

Of the patients referred to in the second table, 2 exhibited temperature charts steadily above normal, 2 showed normal temperatures in the morning, and 1 showed a subnormal temperature throughout. The marginal notes give an indication of the symptoms and conditions which called for comment and also draw attention by cross references to corresponding doses and other comparisons in the two tables.

Before examining the essential points of difference in the two tables it would simplify the business of comparison to describe what seem to be the main characteristics of the opsonic curve as it is seen after an inoculation of tuberculin in phthisis, and to show how it differs from that following tuberculin in a chronic lesion in some other locality. In the paper above referred to an attempt was made to show that the tuberculo-opsonic curve in phthisis was a complex curve which could generally be resolved without difficulty into two or more successive curves, overlapping each other in their incidence; and there it was further suggested that these curves consisted of a primary curve due to the inoculation and one or more secondary curves due to auto-inoculations set up as a result of hyperæmia in the diseased area in the lung. The accompanying figure shows such a curve (A), and for



Primary and secondary inoculation curves: *p*, primary; *s*, secondary.

comparison is shown what may be termed an ideal inoculation curve (B). A third curve (C) is found to occur not infrequently in febrile phthisis. It consists of an appreciable rise lasting for 24 hours or longer, followed by a fall lasting about the same length of time and succeeded by a prolonged positive phase. Wright has described such a preliminary rise as occurring after an inoculation in other conditions, but I understand that he has found it to be of very short duration, being rapidly succeeded by the negative phase. Now this prolonged preliminary rise occurs no less than ten times quite unmistakably in Table I. (Nos. 5, 8, 9, 10, 13, 14, 16, 21, 23, and 24, and perhaps 7 and 17), whereas in Table II. it occurs only twice (Nos. 9 and 21). Of the two last mentioned the first was undergoing at the time large auto-inoculations with high temperatures, which probably vitiated the curve, and the other has been shown to be possibly uninfluenced by the eucaïne.

Look again at the figure (A). Such a curve is found in 16 out of the whole list, when no eucaïne was added to the dose, and in 5 of the remainder was obscured or replaced by a quite uncomfortably prolonged negative phase, accompanied by malaise. In Table II. the curve is only found 5 times altogether, and then with diminished distinctness. Compare Table II., No. 10, on Sept 16th, where eucaïne was used, with Table I., No. 24, on the 23rd of the same month, where the same dose was given only a week later, but without eucaïne. Compare also Table II., Nos. 4 and 5, with Table I., No. 13. Finally, malaise follows 13 of the doses without eucaïne and only 2 in Table II., of which one is again the doubtful No. 21.

Conclusions.—1. There is a distinct difference in the response to an inoculation of tuberculin in phthisis if eucaïne be combined with the dose. 2. The chief proof of this rests on the form of opsonic curve which follows such doses as compared with doses in which no eucaïne was given. 3. There is a possibility that an inoculation of tuberculin produces its effect in part by stimulating the central nervous system. 4. Such stimulation may take place at the site of inoculation.

Yelverton, Devon.

SOME REMARKS ON PANTOPON ANÆSTHESIA.

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DURING the last ten years so many new methods of inducing and maintaining surgical anæsthesia have been placed before the profession that it seems almost supererogatory to add yet another to the number demanding investigation and criticism. But it is fairly obvious that none of the methods now in use can honestly be styled ideal; the very fact that so many novelties are competing for popularity is a proof of the absence of a thoroughly satisfactory anæsthetic. So far as I am aware, up to the present no report of any case in which pantopon has been used as a "combined anæsthetic" has been published in English medical literature, and the conclusions of continental surgeons with regard to this new adjuvant have hitherto received scant attention in this country. As I have now for some time been using the drug a preliminary *résumé* of the results obtained with it may not be without interest to those who are not already acquainted with its possibilities, and it is with that object that these initial notes have been written.

In the early part of 1909 Sahli¹ of Berne, experimenting with the various alkaloids contained in crude opium, concluded that the most effective narcotic was a definite, stable solution of these alkaloids, in which the relative strength of the various constituents was definitely known or could be accurately measured. At his request, Schärger of the firm of La Roche prepared such a mixture, which was provisionally styled "pantopon" (from παν all and ὅπος juice). This, briefly, is a mixture of the soluble chlorides of opium in which the relative strengths of the following are claimed to be known: morphine, narcotine, codeine, papaverine, narceine, thebeine, hydrocotarnine, codamine, laudanine, laudaniidine, laudanoine, meconidine, papaveramine, protopine, lanthopine, cryptopine, goscopine, oxynarcodine, xanthaline, and tritopine. It is obtained as an amorphous, yellowish-brown powder, resembling somewhat finely powdered crude opium, easily soluble in water, less easily in alcohol and acetone, and forming a clear, colourless, or slightly brownish solution which is apparently quite stable at the ordinary temperatures, and which is faintly acid in reaction. One gramme of pantopon is estimated as being equivalent to five grammes of 10 per cent. morphine and 18 per cent. opium, but this estimate is probably too low, especially for anæsthetic purposes. The powder and the solutions have been extensively tried in continental clinics as narcotics and anodynes, and are claimed to be superior to other opium compounds and derivatives. Already a large number of reports on the clinical usefulness of the combination have been published, among which the work of Hallervorden,² Heimann,³ Rodari,⁴ Gottlieb,⁵ Witowski,⁶ and Raffalovitch⁷ contains much interesting information. For some time the drug has been used as an adjuvant to general anæsthesia, and the results so far obtained, notably by Brustlein,⁸ are so eminently satisfactory that the combination deserves wider trial and investigation. It is almost regularly employed at the German Hospital, Dalston, and has proved remarkably useful.

Combined anæsthesia, in which narcotics are used as a preliminary to the administration of the general anæsthetic, has now been so generally tested that we are in a position to draw certain definite conclusions with regard to its advantages and limitations. The combinations are so varied, ranging from the chloral-urethane group to that in which morphia in some form, either alone or combined with hyoscine, is administered, that it is not easy to collate the findings of various observers. The whole question opens up

¹ Sahli: Münchener Medizinische Wochenschrift, No. 26, 1909. Therapeutische Monatshefte, No. 1, 1909.

² Hallervorden: Über die Anwendung des Pantopons, Therapie der Gegenwart, 1910, No. 5.

³ Heimann: Münchener Medizinische Wochenschrift, No. 7, 1910.

⁴ Rodari: Therapeutische Monatshefte, 1909.

⁵ Gottlieb und v. d. Eeckhart: Festschrift für Schmiedeberg, p. 235.

⁶ Witowski: Archiv für Experimentelle Pathologie und Pharmakologie, Band xvii. V. Schroeder: Ibid., Band vii.

⁷ Raffalovitch: Deutsche Medizinische Wochenschrift, 1910.

⁸ Brustlein: Correspondenzblatt für Schweizer Aerzte, 1910.

such an interesting field of possibilities that it is not surprising to find extreme differences of opinion with regard to individual methods. A few points, however, stand out clearly, and it may not be without interest to draw attention to Burgi's⁹ recent elaborate series of experiments in which a large number of combinations were tested. These conclusions have not been challenged; on the contrary, more recent work by Italian critics seems to confirm Burgi's work in substance. He found, what was already known clinically, that two narcotics introduced simultaneously or shortly after each other have a much more powerful effect than when a total quantity of one narcotic, equivalent in strength to the combination, is administered. This triple or quadruple increase of action is greatest when the two narcotics have different cell receptors, and a dose of one drug acts much better when it is given in relatively small quantities, with an interval between each administration, than when it is exhibited at once. These conclusions are of some interest as supporting the Burker¹⁰ theory of narcosis and as yielding certain data which seem at variance with the hypotheses of Overton-Meyer and the Verworn school generally. They are supported by Madelung,¹¹ who, working with small quantities of scopomorphine, found that this combination very powerfully increases the anæsthetic effect of ether, and that it suffices to produce surgical anæsthesia in animals who are allowed to inspire CO₂ or a mixture of this gas and oxygen. Neu's¹² more recent work in this direction is equally interesting, for he found that the administration of small doses of scopomorphine materially increased the effect of gas and oxygen. Rocchi's¹³ results were similar with regard to atropine-morphine combinations, and as early as 1880 Surmay¹⁴ pointed out that a preliminary dose of chloral enabled the anæsthetist to use a much smaller quantity of ether than in cases in which no adjuvant had been used. Rave¹⁵ in America and Franck¹⁶ of Bordeaux reported similarly with regard to other combinations; and much more recently Wolffsohn¹⁷—who was the first observer, I believe, to draw attention to the interesting fact that a positive Wassermann reaction is the rule after combined anæsthesia—has laid stress on the important summative effects of small quantities of a narcotic drug, not in themselves sufficient to produce any appreciable degree of narcosis, in influencing the rapidity of action of general anæsthetics. The advantages of dividing the preliminary dose of narcotic have been concisely summed up by Beinaschewitz,¹⁸ whose conclusions on this subject are well worth study.

These findings are valuable when we consider that pantopon appears to be in many respects an ideal narcotic to employ for anæsthetic purposes. In the majority of cases, as Sahli and his co-workers¹⁹ have shown, it is well tolerated, producing none of the unsatisfactory after results that sometimes follow the administration of solutions of morphia. Raffalovitch, in the interesting thesis already alluded to, states that it influences the respiratory centre much less than does morphia, and Grafenberg,²⁰ in an equally instructive study in which he contrasted it with scopomorphine, comes to the conclusion that it is in every way preferable, since it is more reliable and has no tendency to cause collapse. It is at present used mainly as an injection, 1 c. cm. of a 2 per cent. solution of the drug being injected an hour before the operation, though, as has already been stated, it is much to be preferred that the dose should be subdivided and administered at intervals. The solution can be bought ready prepared in ampoules, each containing the requisite dose, or it can be readily made by dissolving the powder in a mixture of 75 per cent. water and 25 per cent. glycerine, the solution so obtained being quite stable and sterile. At the

German Hospital the ampoules are used, and they have so far proved quite satisfactory. The injection causes a slight tingling, similar to the sensation which is experienced after an ordinary hypodermic of morphia; this soon passes off, and the patient feels no further discomfort. The anodyne action of the drug is very striking; the pulse becomes slower and steadier, the respirations are quieter and more regular, and—a matter of considerable importance to the anæsthetist—the patient is quite tranquil and composed when brought in. The difference between pantopon and scopomorphine in this last particular is very marked. Where a patient has received a comparatively small dose of the latter it often happens that his behaviour on the table is the reverse of satisfactory, especially in cases where oxygen is used in combination with ether or chloroform; in sturdy alcoholic adults this negativism, to use a charitable expression, is sometimes very great. With pantopon I have as yet observed no such preliminary excitement, and the period of induction is very much shortened, even when contrasted with the relatively short stage in scopomorphine anæsthesia. In some cases, where two injections of the drug have been given, somnolence is much greater, and Brustlein has been enabled to perform operations on patients in this condition without availing himself of a general anæsthetic at all. For obvious reasons, however, this course is to be deprecated, especially since we lack conclusive evidence with regard to the narcotic strength of the preparation. I have already stated that I consider the morphia equivalent of pantopon is too low, and it must always be remembered that individual idiosyncrasy towards opium derivatives is sometimes very marked and can never be previously estimated. The combination of morphia with narcotine may have something to do in determining the action of the preparation in certain individuals who appear to respond to it much more quickly than others, and in future it may be preferable to use pleistopon, a combination in which the latter alkaloid does not enter. I have as yet had no opportunity of trying this combination myself, and I know of no reported cases in which it has been employed as a preliminary to general anæsthesia.

A considerable experience of scopomorphine anæsthesia, especially in combination with ether and oxygen, has convinced me that Perrier's²¹ strictures on this combination are not altogether undeserved. However easy and pleasant in the majority of cases it renders the anæsthetist's task, especially with regard to inducing narcosis, and however much it minimises the dangers of general anæsthesia, its after results are not always so satisfactory as one could wish. In the first place, the relative length of the apnoic periods during the administration of ether and oxygen are greater than where no narcotic has been used as a preliminary, and though it is easy to overcome this tendency towards apnoea by allowing the patient to breathe into the bag and so to obtain a small quantity of CO₂, this course has manifest disadvantages, not to speak of dangers. In the majority of patients the breathing under scopomorphine anæsthesia is apt to be shallow when oxygen is used. The result is invariably some congestion at the lung bases, and there is reason to believe that the percentage of post-anæsthetic broncho-pneumonias is higher in cases where this combination has been used than in those in which ether-oxygen-chloroform alone has been employed. At the German Hospital, where the Roth-Dräger is used as a matter of routine, there is a general feeling that this apparatus is occasionally responsible for the lung complications that sometimes ensue. This opinion I confess I do not share, for ordinary anæsthesia maintained by means of the apparatus certainly does not show an increased percentage of post-operative pulmonary complications. At the Graz clinic, where the Roth-Dräger is constantly used, lung complications are relatively infrequent, though the patients are exposed to more adverse atmospheric conditions than is the case at Dalston. My own experience at Graz certainly does not support the supposition that the apparatus is primarily responsible for such complications, though I am aware that there is ground for believing that the inhalation of oxygen itself under high pressure is likely, in some patients at least, to give rise to such complications owing to the apnoea produced during the administration. Dr. St. John, who is at present working at Professor von Hacker's clinic, has very

⁹ Burgi: Deutsche Medizinische Wochenschrift, 1910; Correspondenzblatt für Schweizer Aerzte, 1909. Deutsche Medizinische Wochenschrift, 1909.

¹⁰ Burker: Münchener Medizinische Wochenschrift, 1910.

¹¹ Madelung: Archiv für Experimentelle Pathologie und Pharmakologie, Band lxiii.

¹² Neu: Münchener Medizinische Wochenschrift, 1910.

¹³ Rocchi: Bolletino della Società Lancisciana degli Ospedali di Roma, 1891.

¹⁴ Surmay: Union Médical Commun, 1880.

¹⁵ Rave: New York Medical Journal, 1886.

¹⁶ Franck: Journal de Médecine de Bordeaux, 1880.

¹⁷ Wolffsohn: Deutsche Medizinische Wochenschrift, 1910.

¹⁸ Beinaschewitz: Therapeutische Monatshefte, 1910.

¹⁹ Sahli: Loc. cit. Ewald: Berliner Klinische Wochenschrift, No. 35, 1910. Burgi: Deutsche Medizinische Wochenschrift, 1910. Sahli: Zentralblatt für die gesammte Therapie, 1909.

²⁰ Grafenberg: Deutsche Medizinische Wochenschrift, No. 34, 1910.

²¹ Perrier: Inaugural Dissertation: Die Scopomorphin Anaesthesia, Geneva, 1908.

kindly supplied me with his observations on the subject which coincide with mine, and Dr. Streissler, the chief assistant at the Graz Hospital, writes to me that he has not met with any pulmonary complications that can justifiably be attributed to the apparatus. At Graz no scopomorphine is given, and at Prague, where the Roth-Dräger is also extensively used, the results, without scopomorphine, are equally satisfactory. It is therefore not unreasonable to regard the pulmonary complications which have occurred in my own practice where the Roth-Dräger has been used, as dependent, to some extent at least, upon the action of this combination. The shallow respirations, together with the initial quickened breathing, may legitimately be regarded as predisposing to such complications, and in my opinion both are due to the scopomorphine. The recent work of Henderson and Scarborough²² on the causes of death under anæsthesia, and of Collingwood and Boswell²³ on the influence of morphia in raising the threshold for CO₂ is of great interest in this connexion, but a discussion on the subject would be out of place in this paper.

Further disadvantages of scopomorphine when oxygen is used conjointly with ether or some other anæsthetic are the increased excitement manifested during induction and the prolonged stupor that follows, during which Cheyne-Stokes breathing is sometimes to be observed. The tendency towards post-operative nausea and sickness, which is greater than when no scopomorphine has been used, must be added as another unsatisfactory concomitant. A preliminary dose of scopomorphine does not diminish the tendency to vomit during the administration, and appears to increase the sickness after the operation, especially in operations on the neck and thorax in which prolonged retching seems to be invariably the case. None of these objections—with the possible exception of vomiting—appear to hold with pantopon. The breathing is throughout regular and quiet, never, except when a double dose has been given, shallow; there is no apnoea whatever. I have never yet observed any vomiting during the administration or immediately afterwards, though the patients sometimes retch considerably later on when returned to bed, so that in this respect pantopon does not seem to be much superior to scopomorphine. It is only fair, however, to say that the after course in the great majority of cases of pantopon anæsthesia is excellent, the patients do not vomit, do not complain of pain, and are quiet and comfortable in bed. The initial stage of induction is almost ideal; the patients are absolutely tranquil, and the calming and quietening effect of the drug is much more marked than is the case with scopomorphine. There is no struggling or excitement, the patient breathes deeply and regularly, the pulse is full and slow, there is an absence of all signs of negativism, and once the case is "under" a very small amount of anæsthetic suffices to keep it in a suitably relaxed condition for the surgeon. I have been at some pains to compare the amount of anæsthetic used in pantopon cases and in those in which scopomorphine has been given; Grafenberg²⁴ using the Wansch-Grossmann apparatus and employing ether only, found that a much smaller amount of the anæsthetic was sufficient in pantopon cases than in scopomorphine cases. Sick,²⁵ employing the Roth-Dräger apparatus, averaged with scopomorphine anæsthesia 8–10 c.cm. (men) and 6–8 c.cm. (women) of chloroform, together with 60–100 c.cm. (men) and 60–90 c.cm. (women) ether per hour of anæsthesia. My own results under similar conditions average 8–14 c.cm. chloroform and 60–130 c.cm. ether per hour. Where no oxygen is used a much smaller quantity of anæsthetic suffices. The following details of some early cases of pantopon anæsthesia are interesting for purposes of comparison:—

CASE 1.—Stout, flabby woman, with apical mitral murmur. Operation for umbilical hernia together with total hysterectomy. $\frac{1}{2}$ c.cm. pantopon administered an hour previously to, and another $\frac{1}{2}$ c.cm. just before, operation. Patient calm, breathing regularly, respirations 18; pulse full and steady, 74. Pupils moderately contracted, reacting to all stimuli. Induction period eight minutes; commenced with oxygen, 7 pints per minute, and ether, starting at 0.5 gramme per minute, gradually rising to 1.5 grammes per minute. Conjunctival reflex present throughout operation which lasted an hour and ten minutes. Pupils small, anæsthesia perfect, no vomiting or retching, no mucus. Patient had edentulous jaws and a very large tongue, with loose, flabby, lips, which interfered somewhat

with the mask. Pulse an hour after commencement of administration 72; respirations 14 to 16. Total amount of ether used 62 grammes; no chloroform.

CASE 2.—Male, 33 years of age. Nephrotomy. Similar injections of pantopon. Anæsthesia excellent throughout; conjunctival reflex present. Induction time 10 minutes, period 40 minutes; 96 grammes ether.

CASE 3.—Female, 58 years of age. Cholecystectomy. Patient in very poor condition; pulse at commencement of administration 104, dropped to 85 during anæsthesia. Conjunctival reflex abolished at early stage of anæsthesia. Duration 1 hour and 20 minutes; 160 grammes ether.

CASE 4.—Male, aged 15 years. Hernia inguinalis sinistra. Induction period eight minutes; conjunctival reflex present. Anæsthesia completely satisfactory. Ether 40 grammes.

CASE 5.—Female, aged 44 years. Gall-stones. Cholecystectomy. Very much emaciated, feeble woman. Duration of anæsthesia 1 hour and 40 minutes; ether 160 grammes.

In none of these cases was there the slightest difficulty during the induction or administration. There was no retching, no mucus had to be sponged out from the throat, and the patients were completely relaxed, although for the greater part of the operation they only received ether at the rate of 0.5 to 1 gramme per minute with the full quantity of oxygen—7 pints per minute. In a few cases it has been necessary to give chloroform, mainly during the induction, in order to hasten the anæsthesia in strong, vigorous male patients. Lately, however, I have not used chloroform with pantopon, and when it is remembered that it is exceedingly difficult to keep a sturdy patient sufficiently under the anæsthetic (and almost impossible to do so in the case of an alcoholic) with the Roth-Dräger apparatus when ether is given alone and at a less rapid rate than 1.5 grammes per minute, these results are very satisfactory.

I do not know of any contra-indications for the use of the drug. In no case have any bad results followed its use in kidney operations, and, from an anæsthetic point of view, the most successful cases were those in which the patients were deeply jaundiced. I am inclined to think that pantopon predisposes to bleeding, as in some cases there was considerable oozing; this, however, is probably to be ascribed to the stimulating effect on the skin by the iodine sterilisation. Some observers are apparently averse to administering scopomorphine in cases in which valvular disease of the heart is present: I have not found the slightest disadvantage in doing so, and in one case of pantopon anæsthesia where the patient had very well marked mitral regurgitation the anæsthetic was excellently borne. A possible objection to using the drug lies in the fact that it renders the mucous membranes very dry. Patients are usually very thirsty when they wake, though not as a rule constipated. Cutaneous excretion is augmented, and the sweating is sometimes exceedingly profuse, the patient's shirt being almost saturated with moisture in some cases. There is naturally a very strong opinion against administering opium derivatives to children as a preliminary to anæsthesia. This seems to me to be acting over-cautiously; there are undoubtedly cases in children in which a preliminary administration of a small amount of pantopon would be of great usefulness. The Abbott compound (hyoscine-morphine-cactin) has been used with some success in children's cases and I see no reason why pantopon should not be employed as an adjuvant, as I am convinced that its advantages in mitigating the effects of a prolonged operation on a child, as regards shock, are great, and these advantages outweigh the possible, but more or less theoretical, dangers. Wiki²⁶ has recently shown that children bear morphia injections remarkably well, especially in cases of profound collapse from pain, and it is just in this class of case that it seems advisable to use pantopon on account of its sedative effect.

The ideal combination for pantopon, so far as surgical anæsthesia is concerned, is with gas and oxygen as a general anæsthetic. This method demands a somewhat complicated apparatus, but is undoubtedly to be preferred to any other. For ordinary purposes, however, the usual methods, either open ether or chloroform administered on a Skinner's mask or A.C.E. on a Rendle, will be found thoroughly satisfactory when pantopon has been given in divided doses beforehand.

A word must be said in conclusion with regard to the dangers of the method. No anæsthetic is ideally safe, but it is always well to bear in mind Billoth's dictum that an anæsthetic, by itself, is never responsible for a death under anæsthesia. The concomitant causes are so various and so manifold that it is difficult, if not

²² Henderson and Scarborough: American Journal of Physiology, 1910.

²³ Collingwood and Boswell: Ibid., 1907.

²⁴ Grafenberg: Loc. cit.

²⁵ Sick: Deutsche Zeitschrift für Chirurgie, 1903, Band xvi.

²⁶ Wiki: L'Opium chez les Enfants, Revue Médicale de la Suisse Romande, vol. xxx., 1910.

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. Scopomorphine 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: scopomorphine, 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 scopomorphine, 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 scopomorphine 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.

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

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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.

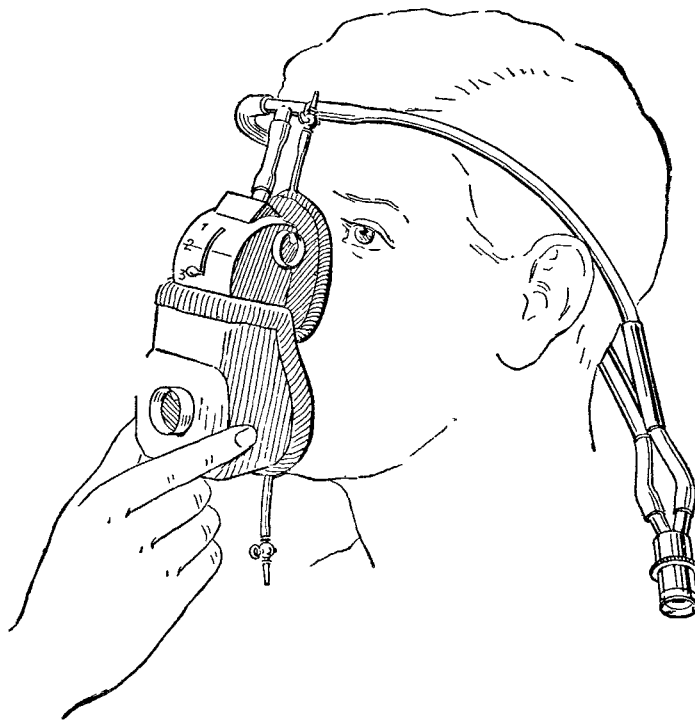
²⁹ Neuber: Surgical Congress, 1909.

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