the administration at which to remove mouth-piece.—(i.) Eyes become dull and expressionless, but sclerotic reflex persists; (ii.) the pupils begin to dilate; (iii.) strabismus sometimes occurs; (iv.) limbs become flaccid. While the dental operation is proceeding, anæsthesia is kept up, until the breathing loses its rhythm and a slight stertor is audible, together with other approaching signs of deep nitrous oxide anæsthesia. These signs generally occur within 30 seconds of the removal of the mouth-piece, and at this point two full inspirations of air should be allowed, or the patient should be permitted to breathe air for about five seconds. When these deeper signs again appear the patient can have, as a rule, from 5 to 20 seconds for breathing air—i.e., from two to eight inspirations—when the gas should again be turned on by the regulator on nose-piece.

The administrator should endeavour to steer clear of deeper nitrous oxide narcosis, and should avoid such signs of deep anæsthesia as "oscillation of the eyeballs," and "jactitations" (clonic muscular movements of the thoracic and abdominal muscles and extremities, and spasmodic elevations of the larynx towards the epiglottis and base of the tongue, the last mentioned giving rise to the stertor).

I find it better to begin the administration of gas through the nose only, as it is easier for the patient to continue breathing so, after the removal of the mouth-piece. The mouth-piece could be discarded in normal cases, the patient's mouth being closed at the beginning of the administration, which is conducted by means of the nose-piece alone. When the patient is sufficiently under his mouth could be opened up with a Mason's gag.

(b) *In the case of alcoholic patients and mouth-breathers, &c.*—The administration is proceeded with on similar lines as before, with the exception that when the patient has inspired one or two breaths of air through the nose-piece, and has become used to the inhaler, the mouth piece is adjusted immediately, and the regulator moved to Position 3 (as depicted in the illustration)—i.e., the inhaler is practically converted into an ordinary face-piece. The patient is now having gas administered to him through the nose and mouth. This is kept up until the patient is ready for the operation, when the regulator is moved to Position 2, and the mouth-piece withdrawn. This method is desirable with powerful men, or alcoholic and other excitable patients, as the period

of induction is considerably lessened. Mouth-breathers are certainly not very good patients as regards nasal administration, but even they can be made to have a longer period of anæsthesia than they would have with the ordinary face-piece method.

II.—When used for the Administration of Nitrous Oxide with Oxygen.

As already explained, there is a short metal tube of narrow bore at top of nose-piece as a fixture, to which another tube of similar bore can be adjusted. This latter tube is the oxygen attachment, and has fixed to it an ordinary long-arm tap for regulating the supply of oxygen. This tap can be made to pass across an arc plate, which has a series of depressions into which a stud spring catches. The depressions are placed very close together, so as to give the smallest variation to the arm, at the same time holding it securely during any of the movements (Weiss). When the arm, or tap, is vertical it is full on, and when horizontal the oxygen is turned off.

A rubber tube of equal bore is joined to the other end of this metal tube, and communicates with the oxygen bag, which should have a capacity of about one and a half gallons. The nitrous oxide and oxygen bags are both filled and hung on a stand or on to a metal bar, which can be adjusted to any operating chair. The bags should hang immediately to the left of patient (out of the operator's way), and in such a position that they can easily be seen by the anæsthetist. They should also be as near to the patient's head as possible, so that the minimum distance from gas bags to nose-piece can be obtained.

If a pressure regulator for the N_2O is used, only one bag with a spring compressor will be needed—viz., that for the oxygen. The N_2O and the oxygen must, of course, be administered under an equal pressure.

The oxygen is used simply to control the number of respirations, and keep down the cyanosis.

Usually in about 45 seconds the breathing becomes slightly laboured and noisy. At this point oxygen is gradually admitted, when the breathing will generally quieten down. If excitement ensues, the supply of oxygen is lessened or turned off altogether, and two or three inspirations of nitrous oxide allowed. After this the oxygen can be turned on again very gradually. *In this manner the respirations can be controlled.* Air, however, should be admitted from time to time.

Signs to watch for to indicate the best time for removal of mouth-piece: (i.) *Respiration* is regular and tranquil, or is softly snoring in character (similar to the breathing in a good chloroform anæsthesia); (ii.) the sclerotic or corneal reflex is abolished; (iii.) the eyeballs are fixed and widely staring, or present slight oscillatory movements; (iv.) *extremities* are flaccid (or, in rare cases, very rigid). Sometimes the corneal reflex is still present, when the other signs appear, in which case the mouth-piece can safely be withdrawn and the operation started. The other particulars are essentially the same as in the administration of nitrous oxide alone. This method should be used in cases of disease in the circulatory system, heart weakness, &c.

Advantages of the Method.

I. *Its advantage over the usual method of administering nitrous oxide and oxygen, or nitrous oxide alone.*—1. A much longer anæsthesia is obtained. Mr. J. H. Patterson, by means of the nasal method of administration, maintained anæsthesia for 9 minutes 55 seconds, using nitrous oxide without oxygen. This was at a public demonstration at Cambridge on a man aged 35 years. The patient was kept absolutely quiet, and recovered after a very few minutes. During anæsthesia two exposed and inflamed pulps were removed, and the two teeth partly prepared for crowning. In addition to this 18 teeth were extracted. On 23 occasions the anæsthesia has exceeded four minutes, but it must be mentioned that these times represent the actual duration of the operation and not the total available anæsthesia, which would be 20 or 30 seconds longer, and which could have been further prolonged had the operation required it.]

2. There is no necessity to "push the anæsthetic" at all, as is often done to an asphyxial point in the ordinary face-piece method, in order to maintain a longer anæsthesia. Many hold the view that this "pushing the gas to the utmost limit" is unscientific and wrong in principle, though

one need not doubt for a minute that it is perfectly safe in the hands of an expert anæsthetist.

3. *The operator* would appreciate this method, as it gives him longer time to do the work in hand thoroughly. Each extraction being performed deliberately, would be a great advantage to—

4. *The patient*, inasmuch that it would mean less damage to the alveolar process, and thus a quicker healing and absorption of the tooth sockets.

5. The instantaneous action of the oxygen in arresting accelerated breathing.

11. *Its advantage over ether, ethyl chloride, and chloroform.*—1. It is a safer anæsthetic. 2. It requires no special preparation of the patient. 3. The patient's recovery is much quicker, and is, as a rule, unattended by any unpleasant after-effects, as vomiting, headache, &c., the patient being quite able to go home after a few minutes.

Advantages of the Apparatus.

1. The extreme simplicity and ease in learning how to manage it. The anæsthetist practically has the whole control of the inhaler and the patient, in the small handle of the regulator.

2. Only one hand is necessary to hold the entire inhaler in position (i.e., both nose-piece and mouth-piece together), leaving the other hand free to manipulate the gag, &c.

3. The same movement of the regulator cuts the "gas" off and simultaneously admits air, which enters immediately below the patient's nostrils.

4. There is no need to remove the nose-piece from the patient's face to admit air, this being a great advantage to the operator. Its shape, also, is such that it is well out of the operator's way.

5. The Naso-Oral Inhaler will fit practically everybody.

6. The nose-piece is so made that it takes up the minimum amount of space, and at the same time has the maximum size for its apertures.

7. The oxygen is quite independent of the N_2O .

8. The quantity of oxygen used is always visible.

9. Great economy of oxygen.

10. Great economy of N_2O if a regulator is used.

11. Definite proportions of air, N_2O , and oxygen can be admitted, if required, by decreasing the pressure of the N_2O and the oxygen, and moving the regulator on the nose-piece to any desired point between positions 1 and 2.

12. Both nose-piece and mouth-piece are supplied with expiratory valves.

13. The apparatus can easily be adjusted to any gas-bag, gasometer, regulator, or stop-cock that the dental surgeon may already have in his possession.

This apparatus has had a successful trial at Guy's Hospital Dental Out-patient Department during the summer term and long vacation, and has been approved by the dental surgeons and anæsthetists present.

The following can be cited as examples of two of the cases, which we had during the winter session:—

CASE 1.—One Saturday morning (Oct. 22nd, 1910) Mr. Marmaduke Page easily maintained anæsthesia with this apparatus for a period of about seven or eight minutes, though, unfortunately, no exact time was recorded. During anæsthesia, Mr. Montagu Hopson removed a myeloid epulis from an upper jaw, and at the same time extracted the adjoining right central incisor. Both sides of the alveolar process were thoroughly scraped and then cauterised with pure carbolic acid. After this, the incisor was replanted, being kept in place by a special dental splint made of metal, which was cemented over the teeth with copper oxy-phosphate. The splint was held firmly in position while the cement set, anæsthesia being maintained during the whole process. The patient, a girl, aged 13 years, had a quick recovery, with no unpleasant after-effects, and was able to walk home almost immediately.

CASE 2.—A similar operation took place on Saturday, Nov. 19th, 1910, when Mr. Montagu Hopson again removed a myeloid sarcoma, with extraction and replantation of the adjoining lateral incisor. In this case anæsthesia was maintained for 10 minutes 25 seconds—i.e., until the completion of the operation. A longer anæsthesia was required on this occasion, owing to the fact that the dental pulp was removed and the nerve canal carefully filled with an antiseptic material prior to the replantation of the incisor. A special dental splint was then applied as before. The patient

(female, aged 22 years) had a similar recovery as that mentioned in Case 1, which was excellent in every way. It should be remarked that she was distinctly a very neurotic patient, and a pronounced mouth-breather. The third position of the regulator on the nose-piece proved of great value.

I should like to acknowledge that the appearance of this apparatus is largely due to the excellent instruction and practice that I was fortunate enough in obtaining from the staff anæsthetist who taught me. If, by chance, he should read this article he will see that I fully appreciate the 12 months' course of instruction that he gave me, and the splendid practice I had in administering general anæsthetics as his "full clerk" in the surgical and dental out-patient department.

I am grateful also to the dental surgeons, assistant dental surgeons, and anæsthetists, for their courtesy and kindness in allowing me to use the inhaler in the out-patient department at Guy's Hospital.

Acknowledgments are due to the Dental Manufacturing Company, of Newman-street, Oxford-street, W., for their willingness in making the apparatus for me, for their help in assisting me in getting out a universal shaped nose-piece, and for their patience in making many slight alterations to perfect the same.

In conclusion, I wish to thank Mr. Kenneth Hoby, L.D.S. Eng., and Mr. Ellison, co-manager of the company, for help as regards the drawings and woodcut.

Brockley-road, S.E.

Clinical Notes:

MEDICAL, SURGICAL, OBSTETRICAL, AND THERAPEUTICAL.

THE ADMINISTRATION OF THYROID GLAND SUBSTANCE UPON SERUM RASH AND SERUM SICKNESS IN DIPHTHERIA.

BY A. E. HODGSON, M.B. EDIN., D.P.H. CAMB.,
RESIDENT MEDICAL OFFICER, CITY HOSPITAL EAST, LIVERPOOL.

THE occurrence of serum rashes, either alone or in conjunction with high temperature, arthritic pains, oedema, inflamed throat, adenitis, rhinitis, albuminuria, &c., forming the syndrome designated by von Pirquet as "serum disease," after the hypodermic injection of diphtheria antitoxin and other sera, and the graver anaphylactic complications, have attracted very considerable attention during recent years, both at home and abroad.

The conclusions most generally accepted are: (1) That the phenomena are not due to any substance in the antitoxic elements of the serum, but to a protein body inherent in the serum itself; (2) that serum rash and serum sickness or disease may follow one injection only, but will follow more rapidly when a second injection is made, coming on earlier as a rule, the more recent the first injection; and (3) that anaphylaxis usually only becomes a possibility when a second injection is made from 10 to 12 days and onwards, after the primary one.

Simple serum rash may be of no consequence in a case of diphtheria, in so far as bad results are concerned. On not a few occasions however, I have seen infants rendered distinctly "croupy" by oedema of portions of the air passages, coincident with, or resultant upon, an urticarial serum rash. Serum sickness, when severe, may very considerably tax a patient whose system is already burdened with the toxins of diphtheria; and I cannot agree with a recent writer in whose opinion the occurrence of a sharp febrile reaction has been rather useful than otherwise in very prostrate patients. The pyrexia, amounting to 103° F., or even 104° in some cases which I have observed, cannot but have some detrimental effect upon the cardiac muscle. Similarly, the sudden oedemas are commonly accompanied by an alarming fall in blood tension. Two cases in my recollection—each suffering from only a comparatively mild attack of diphtheria—came to a fatal issue as a result of exhaustion following a severe attack of serum sickness. The condition of anaphylaxis, I have fortunately not encountered as yet.