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<th>Anaesthetics and their administration</th>
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<td><strong>Author</strong></td>
<td>Jackson, John Lowthian</td>
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To the Dean of the Faculty of Medicine,
Edinburgh University.

Dear Sir,

I beg leave to thank you for your letter of 30th May, informing me that the faculty of Medicine are satisfied with my Thesis. Enclosed please find a copy in conformity with the Regulations.

Believe me,

Dear Sir,

Yours obediently

John Squattman Jackson
Nedon near Hull.

June 18th, 1874.
In considering the subject of anaesthesia the principal points to be determined are — which of the numerous agents now in use shall we choose, and how shall we administer them, so as to suffer the fewest possible fatal consequences.

In musingating the fact that chloroform stops the act of respiration before the heart ceases to beat, the first Hydrated Commission confirmed the teaching of Syne, Lister, and the Edinburgh School. In this the second Commission entirely concurred, but seemed to have a difficulty in acknowledging that chloroform depresses the heart directly at all. Lander Brunton, a member of the Commission individually looks on chloroform as a general protoplasmic poison affecting all tissues of the body, the heart included. Professor Wood, of Philadelphia, definitely proved that in a dog chloroform has a direct paralysing influence on both respiration and circulation, that the respiration may cease before the heart ceases to beat, and that the two functions may be simultaneously abolished, but that in some cases the heart is arrested before the respiration. With Dr. Hobart Hare he has several times seen the respiration
continue as long as one, and even two, minutes, after the blood pressure had fallen to zero, and the pulse had completely disappeared from the carotid artery. The experiments by Professor M. Kendrick, Dr. Joseph Condo, and Dr. David Irovan show that the heart of a frog exposed to the direct action of chloroform vapour becomes rapidly weaker until it ceases to beat. In experiments upon dogs, by attaching to a tracheal tube in their throat an arrangement ofidia rubber tubes connected with a double-acting pump, (one cylinder forcing air in, the other sucking it out) chloroform or any other anaesthetic was introduced into their lungs, the air being saturated with its vapour. After the artificial respiration commenced the heart was exposed, beginning with a median incision. They found that chloroform obviously distended the right ventricle with blood. In the case of rabbits exposed thus to the vapour of chloroform, the heart came to a standstill within a minute. Ether, on the other hand, they found might be given for an indefinite period without interfering with the heart's rhythm. The blood pressure of a dog under chloroform was more than one instance, became enormously reduced, the pulsations being so infrequent as to be virtually imperceptible, while respiration still continued. This they attributed to a peculiar and apparently capricious
influence of chloroform, differing from the
Hydehead Commission who attributed similar
symptoms in their experiments to asphyxia.
Professor Mr. William of Aberdeen, carried out a
similar series of experiments on cats and rabbits,
and found the fall of blood pressure due to the
influence of chloroform sometimes slight, at others
severe, sometimes gradual, and at other times
rapid. He found, after chloroform, diminution
in the force of the heart's beat, with dilatation of
both auricles and ventricles, due to an increased
distension, or imperfect emptying, of their cavities.
Unless an overdose of chloroform had been received,
the dilatation passed off, and this change could
be repeated over and over again in the same
animal by giving a fresh dose of chloroform.
Dilatation was sometimes remarkable in its
suddenness, often occurring under five seconds
from the commencement of chloroform. Sometimes
the auricles and ventricles were unequally
affected. The dilatation occurred after section
of the vagus or its inhibition with atropine,
showing that the action of the drug was on the
heart itself. In some animals a peculiar
result was observed during recovery from chloroform,
while the blood pressure was rising, and the
cardiac condition improving, the force of the beats
became suddenly greatly diminished, and the
ventricles imperfectly emptied. Though quickly
recurred from, it sometimes recurred again and again. A dose of ether speedily made this phenomenon to disappear. Under ether there was practically no dilatation of the heart, though the blood pressure usually fell to some extent. A brief dilatation was sometimes seen when ether in large amount was suddenly administered. Generally there was not the slightest indication of cardiac dilatation. In some experiments, by alternating the anaesthetics, the characteristic effect of both chloroform and ether was repeatedly displayed in the same animal. Where the cardiac systole was lowered by ether it was due to diminished blood pressure from depression of the vasomotor centre. In the case of chloroform-dilatation encephalitis was disproportionate to the fall of blood pressure, the heart being directly affected. The relative susceptibility of the heart and vasomotor centre to chloroform varied considerably; generally the vasomotor centre was markedly depressed before cardiac dilatation occurred. Sometimes, however, cardiac dilatation began early, before there was any evidence of vasomotor depression, the difference probably depended on the state of the heart and its reserve power. Professor Dr. William thought that the fall of blood pressure was in some sense protective, in as much as animals with vasomotor
paralysis showed great-resistance to the effect of chloroform and ether.

Dr. Gaskell and Shaw, of Cambridge, by means of cross circulation between animals, allowing the blood of an animal under chloroform to circulate through the brain, but not the heart, of another animal, and conversely, allowing the blood of an animal vitally taking chloroform to circulate through the heart of a second animal without passing through its brain, have convinced themselves that chloroform has an immediate powerful action on the heart itself, (or the intrinsic cardiac nervous mechanism.)

The instructive experiments of J.W. Pickering, D.S., London, on the embryos hearts of chicks between the fiftieth and eightieth hours of incubation give a convenient means of determining whether a drug acts directly on the heart or through the agency of a nervous system. That the embryo heart is affected by many drugs similarly to adult hearts is seen in the action of digitalin, caffeine, strophanthus, veratrine, whose dilute solutions may be recognised by their physiological action on the embryo heart. Experiments were performed with chloroform, ether, and nitrous oxide, either pure or mixed with air, oxygen, or carbonic acid gas.

00003 C.C. of chloroform injected under the blastoderm of embryos reduced the cardiac rhythm,
exaggerating the diastole. 0.004 c.c. of chloroform stopped the heart in an extremely dilated condition, and mechanical stimuli only elicited a few twitches of the auricle. Ether, on the other hand, was found to be so strong a stimulant that after the embryo heart had been stopped by exposure to cold 0.003 c.c. dissolved in 1 c.c. of normal saline restored the heart to its normal rhythm. Only comparatively enormous doses of ether depressed the cardiac rhythm. Nitrous oxide and air had but little depressing effect on the embryonic heart. In nitrous oxide plus thirty per cent of oxygen the heart's action was unimpaired after several hours' action, comparing with Mr. Claude Martin's dog exposed for seventy-two hours without ill result to a similar atmosphere.

Nitrous oxide pure stopped the embryonic heart in diastole, but only after several minutes' duration. Nitrous oxide plus thirty per cent of carbonic acid gas stopped the heart after thirty seconds' exposure. Pure oxygen often restored the above heart when removed from the carbonic acid atmosphere, but had no effect on a heart stopped by chloroform. Chloroform and carbonic acid gas proved far more toxic than chloroform and air. Raising the temperature of an embryo still in an atmosphere of chloroform or nitrous oxide restored interrupted cardiac function.
cardiac rhythm, but with increasing difficulty if carbonic acid gas were present. Ammonia partially restored the rhythm of hearts stopped in extreme dilatation by chloroform. Caffeine and atropin failed to restore the embryo heart stopped by chloroform; with digitalin and strychnin the results were uncertain and needed further elucidation. 0.0002 gram of strychnine increased the force and frequency of the heart's rhythm, but larger doses were very depressing.

The second Hyderabad Commission found that when an animal was poisoned by carbonic acid gas, its heart stopped before its respiration, and that if the animal were quickly removed to an ordinary atmosphere, artificial respiration would sometimes succeed in reducing a few gasping inspirations, but never affected the blood pressure, or ultimate recovery. The Commission found that asphyxia very greatly increased the dangers of chloroform inhalation, and Lauder Brunton gives it as his own opinion that asphyxia increases the toxic action of chloroform on the heart. The second Commission described three distinct falls of blood pressure under chloroform: 1. Haemless fall (due probably to action on vasomotor centre) 2. Preservative fall, due to slowing of the heart from irritation of the vagi, preventing too rapid conveyance of
chloroform to the medulla. 3. Dangerous fall, due to an overdose of chloroform. If an inhaler saturated with chloroform be suddenly applied to the face of an animal, the effect will be: 1. an involuntary holding of the breath, with sudden fall of blood pressure, and a marked slowing of the heart's action; then as soon as the animal draws breath again: 2. the blood pressure rises as quickly as it fell, gasping or respirations ensue, causing very rapid inhalation of chloroform, with fall of blood pressure, and insensibility. 3. the rapid fall of blood pressure quickly becomes dangerous.

1. Teaches that chloroform inhalation must be commenced freely, diluted with air to avoid struggling and holding the breath. 2. Teaches that if struggling, or holding the breath, occur, the next one or two inspirations must be given with a very free dilution of air. 3. Teaches that after one or two inspirations it may be wise to withhold the chloroform for a few breaths.

In like manner Dr. Woodhouse Braine explains the deaths occurring after the addition of a small quantity of chloroform when intermittently given. The stimulus of the fresh air unloaded with vapour causes a deeper breath to be taken, and this being followed by a more complete expiration, the following inspirations are proportionately deep ones, and on the face-piece
being reapplied more chloroform vapour is inhaled than in any previous breaths, and, moreover, is drawn at once into the bases of the lungs. If this be the true explanation, it clearly points that we should never remove the inhaler, but drop chloroform on it. While on the patient's face, or if we do take it away, that it must never be replaced within an inch or two of the face for the first two or three inspirations. Where chloroform is preceded by ether, the brisk circulation and respiration of the etherised patient favours a large intake of chloroform when the change is effected, and a like precaution is necessary.

In considering the failure of the circulation during anaesthesia, it must not be forgotten that there are other causes of cardiac depression than the drug administered. These may be conveniently divided into:

1. Exciting
2. Predisposing, causes of cardiac failure.

The exciting causes of cardiac failure are,

1. Surgical shock, from a too light anaesthesia, from interference with Solar plexus or vagus, from severe haemorrhage, or from shock of large amputation
2. Any pronounced asphyxiating condition, as laryngeal spasm, or blood in the air passages, or spasm of the respiratory muscles
3. The act of vomiting: 8. Impurity in the drug administered
4. May be avoided by suitable anaesthesia, deep
To avoid reflex shock, light in the case of hemorrhage.
B. may be avoided by keeping the air way clear,guarding against spasm, in the case of ether,
pressing the inhaler to the face, in the case of chloroform the inhaler is often better removed.
Vomiting never takes place during very profound anesthesia, or when no food has been taken for
four hours preceding the operation. The head
should be turned to one side, the opposite shoulder
raised, and the face directed slightly downward,
the lower jaw should be pushed forward from
behind, sometimes gently wiping the lips or
passing in the finger will expedite matters.
The mouth may be sponged out, and the finger
may remove any obstruction in the back of the
throat. In cases of intestinal obstruction
special care is necessary in the matter of
vomiting.
The predisposing causes of cardiac failure are —
1. Exhaustion from disease or accident;
2. Cardiac affection;
3. Fright and apprehension at the outset of inhalation.
A. may be avoided by using ether where
practicable, and keeping the patient warm,
and giving beef tea enemata; B. Choose
the anesthetic which causes least disturbance,
preferably one containing some proportion of ether.
Y. Death from this cause is unknown under
other, on account of its stimulating properties.
The dangers of respiration may be subdivided into:
1. Difficulty and failure due to mechanical obstruction
2. Weakness and failure without mechanical obstruction

Obstructive respiratory failure
A. Mouth:
   a. Lips pursed up or falling together.
      (extend head, keep gums apart.)
   b. Tongue in contact with teeth.
      (push lower jaw forward, open the mouth)
   y. Soft palate and tongue meeting
      with spasm of the masseter.
      (treatment as in B.)

B. Nose:
   a. Alae nasi falling together.
      (treatment as in A, B)
   b. Mucous membrane so swollen
      that airway is unattainable.
      (treatment as in A, B)
   y. Soft palate in contact with pharynx.
      (treatment as in A, B.)

C. Throat:
   a. Base of tongue in contact with
      pharynx.
      (treatment as in A, B)
   b. Larynx covered by epiglottis as in the middle of a half
      completed swallowing action or spasm of nitrous
      oxide.
      (treatment: — pull chin away from sternum,
       push lower jaw forward, if necessary put finger
       in mouth to back of throat, hook tongue forward,
       use tongue forceps with rigorous action, try this
       does not succeed, forcibly compress the sternum
       and thorax.)
   y. Closure of superior aperture
      of larynx, spasm of sphincter muscles, causing
      continuous high pitched inspiratory stridor, generally
      due to a light anaesthesia.
      (treatment: — under
      chloroform if uninfuenced in extreme cases either
      by pushing the face forward or by moderate tongue
tongue traction; if due to the manipulation of some sensitive part, or to a tendency to swallow and cough, or to the presence of a small plug of mucus, an increase of the anaesthetic will generally cause it to subside; if, on the other hand, it be due to imminent vomiting or asphyxia, remove the anaesthetic for a time; sometimes in spite of increase or decrease, the spasm persists and may go on to complete cessation of breathing, in which case, if the treatment as in C. B. fail, recourse must be had to intubation or laryngotomy. Under ether laryngeal spasm rarely gives rise to trouble, but is readily overcome by a stronger inhalation; if, however, clonic movements appear at the same time as the spasm, asphyxia is the cause and more air must be admitted.

Dr. Hooper of Boston and Victor Horsley both found that, in dogs deeply under ether, stimulation of the recurrent laryngeal nerve caused abduction of the cords, whereas, if only a light degree of etherization were present, adduction resulted.

D. Adventitious substances in air passages, blood, vomited matter, mucus, fluid, portions of morbid growths, fragments of teeth or stoppings, artificial teeth, mouth props, portions of instruments and tobacco. Treatment as above, keeping the head in position most favourable for escape of blood, etc., avoid deep anaesthesia, as a cough is often of service; sponge frequently, wiping the larynx is necessary by passing the sponge..
over the glosso-
non obstructive respiratory failure.
A. Overdose.  B. Intercurrent asphyxia
C. Morbid respiratory mechanism (affecting of lungs
or abdomen)  D. Syncope, causurious of
respiratory centre.  E. Direct irritation of the
Vagus.  F. Preliminary administration
of morphine.  (TREATMENT: - remove the
Anæsthetic, apply friction to the lips, flack and
compress the chest during expiration, inject
strychnine, apply artificial respiration.)
Dastre found that while it required a weight
of 45 kilogram on the chest to bring the respiration
of a conscious dog to a standstill, after one hour
Anæsthesia a weight of twenty five kilogram
applied in the same way entirely stopped the
animal's breathing.
It has long been known that strychnine stimulates
the respiratory centre in the Medulla, and that
chloroform is the antidote for strychnine
poisoning, but the converse that strychnine is
an antidote for chloroform has not been so
readily perceived. Professor Worth of Philadelphia
in his experiments with chloroform on dogs
found that strychnine gave most surprising
results in chloroform overdose, producing a
gradual rise of arterial pressure and a rapid
increase in rate and power of respiration.
Other drugs he tried, and found that alopin
Amyl nitrite, and caffeine were of no value, that alcohol actually increased the cardiac depression, whilst ammonia only slightly benefited. Digitalis, however, frequently averted death, probably by vaso-constrictor action. He also found that by raising the animal by his hind feet and so letting the blood in his abdominal vessels gravitate into the right side of the heart, he could stimulate the organ to renewed effort. Professor W. William thinks that raising the feet is principally beneficial by increasing the blood pressure in the cerebral vessels by the weight of the column of blood in the aorta, on which account he recommends bandaging the abdomen and pressure on the aorta. He also recommends for cardiac failure a rather strong induction shock with one electrode placed over the moistened skin at the apex beat, and the other electrode placed over the fourth dorsal vertebra, at the same time cautioning that under certain conditions the interrupted current produces an a-rhythmic fibrillar contraction of the heart, and not the normal cardiac rhythm. Heat is a valuable stimulus, and may be applied by hot fomentations to forehead and precordia, by warm bottles and warm enemas into the bowel.

Dr. Arbuthnot-Lane has found the intravenous injection of saline solution, one drachm of
common salt to a pint of water) to be of great benefit in exhaustion and collapse after operation.

Notwithstanding the fact that Ether stimulates the heart, and helps it to overcome the faintness of fright at the commencement of operation, the faintness of shock during operation, enabling it to tide over temporary respiratory trouble, many cases are more suitably treated by chloroform inhalation, and occasionally no other anaesthetic can be borne. No question can be entertained that chloroform is the anaesthetic par excellence for producing an analgesic state during the pains of labour, and also in renal and biliary colic, and other acutely painful afflicts. It must from its portability be the anaesthetic for warlike undertakings and expeditions of all sorts. On this account it is salutary that it should be freely used in medical schools, lest the student should depend too much on the more easily administered ether, and when called upon to give chloroform should shirk his responsibility, or feel unduly nervous during the administration. A too sparing use of the drug may produce so quiet an anaesthesia that it is difficult to tell whether respiration is proceeding or not, a state not always easy to get out of without vomiting.
occurring, or true anaesthesia being unduly delayed. Again, if tempted to give chloroform in an intermittent fashion, there will be increased danger of shock during imperfect anaesthesia, of syncope during vomiting, and of a dangerous aphysiologic state from coughing, swallowing, or holding the breath. The danger, too, of too great intake of chloroform has previously been mentioned. The vapour of chloroform is more pleasant to inhale than ether, and given with plenty of air is a little less irritating to the larynx and respiratory tract. Moreover, ether gives rise to a too vigorous use of the chest and its viscera for most cases of advanced emphysema, pulmonary phthisis, chronic bronchitis with expectoration and dyspnœa; this, too, is true in dyspnœa due to narrowing of the upper air passages, for which chloroform or a mechanical mixture containing it should be used. Where the actual cautery has to be used in the mouth, and in operations on the lips, cheeks, jaws, tongue, nasal cavities, palate, tonsils and pharynx, chloroform must be the anaesthetic principally depended on, though it may be preceded by ether for extra septum while attaining deep anaesthesia. In many cases of heart disease, more especially with pulmonary engorgement, dyspnœa and an intermittent pulse, a mixture containing
one part of alcohol, two of chloroform and three of ether has proved better than ether or chloroform by themselves. In congenital cyanosis nitrates with oxygen should be tried for brief, and the above A.C.E. mixture for more prolonged operations. Old persons take chloroform particularly well, though often the A.C.E. mixture is still better borne. Ether makes too great demands on rigid, stiffened chest, and in extreme obesity with laboured breathing. In marked Atheroma the brisk circulation of ether anaesthesia might give rise to cerebral haemorrhage, and therefore chloroform or the A.C.E. mixture is advisable. In abdominal surgery many surgeons prefer chloroform, owing to the more powerful respiration, and greater liability to temporary interruptions of breathing under ether, unless it be very well administered. They complain too of increased vascularity, owing to the sluggish circulation under ether, but this is more than counter-balanced by the decreased risks of secondary haemorrhage. With regard to retching after operations, though more common and more sudden and violent with ether, it is more apt to persist after chloroform. In operations for acute intestinal obstruction all asphyxial element must be
carefully avoided, more especially where the patient is already under the influence of opium. Here the A.C.E. mixture, or chloroform should be carefully tried, and a lighter anaesthesia produced. In operations in the neck, chloroform gives rise to less vascularity than ether, but renders the patient more liable to failure of the heart if there be any interference with the pneumogastric, the shock of which would be better supported by ether. In cerebral haemorrhage Professor Victor Horsley recommends that an injection of morphia should be given before chloroform is inhaled, with the intention of constricting the arteries of the brain; care, however, must be taken to remove the anaesthetic as soon as anæsthesia is attained. Lastly, chloroform is desirable wherever ether or the A.C.E. mixture is badly borne, that is, when there is produced by them uncontrollable coughing, embarrassed respiration, spasms, or prolonged chronic spasm. In very hot climates chloroform is preferable to ether, on account of its lower diffusibility. Fortunately it has been found to be much less lethal in the tropics, probably owing to its easier elimination.

The great advantage of ether is, that it stimulates not only the circulation, but-
the respiration, which is almost invariably so deep and audible that the slightest departure in the direction of failure must at once attract attention. Moreover, there is less objection to placing the patient in the upright or constrained positions than when chloroform is being administered. During imperfect etherisation laryngeal spasm hardly, if ever, gives cause for anxiety, with chloroform there are certain cases, more especially amongst the florid, vigorous patients, in which a crowing high pitched inspiratory stridor is met with, un influenced in extreme cases either by pushing the lower jaw forward or by tongue traction. It seems to be connected with a moderate degree of chloroformisation, is more common in abdominal surgery, and in operations upon the genito-urinary organs. A deeper anaesthesia generally causes it to subside, but sometimes the opposite treatment proves more efficacious. When dealing with such powerful agents, an allowance must always be made for errors in administration. The advantage of ether here comes out prominently, for even when this agent is administered in toxic quantities, in the vast majority of instances the administrator has ample time to resuscitate his patient. The workable area of ether is a large one; that
with chloroform is small. We may err either on the side of too light, or on the side of too deep, an anesthesia, with but little risk to the patient, but with chloroform any departure from that depth of anesthesia which is proper in each particular case, whether on one side or the other, is liable to be attended with difficulty. There are appreciable risks in all anesthetics. Chloroform acts more promptly and more powerfully on both respiration and circulation, but persists longer than ether after the inhaler is removed, it causes death in a double manner through stoppage of the respiration and circulation, ether kills by respiratory paralysis, and only when the heart is feeble and involved has any prejudicial cardiac effect. Moreover, by statistics, chloroform kills, in any given number, from three to five times as many as ether. With chloroform may be included dichloride of methylene, Sir Spencer Wells anaesthetics for ovariotomy, dichloride of ethylene, bromide of ethyl, ethyllic methyllic ether, and many other of the chlorine series.
With regard to nitrous oxide, it was estimated in 1870 A.D. that it was administered not less than three quarters of a million times yearly in the United States, often by very ignorant dentists, in all positions, and to people in all states of
health indiscriminately, with a result that out of many million inhalations three deaths only had been recorded as directly due to nitrous oxide. Dr. J.W. Hewitt has displayed much patient skill and unerring zeal in perfecting an instrument to administer nitrous oxide with any required percentage of oxygen. No fatal result has yet been recorded, although it has been employed in cases which appeared unsuitable for the risks of other anaesthesia. When the part operated on is not ciliated within the mouth or nose, two minutes or even longer anaesthesia may easily be secured, otherwise the time available for operation varies from thirty to sixty seconds. When given without oxygen, full anaesthesia is recognised by a peculiar throat sound indicating a tendency to obstruction about the epiglottis; sometimes there is deep snoring breathing. The rhythm of breathing is liable to be further interfered with by tonic spasm of thoracic and abdominal muscles. Occasionally respiration becomes feeble and expiration stridulous, which should be taken as an indication of full anaesthesia, and the face piece be removed. The pupils are generally dilated, the lid reflex may sometimes be elicited when other signs indicate that the anaesthesia has been pushed as far as
is advisable, though it often disappears. When oxygen is given with nitrous oxide anesthesia is known to be present by loosening of the conjunctival reflex, with tranquil or softly servo breathing, flushed extremities, and the eyeballs fixed or presenting slightly oscillatory movements. Ether should be chosen as a general rule for all operations which cannot be satisfactorily performed under nitrous oxide, unless coming under the head of those previously mentioned as more suitable for chloroform and its mixtures. Whenever practicable it is a good plan to precede ether with nitrous oxide or the A.C.E. mixture. The former is particularly useful in hysterical or nervous people, owing to the rapid loss of consciousness, and may be used generally between six and forty-five to fifty years. The A.C.E mixture before ether is of special service in children from one to five years, in very stout and flabby patients, in most patients above forty-five, and in those who dislike a closely fitting mask or deprivation of air, and those who are subjects of intra-thoracic or abdominal disease. Ether may be given by the open or closed method. In the open method one or two drams are placed on a folded towel or inhaler which is held just such distance off as to avoid
coughing or holding of the breath. If too small a quantity be administered, anaesthesia is long in appearing, and if excitement occur it will take longer to subdue than when larger doses are given. Too pungent a vapour, on the other hand, produces a most horrible sense of suffocation, the breath will be held, and violent struggling ensue. Starting then with a dilute vapour, as patients commence to lose consciousness the strength should be quickly increased. Respiratory rhythm is always interfered with more or less by swallowing movements and temporary closure of the larynx until it becomes less sensitive and more accustomed to the vapour. When consciousness has once departed any struggling or excitement must be met by more continuous application of the anaesthetic. Not less than a pint of ether should be at hand for a long operation by the open method. It has, too, greater risks of pulmonary and catarhal affections than the closed method. In the closed method with Clover's inhaler care must be taken during cold weather to immerse the reservoir for a few minutes in warm, but not hot, water, before commencing the inhalation. About an ounce and a half of ether should be poured into the reservoir.
and the indicator turned to zero. After applying a suitable sized face piece the anaesthetiser should first apply the apparatus to his own face and blow out to expel any traces of ether, and then get the patient to breathe in and out through the apparatus before applying the india rubber bag.

When the patient breathes freely the bag should be attached to the reservoir during an expiration, pressing the face piece more tightly during expiration than inspiration will soon fill the bag. Before turning on the ether vapour let the patient breathe backwards and forwards for half a minute, if the breathing is unsatisfactory tell the patient to blow out at the end of expiration and the corresponding inspiration will become deeper. When once the bag is full of air do not admit any fresh, but very gradually rotate the reservoir so that the O on its circumference moves cautiously away from the indicator, about one eighth of an inch should be turned every three breaths. Should the patient swallow or hold his breath the reservoir must be turned back until the breathing is more regular. During deep and regular respiration the reservoir may be turned more quickly. Whilst respiration is proceeding regularly buildt
med not be regarded as an indication for fresh air, but when stridor commences one breath should be allowed, after which the strength of vapour should be somewhat increased. During excitement or struggling the inhaler should be more closely applied, except in feeble, flabby, or elderly people, where prolonged suspension of breath is undesirable. When breathing is regular and stridorous and the conjunctiva insensitive, the inhaler may be removed for two or three breaths, but not longer, or we should run the risk of holding of the breath and spasm. It is best to secure full anaesthesia for two or three minutes before allowing the air to quite restore colour. In ordinary cases it is unnecessary to go beyond 3. on the ether reservoir, in the feeble and anaemic anaesthesia may often be reached by 1 or 1½. When once surgical anaesthesia is fully established, turn the reservoir back to 2, 1½, and 1, and give a breath every thirty seconds. Take care to replenish the ether before it is exhausted in the reservoir. With the exception of nitrous oxide food should not be taken within four hours of the operation. Before giving any anaesthetic, observe the general appearance and bearing of the patient.
his manner of respiration, his pulse, and remember to stethoscope the chest. This tends to encourage the patient, each of whom is apt to think that his own case is different to any other that preceded it. Look into the patient's mouth and see that there be no artificial teeth or loose body to be removed. Old people who have a complete upper and lower set had better retain them to prevent lip flapping. If there is any nasal obstruction place a small prop between the teeth.

It is clearly the duty of the anaesthetist to administer the anaesthetic in any position preferred by the Surgeon; the most comfortable for the patient is lying somewhat on one side, with the shoulder slightly raised by a pillow, the neck a little bent, so that the saliva may run from the lower corners of the mouth and not be swallowed. The best time for operations is undoubtedly about 8 A.M. Nurses say that a previous purge greatly reduces the chance of after sickness. There should be at hand instruments to open the mouth, a pair of tongue forceps, basin, towel, a small piece of sponge, instruments for tracheotomy, and bellows attached to an intubation tube or face piece.
with special valves, a hypodermic syringe, strychnine solution, and tincture of digitalis. See that the patient is loosely and warmly clad.

During the administration of both ethere and chloroform close attention must be paid to: a. Respiration. b. The occurrence of swallowing movements.

c. The lid reflex d. The state of the pupil and in addition to these in the case of chloroform attention must be paid to:

e. The strength of the pulse
f. The colour of the face and lips

g. Occasional rigidity of muscles in various parts of the body.

a. Respiration should be regular and audible.
b. Swallowing movements generally mean too light anaesthesia.

c. The lid reflex is more completely abolished with ether than with chloroform.

d. The size of the pupil of chloroform is decidedly less than that of ether. The meaning of an increased dilatation must be sought for in the presence or absence of lid reflex, which will show whether the pupil is dilating on account of deep anaesthesia or the irritation of some sensitive part.

e. The pulse may be conveniently felt in either the temporal, facial, or coronary artery, which can easily be felt on the inside
of the upper lip) like the pupil the pulse is of value as a corroborative landmark. During deep anesthesia a marked slowing of the pulse indicates some reflex shock, and the need for increasing the strength of the vapour. The colour of the face and lips does not always herald danger; cyanosis with good respiration indicates that the heart is doing well, but that more air should be admitted; pallor, on the other hand, warns us of the approach of vomiting; deep anesthesia is favourable to good colour, deep respiration, good circulation, and the avoidance of spasm of all sorts.

Recovery from anesthesia takes place with a rapidity proportionate to the previous duration of narcosis. Patients with good respiration, brisk circulation, and clear air-way eliminate the anaesthetic more quickly than others. The patient should be placed well upon his side in the position recommended by Dr. Boules during epileptic seizures, when ataxia will cease, and mucus and saliva and any vomited matter readily escape. A free air-way is thus established, and coughing prevented. The administrator must stay by his patient until come semi-
- voluntary action takes place, so as to be ready to push the jaw forward and clear the mouth and pharynx if necessary. The patient should be kept quiet with his eyes closed, and every care be taken not to shake him. Nourishment should not be given by the mouth for some four hours after the operation, after which time a little clear soup or broth seems best. For vomiting some recommend ice, but sipping very hot water generally gives better results; should this fail, hot coffee may be tried; failing this, ten or fifteen grains of bicarbonate of soda; champagne is sometimes of service, and oxalate of Cerium. For persistent hiccup a small cup of green tea, without milk or sugar, or a drop of dilute hydrocyanic acid is often of benefit.

The above thesis, though laying no claim to originality, is the outcome of the practical experience gained: — in the operating theatre, Edinburgh, where, amongst the cases one death occurred at the outset of inhalation in a woman about to lose her superior maxillary bones for malignant disease — an experience of one year and nine months
whilst house surgeon at Grimsby Hospital, where chloroform only was given—
one year and three months at S. Bartholomew's,
Chatham and Rochester, 250 anaesthetics,
most of which were given with ether in
Clover's inhaler, a few cases of mixed
anaesthesia, and a few of chloroform.
Notes
of each case were entered in the hospital
anaesthetic case book—

Emile January, 1887, in general practice, cases
of ether and chloroform, single-handed, and
with my medical neighbours. One fatal
case, where the excessive nervousness of the
patient depressed an already weak heart,
which was finally paralysed by too rapid
an in-take of vapour after struggling.
I have given nitrous oxide, followed by ether,
for dental operations.

The works I have consulted are as follows:

"Anaesthetics and their administration"
by Woodhouse Brawn F.R.C.S. Nov. 24. 1884.
The Medical Society's Proceedings, Vol. VIII

"Remarks on the report of the second Hyderbad
chloroform commission " B.M.J. June 14th 1890.
by John G. McKendrick, M.D., Joseph Coats M.D.
and David Newman M.D.

"An address on anaesthetics B.M.J. Aug. 16th 1890
by H. E. Wood, M.D., L.L.D.

"Report on an experimental investigation of
the action of chloroform and ether" B.M.J. Oct. 11th 1890. by John A. M'William, M.D.
"Nitrous oxide and oxygen" Odontological Society June. 1892. by Frederic Hewitt, M.A., M.D.
"Remarks on the action of chloroform B.M.J. March 11th 1893. by T. Lauder Brunton, M.D.
"Note on a specimen of chloroform after the inhalation of which death occurred" B.M.J.
June 17th 1893. by Gordon Sharp, M.D.
"The physiology of the heart in relation to anaesthetics" Odontological Society Dec. 1893
by John W. Pickering, D. Sc. London.
"Manual for medical and dental practitioners" and students" by Frederic W. Hewitt, M.A., M.D., anaesthetist at the London and Charing Cross Hospitals

John Lowthian Jackson, M.B., C.S.R.
Hedon near Hull.
27th April, 1894.