

# The History of Anesthesiology

Reprint Series: Part Ten

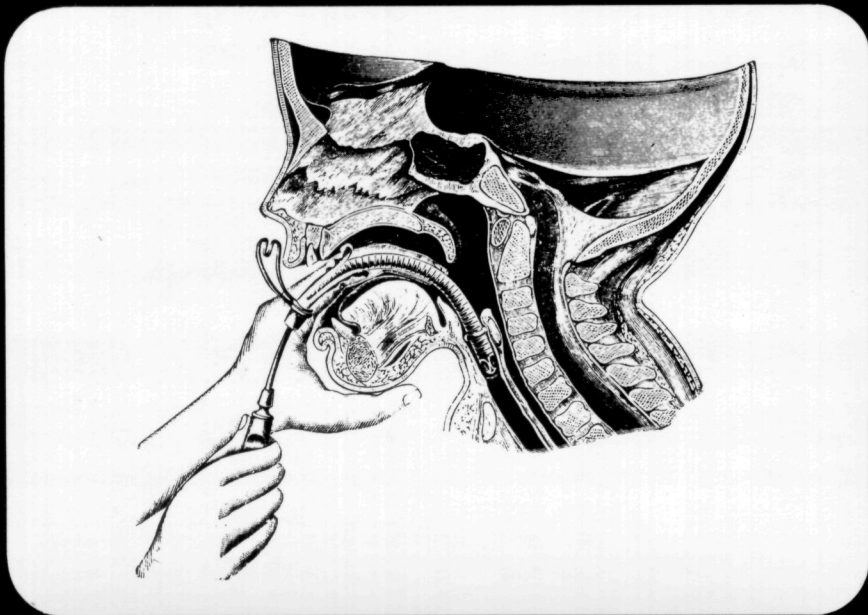


Illustration from Franz Kühn, *Die Perorale Intubation*, Berlin, S. Karger, 1911, p 141

## ENDOTRACHEAL ANESTHESIA

Intubation of the trachea was used for purposes of resuscitation over at least three centuries before the discovery of anesthesia. Before that era, Vesalius had demonstrated expansion of the lungs by blowing into a reed inserted into the trachea. Hook whose 1667 paper is included in this collection, and Leroy d'Etoille, in France, did further work on insufflation of the lungs using a bellows.

Although John Snow, the pioneer English anaesthetist, recorded the administration of chloroform to a rabbit via a tracheotomy tube, it was not until 1871 that Trendelenburg applied this method to man. MacEwen then utilized a metal, orotracheal tube during removal of a malignant growth from the base of the tongue.

Subsequently, Franz Kühn, a German surgeon published a series of papers on endotracheal anesthesia. He designed a tube consisting of a coil of flat metal with a curved introducer, thereby allowing it to be inserted with the fingers via the sense of touch. His monograph of 1911, "*Die Perorale Intubation*" summarized his work on development of techniques for inhalation, endotracheal anesthesia.

The English language papers reprinted here include those which first described endotracheal insufflation techniques, others relating to various appliances and equipment for tracheal intubation, and lastly the use of endobronchial anesthesia.

By Betty J. Bamforth, M.D.

# BRITISH MEDICAL JOURNAL

THE JOURNAL OF THE BRITISH MEDICAL ASSOCIATION



Edited by

NORMAN GERALD HORNER, M.D., F.R.C.P.

Assisted by

HUGH CLEGG, M.B., M.R.C.P.

VOLUME II 1941

JULY TO DECEMBER

Published at the Office of the British Medical Association, Tavistock Square, London, W.C.1, and  
Printed by Fisher, Knight & Co., Ltd., Gainsborough Press, St. Albans



he became secretary of the Industrial Health Research Board of the Medical Research Council. In 1938 he was made Rector of St. Andrews University. Though written in lighter vein and for the general public, his book will be found full of interest by medical men, especially those who by force of circumstances stay at home and do not know the wide horizon, the golden land of opportunity which awaits members of the profession who go out to the Empire to practise.

### PHYSIOPATHOLOGY OF THE EXTRAHEPATIC BILIARY PASSAGES

*Fisiopatología del Hepato-Colédoco: Colangiografía Operatoria.* By Pablo L. Mirizzi. (Pp. 279. No price given.) Buenos Aires: "El Ateneo."

The reviewer has not been able to find an existing English equivalent for the compound term "hepato-colédoco," which neatly suggests the physiological reciprocity between the hepatic duct (hepático) and the common bile duct (colédoco). In this handsomely produced and lavishly illustrated monograph the author, who is professor of clinical surgery in the University of Córdoba (Argentina), has summarized his views and experiences of the technique of radiographic visualization of the extrahepatic biliary passages by the direct injection of contrast media. The first chapter deals briefly with the anatomy of the bile passages, while the second is a rather more detailed account of their physiology, with particular reference to the hepatic and common bile ducts. In Chapter III are discussed the advantages and disadvantages of operative cholangiography and the techniques of injection and radiography. The results of the author's own experiments on thirty-seven dogs are described in the following chapter. The contents of further chapters are well indicated by their titles: V, The Normal Biliary Tree; VI, Odditis (an exhaustive account of this condition); VII, Stenosing Pancreatitis; VIII, Lithiasis (of the hepatic and common bile ducts); IX, Anomalies (of the hepatic and common bile ducts). The final and tenth chapter is devoted to a consideration of errors of technique. The bibliography is conspicuous by a complete absence of references to British sources, though French, German, and North American authors are freely cited.

### Notes on Books

Of Sir COMYNS BERKELEY's services to gynaecology, and so to the welfare of our women patients, not the least is his textbook. *Gynaecology for Nurses and Gynaecological Nursing* (eighth edition, Faber and Faber, 8s. 6d.). It contains just about as much information as can be written down profitably, as an accompaniment to experience. All that a nurse need know seems to be there, including specimens of G.N.C. examination questions, which sometimes, however, seem to ask for more than a nurse need know. The price is low, the format comfortable, the style clear, with helpful paragraphing. Though no two gynaecologists would agree on every detail, Sir Comyns Berkeley has steered through the whirlpools of controversy, and has always left room for an individual gynaecological surgeon's orders to his nursing staff. The one-page chapter on "The Bearing of the Nurse" is a gem. The tabulated systems of nursing are clear and reliable. Could the index be a little fuller next time, including, for instance, "Fistula"?

The *Proceedings of the Cardiff Medical Society* for the session 1940-1 have been published by William Lewis (Printers) Limited of Cardiff. They include an article on blood transfusion by Dr. R. Drummond, regional blood transfusion officer for Wales; reports of clinical meetings and discussions; and the text of Sir Thomas Lewis's annual address to the society on April 8, 1941, entitled "Caleb Hillier Parry, M.D., F.R.S. (1755-1822): A Great Welsh Physician and Scientist." Sir Thomas described Parry as a man who in the fullness of his career was an eminent physician

of Bath, a philosophic writer in advance of his times, a progressive agriculturist, and a clinical scientist of outstanding merit. He quotes from the clinical description that was Parry's masterpiece—the first account of the disease exophthalmic goitre, written in 1786.

## Preparations and Appliances

### AN IMPROVED LARYNGOSCOPE

Prof. R. R. MACINTOSH, D.M., D.A., writes from the Nuffield Department of Anaesthetics, Oxford:

The laryngoscope illustrated incorporates an epiglottis retractor and an improved method of illuminating the larynx.

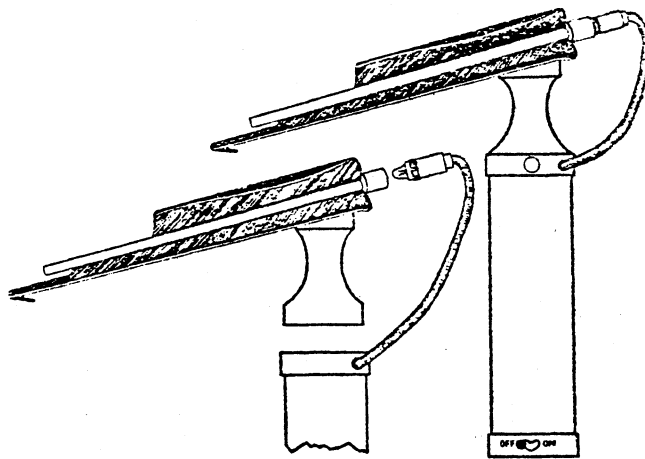


FIG. 1

**Epiglottis Retractor.**—When the blade of a laryngoscope is inserted the epiglottis is at first pushed backwards over the laryngeal entrance (Fig. 2a). Every anaesthetist has on occasion had difficulty in everting the epiglottis so as to expose the larynx. When the new blade is used the metal elevation passes over the epiglottis, which then lodges in the notch (Fig. 2b). When the blade is withdrawn slightly the epiglottis is everted (Fig. 2c) and the larynx comes into view.

**Illumination.**—The orthodox illumination consists of a small electric bulb attached to the blade. This bulb is difficult to sterilize, expensive (6s. 6d.), fragile, and if it breaks in the presence of ether vapour or cyclopropane might cause an explosion. In the new laryngoscope the source of light is an ordinary robust torch bulb (price 1s.) attached not to the blade but to the battery in the handle by a flexible lead. From the bulb the light is carried to the field of operation by a pencil-shaped rod of curvelite fixed to the blade. The blade is readily detached from both bulb and handle and after use is washed and boiled.

I am indebted to Mr. R. Salt, technician to this department, for his help in making the original model. The laryngoscope can be obtained from either Medical and Industrial Equipment Ltd., of 12, New Cavendish Street, London, W.1, or Vann Bros., Ltd., 63, Weymouth Street, London, W.1.

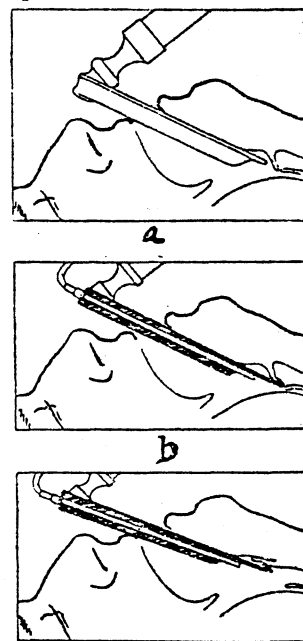


FIG. 2





The entire cover is framed by a wide, ornate border of black and white floral and foliate patterns. The patterns include acanthus leaves, scrolling vines, and clusters of berries, reminiscent of Art Deco or early modernist decorative styles.

# Current Researches in Anesthesia & Analgesia

F. H. McMECHAN, A.M., M.D.

*Editor*

VOLUME XI, NUMBERS 1-6

1932

*Published by the*

International Anesthesia  
Research Society



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## Closed Endobronchial Anesthesia in Thoracic Surgery: Preliminary Report\*

Joseph W. Gale, M.D. and Ralph M. Waters, M.D., Madison, Wis.



WHEN MANY TECHNIQUES for a given surgical procedure are in vogue, it is usually good evidence that no one is completely satisfactory. This statement applies to anesthesia for intrathoracic surgery. In 1928, Guedel and Waters<sup>1</sup> described the closed endotracheal technique for administration of inhalation anesthesia. The absorption of carbon dioxid from the anesthetic gases<sup>2 3 4</sup> was thus made applicable to surgery of the upper air passages.

### Technical Developments

**M**ORE RECENTLY, the same authors have described further development and application of this technique.<sup>5</sup> There follows a description of a further adaptation of similar equipment to maintain a completely closed endobronchial anesthesia for surgery within the thoracic cage. In their previous communications, Guedel and Waters have described an inflatable balloon or cuff which may be slipped over the various types of to-and-fro endotracheal airways in common use. This inflatable cuff is made of very thin rubber, fits snugly on the outside of the airway and carries a very small inflating tube through which air can be forced into the balloon, bringing its outer wall into air-tight contact with the tracheal wall. By the use of this device, they have found it quite possible to administer anesthesia while the patient's upper air passages are filled with fluid. No leak occurs beyond the inflated balloon. They have anesthetized dogs while both the anesthetic apparatus and the

dog were completely immersed in a tank of water.

**Technique.**—To-and-fro endotracheal airways are used ranging in size from 28 French to 34 French for adults. These are usually marketed in fourteen inch length which is ample to reach from the incisor teeth to a point beyond the tracheal bifurcation and well within either bronchus. The inside diameter should be as large as is consistent with reasonable rigidity of the catheter wall. Rubber tubing, silk fabric and silver fabric materials are used in catheters now on the market. The catheter should preferably have a beveled opening in the end. The important qualities are reasonable stability at body temperature in resisting collapse, together with maximum inside diameter in relation to outside diameter.

The end of such an airway is powdered with talcum and a proper sized inflatable cuff is selected from the stock supply. The cuff is easily brought into position on the catheter if both are well powdered. Now the terminal one and one-half inches of the catheter is moulded in warm water so that it curves toward the side of the bevel tip. The catheter and cuff are sterilized by passing through bichlorid solution and sterile water. Sterile vaseline is liberally applied to the airway and the cuff. Anesthesia is induced as for introduction of an endotracheal airway.

\*Read during the Tenth Annual Congress of Anesthetists, the International Anesthesia Research Society in Joint Meeting with the Associated Anesthetists of the United States and Canada, the Eastern Society of Anesthetists and the Mid-Western Association of Anesthetists, Clinical Congress of Surgeons Week, Hotel McAlpin, New York City, October 12-16, 1932. From the Departments of Surgery and Anesthesia, University of Wisconsin, Madison, Wis. Courtesy of the *Journal of Thoracic Surgery*.

We have not found preliminary cocaineization of the larynx essential. Nitrous oxid or ethylene, with one of the adjuvants ether, tribromethanol or chloroform, when necessary, have been found satisfactory. The vocal cords should be in complete abduction during intubation. This can be assured by proper excess of carbon dioxide in the anesthetic atmosphere just previous to exposure. The glottis is brought into view with a direct vision, anesthetist's laryngoscope and the endobronchial catheter passed rapidly to the bifurcation. The hand carries the catheter close to the right side of the glottis with the

curved tip pointing to the left and sliding down the left tracheal wall for entry into the left bronchus and vice versa. After the region of the bifurcation is reached, the airway is advanced slowly into the bronchus, stopping at the first feeling of resistance. Resistance to advance will indicate that the bronchus has been entered too far, reaching a bronchial diameter no greater than that of the airway. Stop short of such resistance if possible.

The average distance from cords to bifurcation is eleven to fifteen centimeters. An advance of two or three centimeters beyond the bifurcation is

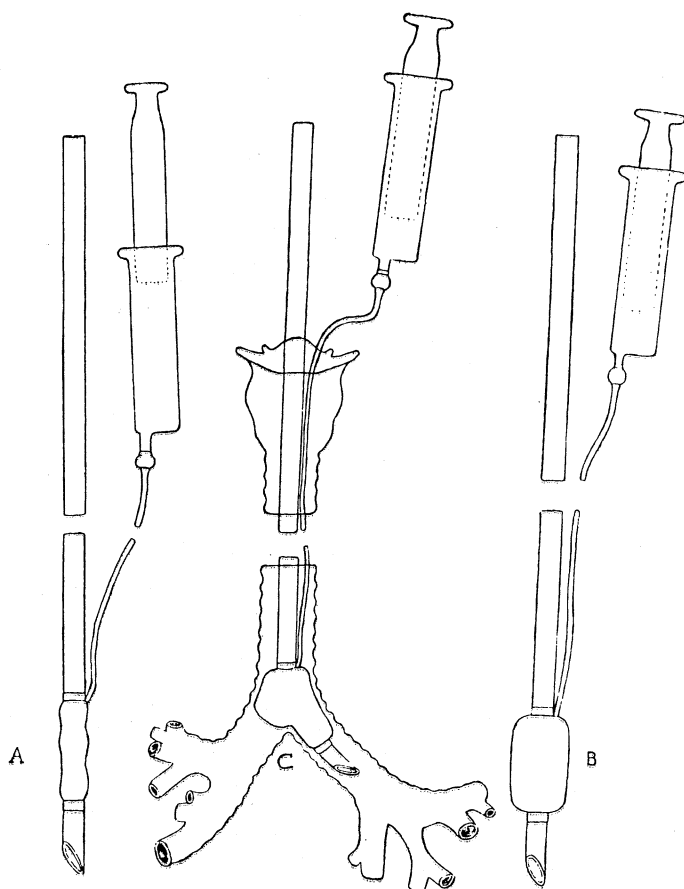


Fig.1—(A) Shows the catheter with surrounding rubber balloon collapsed, (B) Shows the rubber balloon inflated, (C) Shows catheter in place and balloon inflated, completely blocking bronchus on the side of operation and insuring no leak contact of airway in the opposite brouchus.

sufficient. The airway is now quickly attached to the anesthesia apparatus. The respiratory space thus consists of one lung, bronchial airway, soda lime canister (to absorb carbon dioxide) and spirometer. This system is filled with anesthetic mixture from the apparatus. A constant flow of oxygen is set to replace that used by the patient in metabolism. The cuff is now inflated with air by means of a ten cubic centimeter glass syringe and the inflating tube sealed with a small forceps. With experience the feel of the plunger in the anesthetist's hand is the best guide as to the proper amount of air to inject. A small water manometer may be used to aid the inexperienced in learning the necessary pressure to insure air-tight closure at the bifurcation without causing undue pressure on the bronchial mucosa. Practice in this regard may be gained by passing the airway into a glass tube and inflating the balloon under direct vision. Anesthesia is then conducted only through the one lung. (*See Figure.*)

When the chest wall is opened, normal respiration may be allowed to continue or, better, artificial respiration may be instituted. The lung on the side of the operation is allowed to collapse and remain in a state of atelectasis throughout the procedure. Artificial respiration is under second to second control as to individual depth and minute-volume exchange. A spirometer is used which accomplishes both inflation and deflation of the active lung. A moderately heavy rubber accordian-like bag, cemented to its metal covers, serves the purpose. It may be operated by raising and lowering one cover away from and toward the other by hand, or a small motor may be used. A manometer connected to the closed system gives information of the intrapulmonic pressure at all times. At the end of the operation and before closure of the chest cavity, the balloon is deflated, the airway withdrawn into the trachea and the balloon is again inflated. By proper manipulation of pressure in the breathing bag or spirometer, the collapsed lung is again brought into a state of activity by artificial means and inflated to a proper degree to insure filling of the pleural cavity. After the last stitches

are placed in the pleura, sufficient pressure is used to expel completely the air from the pleural cavity, and the closure finished. This pressure, measured in millimeters of water, is maintained throughout the closure of the overlying structures and skin. The surgeon will, of course, make every effort to produce an air-tight closure.

### Advantages

THE ADVANTAGES of a closed endobronchial or one-lung anesthesia for intrathoracic surgery may be considered in two general groups; namely, anesthetic and surgical. By means of closed endobronchial anesthesia and the carbon dioxide absorption technique, it is possible to maintain complete control of anesthetic concentration in a single lung. A warm moist atmosphere is in contact with the lung at all times rather than a cold dry one as is the case with an open system in which moisture and heat must be lost along with carbon dioxide through an exhalation valve. A moderate preanesthetic dose of tribromethanol has been found satisfactory when administered by rectum previous to the induction of inhalation anesthesia. By its use, ether can be completely dispensed with in cases where it is especially contraindicated. By this technique, the control of oxygen and carbon dioxide exchange is directly in the hands of the anesthetist. Anoxemia is eliminated. There is perfect control of artificial respiration as to depth, frequency, and intrapulmonic pressure. Direct observation through the chest wound of the resulting lung activity is a most satisfactory check of the effectiveness of artificial respiration. A manometer to record intrapulmonic pressure gives information as to maintenance of sufficient distention to eliminate pneumothorax during wound closure since the catheter is sealed in place by the inflation of the rubber balloon.

The advantages offered the surgeon through this method of anesthesia are worthy of consideration. Intrathoracic procedures for the thorough exploration of the lung or removal of a lobe necessitate a large opening in the chest wall. Because of the danger resulting from such wide thoraco-

tomy wounds, surgeons in many instances have been willing to operate with inadequate exposure through a small opening with disappointing results. The sudden creation of an open pneumothorax with a resultant collapse of the homolateral lung and a shifting of the mediastinum to the side of the contralateral lung produces a great diminution in the patient's vital capacity which causes considerable shock. To this is added paroxysmal respiration with inadequate oxygenation of the blood and irregular and violent respiratory movements. The returning blood flow to the heart is immediately altered in quantity and regularity. This initiates a sudden circulatory disturbance which when combined with the radical alteration in respiration may bring about sudden and sometimes fatal circulatory collapse. If the patient successfully endures the early effects of such procedure and the respiratory movements are held down to a minimum through careful anesthesia, his chances of surviving the operation are much greater. The continuation of such conditions for more than a few minutes, however, materially decreases the chances for recovery.

With the method above described, the one lung is allowed to function under slightly more than atmospheric pressure. This is sufficient to prevent the raised pressure in the open pleural cavity from pushing the mediastinum against the contralateral lung, thereby diminishing the vital capacity to that extent. With this technique and artificial respiration, the lung which is receiving the anesthetic gases is permitted to maintain its respiration to practically a normal degree. At the same time, all paroxysmal respiration is eliminated. The functioning lung is given a sufficient amount of oxygen to prevent oxygen want. The volume of blood passing to the heart is held constant and sudden circulatory collapse is not encountered. The blood pressure and pulse rate remain constant. The only movement observed on the side of the operation is that due to the pulsation of the great vessels.

The lung is collapsed and immobile. The lobes remain pink throughout the

operation. Exposure is excellent and the procedure may be carried on without interruption. Ligatures and sutures can be deliberately applied. Dislodgment of infected material is reduced to a minimum because of the advantageous deflation of the lung. Following the ligation of the pedicle, the balloon around the catheter is partially deflated, withdrawn into the trachea and reinflated. The operated lung is then gradually inflated. If a leak or fresh bleeding occurs, the balloon is immediately deflated, reinserted into the bronchus to effect immobility of the operated side, and the repair made at once. The operated lung is again gradually and completely inflated while the pleura is being closed. Just before the final closure, the lung is well distended to eliminate pneumothorax and maintained in that condition until the dressing is in place. The whole procedure can be carried out very rapidly without undue shock to the patient and without any radical or sudden pressure changes occurring during the entire time.

### Summary

CLOSED endobronchial anesthesia has been employed in several experimental animals for the removal of different lobes of the lung, and in one patient for the removal of a mediastinal tumor. Artificial respiration may be maintained in the one lung with perfect control of its respiration and minute-volume respiratory exchange. Intrapulmonary pressure is measured by a side tube to a manometer. The incorporation of the closed carbon dioxid absorption technique assures a warm moist anesthetic atmosphere at all times.

The shock usually encountered upon the sudden creation of an open pneumothorax has been very slight. This has been demonstrated by the blood pressure and pulse rate remaining constant. The irregular and violent respiratory movements, so often seen, have been replaced by slow, regular and deep breathing. Exposure is simple for the surgeon because the lung in the operative field is immobile. Chances of infection are reduced because a sucking wound has

been entirely eliminated. Little chance exists for infected secretions to be squeezed into the trachea because the bronchus is blocked.

Although the method has been employed in a series of cases, too small from which to draw conclusions, the evidence so far obtained gives promise that the closed endobronchial type of anesthesia is a most practical method to employ in intrathoracic operations in which the pleural cavity must be opened.

1300 UNIVERSITY AVE.

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THE  
**British Medical Journal.**

THE JOURNAL OF THE BRITISH MEDICAL ASSOCIATION.

EDITED BY

DAWSON WILLIAMS, M.D., D.Sc.(HON.),

AND

NORMAN GERALD HORNER, M.A., M.B.

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VOLUME II, 1880

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JULY TO DECEMBER.

London :

PRINTED AND PUBLISHED AT THE OFFICE OF THE BRITISH MEDICAL ASSOCIATION,  
429, STRAND, W.C.



universities during the war, no new issue has been made since 1916; for the same reason the present edition records numerous changes in staffs and far-reaching alterations in regulations and courses of study. In sections dealing with each of the forty universities and university colleges in the United Kingdom and of the sixty in the Dominions and Colonies the *Yearbook* furnishes, as well as a list of the staff, information relating to the foundation and development of the institution, its libraries and museums, residential accommodation for students, affiliated institutions, degrees, diplomas, certificates, fees and scholarships, and its regular publications; a summary is also given of new posts lately created and of recent alterations of curriculum. In an appendix outlines are given, so far as the confidential nature of much of the work will permit, of the various forms of non-combatant war service undertaken by the universities; even in their present incomplete state these records describe so extensive and successful a mobilization for war purposes of every kind of special knowledge and every type of trained intelligence that there is much to justify the assertion made that "brains, rather than arms, have been the determining factor in the Great War."

## APPLIANCES AND PREPARATIONS.

### *Forceps for Intratracheal Anaesthesia.*

DR. IVAN W. MAGILL (Anaesthetist, Queen's Hospital, Sidcup) writes: Following on Dr. Rowbotham's article in the *JOURNAL* of October 16th on intratracheal anaesthesia by the nasal route, the accompanying illustration of a forceps, made for me by Messrs. Meyer and Phelps for a similar purpose, may be of interest. The forceps are constructed with a bend to clear the field of vision, as in Heath's nasal forceps, the ends which grasp the catheter representing a cylinder split longitudinally and



serrated on the inner surface. Introduction of the catheter into the trachea is carried out with the aid of an electrically illuminated speculum, as in Dr. Rowbotham's method, but I find in the forceps the following advantages over Dr. Rowbotham's guiding rod:

1. There is no injury to the end of the catheter, and therefore no liability of small pieces of the friable material being left in the trachea.
2. The catheter is more easily picked up in the oral pharynx, and once grasped the hold is secure, without the necessity of holding the free end which protrudes from the nose, as is the case with the guiding rod.
3. The forceps can be used at the side of, as well as inside, the speculum.
4. The field of vision is always clear.

I need hardly add that in operations involving bleeding into the pharynx the fixation of a suitable suction pump to the expiratory nasal tube provides even a clearer field for the surgeon by removing blood without continual swabbing.

## MEDICINE AT THE UNIVERSITY OF LEEDS.

DR. T. WARDROP GRIFFITH, C.M.G., professor of medicine in the university and honorary physician to the Leeds General Infirmary, opened the session of the Leeds University Medical Society by an address in which he reminded his hearers that they were students of a university and not merely members of a school of medicine. Although the university was not of ancient foundation, it could be recalled with pride that its germ lay in the old school of medicine founded in 1831. Dr. Griffith continued:

I wish I could see a more intimate association than now seems to exist between the different faculties of the university, both as regards staff and students; one of the dangers which assails those who study and practise medicine is a certain insularity, which I am convinced is contrary to the proper development of our intellect and is not conducive to our happiness or our usefulness. Let us take a wide view of what a university should be and at the same time see what it should not be. Carlyle's opinion that "The true university in these days is a collection of books" can not be accepted, for, besides a good library, a university must furnish that which books alone can not provide—the personal influence of those who guide the studies of the students, or who perform the

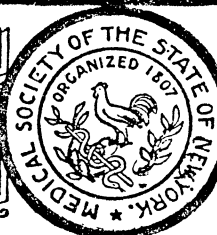
humbler function of imparting information to them. We require laboratories in the widest sense of the term, and here I include hospitals, with all that they imply; we require facilities which permit and encourage free association between the members of the different faculties—staff and students alike. The functions of a university have been described as comprising the acquisition, the development, and the dissemination of knowledge. Yes, this indeed at least; but one of the imperative duties of a university is to grant its students adequate and reasonable time and opportunity for recreation and athletics. The intercourse and the good-fellowship between the various faculties will be of benefit to the university as a whole, to each separate faculty, and to every individual student. We do not now impose so many lectures on our students; in this, I think, we are wise, but I am not one of those who deprecate this form of teaching.

In such subjects as medicine and surgery no man should try to vie with the textbooks in the mere enumeration of facts, but by lectures I think that much may be done, and is done, in the way of arresting the attention of the student and guiding him in his reading. Regularity, punctuality, and enthusiasm, on the part of the lecturer must be met, and must be aided and abetted by similar characteristics on the part of the students, but the lecturer must set the example. Under the direction of your teachers in your practical work, in the dissecting-rooms, in the laboratories, in the wards, and in the *post-mortem* room, you must work out your own salvation. Thus you may build up a secure platform for the acquisition of more real knowledge and for the utilization of that which you may already possess. Here I would impress upon you the advisability of associating yourselves with those who are investigating special points in your cases. It is infinitely better that, under the guidance of those in charge of the laboratory of clinical pathology, you personally should make an examination of a urinary deposit, or a suspected sputum, or of a doubtful blood count, than that you should merely await and read the reports of the special investigators. In private practice the cases in which you can call for information from these special sources must be few and will be confined to the opulent; do as much as you can, therefore, for yourselves, and do it now when you can expect and when you will receive willing assistance. While it is right that as students you should utilize every opportunity of obtaining practical acquaintance with the use of special methods and special instruments, the use of the sphygmograph, sphygmomanometers, polygraphs, endoscopes, string galvanometers, and other instruments of precision should in the overwhelming majority of cases be reserved till ordinary methods of investigation have been fully employed. First, there comes the complaint of the patient. He is the only man in the world who knows what his feelings are; let him tell you as best he can, and as far as possible without the influence of leading questions. Then question him as to details with as open a mind as you can, and with that patience which will breed accuracy, but which in the case of a garrulous or obtuse patient may be hard to exercise. Then will come your particular part of the business—the examination of the patient is undertaken; here again I would claim that what we understand by the ordinary methods should have our first attention. It is, for example, better and more conducive to the retention of an open mind that you should not know whether the patient has tubercle bacilli in his sputum or not before you have formed an opinion as to the physical signs in the chest—I do not say until you have made a diagnosis. It is better that by palpation you should try to gauge the size of a man's heart than that you should be biased by information derived from the fluoroscopic screen. It is better, far better, that you should try to discriminate between the various forms of cardiac irregularity without the knowledge of what is revealed by the polygraph or, with greater authority, by the electrocardiograph. It is true that, until the advent of these instruments and the careful use which has been made of them clinically and in the methods of experimental physiology, our knowledge of cardiac irregularities was imperfect and chaotic; but now that they have been "worked out"—and the field of inquiry appears to be almost complete except as to their causation, and in some measure as to their prognosis—my experience is that year by year I become more and more independent of these instruments and their use in individual cases, though, of



# NEW YORK STATE JOURNAL OF MEDICINE

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# INTRATRACHEAL INSUFFLATION ANESTHESIA, ITS VALUE IN THOR- ACIC AND IN GENERAL SURGERY.\*

By CHARLES A. ELSBURG, M.D.,

NEW YORK CITY.

**I**F the chest wall is opened through injury or by the surgeon, the normal difference between the pressure on the inside and on the surface of the lung disappears, and the lungs collapse and remain so. The dangerous symptoms which then ensue (in many, but by no means in all cases) are well known to all. Various methods have been devised to prevent these dangerous symptoms, but none of them have proved satisfactory. Few surgeons ventured to invade the normal chest cavity, with the hope that adhesions between the two layers of the pleuræ were present. Some attempted to cause adhesions to form by the injection of irritating substances. Others recommended that the surgeon should quickly grasp the lung when the chest was opened, pull it into the wound, and fix it there. None of these procedures were sufficiently certain to make thoracic surgery even relatively safe. What wonder, then, that the surgery of the chest was far behind the surgery of other parts of the body! What wonder that the greatest surgeons all over the world considered the surgery of the thoracic cavity as a *noli me tangere*.

About ten years ago were published the epoch-making discoveries of Sauerbruch, made under the stimulus of and controlled by that master of surgery, von Mikulicz. Sauerbruch's idea was to surround the chest of the patient by an airtight box or chamber in which the air pressure was lowered to such a degree that it corresponded to the pressure conditions within the normal pleural cavity. The head of the patient was outside while the surgeon worked inside of the chamber. When the chest was opened, the lungs did not collapse, for the pressure within the chamber was like that of the normal pleural cavity. In other words the difference between the pressure of air inside and on the surface of the lung remained the same as in the unopened chest.

Brauer, another German investigator, accomplished the same end by enclosing the head of the patient in a box or chamber in which the pressure was raised, so that the difference between the pressure inside and outside of the lung remained the same as in the Sauerbruch cabinet and in normal respiration. Both of these methods,—almost equal physiologically,—were found to be entirely adequate to prevent collapse of the lung when the thorax was opened. They became known as the negative and positive pressure methods, and proved a great stimulus to thoracic surgery; positive and negative pressure cabinets were constructed in a number of insti-

tutions. One of the best and most complete is that devised by Dr. Willy Meyer of New York. Intrathoracic operations, only dreamed of by the surgical enthusiast and never before attempted even on animals, were now performed. These were successful as far as the danger from the opening of the chest and collapse of the lung were concerned. Nevertheless, intrathoracic surgery did not develop as rapidly as it should. Only few surgeons and few institutions could possess the large, complicated and very expensive apparatus required. A branch of surgery can only be developed to its full extent when it becomes the property of the many instead of of the few.

This, then, was the condition of affairs when Meltzer and Auer, in the Rockefeller Institute of New York, made their physiological experiments which culminated in the method of intratracheal insufflation concerning which I am going to speak to you.

Before this, however, it is only fair to state, a number of investigators had attempted to devise a simple method by means of which the lungs could be kept distended when the chest cavity was opened. I need only mention the names of Fell, O'Dwyer, Matas, Kuhn, Volhard, Hirsch, Sollman, Robinson, and others.

It is well known that ordinary breathing is kept up by alternating respiratory movements; the ventilation of the lungs depends, therefore, upon the normal activity of the respiratory muscles and the intact condition of the chest cavity. During inspiration, air from the outside reaches the smaller bronchi where the exchange of gases between the inspired air and the air in the pulmonary alveoli occurs through diffusion. Meltzer and Auer discovered that "the ventilation of the alveolar air can be accomplished through a continuous stream of air passing in one direction instead of the double movements in opposite directions." In making some investigations upon the mechanism of breathing in the Brauer positive pressure apparatus, Meltzer and Auer found that if they passed a tube through the larynx of a dog down the trachea almost to the bifurcation, and blew air through this tube in a continuous stream, that the animal could be kept alive for many hours even after all voluntary respiratory movement had been paralyzed by curare. By allowing the stream of air to pass over the surface of ether in a bottle, they were able to anesthetize the animals very satisfactorily, and in these anesthetized dogs, it was possible to open both sides of the thorax widely and to have the animals remain alive for any number of hours. The air and ether mixture was blown in at a pressure of 15 to 20 mm. of mercury. The only conditions for success were that the tube was of a size less than one-half of the diameter of the glottis so that the stream of air and ether which passed up the trachea and out through the larynx and mouth in a continuous stream had free es-

\* Read at the annual meeting of the Medical Society of the State of New York, at Albany, April 17, 1912.



cape. Later, it was found of advantage to interrupt the stream three to six times a minute so as to allow the lung to collapse for a moment at times and thus to get rid of small quantities of CO<sub>2</sub> which are apt to remain in the pulmonary alveoli. This method of anesthesia, Meltzer and Auer named *intratracheal insufflation*.

The apparatus they used was a very simple one. It consisted of a foot bellows connected by tubes with a bottle containing ether and a mercury manometer; the tubes being so arranged that more or less of the inblown air passed over the surface of the ether and thus became more or less saturated with ether vapor. With this simple apparatus Meltzer and Auer, Carrel, and I, and later others, made a number of experiments on animals. One or both pleural cavities were widely opened, the lungs remained moderately distended, the heart action remained good and regular, superficial respiratory movements persisted, but these had no effect upon the lungs which remained moderately distended.

With this method, I made a large number of experiments upon dogs at the Rockefeller Institute and performed many operations upon the intrathoracic viscera. Among these might be mentioned removal of one lobe or of one entire lung, of both upper or both lower lobes, of one upper and one lower lobe, resections of the esophagus and bronchi, etc. Unless the animals died from the experiment itself or from post-operative sepsis, they regularly recovered and when killed and examined weeks or months later, the lungs were found in perfect condition.

It having thus been proved that the method of intratracheal insufflation was very satisfactory for operations upon animals, and that in animals anything could be done that could be done in the thorax with the positive or negative pressure chambers, the next step was to try it in the human being. First it was necessary to devise an apparatus for the human being, then to test the anesthesia, to learn of its advantages and dangers. All of my first investigations upon human beings were made with great care, and the first cases in which I used intratracheal insufflation were in patients who had stopped breathing, and in whom pure air without ether vapor was insufflated for the purpose of artificial respiration.

The apparatus I use is small and easily portable. Another and larger apparatus, although it is also simple and portable, is meant for hospital use and has been described in detail elsewhere.

#### THE TECHNIQUE OF INTUBATION.

Although it is possible to introduce the intratracheal tube and then anesthetize the patient, it is preferable to first anesthetize the patient in the usual way and then to introduce the tube. Some of those who have investigated the subject, have had difficulty in introducing the tube. In the beginning I also met with some patients in whom

the tube could not be introduced through the larynx because the tip of the epiglottis could not be reached with the finger as a guide. Ever since I have made use of the laryngoscopic introducer of Dr. Jackson, I have never had much difficulty. The larynx can be brought into plain view and one can estimate the proper size of tube to be used and introduce the tube without difficulty.

One should use an ordinary silk woven urethral catheter, with a lateral opening near its end. These catheters can be procured everywhere and they are sufficiently rigid so that they can not be coughed out of the trachea and rigid enough that they can not be compressed by a possible spasm of the glottis. The catheters have a mark 13 centimeters and 26 centimeters from the tip. When the catheter is introduced up to the first mark, its tip is engaged in the glottis, when the second mark is reached, its tip is about five centimeters from the bifurcation.

The tube is introduced with the head of the patient hanging down over the end of the table and the mouth held open by a gag. One must be sure, of course, that the tube is introduced between the vocal chords and that no force is used. It is then rapidly pushed down the required distance, the gag then removed and the clip by which the tube is kept in place attached. The patient is very apt to have an attack of spasmodic coughing when the tube is first introduced, but this regularly ceases in a few seconds, and one is then ready to connect the tube with the insufflation apparatus and begin insufflation.

For adults, a tube of the size of 24 F. is usually the correct size, but the catheter should always be less in diameter than half the length of the glottis as seen through the laryngoscope. For children, smaller sizes must be used and the tube pushed down a less distance.

Always be sure that the tube is in the trachea and not in the esophagus,—the spasmodic cough is a good proof that the tube is in the correct channel.

#### THE ANESTHESIA.

I have written elsewhere in detail concerning the characteristics of the anesthesia. I shall therefore pass over this part of the subject with a few words. The color of the patient should be pink, the pulse normal, the breathing regular but superficial. The pressure in the manometer should be kept at about 20 mm. of mercury, and three to six times a minute the current should be interrupted for a moment at a time. When the operation is almost finished, one should shut off the ether and insufflate pure air for a few minutes. Then the patients will awaken very quickly, they will often answer questions before they are removed from the operating room. When the tube is removed, they often have apnea for a part of a minute and then regular breathing again begins.

In almost 500 operations under insufflation

anesthesia, we have never seen any bad after effects. The tube is well tolerated by the larynx and trachea, the patients do not complain of any laryngeal discomfort of any kind after the operation. In not a single instance have we observed any pulmonary signs after the anesthesia. Vomiting is very unusual after insufflation anesthesia, and even after operations lasting several hours, the patients are free from nausea and vomiting.

#### THE VALUE OF THE ANESTHESIA IN OTHER THAN INTRATHORACIC OPERATIONS.

In addition to the great value of this method of anesthesia for intrathoracic surgery of which I shall speak in a few moments, the anesthesia is very useful in a large number of other operations.

In the first place, it is of great value in cases of intestinal obstruction for it entirely does away with the danger of aspiration of vomited matter and broncho-pneumonia. Because of the continuous stream of air which is passing up the trachea and out through the larynx and mouth, no vomited material matter can be aspirated and therefore under insufflation anesthesia no cases of drowning in vomit can occur.

The anesthesia seems to be especially well borne by weak and cachectic patients, as they seem to be far less apt to present symptoms of shock after an operation done with this method of anesthesia.

The method is of extreme value in all operations upon the head and neck. The fact that the anesthetist can be a number of feet away from the operative field, is, of course, very convenient—the entire space around the part to be operated upon can be covered by sterile sheets and the anesthetist is never in the way of the operator or assistants. The value of the method is also shown when an operation is done in the mouth, such as the removal of the tongue, excision of a tumor of the tonsil, the hypophysis operation, excision of the superior or inferior maxilla, etc. There need never be any fear that blood can run down into the trachea, for the outflowing stream of air and ether continually blows out the blood in the mouth and pharynx. If one has once done an intrabuccal operation such as the complete extirpation of the tongue through the mouth, under insufflation anesthesia, and has seen how easy the operation is made, how the tube is never in the way of the operator, how one need pay no attention to the blood that runs down the throat, how the anesthesia is smooth and the anesthetist never in the way, then one can not fail to recognize the great advantage of insufflation. It is only a repetition to speak of the smoothness of the anesthesia and the advantages to the operator of this anesthesia in goitre operations. The patients do not cough when the trachea is pulled upon or compressed during the necessary manipulations, there is no danger of collapse of the trachea. The same advantages of the method apply to the operation

of laryngectomy. The method is also of value in those operations in which the patient has to lie prone upon the face such as laminectomy and bilateral suboccipital craniotomy. The anesthetist no longer need sit almost under the operating table. When the tube is in place, he can have the apparatus six feet away, if he desires, and can thus manage the anesthesia from a distance.

The anesthesia seems to be very valuable for those patients who have a chronic bronchitis or some pulmonary affection, as the danger from pneumonia seems to be avoided entirely.

I have done at least one of the various operations above mentioned under insufflation anesthesia and in many cases have performed a number of operations of the kind referred to. I can only say that the method of anesthesia has been extremely satisfactory to us, has made all these operations very much more easy and has enabled us to protect our patients from a number of post-operative complications which before this were always a danger and a cause for concern. I have used insufflation anesthesia for every variety of operation that one meets with on a large surgical service in a general hospital.

#### THE VALUE OF INTRATRACHEAL INSUFFLATION FOR INTRATHORACIC SURGERY.

On this subject I could spend more time than I may take up in recounting to you the many and interesting experiences that my colleagues and I have had. The method is absolutely efficient in preventing collapse of the lung when the normal pleural cavity is opened, and with an apparatus for intratracheal insufflation any surgeon may open the thorax with safety as far as the danger from pneumothorax is concerned. I think the great importance of the method of Meltzer and Auer is that it has made it possible for every surgeon to practice intrathoracic surgery without the large, complicated and expensive positive or negative pressure chambers. The technique is easily learned so that the surgery of the thorax can be developed not by few surgeons but by the many. Needless to say, the method should be very valuable for the battlefield in time of war.

The technique of intratracheal insufflation when the thorax is open, does not differ essentially from that used for other operations. When the chest is widely opened, the lung does not collapse. It remains moderately distended and this distension can be increased or diminished by increasing or diminishing the pressure of the inflowing air and ether mixture. The lungs are immobile although the patient continues to make respiratory movements for the breathing movements are not communicated to the lungs. The lung is therefore quiet, one can pack it away with the appropriate packings so as to expose the part to be operated upon. The lungs usually appear of a pink color mottled perhaps with black. With absolute ease the esophagus, the aorta, the

trachea and main bronchi can be exposed. I have, thus far, performed 14 intrathoracic operations under intratracheal anesthesia with great satisfaction.

Finally I want to call to your attention the value of insufflation of pure air or of air and oxygen as a method of artificial respiration. This is a feature upon which too little stress has thus far been laid. Whenever there is need for prolonged artificial respiration such as in opium poisoning, drowning, etc., the method will surely be very useful. In several instances we have kept patients alive and in good condition for three, four, six, or seven hours, although during that time they never made a single respiratory movement. The color of the patients remained pink and their blood was well aerated. It is a valuable characteristic of this method that the patients need not breathe in order to have oxygenation of their blood occur, the apparatus does the breathing for them. In this respect, the method differs from all other apparatus for this purpose, and, I may add, it has this advantage over both the positive and negative pressure methods for thoracic surgery, in the latter the respiratory movements of the patients are absolutely necessary, without them aeration of the blood can not occur, but oxygenation of the blood will occur just as well whether the patient makes respiratory movements or not with intratracheal insufflation. The patient makes the movements, but thereby does not get any air into the lungs, the apparatus attends to that.

These then, are the advantages and uses of intratracheal insufflation. They seem to be many and important, but much more investigation is necessary before the method is put upon the firm basis necessary. In Mount Sinai Hospital in New York, we have used the method in more than 400 patients with much satisfaction. It has been used in a number of other hospitals in New York and elsewhere, and we will soon have large statistics which will allow us to gage fully the value of the method. Then we shall know whether intratracheal insufflation anesthesia is as valuable as it would seem to be from the experiences up to the present time. I believe that this method of anesthesia has a wide and varied field. Its simplicity, its apparent safety, its efficiency, seem all to point in that direction. The time is near when we shall know the technique of giving gas and air, or gas and oxygen by intratracheal insufflation, and thus its field will be still further extended.

#### *Discussion.*

DR. SAMUEL LLOYD, New York City: I think we must all agree with Dr. Elsberg about the advantages of this method of anesthesia in almost every instance he has spoken of. I want to emphasize one thing, however, and that is, he is in error in saying the lung will not collapse when the thorax is opened, as long as only one side is open, and as long as the patient is not completely under the anesthesia. I make that

statement emphatically because I am demonstrating it to my classes at the Post-Graduate every week. You cannot collapse the lung after it has once expanded by leaving the cavity open, and as soon as it is fully expanded its respiratory motion resumes. In the cases of empyema, and in the other surgical cases, I have had occasion to operate upon and remove a section from the lower lobe of the lung, I have resected the lower lobe of the lung four or five times in the human being. I have closed the opening in the trachea in pyopneumothorax by a plastic operation without apparatus of any kind. In these cases the rule is to stop the anesthetic before you open the pleura; open the pleura after the anesthesia is removed and as soon as the reflexes begin to be re-established. If the patient comes out of the anesthetic just as the reflexes are established the slight cough, the slightest strain will begin to distend the lung, and just as soon as it reaches its full distension its respiratory motion is restored. That renders it possible for us to treat abscesses of the lung.

I have had twenty post-pneumonia abscesses of the lung in this way in which I have taken out a lobe two or three times, have taken out cancer, besides all cases of empyema, without any apparatus as long as it has stopped to one side and as long as we stopped the anesthesia before we penetrated the pleura.

DR. JOHN B. DEEVER, Philadelphia: I want to congratulate our friend Dr. Elsberg personally, although I have not had any personal experience with this method of anesthesia, and yet I have been highly pleased with it. My colleague, Dr. Frazer has used it at the University Hospital with most satisfactory results, and I am very glad to pay this tribute to the doctor.

DR. G. FRANK SAMMIS, Brooklyn: This new method is a popular one for many cases, and is in general use on account of its lack of irritation of the lungs. Some have said that it causes irritation of the lungs, but it has been my experience that there is no irritation of the lung from ether administered this way. The use of gas and oxygen has been quite successful with this apparatus. The cotton introducer has been successful in my experience, also the Jackson laryngoscope, which give direct vision of the trachea and vocal cord. Collapse has been experienced by some men in brain surgery, and it seems to be overcome by this anesthetic, and although it may not be used for lung surgery, it can be used in general surgery on account of its pleasant effects, safety, complete relaxation and quiet respiration. Fatalities have been explained and may to a great extent be avoided by more complete understanding of the apparatus. A portable apparatus will increase its popularity.

DR. McWILLIAMS, New York City: Intratracheal anesthesia is as safe an anesthetic as we have, but I would call the attention of the so-

ciety to the fact that it is not absolutely free from danger. I saw a patient die from the direct use of it, the patient having been operated on for suspected adherent pericardium. There was no difficulty in introducing the tube and the chest wall had been opened up, when suddenly it was noticed that the left eye of the patient practically bulged out of the head, and the left eye-lid became enormously distended. The left side of the face became distended, and the swelling extended down the neck, and the patient became blue and died. What happened I do not know. Whether the tube was pushed too far in the bronchus, and the lung was ruptured, I do not know, and I have no explanation to offer. It is certain the air must have rushed along the great vessels into the neck and head. It must have followed the internal carotid into the back of the eye and infiltrated the eye, and then the side of the face and the neck. I cannot explain it except that the patient died as the result of the anesthetic.

DR. CHARLES A. ELSBERG (closing the discussion): I do not feel that I want to go into a technical discussion as to whether the lung will collapse or how we can otherwise prevent the lung from collapsing. When you have an empyema with adhesions the lungs will not collapse. Every surgeon knows that when one pleural cavity is opened in the large majority of cases the lung will collapse, and in a considerable number of cases severe and dangerous symptoms ensue. That is a point in surgery with which we are familiar, and I do not think it need be discussed at this time.

I do not want to speak of the possible dangers of this method and what has happened in several cases, except to say this, that in every single case in which something has gone wrong, and there are three such cases on record, one of them from abroad, and two in this country, there was an error in the technic, as in the case referred to by Dr. McWilliams. I knew of a case that had been anesthetized with a new apparatus, in which several grave errors in the technic were made. In the first place, a soft rubber tube was used which can be compressed by a possible spasm of the glottis; while a silk woven catheter cannot be compressed. In the second place, there was no way of knowing where the end of the tube was. If I heard the facts correctly, the tube was too far down. You can push the tube down and plug one of the bronchi with the tube so that no air can get out, and then the lung will be over distended. There ought to be a safety device by which pressure of the inflowing air cannot go beyond a certain point. If you have an automatic regulator, so that the pressure cannot get beyond twenty-five millimeters of mercury, you cannot do injury to the lung, and will not have these occurrences of which we know several instances. It is important to be familiar with the method and use the right kind of tube, and if you have an automatic blower on the apparatus, so that the pressure cannot rise suddenly,

there is not so much likelihood of injuring the lung from pressure. I say emphatically that these are errors in technic which can and should be avoided.

## CHANCE AND THE PREPARED MIND.\*

By RICHARD MILLS PEARCE, M.D.

PHILADELPHIA, PA.

(“In the fields of observation chance favors only the mind which is prepared.”—*Pasteur*.)

IT was at the opening of the *Faculté des Sciences* at Lille, on December 7, 1854, that Pasteur, only thirty-two years of age at the time, but already professor and dean of the faculty, uttered these words in upholding, in his inaugural address, the value, on the one hand, of practical laboratory instruction as an aid to the solution of industrial problems, and on the other the importance of investigation in pure science, even though the resulting discoveries might have no immediate application. The point of view may have been novel when it was uttered, but in the sixty years that have elapsed how familiar it has become! How closely it approximates the ideals of those who are striving to improve the conditions of medical education and of medical research in our own day and country. What better argument can the most ardent advocate of detailed practical instruction in laboratory or hospital (medical training at first hand) present, than that which Pasteur offered in 1854?

(*The author then gives a detailed consideration of Pasteur's argument.*)

... what are, conditions to be fulfilled to ensure the “prepared mind” of Pasteur's adage?

*The Preliminary Education* of the individual is the first, and in many ways the most important consideration. I know it is bringing coals to Newcastle to discuss this question before the students and faculty of Syracuse University, for you have been among the first to recognize the value of two years' college work which shall include physics, chemistry and biology. Still, this principle is not generally recognized. Many of those in positions of authority in our medical schools, while loudly proclaiming the right of medicine to a place among the sciences and, indeed, characterizing it as the “Mother of the Sciences,” deny that a scientific education is a prerequisite to medicine. True, the opposition is frequently due to a realization of the awkward financial position in which an administration might be placed if students' fees diminished.

(*Dr. Pearce then discusses the importance of the preliminary education and of the “do it yourself” or “learn by doing” method in teaching.*)

*Influence of the Spirit of Investigation.*—But aside from this training the university has another duty to the prospective practitioner of

\*An address on medical education, delivered at Syracuse University, May 21, 1912, under the auspices of the Alpha Omega Alpha Honorary Medical Fraternity.

Owing to lack of space this address has been reduced over two-thirds. Abridgement made by H. S. Steensland, M.D., Syracuse University. The unabridged article is published in *Science*, 1912, N. S., XXXV., 941.



# ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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VOLUME LVIII  
JULY—DECEMBER, 1913

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PHILADELPHIA  
J. B. LIPPINCOTT COMPANY

1913



## INTRATRACHEAL ANÆSTHESIA.\*

A. BY NITROUS OXIDE AND OXYGEN.

B. BY NITROUS OXIDE AND OXYGEN UNDER CONDITIONS OF DIFFERENTIAL PRESSURE.

BY HENRY H. JANEWAY, M.D.,

OF NEW YORK,

Assistant Surgeon to the City Hospital.

(Published from the Department of Experimental Surgery of N. Y. University and Bellevue Medical College.)

A. THE introduction of intratracheal anæsthetization by ether immediately suggested the desirability of using nitrous oxide and oxygen by the same method.

Much evidence exists that surgery may be made more successful by the more general use of nitrous oxide anæsthesia. Both nitrous oxide and intratracheal anæsthesia have acknowledged advantages, and it becomes, therefore, a matter of importance to combine the good features of each.

Cotton, Boothby, Gwathmey and others have successfully kept patients under surgical anæsthesia by nitrous oxide, after a preliminary etherization, by simply allowing the mixed nitrous oxide and oxygen to stream in through the intratracheal catheter in the same manner that ether vapor is given intratracheally.

Such a method is wasteful of the anæsthetic, which under these conditions must be supplied in such excess that, at each inspiration by the patient, there is a very little dilution of the anæsthetic within the trachea by air which, otherwise, would be drawn through the larynx around the intratracheal catheter. There must, in other words, be such a supply of nitrous oxide, that only a minimum amount of air is drawn in around the intratracheal catheter during inspiration. To supply such an excess of anæsthetic is not perhaps objectionable when ether is used, as ether is cheap in comparison to nitrous oxide, and further it is a comparatively easy matter to secure a sufficient degree of concentration of ether vapor

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\* Read before the American Association of Anæsthetists, June 18, 1913.



to anæsthetize satisfactorily a patient by the usual intratracheal technic. Moreover, the escape of the air around the tube during the intratracheal anæsthesia by ether has been encouraged for the purpose of preventing the inhalation of blood and mucus during intra-oral operations.

Nevertheless, during ether anæsthesia the escape of large quantities of ether in the room is at least unpleasant, even if the waste of the ether is not considered a matter of importance.

In order to overcome these difficulties, in connection with anæsthesia by nitrous oxide, the writer has devised the little bag illustrated in Fig. 1. It is tubular in shape possessing a double wall so that it is capable of distention whether fitted over the catheter or not. It is pulled over the latter to a short distance above its extremity, and after the catheter is inserted into the trachea, the bag is distended with air through the fine rubber tube attached to it, thus effectually closing the space between the outside of the catheter and tracheal walls. The patient may now breathe in and out through the intratracheal catheter, and when the external end of the latter is attached to a respiration bag, receive the nitrous oxide and oxygen directly from the tanks undiluted with air.

Fig. 2 represents the arrangement of the various parts of the apparatus used for intratracheal anæsthetization by nitrous oxide and oxygen according to this method. (4) is a reducing valve, the legs of which are detachable so that everything necessary for this method of anæsthesia can easily be carried in a small bag.

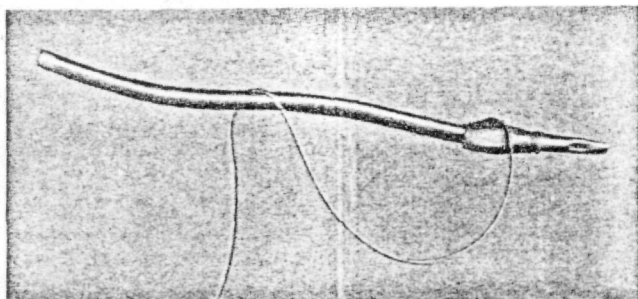
The tank is attached to the reducing valve, as illustrated, and because of the latter, a regular flow of the gas passes to the wash bottle (3) through the tube (2). Into the same bottle, upon the opposite side of a central partition the oxygen enters through the tube (8).

The purpose of the wash bottle is to furnish a visual method of estimating the flow of the gases. We are perfecting a more exact method of measuring the gases. By means of the third tube the mixed gases are conveyed to the respiratory bag (6). This bag must never be allowed to become completely filled and, in order to guard against distention, it is wise to insert a safety valve between it and the wash bottle. The respiratory bag is attached by its opposite end to a cylindrical valve. The latter is made of two cylinders, the external one of which possesses three openings upon one side (A, E, D) the intake side, and one (C) opening upon the opposite side, to which the tube passing to the intratracheal cannula (7) is attached.

The openings through the inner cylinder are so arranged that as it is rotated, one of the three openings (A, E, D) entering the cylinder upon one side, may be thrown into communication with the single opening (C) emerging upon the opposite side.

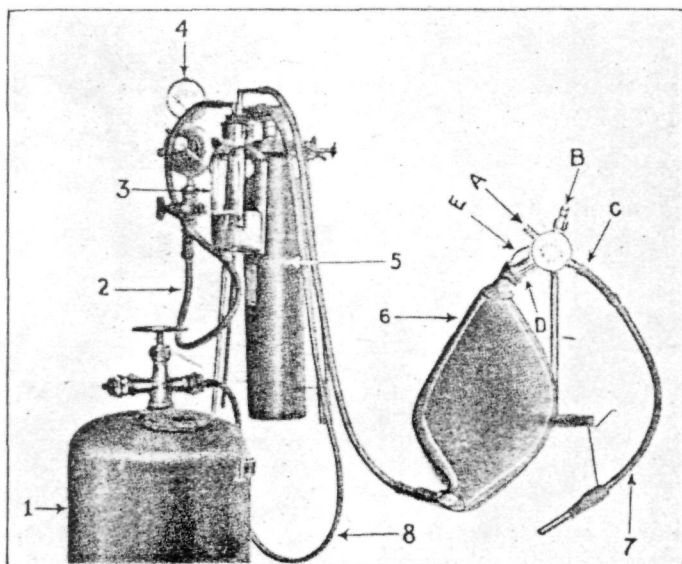
According as opening D, E, or A is placed in communication with the tube C emerging from the cylinder, the patient inhales, from the respiration bag and exhales through B into the external air or rebreathes back

FIG. 1.



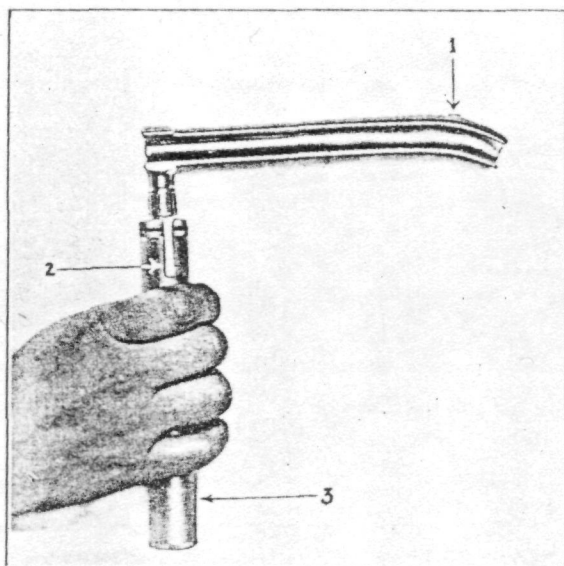
Intratracheal catheter surrounded by distensible rubber bag for occluding the trachea.

FIG. 2.



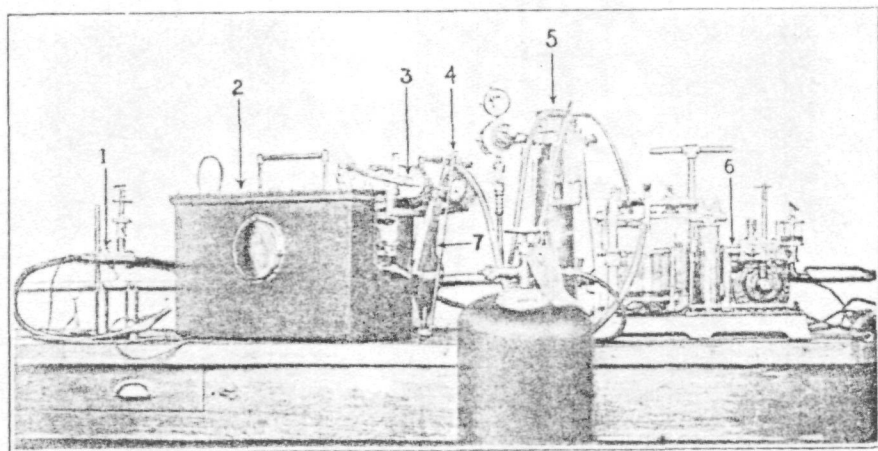
Arrangement for apparatus for intratracheal anaesthesia by nitrous oxide and oxygen. 1, oxygen tank; 2, rubber tube conveying nitrous oxide from the reducing valve (4) to the wash bottle (3); 5, nitrous oxide tank; 8, rubber tube conveying oxygen from the oxygen tank (1) to the wash bottle (3); 6, respiration bag; 7, intratracheal catheter. A, B, C, D, and E, openings in valve controlling the amount of rebreathing.

FIG. 3.



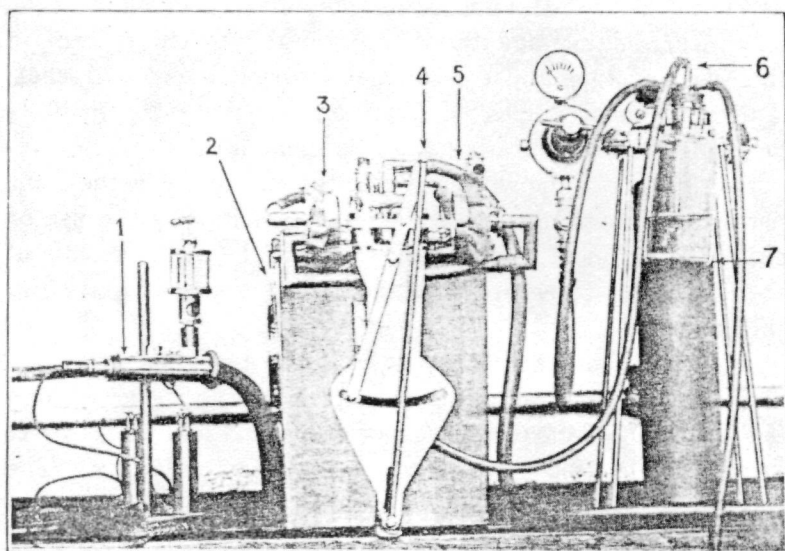
Speculum for catheterizing the trachea; 1, lamp; 2, spring which closes the circuit in the dry cells contained in handle (3).

FIG. 4.



Arrangements for apparatus for nitrous oxide anaesthesia under conditions of positive pressure. 1, valve controlling amount of rebreathing; 2, aluminum box containing respiration bag; 3 and 4, tamboours controlling the position of valves which permits of rise and fall of pressure within the box (2); 5, nitrous oxide tank and reducing valve; 6, motor; 7, spring controlling height of pressure within box (2).

FIG. 5.



Arrangements for spring, tambours, and valves attached to the end of aluminum box described in Fig. 4. 1, rebreathing valve; 2, aluminum box; 3 and 5, tambours controlling position of valves; 4, spring controlling height of pressure within box; 6, nitrous tank with reducing valve attached; 7, wash bottle measuring the flow of nitrous oxide and oxygen.

and forth from the inhalation bag or may breathe pure air. In occasional cases, in which a more profound anæsthesia may be needed for short intervals, the action of the nitrous oxide may be intensified or pieced out by dropping a few drops of ether into the cylinder. Provision is also made by means of a little electric heater within the cylinders for rapid volatilization of the ether and the prevention of the condensation of moisture on the mica valves.

One-quarter of a grain of morphine and one-hundredth of a grain of atropine are administered one hour before the operation. Better than morphine is narcophine, which has given greater satisfaction.

The back of the tongue is touched with 10 per cent. cocaine. The patient is then anæsthetized, preferably by chloroform, in the usual manner and the catheter inserted into the trachea. This may be accomplished by means of the Jackson direct laryngoscope so modified that it is deficient at the side in a manner permitting of the withdrawal of the instrument without the necessity of pushing the catheter through it. By the use of such an instrument it is possible to insert the catheter without thereafter detaching it from the tubing connecting it with the gas bag.

The speculum represented in Fig. 3 is a convenient instrument for catheterizing the trachea. The curve is just enough to still permit of the direct view of the larynx and yet to direct the distal end of the catheter forward into the larynx. The lamp of this speculum is illuminated by dry cells contained in its handle.

After the tube has been inserted into the trachea, its external end is attached to the outlet tube of the three way valve which has been previously attached to the stand. The little rubber bag around the trachea is distended and the anæsthesia will now proceed uninterruptedly with nitrous oxide and oxygen alone and will give efficient relaxation in the normal individual for all the usual abdominal or mouth operations.

The rubber bag distended around the catheter, prevents the inhalation of blood and mucus into the trachea and in no way adds to the danger of the procedure, as the pressure of the gases can never exceed that in the inhalation bag. Two provisions prevent the gases in the bag from rising above the

atmospheric pressure. First, the safety valve introduced between the respiration bag and the mixing bottle. Second, the respiration bag itself, which cannot become overextended without its being noticed by the anæsthetizer.

Rebreathing is an important feature of this method of anæsthesia—all that remains for the anæsthetizer to do after the intratracheal catheter has once been introduced into the trachea, is to turn the three way valve back and forth between the breathing tube (E) and the tube (D) as the respiration bag empties and fills. About one-half the time the average patient is rebreathing.

The dimensions of the catheter are important. It must have a lumen of at least  $\frac{5}{16}$  inch. The author has used a very thin-walled, flexible metal tube covered with a piece of Penrose drainage tube.

Further experience with this method has demonstrated that care to avoid traumatism during the insertion of the catheter is necessary; and moreover that even though nitrous oxide alone be used as the anæsthetic it is possible for the anæsthesia to be complicated by pneumonia in those cases in which this complication is to be feared.

Nevertheless in properly selected cases this method of anæsthesia is a useful one.

#### B. BY NITROUS OXIDE AND OXYGEN UNDER CONDITIONS OF DIFFERENTIAL PRESSURE.

It will be appreciated that successful anæsthesia by the method previously outlined depends entirely upon active respiration by the patient. It is for this reason that narcophin, which exhibits a much less toxic effect upon the respiratory centre than morphine, has been found so valuable as a preliminary narcotic and that it is advised to give atropin if a preparatory injection of morphine is depended upon.

If the pleural cavity is opened and active respiration is rendered impossible, the lungs will be unable to fill and empty themselves with the gases during inspiration and expiration. In order to permit of passive inflation and deflation of the lungs with nitrous oxide and oxygen when the chest has been opened

and also without that extravagant waste of the gases which is incidental to true intratracheal insufflation, provision has been made for exerting an alternating increase and decrease of pressure upon the outside of respiration bag described in this paper.

The arrangement adopted to produce this effect has been perfected in conjunction with the catheter and special device for obstructing the trachea described in this article though it may be used in connection with a simple face mask. It provides for true artificial respiration synchronously with the patient's respiration, in other words, merely accentuating the patient's efforts of respiration.

The gases are forced in and out of the respiration bag by the alternating pressure upon it with provision for any desired amount of rebreathing as though the patient were doing his own breathing.

Actually, inspiration alone is assisted. Provision has been made for the loss of that amount of expired air in the passage back to the respiration bag which it may be necessary to replace from the gas tanks.

These results are accomplished by inclosing the respiration bag in an air-tight aluminum box, Figs. 4 and 5 (2).

By means of the attachment at one end of the box of which the important parts are four valves, a spring and two flaccid rubber tambours (3 and 5), air from the insufflation apparatus is allowed to pass alternately into the space around the bag within the box and outside the box into the room. When the air passes into the box it increases the pressure around the respiration bag which contains the nitrous oxide and oxygen. This increase of pressure is transmitted to the gases within the bag so that they are forced into the patient's lungs. It must be borne in mind that there is, of course, no communication between the interior of the respiration bag and the space enclosed outside of the rubber bag by the aluminum box. When the pressure within the box reaches a certain height for which the spring (4) may be set the air blows out the rubber tambour and reverses the position of the four valves. This reversal of the valves occurs suddenly, inasmuch as the rubber diaphragm cannot start its movement until the resistance of the spring is overcome; again the resistance offered by the spring is greatest at the extreme positions of its swing. In the reverse position of the valves the current of air from the machine no longer enters the box, but exhausts in part into the room and in part into the space enclosed by the second tambour. The stop-cock controls the amount of air acting on this tambour and, consequently, the time when the membrane of this tambour blows out, changing the valves

back to their original position. It will be appreciated that the speed with which the position of the valves is changed back to their original position depends only in part upon the second tambour. If a minus pressure suddenly occurs within the aluminum box, this will tend to suck in the first tambour which of itself tends to change the position of the valves back to the first position permitting the entrance of air into the box. Because of this fact there is a strong tendency for the increase and decrease of pressure within the box to be synchronous with respiration.

The synchronism of the movement of the valves with respiration depends upon the fact that the changes in the pressure of the gases within the rubber bag transmit themselves to the space outside the bag and within the aluminum box and so to the rubber tambour. The piece (1) is a valve permitting of the loss of any desired amount of the gases exhaled from the patient's lungs. It permits, in other words, of any desired amount of rebreathing from no rebreathing up to complete rebreathing of the expired air. We have therefore, in this apparatus a means of true artificial respiration with whatever gas (either air or nitrous oxide and oxygen) that is allowed to fill the respiration bag.

Should it be desired at any moment to change from nitrous oxide to pure air, respiring the patient with only the latter, this change may be accomplished by moving a slide valve, which immediately connects the intratracheal catheter with the space outside the respiration bag.

It is important to remember that the only manner in which a minus pressure may be produced within the box is by a sudden inspiratory effort by the patient. While there is provision for artificial suction of the air out of the aluminum box yet the mechanism by which the valves are changed from the position permitting of expiration by the patient to that of inspiration is not accomplished by artificial suction. Particularly when the chest wall is open if during artificial respiration the expiratory phase depends upon an artificial suction a complete collapse of the lungs will result. This complete collapse combined with the replacement of the negative intrathoracic pressure during inspiration with a positive pressure which compresses the pulmonary vessels will so obstruct the pulmonary circulation that death will result in a little while.

For this reason the author believes that the principle of an extensively advertised machine for artificial respiration certainly when the chest is opened is a wrong one. It is much better to depend upon the elasticity of the lungs even when the



chest is closed for expiration, except in rare intervals and then only for a few respirations.

During artificial respiration with the chest wall open as in thoracic surgery, it is absolutely necessary to depend alone upon the elasticity of the lungs for expiration and to absolutely avoid artificial suction.

The above described apparatus may be used with the intratracheal catheter provided with the little rubber occluding bag described in this article.

It may, however, be used in connection with a tightly fitting mask and therefore without the intratracheal catheter. When used with a mask it is better to provide the mask with an elastic band which passes around the head and by which it is tightly held over the mouth and nose.

Used in either manner, the apparatus furnishes a method of administering nitrous oxide and oxygen by true artificial respiration in a manner which will be synchronous with any of the more forcible respiratory efforts of the patient.

It will simply accentuate the voluntary efforts of inspiration and expiration. It increases the safety of nitrous oxide anæsthesia and for two reasons its efficiency. The first reason is that it administers the gas under conditions of increased pressure. The second is that morphine may be used with greater freedom with it. The preliminary injection of morphine has been always viewed as almost a necessary adjunct to the best nitrous oxide anæsthesia. Unfortunately morphine diminishes the respiratory movements to a marked degree and with them the power of the patient to inhale regularly the gas. This disadvantage, however, is not noticed if the gas may be introduced under conditions of differential pressure. The safety of nitrous oxide anæsthesia is increased because failure of respiration cannot take place, and may at once be relieved by respiration with air.

The slide valve described ensures against the possibility of excessive pressure within the lungs. Its exhaust opening is simply closed on inspiration, being guarded by a piece of mica which raises upon the slightest expiratory effort. During inspiration the spring never allows the pressure within the respiration box to exceed 10 mm. of Hg.

# CONTINUOUS RESPIRATION WITHOUT RESPIRATORY MOVEMENTS.<sup>1</sup>

BY S. J. MELTZER AND JOHN AUER.

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The object of the function of respiration is to supply the animal with oxygen and to remove carbon dioxide. To attain this object the vertebrates are provided with a complicated mechanism of which the respiratory movements are an essential feature. The respiration appears as a continuous chain of rhythmically recurring cycles, each cycle consisting of two antagonistic movements, one which carries air into the body and the other which assists its removal from the body. When the muscular activity of the body is eliminated by one cause or other and the exchange of the gases is carried on by so-called artificial respiration, again the respiration is rhythmically discontinuous and each cycle is composed of the two antagonistic movements: the inflow of air is carried on rhythmically by some external mechanism, while the return of the air is accomplished during the intermission by the elastic forces of the body. The rhythmic antagonistic movements seem thus to be inseparable from the function of respiration.

In studying recently the nature of the mechanism of the respiration in the presence of a double pneumothorax, while the animal is breathing compressed air by the Brauer method of overpressure, we discovered the fact that under certain conditions respiration can be carried on by continuous inflation of the lungs, and without any normal or artificial rhythmical respiratory movements whatever. This observation was verified by many experiments and we will describe here briefly the essential features of the experiment.

A longitudinal slit is made in the trachea of an anesthetized dog or rabbit and a glass tube introduced down to the tracheal bifurca-

<sup>1</sup> Received for publication June 4, 1909.

tion. The protruding end of the tube is then connected with a pressure bottle by means of a *T*-tube, the opening of the free branch of which is regulated by a screw clamp. The air which streams from the bottle under pressure partly escapes through the free branch of the *T*-tube and partly enters the trachea and reaches the bifurcation from which it returns through the space between tracheal wall and tube and escapes through the slit in the trachea and through mouth and nose. It is essential that the tube should fill out two-thirds of the lumen of the trachea, that the slit in the trachea be not too short and that the pressure of the air which enters the *T*-tube should amount to about fifteen to twenty millimeters of mercury. The pressure within the trachea is of course much lower than that. In the connection between the trachea and the pressure bottle are interpolated a manometer, an ether bottle and a bottle with Ringer's solution to keep the mucous membrane of the trachea moist. The essential point of the arrangement is that air is reaching the bifurcation under pressure and returns through another path than that through which it entered. When the air is thus circulating through the trachea the diaphragm descends, the thorax becomes moderately distended and the respiration mostly becomes very slow. The heart beats also frequently become dangerously slow. This danger, however, is easily obviated by an intravenous injection of one milligram of atropin; in a few seconds the pulse becomes frequent and remains so for many hours. The animal may receive now an intravenous injection of curare sufficient to completely abolish any spontaneous or reflex movements; its life is as safe as under regular artificial respiration. When the anterior thoracic wall is removed, the distended lungs are seen to be immobile while the heart continues to beat with a regular rhythm. If the above described arrangement is carried out properly the lungs retain their pink color, the heart continues to beat regularly and efficiently for many hours and the blood-pressure shows but little variation.

We have observed animals four hours and longer under these normal conditions. If the glass tube within the trachea is a little too wide or too narrow in relation to the lumen of the trachea the lungs acquire easily a slightly cyanotic appearance. But then a disconnection of the tube from the pressure bottle for two

seconds, which means a momentary collapse of the lungs, restores immediately the pink color of the lungs and a repetition of this procedure once every three or four minutes is sufficient to maintain the life of the animal in a satisfactory fashion for many hours, although under these circumstances the blood-pressure is subject to frequent variations.

In another method, the tube which conveys the air to the lungs is short—a regular tracheotomy tube—and is tied in firmly in the upper part of the trachea, while another narrower tube is inserted into the trachea through a narrow opening made at a lower place. This tube reaches the bifurcation and serves for the removal of the air. This method also was found to do satisfactory service. In a third method, a long O'Dwyer tube, bent at right angles, was introduced through the mouth and inserted into the larynx. Through this tube a catheter was pushed into the trachea until it reached the bifurcation. Both tubes were then connected with the pressure bottle in such a manner as to let the air enter through the O'Dwyer tube and escape through the catheter. This arrangement, however, has failed as yet to give uniform results. The method, however, is surely capable of improvement and it is probable that it will finally give satisfactory results.

If the air is made to enter the lungs through a short tracheal tube firmly tied into the trachea, the curarized animals die in a very short time from asphyxia. With this method, the spontaneous respirations of the animals are apparently indispensable for the maintenance of their life. The result is not perceptibly better even if the firmly tied-in tube reaches the bifurcation. The difficulty of this method consists mainly in the fact that the removal of the carbon dioxide has to take place against the stream of the air within the tube; while in our method the removal of the carbon dioxide is rather assisted by this stream of air.

The following three points are the essential factors in the success of our method: (1) The lungs are kept in continuous inspiratory state of distension which facilitates the exchange of the gases. (2) The fresh air reaches the lowest part of the trachea. (3) The air escapes by another path (although also through the trachea) than by the one it enters. Under these conditions the supply of oxygen

and removal of carbon dioxide take place apparently in physiological fashion without the aid of any rhythmic antagonistic movements.

Besides the direct physiological bearing of our experiments on the function of respiration the method is destined to be of methodical service in other physiological investigations, for instance in the study of the heart actions where the movement of the lungs is a disturbing factor. This method might in a certain way offer some advantages over the known methods of Langendorff and of Bock-Hering. Furthermore the method promises to be of practical service in various directions. We shall not omit to refer to two statements in the literature which can be considered as forerunners of our method. In the first place, there is the statement<sup>2</sup> that Hook in 1667 maintained the life of a dog for an hour by continuous inflation of the lungs previously punctured at various places. In the second place, we have to mention Nagel's<sup>3</sup> communication according to which the life of curarized pigeons were maintained by sending a continuous stream of air through the humerus which in birds is connected with the air sacs. In this case the air escaped through the trachea. In both instances the air escaped through the paths opposite to those through which it entered. In our method the air enters and escapes through the trachea, although through the separate paths within it.

<sup>2</sup> Rosenthal, Hermann's Handbuch der Physiologie, 1882, iv, 238.

<sup>3</sup> Nagel, *Centralbl. f. Physiol.*, 1900, xiv, 238.

THE  
**British Medical Journal.**

THE JOURNAL OF THE BRITISH MEDICAL ASSOCIATION.

EDITED BY

ERNEST HART, ESQ

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VOLUME II, 1880

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JULY TO DECEMBER.

London :

PRINTED AND PUBLISHED AT THE OFFICE OF THE BRITISH MEDICAL ASSOCIATION,  
429, STRAND, W.C.

# CLINICAL OBSERVATIONS

ON THE

## INTRODUCTION OF TRACHEAL TUBES BY THE MOUTH INSTEAD OF PERFORMING TRACHEOTOMY OR LARYNGOTOMY.

BY WILLIAM MACEWEN, M.D.,

Surgeon and Lecturer on Clinical Surgery, Glasgow Royal Infirmary.

A FEW facts concerning the introduction of tubes passed through the natural passages into the trachea, instead of having recourse to operations for opening the windpipe through the neck, are considered worthy of attention; and in presenting these, it is thought advisable to confine the remarks as far as practicable to the relation of facts, refraining from entering into the merely discursive side of the question.

In considering the practicability of such a procedure, facts were looked for from various sources. *Post mortem* experience showed that instruments of the tube kind could, after a little practice, be passed with facility through the mouth into the trachea. This was accomplished by introducing the finger into the mouth, depressing the epiglottis on the tongue, and so guiding the tube over the back of the finger into the larynx. In experimenting with various instruments, it was found more easy to introduce those of a large calibre, such as Nos. 18 to 20, than instruments of the size of 8 to 10 catheters—the latter being more liable to catch on the various irregularities on the internal laryngeal surface.

While it was easy to introduce instruments by the mouth into the trachea, it was difficult to pass them through the nose into the air-passages. The nasal passages being on each side of the middle line, catheters passed through them were found to glide to the side of the pharynx, away from the middle line, and consequently away from the larynx; so much was this the case, that it was found impossible to introduce a nasal unarmed catheter through the nose into the trachea by any manipulation outside the mouth. A catheter, having a strong properly curved stilette, after considerable labour and many efforts, might find its way into the larynx; but even this could not be depended on. An instrument can, however, be passed through the nose into the pharynx; then, by introducing the finger into the mouth and hooking the catheter forward and toward the middle line, it can be guided into the larynx, and in this way respiration in the living might be carried on through the trachea, it is yet difficult to pass them when compared to the passage of like instruments through the mouth. The nasal tubes have also a decided disadvantage; they are necessarily of much smaller calibre than the tubes which are admitted through the mouth; in most people, one or other nasal aperture does not admit a tube of sufficient calibre to enable the respiration to be carried on easily.

The facility of introducing tubes by the mouth into the trachea having been ascertained on the "subject", the question which next presented itself was: whether there were any obstacles in the living body which would prevent or contraindicate their use. The instructions given in almost every text-book teaching the introduction of œsophageal tubes, would lead one to suppose that not only could such instruments be passed into the trachea, but that it was necessary to give special indications of their presence there, in order to avoid the awkward mistake of injecting fluid or food into the lungs. These precautionary indications are necessary, as, on several occasions, the stomach-pump tube has been unwittingly introduced into the trachea and left there, for shorter or longer periods, before the mistake has been recognised. Among these, may be mentioned the mistake made by no less a surgeon than Desault, who passed a tube into the trachea, left it there for some hours, and only became aware of its true situation when he began to inject food into it.\* After the performance of tracheotomy, tubes have been passed through the trachea into the mouth, and the reverse way; and, from the scanty reports of those cases, one gathers that the parts have exhibited considerable tolerance to the presence of those instruments. A couple of cases of cut-throat, which came into my wards about the same time—the one having the windpipe severed immediately above the vocal cords, the other beneath them—showed a great and growing tolerance to external impressions; so much so that, even when the cords were digitally pressed on and held aside, no spasm was produced. Besides these, the passage of metallic and vulcanite instruments, as proposed by Trendelenburg and

carried out by Schrötter, with the view of dilating strictures in chronic laryngeal stenoses, prove that instruments can be passed by the mouth and temporarily retained in the trachea without exciting an unsurmountable degree of spasm. And I would say that if they can be retained for ten minutes they might, as far as the fear of spasm is concerned, be retained for a much longer period. With these brief introductory observations, I will pass to the series of successful cases which I had during the year 1878.

CASE 1.—*Removal of Epithelioma from Pharynx and Base of Tongue: Introduction of Tube into Trachea through Mouth to occlude Hemorrhage from Larynx, and for administration of Anæsthetic.*—W. P., aged 55, a plasterer,\* was sent me by Dr. Anderson, Duke Street, Glasgow, who stated he believed him to be suffering from epithelioma of the mouth. There was an ulcerated surface of the tongue, and also one on the anterior pillars of the fauces. The last two right lower molars were very sharp and rugged, and, though the ulcer had an epitheliomatous look, it was thought advisable to try palliative measures in the first instance. The two lower molars spoken of were removed, and he was placed under a course of iodide of potassium. After a very full trial, these measures were found inefficient, as, when he was seen by me two months afterwards, the disease had extended. He was then admitted into the hospital.

On admission, he stated that he had experienced for over a year sore-throat, pain in the right ear, and shooting pain in the back part of the tongue. On examining, an ulceration was found on the right side of the fauces, extending from the anterior pillar backward to the posterior wall of the pharynx—the latter of which was invaded for about an inch. From the fauces it spread downwards and inwards to the dorsum of the tongue, and the raised ulcerated margins extended from a point opposite the last right molar to the immediate vicinity of the epiglottis. Histologically, the characters of this disease were epitheliomatous.

With the patient's concurrence, it was resolved to remove the growth. As it was an operation which would cause considerable bleeding, precautions had to be taken to secure the air-passages from occlusion. Hitherto this had been effected by opening the windpipe, by laryngotomy, and the introduction of Trendelenburg's stampon-cannula. Instead of this, I had determined, should an opportunity present, to introduce into the trachea, by way of the mouth, a tube, which would extend beyond the vocal cords, and through which the patient would respire. The upper laryngeal opening could then be plugged outside this tube, so as to prevent the entrance of blood into the larynx. The plug could then be effected in various ways, by causing the tracheal tube to perforate a close sponge of suitable size, which, after the tracheal tube had been introduced, could then be fixed in the laryngeal orifice; by fixing to the tube, at a convenient part, a piece of fine muslin or other material, which would act as the *canule à chemise* used after lithotomy; by inflation of a circular closely fitting bag, etc.

Preparatory to the operation, a tube was several times inserted through the mouth into the trachea, beyond the vocal cords; and it was found that, with the exception of the cough which ensued immediately on its insertion, he bore the tube sufficiently well to warrant the success of the procedure. He could breathe freely through it, and the mucus expectorated was expelled through the tube with considerable force.

The operation was performed on July 5th, 1878. The usual cough followed the introduction of the tube; but it ceased as soon as he received a few whiffs of chloroform, and long before he became constitutionally affected by the drug; the chloroform seemed to exercise a local sedative effect. The upper opening of the larynx was stuffed with a sponge to prevent the entrance of blood. The tube projected several inches beyond the mouth, thus enabling the administration of the anæsthetic to be continued uninterruptedly during the whole operation, without in any way interfering with the manipulative procedure. The entrance and exit of air through the tube was both felt and heard distinctly, so that Dr. Symington (who administered the chloroform) had a ready guide to the state of the respirations. After the operation was finished, when the hæmorrhage had ceased and the patient had regained consciousness, the tube was withdrawn, it having acted throughout without the slightest hitch.

The operation may be briefly described as follows. An incision was made through the right cheek, from the angle of the mouth to the angle of the lower jaw—the latter being sawn through. This line of incision, once previously used by Dr. Foulis, though objectionable on *à priori* grounds, was followed chiefly on account of the extensive view of the internal parts afforded by it. The diseased surfaces were thoroughly removed by the knife, the instrument passing wide of the affected parts. The sawn angle of the jaw was afterwards drilled, and coupled by two strong silver wire stitches. The cheek was accurately brought together,

\* Desault, by Bichat, (*Œuvres Chirurgicales*, vol. ii, pp. 250.

\* The patient was afterwards shown at the Glasgow Medico-Chirurgical Society.

and a bandage applied to secure immobility of the lower jaw. His after-treatment consisted in perfect quiescence and fluid food. In a week the wound was for the most part healed, the only portion remaining open was that where the wires uniting the jaw protruded through the skin. In a month the wires were withdrawn, the jaw being then firmly united. He was dismissed to the Convalescent Home July 26th, 1878. Since then, he has several times presented himself, and, as he has cultivated a vigorous growth of hair, the facial linear cicatrix is no longer visible. The larynx in no way seemed to suffer, and the voice was in no way affected. The administration of the anæsthetic was carried on through the tube, which projected several inches beyond the mouth, quite uninterruptedly, and without in any way interfering with the operator. The respiration was felt and heard by the administrator; the tube, as it concentrated the flow of air, increased the sensation to the hand and ear. Once or twice during the time he was under the chloroform, mucus was thrown from the tube by an explosive expiratory effort. It must be obvious that as long as the tube which went beyond the vocal cords remained patent, there could not possibly be any fear of asphyxia, and the most frequent cause of fatality under chloroform would be avoided.

REMARKS.—It may be noticed that the tube answered all the purposes for which it was intended. 1. The chloroform was easily, uniformly, and uninterruptedly administered during the whole operation. 2. The administration of the chloroform in no way interfered with the performance of the operation. 3. The ingress and egress of air through the tube were both felt and heard, so that the administrator had a ready indication of the state of the respiration. 4. No blood entered the larynx. 5. The after-result was excellent.

CASE II.—*Edema Glottidis: Tube inserted into Trachea through Mouth.*—W. L., a commercial traveller, aged 42, was admitted into the Glasgow Royal Infirmary at 1.20 A.M. on 14th Sept., 1878, suffering from acute edema glottidis. He had a note from Dr. Macmillan of Paisley Road, Glasgow, headed, "urgent case", and stating, "case of inflammation of trachea, probably requiring operative interference". After the patient was examined by my house-surgeon, Dr. Symington, he considered it necessary to send for me, and at 2.15 A.M. I found the patient in the following state. He sat in bed supporting himself with stiffened arms; his head was thrown forwards, and he had the distressed anxiety so characteristic of impending suffocation depicted on his countenance. His inspirations were crowing and laboured, and there was a very frequent forced attempt to swallow, attended by extreme pain, at the termination of which a long crowing inspiration ensued. He spoke in a muffled whisper, and confined his answers, when possible, to monosyllables, or substituted signs by head or hand. He complained of intense pain—a feeling of suffocation, and begged that something should be done for his relief. On examination, it was seen that the base of the tongue and the fauces were covered with whitened mucous membrane, at parts shrivelled up and peeling off, at others adherent. The parts not so covered were in a reddened congested state. The fauces and the upper portion of the larynx were much swollen, and had a hard thickened feeling, as if they had been slightly burned. The respiratory orifice was so much constricted that the tip of the forefinger occluded it. He constantly signed for cold water, which he took into his mouth, and after abortive attempts to swallow, he rejected it during a fit of coughing.

History.—It was afterwards ascertained that he had entered the kitchen of his house just as the boiling water had been poured from the potatoes preparing for dinner; snatched up a small potato in his fingers, and, finding it too hot for them, unthinkingly threw it into his mouth and attempted to swallow it, but it stuck at the back of his throat and nearly choked him. This happened twelve hours prior to his admission into the hospital. An hour after this mishap he felt somewhat relieved, and went out to transact some very pressing business, but finding his breathing becoming rapidly impeded, he had to return and send for his medical attendant. From this time the symptoms steadily increased, until he arrived at the hospital in the condition already mentioned.

Treatment.—It was just such a case as required prompt operative interference. Instead of opening the windpipe through the neck, it was resolved to introduce an instrument by the mouth. As the passage was so constricted, a No. 12 catheter was first introduced, and, the orifice being found so far patent, a catheter of larger calibre, and in shape resembling a rectal tube, was introduced. On its introduction there was evinced considerable excitement, accompanied by a spasmodic fit of coughing, which lasted for about a couple of minutes. In order to gain the patient's confidence, he was asked to hold with his own hand the portion of the tube which projected from his mouth, and told that he was at liberty to withdraw it if he felt it necessary. Half an hour afterwards he withdrew the tube, stating that he did so as he wanted to cough. When it was withdrawn, even after this short interval, he could speak

more distinctly, and stated that his breathing was relieved. The tube was then reinserted, and fixed *in situ* for twelve hours. It was then removed, washed, and, after the patient had something to drink, it was reintroduced, and retained for other twelve hours. After the end of the first twenty-four hours, when the tube was withdrawn, he could breathe very much more freely, and could swallow solid food. It was, however, considered prudent to introduce and retain the tube in the trachea for other twelve hours, which was done. During the last period, he slept for four or five hours with the tube in the trachea. After the end of this time, the swelling round the orifice of the larynx had almost entirely subsided. The tube was then finally removed. This would be about thirty-nine hours from the time the tube was first introduced; but, excluding the time during which the tube was withdrawn for the purpose of cleaning it and feeding the patient, the instrument would be retained *in situ* for thirty-six hours. He afterwards made an uninterrupted recovery, and went out of the hospital six days after admission.\* Regarding this case, the following facts seem worthy of note. The first introduction of the tube was followed by a prolonged (fully two minutes) spasmodic cough, which evidently gave pain. The second insertion was likewise followed by a spasmodic expiratory effort, but much slighter and of short duration. The sequence of the third intromission was a single abrupt expiratory effort, resembling a person clearing his throat, but there was neither cough nor pain. On the occasion of the first and second introductions, I perceived that the cough and the painful sensation subsided at the moment when a long inspiration took place. Before introducing the tube a third time, the patient was instructed to take a long inspiration as soon as the tube was inserted. He did so, and it is possible that this affected the result.

It will be observed that the word cough is used; and physiologists will be apt to say that, if the patient coughed, the tube could not have been passed through the vocal cords. The tube was passed into the trachea until the rings of that organ were felt, so that there can be no doubt that the tube had penetrated further than the true cords. The sound, which has been called a cough was at times rather like a person violently clearing the throat, but at others it was a distinct explosion—at such times generally sending some mucus forcibly from the orifice of the tube. A cylindrical tube of the calibre used does not fill the whole larynx at the level of the cords, but, resting chiefly on the respiratory portion, still permits the cords to come into contact anteriorly, to a greater or less extent. It is, therefore, possible that the portions of these structures remaining free could exercise sufficient restraining power on the air on the outside of the tube in front, so as to enable an explosion to take place, provided the volume of air coming from the lungs be greater than what could find ready egress through the tube itself. Whether this explanation be correct or not, there can be no doubt that the patient could say "Yes" and "No" distinctly while the tube was *in situ*—leading the air to the outside of the mouth—and to attempt other sounds and phrases, though the latter were unrecognisable.

Mucus was expelled from the tube by coughing. Sometimes a little mucus would be heard in the tube for a number of seconds, when a sudden expiratory effort would send it to the outlet of the tube, where it would be wiped away, or the cough might be strong enough to expel the mucus clear of the tube. In this instance, the mucus in the tube formed an impediment which was sufficient in itself to permit a distinct explosion when an effort to expel it took place.

This patient was extremely thirsty, constantly crying for drink, owing probably to the burned state of the parts. After the tube was inserted, he demanded a drink, and was much annoyed when he was presented with a teaspoonful of fluid. It was explained to him that it was feared the fluid "would go down the wrong way". This fear on our part was soon dispelled by the patient taking several mouthfuls of milk, and swallowing it while the tube was *in situ*. This he afterwards many times repeated, the parts encircling the tube so as to prevent the ingress of fluid.

CASE III.—*Acute Edema Glottidis, following Chronic Laryngeal Affection: Insertion of Tube into Trachea through Mouth.*—M. R., a housewife,† aged 38, was admitted into the Royal Infirmary on December 8th, 1878, suffering from a laryngeal affection requiring operative interference. For more than a month previously she had suffered from a throat-affection, supposed to be ulceration of the larynx, for which she was treated by Dr. Nairn of Glasgow. From this she partially recovered, but on December 5th she took a relapse. She then experienced pain in the throat and right ear, and difficulty of deglutition, which increased until, when she attempted to swallow, the fluid passed by the nose. Her respirations became greatly impeded until, on the day of admission, her medical attendant considered operative interference imperative, and with

\* This man was shown by me afterwards at the Glasgow Pathological and Clinical Society.

† This patient was afterwards shown at the Glasgow Medico-Chirurgical Society.



this view advised her to go to the Royal Infirmary, whither he himself conducted her in a cab. On admission, she was in the following condition. She had an anxious pained look; her respirations were laboured, crowing, and much impeded. The saliva trickled from her mouth, as she could not swallow, and very often a spasmodic cough took place, ending in bringing up some mucus mixed with saliva and slightly tinged with blood. She had aphonia; attempts to whisper evidently gave pain, so she curtailed them to monosyllables, or substituted a sign, such as a shake or nod of the head. She hesitated about making any attempt at deglutition; she did try, however, and apparently took a spoonful of milk, but after four or five seconds it was expelled during a fit of coughing. This was repeated with a like result. On examining the throat, the orifice of the larynx was found to be very much narrowed—œdematous tissue surrounding it on all sides and extending backwards in the form of a tumour, which completely blocked the pharynx. The tip of the forefinger could occlude the portion of the laryngeal orifice that remained patent. The epiglottis was not active, and neither it nor the surrounding parts exhibited the usual sensitiveness to touch. In consequence of the tumour-like extension of the œdema behind and to the sides, the larynx was pushed well forward and fixed in that position. Her pulse was rapid and weak; her skin was hot and clammy. She was about three months pregnant. It was just such a case as would have been operated upon by tracheotomy under ordinary circumstances.

A fresh No. 12 catheter was passed into the trachea by way of exploration, and then the smallest sized tracheal tube that was at the time obtainable. This was found to be just on the thick side, but it passed. A fit of coughing, which lasted more or less for a couple of minutes, ensued; after which she had comparative ease. The tube was inserted at 6.20 P.M. on December 8th, and was retained till 8 A.M. on December 10th—it being removed at intervals of about twelve hours to be cleaned and to permit an œsophageal tube to be inserted for feeding purposes. In all, it was in the larynx thirty-five hours. At the end of that time, the œdema had greatly subsided; she then breathed easily. She could swallow and speak a little, and from this time she made an uninterrupted recovery.

The following points are particularly noted. The introduction of the tube was easy, as the laryngeal orifice was thrown well forward and fixed, owing to the great amount of œdema; and from the same cause the parts had an impaired sensibility, which rendered the manipulation tolerable. The first tube seemed to fill the entire free portion of the larynx above the cords. The next tube was very slightly narrower, at the same time thinner in its walls, thereby affording a large internal diameter relatively to the size of the tube. The ease which this gave was great, and, after it was introduced, the patient marked her appreciation of it by grasping and clapping the hands of the operator by way of thanks. She turned on her side afterwards, and soon fell asleep. The two last times the tube was inserted, it did not cause any cough or spasm.

In the former case, it was noticed that there was a distinct cough; in this case, the expiratory explosion of air was not what could come clearly under the physiological term cough, except toward the end of treatment, when there were sounds which were more purely explosive in character. Again: at first, after the introduction of the tube, the patient could not give the monosyllables as noted in the former case. It must be remembered, however, that she had complete aphonia on admission. Toward the end of the first twenty-four hours, she began to say "Yes" and "No"; and, after the thirtieth hour, the monosyllables were sounded distinctly.

The expectoration was profuse, semi-purulent, fluid, and streaked or mixed with blood; but it afterwards, towards the end of the first twenty-four hours, began to be thick and tenacious. The expectoration was thrown to the outside of the tube, sometimes by a distinct cough, when a quantity of the mucus had partly occluded the tube for a moment. On several occasions, when the mucus began to be tenacious, a little brush, mounted on a wire of definite length, was pushed into the tube and the expectoration removed. Twice, when the breathing was not quite so free, the tube was removed, and a very thin coating of mucus was found in the interior; this was washed off and the instrument returned.

Remembering the state of the pharynx, rendering deglutition impossible, and the loss of sensibility of the larynx prior to the introduction of the tubes, she was not asked to swallow during the first twenty-four hours while the tube was in position. Several times, a catheter was introduced into the œsophagus, and beef-tea, eggs, milk, and brandy were injected. At the end of the first day she began to swallow a little, and about the thirtieth hour she took several mouthfuls with the tube *in situ*. Several times she slept for hours with the tube in the trachea, and often she had snatches of sleep besides.

In this case, the œdema glottidis, mechanically blocking the pharynx, was so great as to exercise pressure on the superior laryngeal nerves,

exhibited in the non-sensibility of the epiglottis and the parts of the larynx above the true cords. This constituted a danger, as was shewn when she attempted to swallow. The impaired laryngeal sensibility, coupled with the fixity of the structure from the œdema, prevented the epiglottis and the neighbouring parts from closing the laryngeal orifice, when an attempt at deglutition was made. As a consequence of this and the pharyngeal obstruction, the fluid entered the larynx, passing down into the trachea before it produced the irritation necessary for its expulsion. A few seconds of quiescence ensued after the attempt to swallow the fluid before it was again brought up by coughing, and it is likely that the time might have been extended if persistent efforts to feed the patient were made. From cases which I have seen and heard of, this is not an unfrequent cause of at least hastening a fatal issue in children affected with œdema of the glottis. It is satisfactory to note that the patient, who was pregnant at the time when she was suffering from the throat-affection, afterwards had a well-developed strong child at full time.

[To be continued.]

## ON A NEW METHOD OF ARRESTING GONORRHOEA.

By W. WATSON CHEYNE, M.B., F.R.C.S.,  
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HAVING been for some time past occupied with the problem of the infective diseases of wounds, the subject of gonorrhœa, as an affection probably belonging to the same class of diseases, has occupied my attention. The extreme contagiousness of this disease, the existence of a distinct period of incubation, and the steady spread of the inflammation from a given spot, all point strongly to a parasitic origin. Acting on this idea, I made, in the spring of 1879, a number of inoculations of gonorrhœal pus, under certain precautions, into flasks containing infusion of meat or infusion of cucumber. In these flasks micrococci grew in large numbers, and also sometimes bacteria, showing that these organisms were present in the gonorrhœal pus. Circumstances prevented me from pursuing this subject further at that time. In the meantime, Dr. Neisser published an elaborate research on this subject, in which he showed the presence of enormous numbers of micrococci in gonorrhœal pus, and in the pus from contagious ophthalmia. He further asserted that these organisms were always of a definite size, and that they differed in respect of size from the micrococci found in wounds. The presence of large numbers of micrococci in gonorrhœal pus has since been confirmed by several observers. Whether these micrococci are the cause of the gonorrhœal inflammation or not, I do not attempt to say, but the general history of the disease, taken together with these facts, points strongly to the idea that its essence consists in the growth of these or allied organisms.

If this disease be due to the spread of organisms, where are they situated? Several facts lead to the supposition that they are not only free in the urethral canal, but that they are also present in the substance of the inflamed mucous membrane. Thus, in the case of erysipelas, it has been demonstrated that the skin at the margin of the inflammatory redness is full of micrococci. Koch found, in his case of erysipelas in rabbits, that bacilli were present throughout the inflamed part, and coextensive with the inflammation. The same writer obtained a progressive gangrene of the tissues in mice by the injection of putrid blood, and he has demonstrated conclusively that this gangrene is due to an organism—streptococcus—which is present in large numbers around the limits of the gangrenous part. A similar observation was made by him in a case of spreading suppuration in rabbits. Mr. Lister has long held the opinion that, in the case of putrid sinuses, the organisms were present, not only in the canal of the sinus, but also in the substance of the unhealthy granulation-tissue lining them. This view has been justified by the fact that, though formerly, by the simple injection of the sinuses with antiseptics, he did not often succeed in eradicating the septic element, yet, since he has adopted the use of Volkmann's sharp spoon, and has removed the layer of granulation tissue lining them, success is by no means uncommon. And, lastly, I have demonstrated that, though many forms of organisms will not survive if introduced into a healthy animal, yet, if an animal be previously in a state of ill health, these forms of organisms are not destroyed, but may be found alive in the blood or tissues.

In the case of gonorrhœa, then, I suppose that, at the time of infection, a small number of the specific organisms, which in all probability possess a considerable resisting power to the destroying action of the healthy living tissues, are retained in the urethra, that these go on developing, that the products of their growth irritate and weaken the

## CLINICAL OBSERVATIONS

ON THE

## INTRODUCTION OF TRACHEAL TUBES BY THE MOUTH INSTEAD OF PERFORMING TRACHEOTOMY OR LARYNGOTOMY.

BY WILLIAM MACEWEN, M.D.,

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*(Concluded from page 124 of last number.)*

CASE IV.—In this case, the tracheal tube was intended to be used during eradication of an epitheliomatous tumour, this intention being frustrated by the demise of the patient whilst under the influence of chloroform, the tube, however, not being then used. The man was about sixty years of age, but looked older, probably in consequence of excessive alcoholic indulgence, which had been kept up for many years. He had chronic bronchitis with muco-purulent expectoration, in consideration of which considerable doubt was expressed to him about operating; but, as he was very anxious to have the rapidly extending disease eradicated, it was determined to do so.

Owing to the state of his lungs, it was deemed necessary to make a preliminary trial of the tube, in order to observe its behaviour under the profuse expectoration. The tracheal tube was passed, and, during its retention, considerable quantities of muco-purulent secretion were expelled—on several occasions quite clear of the tube, and even in some instances for a considerable distance beyond it—two, three, and even four feet beyond the nozzle of the tube. In order to lessen the secretion, a few days were allowed to elapse, during which remedial measures were resorted to. At the end of this time, the muco-purulent secretion had lessened, and the tube was again tried. On this occasion, the tracheal catheter was inserted, and all the purposes for which it had been introduced having been gained, it was removed at the end of ten minutes. The expectoration was much less; the tube, which the patient held with his own hand, was borne without pain or uneasiness. During the time it was retained, his respirations were easy; he pronounced the monosyllables “Yes” and “No” distinctly; he swallowed his saliva, and drank several mouthfuls of water without disturbing his tranquillity. The way now seemed clear, and it was resolved to operate.

Next morning, in the ward adjoining the theatre, the tube was introduced into the trachea, the patient as usual holding the outer end; he remained there for a quarter of an hour, breathing easily. He then walked into the theatre and lay down on the table. Chloroform was just commenced to be given him, when he rose up, withdrew the tube, handed it to the surgeon, said he would prefer to take the chloroform without it, and that it could be introduced afterwards. He then lay down to inhale the anæsthetic. A few minutes afterwards, he was asked to turn on his side, with which request he readily complied. He breathed quietly and regularly for ten minutes afterwards. He then had what was considered at the time to be the ordinary period of struggle. This ended, the house-surgeon, who was administering the chloroform, stated that for several minutes after the struggle passed off he both felt and heard the respirations going on quite regularly, and certainly his chest was heaving as if from normal respirations.

Nearly five minutes after the struggle had ceased, one of the gentlemen, who held the radial pulse the whole time, cried out that the pulse had stopped. The house-surgeon said: “That surely cannot be, as he is breathing all right.” A few seconds later, the breathing ceased. The moment the breathing ceased, the tongue was instinctively withdrawn, and artificial respiration established. Bloodletting was spoken of at the moment, as it was considered that there was an apoplectic element in the case, interpreting the former struggle as a convulsion; but, the heart not responding, it was not carried out. It must be clearly remembered that the patient spontaneously withdrew the tube and handed it to the surgeon, just as he was about to be anæsthetised, and before he was under the influence of the chloroform. Fully fifteen minutes elapsed from that time till the cessation of the cardiac action. The respirations were never for a moment impeded, and actually continued for a few seconds after the cessation of the cardiac impulse.

Viewing the case as it then stood, I was inclined to believe—though a positive opinion could not be formed—that there was a primary cerebral lesion, probably apoplectic, and that the cardiac cessation was secondary.

The necropsy showed an effusion of serum under the arachnoid; and the lateral ventricles were abnormally distended and filled to distension with serum, showing the chronic nature of the affection. There was no

impediment to respiration in the larynx, trachea, or bronchial tubes. The lungs were cedematous, and exhibited the appearances of chronic bronchitis and inflammation of old standing. The bronchi and bifurcation of the trachea were congested, the congestion extending for about an inch above the bifurcation. From this point, there were several inches of slight congestion, the shade becoming very slight as it proceeded upwards toward the true cords. At these isolated points, two of them above and one below the vocal cords, there were appearances of ecchymosis on the mucous membrane, each having a superficial area of about three *millimètres* in diameter (about the size of a small pea or a large barley-grain). In cutting into these, it was seen that they were superficial, extending no further than the mucous membrane. The cords were very slightly thicker than normal, probably due to some chronic action. There was also a slight thickening of the posterior part of the laryngeal orifice.

The appearances noted from about an inch above the tracheal bifurcation were such as would have passed without observation in any ordinary case; but, as the opportunity offered, it was considered advisable to take a minute note of them, and they are thus given in detail.

Death was due to the chronic cerebral affection, the anæsthetic perhaps acting as an exciting cause.

*Hack's Case of Œdema Glottidis.*—After having had the experience of these cases, commencing in the summer of 1878, and having shown one of these patients at the Glasgow Pathological and Clinical Society, on November 12th, 1878, it was with considerable pleasure that I read, in that valuable paper the *London Medical Record*, a reference to a case of an acute laryngeal affection, in the treatment of which one of Schrötter's bougies was introduced into the larynx through the mouth. In turning to the original, which appeared in Volkmann's *Sammlung Klinischer Vorträge* for November 1878, it is seen that Dr. Wilhelm Hack had a patient who was seized with acute Œdema glottidis, superinduced on a chronic syphilitic affection of the mouth and larynx; and, when he was at the point of suffocation, Dr. Hack introduced No. 3 of Schrötter's triangular vulcanite instruments, which he retained for a short time. This man was then sent to the hospital; but, on the road thither, he became violently affected with dyspnoea, when he (the patient) took the vulcanite tube, which he carried in his pocket, and introduced it into his own larynx, and so appeared at the hospital with his hands clutching the tube, “as if clinging to his last anchor of safety”. Dr. Hack continued the treatment in the Freiburg Hospital. The same evening, he introduced No. 5 of Schrötter's bougies, and, during the two following days, gradually introduced larger ones up to No. 11. He does not mention the precise time these instruments were each retained; but, in the discursive part of his essay, he says, referring to his case, the instruments were retained for almost an hour, and the patient neither complained of particular pain nor disagreeable sensation. From this, it would appear that Dr. Hack retained the instrument in the larynx for a short time only (almost an hour), and that he aims at rapid dilatation of the larynx by the introduction of Schrötter's graduated bougies. His patient ultimately made a good recovery.

*History.*—It may be advantageous to review briefly the few items of history obtainable concerning the introduction of respiratory instruments by the natural passages. Without stopping at Hippocrates, who is accredited with having entertained ideas on the subject which never found practical issue, we pass to Desault. (*Œuvres Chirurgicales. Exposé de la Doctrine et de la Pratique de Desault*; par Bichat; tome ii. Paris.) Toward the end of Desault's life, he endeavoured to introduce instruments through the nose into the trachea. He was induced to do so by having one day by mistake passed a tube into the trachea instead of into the œsophagus. Two hours afterwards, when he attempted to inject food into the tube, he found out his error. Reasoning from the tolerance exhibited by the trachea in this instance, he thought that the same procedure might be purposely adopted in laryngeal affections. He therefore determined to carry it out. The first observation is mentioned by Geraud, in which Desault passes a tube into the larynx of a man having a laryngeal affection, which afforded him relief, the breathing going on freely through it; though the man died the same evening from causes independent of respiration. The second observation was made on a man affected with something resembling Œdema glottidis, on whom Desault passed a tube through the nose into the trachea, which was retained for a day and a half. During this time it was once withdrawn in order to be cleaned. Its reintroduction was attended with little cough; and the man at the end of a day and a half was cured. These observations are given in a very meagre way, almost as isolated statements, and the series of phenomena which attended the introduction and retention of such instruments into the air-passages are barely touched on. In some measure, this may be accounted for by the work not having been written by Desault, the facts not even being gathered from his lips, so that not

only do they lose the life and vivacity which personal description would have imparted, but much also that would have been of value to the surgeon. If these remarks apply to the facts, they are doubly applicable to the instruction which follows, for the introduction of nasal tubes into the trachea. Anyone who doubts this, has but to try to carry out the instructions given by Bichat for the introduction of nasal tubes, in order to convince himself of the correctness of my opinions. Equally erroneous and misleading are the signs given by which evidence may be afforded of the presence of the sound in the trachea.\*

These observations were made at the beginning of the present century, and from that time up till 1858 there is no mention of the subject.

M. Bouchut, in 1858, brought before the Academy of Medicine (*Comptes Rendus de l'Académie des Sciences*, tome xlvii, September 1858), what he termed *le tubage du larynx*. This consisted in placing in the larynx a tube eighteen to twenty-four millimètres long, and from six to fifteen millimètres wide. This little tube was inserted into the larynx on the point of a hollow sound. The sound was withdrawn after depositing the tube on the vocal ends, resting on them by means of a couple of pads. A silken bridle was likewise fastened to this little tube, in order to withdraw it when necessary.

Whatever merit this apparently ingenious little instrument may have possessed, it was brought before the Academy under very unpropitious circumstances. First, that element of success necessary for the favourable reception of a new idea was deplorably absent in his cases; as all of them were failures, five of them having died out of seven; the remaining two only recovered after recourse had been made to tracheotomy. Again, Bouchut was so unfortunate as to fall foul of tracheotomy, which at that time not only had found favour, but was warmly espoused, by the then medical Parisian demigod, Trousseau (*Archives Générales de l'Académie de Médecine*, vol. xii, 5th ser., p. 739; vol. xiii, 5th ser.), who condemned *le tubage*, at least for cases of diphtheria. A long, animated, and somewhat personal discussion followed in the Academy. Malgaigne, Velpeau, and Larrey (*Op. cit.*, Jan. 18th, 1859; also *Bulletin de l'Académie Impériale de Médecine*, tome xxii, 1857-8, tome xxiii, 1858-9), among others favoured Bouchut, and encouraged him to proceed with his observations, the latter remarking, that the Academy ought to bear in mind, that several operations, which were at that time accepted, had been opposed at the outset by that august assemblage; instancing disarticulation of the hip, and tracheotomy itself, in support of his observations. Probably discouraged, Bouchut does not appear to have again attempted the proceeding.

Passing over the abortive attempts of Jules Roux (*Gazette des Hôpitaux*, 1856) and Deprés (*Gazette des Hôpitaux*, 1869) to introduce tubes by the mouth in chronic cases after tracheotomy had been performed, the proposal of Trendelenburg to introduce solid metal bougies into the larynx in chronic cases is arrived at. Though Trendelenburg (Langenbeck's *Archiv*, Bd. xiii, p. 338) realised his proposal in one case, it was left to Schrötter to perfect the idea and to practically carry it out. It must be here clearly understood that both Trendelenburg and Schrötter (Schrötter, *Beitrag zur Behandlung der Larynxstenosen*, Wien, 1876) proposed and practised dilatation of the larynx only in chronic cases. Weinlechner (1870) proposed the use of rounded tubes in chronic cases, instead of Schrötter's triangular or three-cornered ones. There is, however, no case recorded in which Weinlechner carried out his idea on this point. This brings us down to the present time. Dr. Hack of Freiburg published his case in Volkmann's *Sammlung Klinischer Vorträge* for November 6th, 1878, in which he adopted Schrötter's tubes and principles in an acute case of laryngeal stenosis. The date of this case is not given; but from the context it is clear that it must have been not later than the summer of 1878. In the present paper, I detail three cases, the first of which occurred in the summer of 1878, and the other two in the latter part of the same year, all of them being successful. Hack adopts Schrötter's instruments and principles (being a pupil of Schrötter's). I introduced cylindrical tubes by the mouth, retaining them *in situ* for twelve hours at a stretch, and removing them for purposes of ablution. The object in doing so was twofold: first, to enable respiration to be carried on; and, secondly, to cause absorption of the fluid by the presence of the tube exercising pressure of a slight kind.†

**Historical Résumé.**—There are, first, nasal tubes, proposed at the beginning of the present century by Desault, who in two cases passed them into the trachea. One of his patients died; the other recovered.

**Second.** *Le tubage du larynx* was proposed in 1858 by Bouchut, and practised by him in seven cases, all of them being failures.

**Third.** Trendelenburg and Schrötter within the last few years have passed three-cornered vulcanite tubes into the trachea in chronic cases, and retained these cases *in situ* for a portion of an hour at a time; Dr. W. Hack having carried out the same principles with the same instruments in one acute case during or before the summer of 1878.

**Fourth.** The writer introduced cylindrical tubes by the mouth into the trachea, and retained them *in situ* for thirty-six hours, removing them when required for ablution (say every twelve hours); two such cases having been treated with perfect success.

**Is the Introduction of such Tubes easy?**—The following is a question very often asked: Is the introduction of tubes into the trachea easy? This at all times must be a difficult question to answer for others, as the case will depend on the experience of the operator. Personally, having had considerable practice in the passage of cesophageal bougies and catheters, I would be inclined to say that the introduction of tracheal tubes would be more difficult than the passage of urethral catheters into normal urethrae; but they could be passed a great deal more easily than catheters in most cases of urethral stricture. Before passing tracheal instruments in the living, it would be well to practise on the "subject", as this helps to cultivate the touch. Given a quiet patient in health, the introduction of the tracheal tube will be found almost as easy for the operator as its passage *post mortem*. In the two cases of oedema glottidis which I have treated in this way, the introduction of the tubes was more easy than in the cases with healthy larynges. In the former, the parts were fixed, thrown further forward in the mouth, and much less sensitive, all favouring the introduction of the tubes. The first insertion is for the patient the most disagreeable, the subsequent ones being attended with comparatively few manifestations of uneasiness.

**Mode of Introducing the Tubes.**—The mode of introducing the tubes has already been alluded to in the remarks on the dead body. The only difference is that, if any hitch occurred at the level of the cords, it might be overcome by asking the patient to take in a deep inspiration, during which the instrument ought to be passed. The head ought to be thrown back during the insertion of the tubes.

**Advantages over Tracheotomy.**—Besides the superiority which the simple introduction of a tube into the trachea through the mouth has over a cutting operation, which in itself is not unattended with danger, the following points may be noted as advantages on the side of the former. The air, as it passes through the natural passages into the lungs, becomes warmed, moistened, and filtered. When a wound is made into the trachea through the neck and a short tube is inserted, the cold dry unfiltered air gets access to the lungs, and often produces fatal congestions. Every surgeon knows how difficult it is, even in hospital, to maintain for days continuously an uninterrupted supply of extraneous warmth and moisture; and how, now and again, in spite of the very best arrangements, a hitch occurs, during which cold dry air gains access. The tubes introduced through the mouth do away with the necessity of supplying extraneous warmth and moisture. A tubular instrument, passed through the mouth into the trachea, will convey heated moist air into the lungs, and to a considerable extent will filter it of its dust and organic particles. Even a tube, with one end in the trachea and the other projecting from the mouth, will attain, a few minutes after insertion, the same heat as the human body; and as a consequence will temper the air as it passes into the lungs. After a short time its interior will be covered with moisture, which will offer an extended surface for adhesion of organic particles, and so help to filter and at the same time moisten the air.

**Cases in which these Tubes might be Used.**—It will be observed that I do not particularise the kind of cases in which tracheal tubes passed through the mouth may be used, further than by stating, that there are obvious reasons for preferring tracheotomy or laryngotomy when foreign bodies are in the windpipe; and, on the other hand, for preferring tubes through the mouth where there are effusions of blood or serum, or collections of pus, into or about the submucous laryngeal tissue; or when anything overhangs or threatens to occlude the laryngeal orifice. Again, it may be asked, whether such instruments might not be of very considerable service in cutting short many spasmodic affections of the cords and upper portions of the larynx—such as spasmodic croup, laryngismus stridulus, and in some cases of incarceration of the epiglottis, etc. Tubes inserted in some such cases might not only relieve the spasm, but also help to cure the disease by destroying the habit.\*

Cases in which the disease, or at least the necessity for using the tubes, would be of short duration, are the most suitable for this procedure. Again: where the person is too weak or objects to have tracheotomy performed, or where the practitioner does not care about perform-

\* Mention is made in Desault's works of a Toulouse surgeon who attempted to relieve a lad affected with polypoid growths round the larynx. Six times he tried to introduce the catheter, but each time the instrument appeared only to produce irritation, and eventually he desisted.

† A clear distinction must be drawn between respiratory catheters and instruments used for aspirations or insufflation, such as Chaussier's tube.

\* Baginsky agrees with Bretonneau, Gerhard, etc., that the dyspnoea in croup is the result of mechanical obstruction only, and does not believe in the absolute paralysis of the abductors of the vocal cords.

ing it, the tubes passed through the mouth might be used, even in the latter case, to gain time to allow an operative surgeon to be called.

The tubes must necessarily be of various sizes, so as to suit the various larynges into which they may be introduced. At present, a tube of a better shape and form than that now in use, and one which will present other advantages, is being prepared for me.

It must be obvious that the time during which the tubes are retained must depend on the case. In some, a few hours might be sufficient to dispel the oedema; in others, a much longer period is necessary.

*How to recognise that the Instrument is in the Trachea.*—How would one recognise the presence of the instrument in the trachea? 1. By finding the instrument pass over the first ring or two of the trachea; 2. By finding that the air flows into the tube during inspiration and out during expiration—the opposite being the case if it be in the oesophagus; 3. By the mucous expectoration being expelled from it; 4. By the negative signs that it is not in the oesophagus or stomach—i.e., blowing up the stomach through the tube, etc. Before introducing the tubes, an examination by the laryngoscope ought to be made to ascertain the precise state of the parts.

*Deductions.*—The practical deductions which may be drawn, tentatively at least, from these cases are as follows.

1. Tubes may be passed through the mouth into the trachea not only in chronic, but also in acute affections—such as cedema glottidis.
2. They can be introduced without placing the patient under an anæsthetic.

3. The respirations can be perfectly carried on through them.

4. The expectoration can be expelled through them.

5. Deglutition can be carried on during the time the tube is in the trachea.

6. Though the patient at first suffers from a painful sensation, yet this passes off, and the parts soon become tolerant of the presence of the tube.

7. The patient can sleep with the tube *in situ*.

8. The tubes, in these cases at least, were harmless.

9. The ultimate results were rapid, complete, and satisfactory.

10. Such tubes may be introduced in operations on the face and mouth, in order to prevent blood from gaining access to the trachea, and for the purpose of administering the anæsthetic; and they answer this purpose admirably.

#### NOTE ON HOMICIDAL MANIA.

By JAMES RUSSELL, M.D., Senior Physician to the Birmingham General Hospital.

THE following particulars given me by the mother of an out-patient at the Birmingham General Hospital, and by the patient himself, explain themselves. In a forcible manner, they tell the tale of what passes in the mind of many an epileptic when driven by his disease to sudden acts of violence; and explain the homicidal tendency which sometimes springs up under such circumstances.

A young man, aged twenty-nine, has been under me, at times, for several years, a confirmed epileptic, and the son of a father equally confirmed in the same disease. His fits were kept under by moderate doses of bromide of potassium, but, after the 31st of last January, his medicine was suspended in consequence of the want of an out-patient ticket. The fits then returned with frequency; about two severe ones, with tongue-biting, occurring in a week, but very numerous slighter ones. In March, the first attack of the mental disorder, to which this communication refers, took place: it lasted for a fortnight, and yielded to medical treatment. The patient was violent for three days, and then fell into a condition of melancholy, "as though a cloud were on his brain". In a week after his recovery of mental health, the fits returned—they had been absent during the period of mental disorder (of course, I speak only from the mother's report)—but again, at the end of eight weeks, the mental affection returned, and again yielded to treatment at the termination of about a week. As before, the recovery of sanity was followed by recurrence of the epileptic fits, mostly in a slight form; and for the third time the mental disorder attacked him (May 19th), and yielded to remedies in ten days.

The mother gave the following description of the mental disorder. He had a constant fear of being dared to hang himself; he told her that, if she did not take every care of him, he would be obliged to do it; he did not like to be considered a coward by people standing before him (in imagination); they kept showing him how to do it; and he thought that if his mother took him to a doctor, he would drive the figures away. This "thought over him" lasted all the time. He wandered about, sensible in other respects, but with a sort of pitiful expression, more child-like, and with a tendency to cry. "It is ridiculous," he said, "to talk of anything else, for I have got it in my mind, but it never

comes when I am right." He dared not sleep, for, if he closed his eyes, "he saw so many".

The patient himself told me that it was like a man before him; there was like a scaffold and a rope, and they kept showing him the way to do it. They said, "You dare not do it! you dare not do it!" Something felt very heavy on his forehead, and all was dark about him. "I could not bear the thought of hanging myself, but nothing else would come into my mind." When these "feelings" were passing off, something passed from the forehead, over the face, then down the arms, out at the fingers, and then he became himself again, and could think of other things.

This young man has been more or less epileptic from infancy, but he has only suffered once before from any mental derangement. He then had an idea that his mother loved his brother best, and that seemed to work on his mind. He thought he must get rid of his brother. One day his mother heard him threaten his brother, and open his knife; he was easily induced to part with the knife, observing that he thought he had better do it to himself instead.

The patient's attestation to the compulsory nature of this suggestion, and to the impracticability of his varying it by any effort of his will, and at the same time his half-consciousness of the unreality of the whole, are worthy of notice. What if this countercheck be weakened or removed?

#### COLOUR-BLINDNESS AMONGST THE MEDICAL PROFESSION.

By B. JOY JEFFRIES, M.D., Boston, U.S.A.

IN the JOURNAL for October 25th, 1879, Mr. Herbert W. Page published an article on "Colour-blindness: its Examination and Prevalence". I have commented at some length on this subject in a previous communication, and would now merely report in reference to a suggestion he then made. He proposed that the members of the British Medical Association should be most carefully tested at the Cambridge meeting in August next, to ascertain the proportion who are colour-blind "among those who neither lack education, observation, or cultivation".

To partly answer this suggestion, I have recently tested 465 of the members of the American Medical Association at the New York meeting, and of the members of the Massachusetts Medical Society, at the annual meeting here in Boston. I found, among these 465 physicians, 22 colour-blind. Of them, 14 were red blind, 2 green blind, and 6 incompletely colour-blind, using the standard of Professor Holmgren. The whole number of males I have so far tested is 17,327. Of these, 724 were colour-blind in a degree to be included in the classes proposed by Holmgren. I have also tested 13,813 females, finding only 10 colour-blind.

Unless the *whole* of a large number of people are tested, the ratio, we find, may be quite above or below 4 per cent., which seems to be the true average for males. For instance, in New York I found but 6 out of 195; here in Boston, 16 out of 270. As a general thing, perhaps, as many colour-blind, from various reasons, stay away as apply to be tested. Here in Boston none of my professional brethren whom I *know* to be colour-blind came to me. Could I have tested the other 2,000 of the medical profession attending these two meetings, I am quite convinced that the whole would have given me the usual 4 per cent. average. If the members of the British Medical Association are tested at Cambridge, the proportion found colour-blind will depend on the number examined, and whether those thus defective apply or stay away. If 1,500 be present, they can all be tested in three days by one person working six hours each day, provided it could be so arranged as to have a steady stream before the examiner.

Now what method of testing could accomplish this with certainty and accuracy? A pretty extended experience, theoretically and practically, convinces me that such investigations can be carried out only by Holmgren's method, with which none other compares. Certainly with it, as with all methods, it depends largely on the examiner, who must be all eyes in watching the face, fingers, and *look* of the examined. The latter had far better not speak, or at least confine this to a question of what is asked of him to do. The examiner can explain what is needed, and one after another sees what is done by those before him. *It is also a test of mental and physical quickness.*

In a previous communication to the JOURNAL I have defended the accuracy of my published results. In these tests of my medical brethren, I of course had the advantage of their being desirous to appear the best, and also do as nearly as they could just what was asked of them. The bystanders constantly wondered that I did not mark as defective many who seemed so to them. This test of my friend, Professor Holmgren, when the *right worded* are used (a most important point), and the



# PHILOSOPHICAL TRANSACTIONS.

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Monday, October 21. 1667.

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### *An Account*

*of more Tryals of Transfusion, accompanied with some Considerations thereon, chiefly in reference to its circumspect Practice on Man; together with a farther Vindication of this Invention from Usurpers.*

**T**HIS Experiment, as it hath raised Disputes among the Curious, both here and abroad; so it hath put some of them upon considering such wayes, and giving such cautions, as may ren-

*An Account**Of an Experiment made by M. Hook, of Preserving Animals alive by Blowing through their Lungs with Bellows.*

This Noble Experiment came not to the Publisher's hands, till all the preceding Particulars were already sent to the Press, and almost all Printed off, (for which cause also it could not be mentioned among the Contents:) And it might have been reserved for the next opportunity, had not the considerableness thereof been a motive to hasten its Publication. It shall be here annexed in the Ingenious Author his own words, as he presented it to the Royal Society, Octob. 24. 1667. the Experiment it self having been both repeated (after a former successful trial of it, made by the same hand a good while agoe) and improved the week before, at their publick Assembly. The Relation it self follows;

I Did heretofore give this *Illustrious Society* an account of an Experiment I formerly tryed of keeping a Dog alive after his *Thorax* was all display'd by the cutting away of the *Ribbs* and *Diaphragme*; and after the *Pericardium* of the Heart also was taken off. But divers persons seeming to doubt of the certainty of the Experiment (by reason that some Tryals of this matter, made by some other hands, failed of success) I caus'd at the last Meeting the same Experiment to be shewn in the presence of this *Noble Company*, and that with the same success, as it had been made by me at first; the Dog being kept alive by the Reciprocal blowing up of his Lungs with *Bellows*, and they suffered to subside, for the space of an hour or more, after his *Thorax* had been so display'd, and his *Aspera arteria* cut off just below the *Epiglottis*, and bound on upon the nose of the Bellows.

And because some Eminent Physicians had affirm'd, that the *Motion of the Lungs* was necessary to Life upon the account of promoting the Circulation of the Blood, and that it was conceiv'd, the Animal would immediately be suffocated as soon as the Lungs should cease to be moved, I did (the better to fortifie my own *Hypothesis* of this matter, and to be the better able to judge of several others) make the following additional Experiment; *viz.*

The Dog having been kept alive, (as I have now mentioned) for above an houre, in which time the Tryal had been often repeated, in suffering the Dog to fall into *Convulsive* motions by ceasing to blow the Bellows, and permitting the Lungs to subside and lye still, and of suddenly reviving him again by renewing the blast, and consequently the motion of the Lungs: This, I say, having been done, and the Judicious Spectators fully satisfied of the reallity of the former Experiment; I caus'd another pair of Bellows to be immediately joyn'd to the first, by a contrivance, I had prepar'd, and pricking all the outercost of the Lungs with the slender point of a very sharp pen-knife, this second pair:

pair of Bellows was mov'd very quick, whereby the first pair was alwayes kept full and alwayes blowing into the Lungs; by which means the Lungs also were alwayes kept very full, and without any motion; there being a continual blast of Air forc'd into the Lungs by the first pair of Bellows, supplying it as fast, as it could find its way quite through the Coat of the Lungs by the small holes pricked in it, as was said before. This being continued for a pretty while, the Dog, as I expected, lay still, as before, his eyes being all the time very quick, and his Heart beating very regularly: But, upon ceasing this blast, and suffering the Lungs to fall and lye still, the Dogg would immediately fall into Dying convulsive fits; but he as soon reviv'd again by the renewing the fullness of his Lungs with the constant blast of fresh Air.

Towards the latter end of this Experiment a piece of the Lungs was cut quite off; where 'twas observable, that the Blood did freely circulate, and pass thorough the Lungs, not only when the Lungs were kept thus constantly extended, but also when they were suffer'd to subside and lye still. Which seem to be Arguments, that as the *bare* Motion of the Lungs *without fresh Air* contributes nothing to the life of the Animal, he being found to survive as well, when they were not mov'd, as when they were; so it was not the subsiding or movelessness of the Lungs, that was the immediate cause of Death, or the stopping the Circulation of the Blood through the Lungs, but the *want* of a sufficient *supply of fresh Air*.

I shall shortly further try, whether the suffering the Blood to circulate through a vessel, so as it may be openly exposed to the fresh Air, will not suffice for the life of an Animal; and make some other Experiments, which, I hope, will thoroughly discover the *Genuine use of Respiration*; and afterwards consider of what benefit this may be to Mankind.

## F I N I S.

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In the *SAVOY*,

Printed by *T. N.* for *John Martyn*, at the Bell  
a little without *Temple-Bar*, and *Nathaniel Brooks* at the Angel in *Gresham-Colledge*,  
1667.





