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Thesis for M.D.
(degree Edinburgh University)
on the
Administration of
Anaesthetics
by
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The Anaesthetics I intend writing
of are those I have personally used
since qualifying in 1881. & are
Chloroform, Ether, Nitrous Oxide
gas, the A.C.E. mixture, & Hypnotism.
I will first take the preliminary
considerations which I consider necessary
to be observed before administering any
Anaesthetic viz: -

(1) The nature of the operation to be performed.

(2) The general condition of the patient.

Both of which influence me in the
choice of the Anaesthetic to be used.

I shall next consider: -

1. The Properties of the Anaesthetic.

(1) The preparation of the Patient.

(2) The Method of administering the
Anaesthetic.

3. The treatment of the difficulties,
accidents, & dangers arising, during
& after the administration of the Anaesthetic.

(5) Comparison of the different Anaesthetics.

(6) Cases in which something has arisen
differently, from the normal.

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The first of the preliminary considerations
viz, The nature of the operation,
generally informs us whether we
want a long or short state of
anaesthesia. Should the operation
be a short though painful one
such as the drawing of a tooth,
I use Nitrous oxide gas. Should it
be of longer duration, I use either
Chloroform, Ether, or the A.C.E
mixture, to decide which of these
is best suited to each particular
case, we must consider the general
condition of the patient as well
as the nature of the operation.

In considering the general condition of
the patient; I note first whether
he be thin or stout, emaciated & delicate
or robust and full bloodied. Then
the way he walks (if he walks) to the
operating table, then I carefully,
systematically, but quietly examine
the patient. I begin by examining
the oral cavity & removing artificial
& very loose teeth, also sweets, tobacco or

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or any other foreign body that may be
there. It is also well to examine the
eyes to see if either be artificial.

If possible I like to get a report of the
condition of the kidneys from an
examination of the urine; also the
state of the bowels, & generative
organs in the female. Then I examine
the lungs & heart using the stethoscope
often being able to give the patient
greater confidence by telling him he
is sound. I shall note later the different
classes of cases which I consider suitable
for the different anaesthetics simply
mentioning that as a rule I give
chloroform unless I find it contra-
indicated. Before starting the adminis-
tration of an anaesthetic I like to
have at hand a pair of tongue forceps
a small bowl, a sponge & towel.
Instruments for performing tracheotomy,
hypodermic syringe, & of drugs Nitrite
of Amyl, Ammonia, Digitalis (tincture)
Liq: Strychnia & Brandy, also hot water.

5.

I propose first considering the properties & administration of ⁽¹⁾Chloroform; then of ⁽²⁾Ether, then the ⁽³⁾A. C. E. mixture & next of ⁽⁴⁾Nitrous oxide gas & lastly append a few remarks of my experience of ⁽⁵⁾Hypnotism. But as the Preparation of the patient applies equally to the first three above mentioned I will say now what I consider necessary on that point. In preparing a patient for an anaesthetic it is very necessary to regulate his diet. If, as I prefer, the operation is to take place early in the morning the patient should not be allowed any breakfast, & the evening previously should only be allowed light, easily digested fluid food; unless he be very emaciated, & weak, with a feeble circulation when he may have an evening of beef tea & brandy about an hour before the operation. If it takes place later in the day he should have no food by the mouth for at

least five hours before the operation, (6)
& these only of a fluid character.

It is well I find to have the patient's
bowel & bladder empty.

The patient is usually (& should be if possible)
made to lie level on his back on a
flat table with a small moveable
pillow under his head, & the head
turned slightly to one side. I never
give chloroform to a patient in the
sitting position. He should be lightly
warmly, but loosely clad.

111) Chloroform. CHCl_3 , the most
convenient & most frequently used
drug for producing anaesthesia of
any length was first used by
Sir James Simpson nearly fifty
years ago, in 1847, as an anaesthetic.
It is a colourless, transparent & volatile
liquid with a specific gravity 1.497 (Brit. Ph.)
but according to Martindale of 1.5002 at 15°C.
It should be neutral to test paper &
form no precipitate with argentic
nitrate (Hewitt). It should be carefully
excluded from light and air.

7.

Mode of administration: It can be administered either by (1) The drop method, which is done by using a single flannel mask (Skinner), or the corner of a towel drawn through a safety pin as recommended by Sir Joseph Lister. Placing one or other over the patient's nose & mouth, having first dropped some chloroform on the inside; & telling him to breathe steadily, then allowing the Chloroform to flow from a drop bottle on to the inhaler drop by drop till the patient is anaesthetised. Or (2) by the method of giving a fairly large quantity of chloroform at once on a folded towel or cone. Snow invented a special inhaler for chloroform soon after Sir James Simpson had discovered its anaesthetic properties, by which he attempted to give a regular proportion of Chloroform about 4 - 5 percent with air. But Sir James Simpson's & Snyne's methods were & are generally followed.

Dr. Junker has invented an inhaler which is specially suitable in the surgery of the mouth, throat & nose. By means of his apparatus the vapour can be pumped through a narrow tube into the nasal, or buccal cavities; it is not suitable for children.

I generally use a towel so folded that when in use it has the appearance of a hollow cone with the pointed end bent over ^{but} allowing plenty of air to enter at each of the top corners ^{aa}.



I pour inside about $\frac{1}{2}$ to 1 drachm of chloroform & immediately place it over the patient's nose & mouth telling him to breathe quietly & steadily & I find he very soon becomes unconscious.

The effects may be divided into three (not very distinct) stages:-

In the first stage the patient notices as sweetish non-irritating vapour rather pleasant to inhale but may also experience a slight sense of

suffocation, & speak & try to remove the inhaler but he quickly passes into the Second stage: which is one of excitability as there is now (generally) a fair amount of muscular excitement, struggling, talking, shouting, or screeching, some swallowing, & some spasmodic movements; by pushing the drug, (very carefully if there be any prolonged spasm) the excitement soon lessens; if the patient now continues holding the breath I find by raising the towel slightly the patient will often perform the act of expiration & then by again pressing down the towel he will inspire the vapour & the irregular breathing & struggling quickly subside, & the patient will gradually become quiet. But the breathing may become faint & the patient appear pale, the pulse be feeble, this I have found most frequently precedes a tendency to vomit which may be averted by continuing the administration; or if he starts vomiting by turning him on one side & getting rid of

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any food or matter from the stomach, after this he often becomes easily & quickly anaesthetised. The circulation should always be carefully noticed, this I generally do by keeping one finger on the facial artery, if I can get at it, if not the temporal or one of the other superficial arteries. The eye also must be carefully observed, so as to note when the lid reflex becomes abolished & the cornea insensitive to touch. The pupils may become partially dilated but should then contract. The respiration gradually changes its character & becomes more regular, a little quicker than usual & slightly moaning as he passes into The Third Stage which is generally considered to be reached when the breathing has become regular & stertorous, the lid and other reflexes abolished, the cornea insensitive to touch & the extremities flaccid; the circulation slightly slower, and feebler than usual, the pupils contracted

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The temperature is often slightly reduced. Sometimes the first cut in the operation causes a change in the breathing.

The Treatment of the difficulties, accidents, & dangers that may arise during and after the administration of an anaesthetic will now be considered as applying to Ether & the A.C.E. mixture as well as Chloroform except where specially stated. Patients vary very much under the influence of an anaesthetic.

The great danger to be always aware of is I consider cardiac depression when giving Chloroform. Vomiting after the operation may often be alleviated or prevented by covering the patient's eyes on awakening him. Holding the breath; if the patient continues holding the breath much longer than usual & if incompatible with safety I look out for any & every cause; if the lips have fallen together or if the teeth are clenched I separate them with the Tongue forceps, which I have had made with the ends forming a wedge,

when closed; if the tongue has fallen back I draw it forwards with the forceps. By keeping the head on one side & by pressing the lower jaw forwards from behind, or by putting the forceps between the teeth & levering it forward will I find often relieve excessive spasm or obstructed breathing if blood, or vomited matter, or other foreign substance gets into the air passage I either sponge, or hook, it out with the finger; but if unable to get it out we may have to perform tracheotomy. Should the breathing become very faint & then respiration cease I draw the patient up the table taking away the pillow let his head hang over the end draw the tongue forward & employ artificial respiration (Siverters method). If there be cardiac failure I stop giving Chloroform & press heavily & intermittently over the cardiac region & raise the end of the table (where the feet are) if an adult, but if it be a child I lift him up by the legs & give him a slight shake. If breathing exists apply ammonia to nostrils

an injection (hypodermic) of Digitalis $\frac{m}{\text{ij}}$ & Strychnia $\frac{ss}{\text{ij}}$ sometimes useful; also dilatation of the anal sphincter, & Galvanism?

D. Hewitt believes very few deaths occur from an overdose of Chloroform.

If the pulse becomes abnormally slow, a full & irregular & more & more imperceptible & the respiration becomes impaired, & inaudible, tending to cease, the eyelids partially separated & their reflex lost, the pupils dilated & insensible the anaesthetic should at once be removed, & means at once taken to restore the patient to a more natural condition. By pressing the abdomen slightly upward we can raise the blood pressure & by applying very hot water to the brows of the patient will often aid in reviving him.

Billroth believes in Chloroform idiosyncrasy. The Hyderabad Commission laid great stress on the possibility of a fatal result occurring during the deep & gasping respirations consequent on struggling. A patient is then liable to inhale a large quantity of the vapour.

As to one of the modes of death by Chloroform
 Bickersteth's Edin: Monthly Journal 1893 says
 "a peculiarly interesting fact and one
 that I am inclined to think may account
 for many deaths, is that in some indi-
 viduals when fully under the influence
 of chloroform the pulse suddenly fails
 at the moment the first incision is
 made by the surgeon, this too when the
 respiration is altogether natural" in
 support of this he quotes three cases.

There are many divergent opinions
 as to when Chloroform should or should
 not be used a few of which I quote:-
 Richardson says "chloroform is to be avoided
 in cases of dilated heart with varicose veins"
 Balfour (in Braithwaite's retrospect) says that it
 is safe to give it in fatty heart cases.
 Deulop (Hind. Med Times + Gazette) says "no
 heart disease forbids use of Chloroform"
 Mr. Gills experience (Year book of treatment 1896)
 is that the sanguineous take it well,
 the lymphatic are liable to depression.
 When much blood loss is anticipated as
 in post nasal growths the use of Ether

prior to Chloroform is avoidable; The
 sanguineous feel depletion later on in the
 narcosis so rectal stimulating injections
 should be given. Graduate the quantity
 of Chloroform, less being given for children
 & aged than for adults. A small pupil
 indicates safe narcosis. A stimulant
 may sometimes be given to persons who
 fear the anaesthetic. Dilatation of
 pupil when the stage of unconsciousness
 is reached may be due to (1) Struggling
 (2) Stomachic disturbance (3) Fear (4) Pyrexia,
 anaemia, or emaciation (5) an overdose
 of Chloroform showing itself then by
 (a) a sluggish reaction of the pupil to light
 (b) absence of brilliancy of eye (c) cornea
 loses its lustre (d) breathing becomes laboured
 (e) pulse full & veins distended.
 (f) Severe haemorrhage & (g) Surgical
 shock as in tying spermatic cord. "

Have records 6000 cases of $CHCl_3$ in India
 without a death.

Baier says diabetic's view special risks
 under Chloroform

Labbe regards rhythmic traction on the tongue

as superior to artificial respirations.

Roseberg recommends painting mucous membrane of the nose with cocaine to prevent reflex inhibition of heart & Struik's death may be caused by asphyxia from paralysis of the tongue, or general depression of functions.

Lauglois & Maurange recommend oxyphartein injections before giving chloroform.

Cases have been recorded in which a fatal result has followed a few breaths of chloroform, but in permanent by recording them I think we have to consider what (in some minds) constitutes a few breaths & also how much of the result was due to nervous shock & other causes, unless we consider it as due to chloroform idiosyncrasy.

For the analysis of 210 deaths from chloroform collected (109 by Ro. Med. Ch. Society) & (101 by Kappeler)

The period of inhalation at which death occurred is noted as under:—

Those under,	Or	Stage of inhalation,	
1 ^{minute} - 10 deaths.		Commencing to inhale	14
1 to 3 ^{min} - 13		Stage of excitement	30
3 to 5 ^{min} - 12		Incomplete anaesthesia	49
6 to 15 ^{min} - 33		Fully under influence	68
Over 15 ^{min} - 7		After operation	31
Not stated 135		not stated	18
<hr/>		<u>Total</u>	<hr/>
210			210

Or before full effect 93 during full effect 68 & after 31.

Two interesting cases of death under Chloroform, ^{& Acc. ether,} I notice in the Brit. Med. Journal for April 4th 1896 p. 859 Dr. W. Murray reports one which occurred at the Deaconesses Hospital Tottenham on March 19th. The patient was a delicate looking girl of 10 suffering from enlarged cervical glands, those on the right side having commenced to break down her heart and lungs & other organs were normal & she did not appear unduly frightened. The Chloroform was given on an Eschsch's inhaler from a drop bottle. When 3ip had been given she was under, & the operation was about to commence

the pulse being good, the pupils contracted & reflexes gone. Without any warning the pupils dilated, she became livid & after a few spasmodic efforts at breathing the respiration stopped, the pulse could not be detected. The end of the table was lowered the tongue pulled out & artificial respiration commenced a stream of oxygen being allowed to play over the mouth & nose Digitalis & Ether injected subcutaneously: but without success. The opinion, after post mortem examination, was sudden cardiac failure.

2nd Case. A.C.E. mixture was given at Charing Cross Hospital to a delicate woman, for the removal of a rib, & followed by Ether about 3ij of A.C.E., & 3ij of Ether ^{were} given when breathing began to get bad & it was discontinued. She stopped breathing however & all means of resuscitation were in vain. This occurred on March 18th 1896. She had a left sided empyema & was coughing up large quantities of foul purulent sputum.

Cases. I append a few cases which have occurred in my practice & which are illustrative of various peculiarities.

(1) Mrs B - age about 45; full blooded & of an alcoholic temperament, had received a severe blow on right side of face, & eye necessitating removal of latter. Full pulse. I gave her a full dose of chloroform on folded towel she lying flat on her back; at first there was severe struggling with sufficiency of face & talking but she gradually & fairly quickly subsided to complete quiet. The pupil of sound eye remained fairly contracted, respiration became deep, pretty regular & stertorous operation was performed & she gradually recovered consciousness without any bad symptom. This shows an alcoholic behaving very well under chloroform freely given.

(2) Mr. J. aged about 39 of delicate appearance operation iridectomy of right eye. Pulse quick. I gave chloroform as before & he became unconscious with hardly any struggling but the pupil of left eye dilated (4 1/2 - 5 mm)

the chloroform was removed & the operation performed the pupil remaining dilated & face very pale & respiration feeble till he recovered (slowly). No other bad symptoms.

(3) Mrs G. aged about 42 full bloodied & slightly bronchitic, operation abdominal tumour at surgeon's request I at first gave Ether but face soon became very surged, breathing laboured with cough & great discomfort; I changed to chloroform when breathing soon became quieter, anaesthesia supervened & she remained in a quiescent state during the whole operation which lasted ^{1 hour} 20 min & made a very good recovery.

(4) Miss A. aged about 20 well nourished but excitable, operation removal of tumour of upper jaw (left). A cast of the tumour was taken from inside of mouth causing slight vomiting before she took the CHCl_3 . She took the anaesthetic well with very little excitement or struggling but her pupils became very dilated (about 5 mm.) just before she was fully under but on giving more chloroform they contracted ($2\frac{1}{2}$ mm.) & she made a good recovery though haemorrhage great.

(5) Female aged about 50, delicate; pulse slow; operation removal of abdominal tumour in the evening. I gave chloroform under a gaselier of 4 naked lights. She took it well but suddenly towards the close of the operation the assistants & myself were seized with intense throat irritation & coughing which we found was due to the action of the gas on the chloroform vapour.

(6) Male age about 70 alcoholic temperament though thin; operation double iridectomy, both eyes were under the influence of cocaine he did not take the chloroform well his breathing being shallow though his pulse was fairly good but slow. He became unconscious & one eye was operated on but he quickly recovered consciousness more chloroform was given on mask from a drop bottle & other eye operated on when suddenly the pulse stopped beating & face became pale & respiration stopped; the patient's legs were raised, artificial respiration performed & the tongue drawn forwards & backwards intermittently & cardiac region pressed on & he gradually recovered.

(2) Ether (Ethyl Oxide $(C_2H_5)_2O$) is a transparent mobile and highly volatile liquid of a pungent odour, specific gravity .723 at $12.5^{\circ}C$ (Watts) its vapour density is 2.586 (Gay-Lussac) as compared with air. It boils $35.6^{\circ}C$ $96^{\circ}F$ according to Watts & Townes, under ordinary atmospheric pressure.

It was first administered for a surgical operation in 1842 by Dr. Long of Jefferson U.S.A. (according to Dr. Bouxton). It is highly inflammable.

As previously stated the nature of the operation, & the general appearance of the patient are to be noted before administering Ether.

The preparation of the patient is similar to what has been described before, though it is admissible to give ether to patient in the sitting position. As ether leads to greater vascularity, and especially greater venous engorgement than chloroform so the greater the quantity of blood lost the less ether required.

Modes of administration :-

- (1) Close method where a bag inhaler is employed
- (2) Open method where a plentiful supply of air is allowed

The ether being poured on a towel or lint, this method is now seldom used, I never employ it.

(1) The close method which I use is that in which the ether is given to the patient with very little air and one of two apparatuses are generally employed either Ormsby's ether inhaler consisting of a face piece, sponge chamber with sponge for the ether and elastic bag all connected together, or Clover's portable ether inhaler which consists of a face piece metal ether reservoir also containing water in separate chamber, & being graduated on the outside to show quantity of ether being given, and an elastic bag all easily connected together; there is also an index pointer either connected to face piece or metal chamber. This is the one I prefer as the quantity of ether can be so well regulated. The patient being in position I charge the apparatus with about $\mathfrak{z}i - \mathfrak{z}ii$ of ether having the index at 0 and then accurately fit the face piece (which is surrounded with a hollow rubber tube capable of being blown up), over the patient's nose and mouth and let him breathe and rebreathe the air in the bag first

thus giving him confidence then I slowly turns the index pointer to 1 then 2, and 3 thus allowing an increasing quantity of Ether to be inhaled the ratio of air diminishing with each breath. As before we will consider three stages of effects.

In the 1st stage the patient notices a pungent disagreeable vapour which causes coughing & struggling; the pulse becomes accelerated the pupils large and insensible; he then passes to the 2nd stage of loss of consciousness; the reflexes remain, and struggling, talking, singing or shouting generally take place; muscular system becomes contracted; pupils more or less dilated; saliva freely secreted; features are flushed, the face becoming of a dusky hue and turgid, perspiration breaks out sometimes very profusely, pulse quickens & breathing irregular; inarticulate muttering & often swallowing movements occur; patient may vomit becoming pale with shallow breathing and weak pulse before he passes into the 3rd Stage when the breathing becomes more regular and gradually stertorous, the reflexes are abolished the cornea is insensitive to touch & the extremities are flaccid

The heart's action is excited the pulse full and quick, respiration generally forcible with audible snoring which may be relieved by pushing the lower jaw forward. The pupils are of a moderate size but have a tendency to dilate if the Ether be pushed —

Most of the difficulties are the same as those mentioned previously under chloroform.

But in giving Ether we have more particularly to look after the respiration. If an over-dose of Ether be given the conjunction of the patient becomes insensitive, the pupils dilate, eyelids are slightly separated, the colour is dusky, pulse less forcible, respiration shallow, stertor lost, becoming feebler, but may be jerky, & gradually ceases.

The chest may become so rigidly fixed that the respiration may stop altogether & cause death one case mentioned in Brit: Med: Journal March 15th 1884 p. 508 & another May 2nd 1885 p. 887.

It very rarely occurs that the circulation fails before the respiration. There is some danger of cerebral haemorrhage in apoplectic patients. Jaundice may, occasionally, follow Ether inhalation. It produces diminution of the Haemoglobin.

Pneumonia & oedema of lungs are said to be an after effect of giving Ether but I consider one cause of this is allowing too great a draught to blow on ^{the} awakening patient.

Pnephritis it is said may be caused by the Ether chilling the blood stream?

The best methods of resuscitation are.

Pushing forward the lower jaw,
Intermittent traction on the tongue,
Artificial respiration, and other methods mentioned previously (under chloroform).

Carter Coles has employed a mixture of oxygen and ether vapour & claims that he thus avoids cyanosis, struggling and suffocation and secures salvation, nausea, and vomiting.

Rectal etherisation was suggested by Roux (in 1847 Journal de l'Academie des Sciences 146 page) & used by Pirogoff, but ~~was~~ ^{has} not often used; one case terminated fatally.

In giving ether to children the administration should be conducted slowly and plenty of air given, so giving a diluted vapour; the best indication for readiness for operation is the regular and noisy breathing. I prefer chloroform for children & seldom give ether.

Cases of a fatal result from Ether ad-
ministration 27 reported in Lancet &
British Medical Journal during 10 years
 (1880 - 1889) are tabulated by Mr. Hewit in his
 book on Anaesthetics (p 158); into 6 groups.

Group 1. Patients suffering from some pre-existing morbid state capable of impeding respiration during anaesthesia	10.
Group 2. Patients suffering from cancerous or other affections producing extreme exhaustion	10.
Group 3 Patients suffering from renal disease and morbus cordis	3
Group 4 Patients in moderately good health at the time of administration	2
Group 5 Exhausted patient - ovarian tumour - death from pulmonary congestion seventeen hours after operation	1
Group 6 Imperfectly reported	1
<u>Total</u>	<u>27</u>

The case I mentioned previously on page 18 evidently died from Ether & would come under group 1 above.
 I will now append a few cases in which I have administered Ether though I haven't had many that diverged much from the ordinary course.

Case 1. Miss W. age about 60, had been ailing some time; very nervous with thin anxious face operation extirpation of uterus & appendages for carcinoma. Heart sounds weak but fairly regular, Pulse thin respiration fairly good duration of operation For 35 min. Pure (Methylated) Ether given by Clover's apparatus. Patient was rather a long time becoming anaesthetised owing to face piece not fitting face very well also to having to ^{give} her Ether in bed the head of which was against the wall & then having to move her to another room for the operation; she talked a little but did not struggle much before becoming anaesthetised, respiration was at first quick & thin deeply stertorous & I had to keep the lower jaw well pressed forward to keep breathing good. At one time a tendency to vomit which was prevented by giving more Ether. Pupils at one time contracted a good deal but as a rule kept a medium size, recovery slow & great discomfort from vomiting.

Case 2. Mrs A - age about 45; operation recurrent tumour of breast. Average height.

rather thin, florid complexion, though anxious,
 & nervous. Heart sounds & lungs healthy. I
 gave chloroform first for one or two minutes
 then Ether by Clover's apparatus. Face became
 very turgid, perspiration & salivation profuse,
 one or two attempts at vomiting. Fairly
 deep stertor pupils dilated; recovery
 quick but some nausea & vomiting after.

Case 3 Miss O - age about 28 thin, delicate
 and nervous; abdominal operation. Took
 Ether well but breathing became very
 shallow though pulse continued fair
 face became pale towards the close
 of the operation so stopped giving more
 Ether; recovery very slow; she remaining
 unconscious, pale with feeble respiration,
 for some time after being placed in
 bed with hot water bottles round her.
 She eventually made a good recovery.

In comparing Ether with Chloroform it is generally considered better to employ Ether in young adult healthy full blooded males. Also in operations on the kidneys. Also for examining stiff and painful joints; and in breaking down adhesions. It may also be given when operator obliged to have patient in fairly upright or sitting position. Chloroform is preferable in operations on nose, mouth or throat; ~~operations~~ and in any operation where the actual cautery has to be used, or where artificial light (naked flame) has to be used near patient. Also in operations on pleura, lung or brain. It is far the best anaesthetic for obstetrical practice; and is better than Ether as a rule in operations on the abdomen, & rectum and bladder.

Chloroform and Morphine useful in
Brain Surgery.

Nitrous oxide gas is the safest anaesthetic when operation permits its use, & it may be given before Ether.

A Mixture of Chloroform, with Ether, and Alcohol called the A.C.E. mixture is composed of Alcohol one part, Chloroform two parts and Ether three parts, and a few years ago I used it a good deal more frequently than I do now. The same conditions should be observed as in giving chloroform in fact I find the effects to be much the same as that drug alone. I always consider it should be freshly prepared from the purest ingredients & inhaled from a cone or folded towel a small quantity being frequently added, as its constituents evaporate in different ratios. I think it may be given in suitable cases, and sometimes with advantage, before giving Ether; though Trueman says all mixtures are dangerous, and compares Ether and Chloroform together to show they are:

{	Density of Ether vapour	3.7	Square root	6.082
	Density of Chloroform vapour	59.75	Square root	7.729
{	Ether boils at	95° 7'	Specific gravity	.72
	Chloroform boils at	145° 7'	Specific gravity	1.497

of the many cases I have given it in I never had any very alarming symptoms.

I look upon it as producing chloroform anaesthesia but think that the ether may act as a stimulant to a patient with feeble circulation. It is considered preferable to ether in cases of intestinal obstruction and for weak patients with chest mischief or with mitral stenosis.

Mr Moss of Kings College up to 1889 had employed the A.C.E. mixture in 10,000 cases with excellent results

Several fatal cases however have been recorded.

I now find that, using the two drugs, ether & chloroform separately; if necessary, in sequence I can produce all the effects I want.

Case 1. Miss B - age about 25 circulation and heart beat feeble operation several teeth to be removed, gave her A.C.E. on a folded towel about 3 $\frac{1}{2}$ she rapidly became anaesthetised remained so about 20 minutes & made a good recovery.

Case 2. Male age about 26, fairly robust, I gave ether for examination of small tumour in abdominal wall; recovery good

a week after he was admitted into hospital for operation he was anaesthetised with the A.C.E. mixture but died before the operation was begun, as I was not present thus, I was unable to get full particulars.

Nitrous Oxide gas N_2O was first prepared by Priestley (about 1772), investigated by Sir Humphry Davy (about 1779) and employed as an anaesthetic by Wells an American dentist in 1844.

Properties

It is a transparent non irritant gas of specific gravity 1.52 (coline). Liquefaction takes place under a pressure of 30 atmospheres at $0^\circ C$ and was first liquefied by Faraday in 1823. It is now supplied in steel and iron cylinders in liquid form, and is given to the patient by means of a well known apparatus consisting of a face piece of leather having a valve in the upper part so that the patient's breath goes to the outer air, & a tube (brass) with a two way stopcock, connected by a long or short

rubber tube to see elastic bag at the other end of which a rubber tube connects it with the iron cylinder, containing the gas, which can be liberated when wanted by turning the screw valve, or taps of the cylinder with a foot or hand key.

Nitrous oxide may be given pure, or mixed with air, or oxygen, or ether.

Mode of administration: It is always advisable to ascertain first that there is sufficient gas in the cylinder. I always have two bottles side by side so that if one empties or becomes blocked or frozen, the other one can be at once connected and used. The patient may be comfortably seated with the head thrown back, or in the horizontal or almost any other position required by the operator. My experience has been chiefly when using it for dental or eye operations so the patient has generally been required to be in the sitting position. I find it is well not to let the chin touch the sternum.

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Then freed the apparatus from air this is easily done by turning the cylinder tap & letting a little gas escape through the tubes & bag. Then I fairly fill the bag with gas the stopcock being turned to prevent its escape; then the patient having had his mouth propped open I fix the facepiece to his face over the nose & mouth & tell him to breathe steadily and deeply and not to be nervous or excited. To give him confidence if he be very nervous I allow him to breathe air through the face piece for one or two breaths and then turn the stopcock which shuts off the air and allows the gas to enter the facepiece; the bag is always kept well supplied so that the patient is able to take in a good supply of N_2O at each inspiration the expired air and gas going out of the valve into the room. He thus continues breathing till he is fully anaesthetised. On a few occasions towards the close of an administration if the N_2O bottle has become blocked or the supply

has run short I have allowed the patient to rebreathe the gas in the bag, stopping the air valve with the finger, or turning the stopcock so as only to allow the breath to pass backwards and forwards in and out of the elastic bag. I have never found any bad effect follow this proceeding in fact I think it lengthens the anaesthesia by partially asphyxiating him. The effects following the administration are:—The patient on taking the first breath or two notices a sweetish taste. These experiences certain peculiar sensations, which vary with different individuals. When inhaling it for a short period myself I have found that certain peculiar sensations manifest themselves such as a full, and slight buzzing sensation in the ears, expansion of the head, a peculiar dizziness, (and if standing a sense of falling) & a feeling of loss of power.

Patients have mentioned to me on recovering from full anaesthesia sensations of falling from a height, of

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being carried or rushed through space as if in a very fast train & then have felt a crash this latter often occurs in dental operations probably the crash comes when the tooth is extracted, some say they can see everything that goes on but feel nothing, others feel the teeth being taken out but no pain. as the patient is taking the gas he may kick move his arms and body about shout & if at all hysterical become very excitable; but I find most of the patients take it quietly if it be properly given. as they continue taking it, the breathing become rapid, the face gradually loses its colour, the pupils enlarge, & in most patients a peculiar lividity occurs making them look rather death like, the eyelids become slightly separated showing the sclerotic. Then the breathing becomes snoring and stertorous; the patient is now sufficiently anaesthetised for the operation.

I find it is usually desirous to place the patient under the deepest possible Nitrous oxide anaesthesia for surgical operations (especially on the eye).

The recovery of the patient is generally quick, the normal facial colour returns to the face, and the ordinary feelings and sensations come back sometimes in an exaggerated form, as in a dental operation the patient may imagine the removal of the gag from the mouth is the tooth being pulled out; but he is soon himself again, though a few feel slight giddiness numbness or nausea for a time and others become hysterical.

Tonic muscular spasm occurs in some patients when the gas has been administered to its fullest extent.

Dr. Buxton (Brit. Med. Journal Sept 24 1887) found that one third of the men and nearly one third of the women anaesthetised by him at the Dental Hospital displayed a blue colour under Nitrous oxide.

I have made some observations on the time taken to produce anaesthesia and

the time of available anaesthesia after removing the face piece, in 50 cases, I found
Maximum period of inhalation was $\frac{1 \text{ minute } 2.5 \text{ seconds}}$

Minimum " " " " " 30 "

Average " " " " " 55 "

Maximum " " available anaesthesia " 63 "

Minimum " " " " " 25 "

Average " " " " " 42

Dangers and difficulties. If nitrous oxide be carefully administered and patient well watched it is singularly free from danger though one must be prepared for accidents as in dental operations a piece (or whole) of tooth, or other foreign body may become lodged in the Larynx or Trachea which, if unable to be hooked out with the finger, the head at the same time being pushed forward and to the side; may necessitate the operation of tracheotomy. The chest may become fixed and rigid the patient being unable to expel the air or gas from his lungs; this should call for immediate action and can generally be relieved by compressing the chest walls with the hands.

I have found this condition more liable to occur when the elastic bag has been over distended with gas.

Syncope from circulatory failure is to be promptly treated I have found in the few cases that have occurred in my practice that laying the patient flat, and pressing the chest wall over the heart, suddenly and intermittently; or in a slight case pressing the head well forward and toward the ground & putting a little ammonia under his nose (if he remains in the chair) will give relief.

The number of cases of death reported
are six viz.

- (1) Brit: Journal of Dental Science October 15th 1889
- (2) Brit: Journal " " " p. 164 Feb: 15th 1885
- (3) Transactions Odont: Soc^y Vol V (new series) p. 83 1873
- (4) Trans: " " " Vol IX p 218 1877
- (5) Lancet p 1451 June 28th 1890
- (6) Journal Brit: Dent: Association p 504 Oct. 1880

I have occasionally administered Nitrous Oxide with a small percentage of air when the patient has appeared anaemic & the circulation feeble.

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I find the period of inhalation is longer
and it appeared to give a slightly longer
period of anaesthesia

When I have given it with Ether I have
found I have been able to prolong the
anaesthesia slightly.

When given with oxygen there has been
observed less tendency to lividity and
asphyxiating symptoms.

Case 1. Miss C. a nurse age about 30
rather thin but fairly healthy looking,
placed in a sitting position, operation
extractions of teeth, she inhaled gas for
48 seconds, about 10 seconds after the
commencement of inhalation she be-
came restless, jactitation occurred
becoming more marked as inhalation
proceeded, she had hardly become
fully anaesthetized when her hand
jerked up and knocked the face
piece from her face I did not re-
-apply but allowed the operator to
proceed. She did not revive at all
well or quickly after the operation.
The breathing was very feeble and at

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one time almost stopped and she lapsed into a semi unconscious condition, a kind of faint, for over 20 minutes, but was roused by pressing the head forwards, and pressing the thorax over the region of the heart with the hand. On coming round to herself, she told us she felt as if she was coming round from chloroform anaesthesia. However she soon recovered sufficiently to get up and walk out of the room.

Case 3. Master H. aged 15 pale thin and delicate appearance, operation extraction of tooth; I gave him Nitrous oxide in the usual way he being seated in the chair, he took it well without struggling and was quickly under its influence but on the completion of the operation, finding he remained pale and listless, and was breathing feebly and appeared to be in a faint I pushed his head forwards and downwards at the same time pressing and rubbing his chest. He made a slow recovery.

Case 3. Female age 20 a Hystero-epileptic to whom I gave gas for the extraction of some teeth; at first she took it well but as she got more under the influence she had an epileptiform seizure which did not last long for on moving the chair so as to place her in a horizontal position the operator was able to extract the teeth & she recovered without any bad symptoms.

Case 4 Female age about 35 fairly healthy looking but rather pale had an enlarged thyroid gland she took the nitrous oxide fairly well for 45 seconds the operator then removed 14 teeth, she remaining anaesthetised for just over 50 seconds. She made a good and quick recovery.

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Hypnotism which is hardly a recognized anaesthetic I have used in a few cases in an experimental way and have found it useful though I do not recommend its universal adoption.

It may be applied by ~~one~~ or two methods
^{either} (1) Either by letting the patient sit quietly in a chair with the head thrown back; standing in front of him and impressing on his mind the necessity of absolutely trusting, and obeying the operator and not in any way to resist his wish, then while steadily gazing at his eyes place the hand on the forehead gently stroking it, and suggest the different phenomena of natural sleep in an authoritative voice thus:-

- (1) You are beginning to get sleepy
- (2) Your eyelids feel heavy and are gradually closing
- (3) You are now fast asleep
- (4) You cannot open your eyes.

His head then sinks back, his breathing is regular, and sleep, as in natural sleep. Patients vary very much in the length of time required to send them into hypnotic sleep

12) Another method I have tried is that of making the patient in the chair lean slightly forward and gaze intently at some bright object such as a metal button or disc, or a three penny piece placed in the palm of his hand, then after a varying time the operator holds up his hand before the patient's face without touching him and impresses on him that he is to go to sleep, & then that he is asleep. There are other methods such as making the patient stare at revolving discs of looking glass or bright metal but I have had no success with them. The great object is to fix the patient's attention, causing him to think only of the one thing wanted. The hypnotic sleep may be ⁽¹⁾ light or ⁽²⁾ deep it is in the latter ⁽²⁾ condition one can operate ^{best}; the former ⁽¹⁾ may be used to influence the patient's mind for good, to correct a bad habit, and according to Dr Lloyd Luckey in his little book on The Value of Hypnotism in Chronic Alcoholism

may cause a chronic drunkard to take a dislike for alcohol for a time and gradually by repeated treatment enable him to be an abstainer. Effects.

When the patient falls into the condition of hypnotic sleep, the body generally, becomes relaxed, the head falls either backwards, or to the side, or forwards, the face becomes slightly paler; the pupils are of a moderate size. He appears in a deep sleep. The mind however is sensible to some external impressions, the patient implicitly obeys the commands of the operator he will if told open his mouth or eyes, will answer questions will touch with his finger any substance within his reach that he is ordered to, and if told it is very hot (although it is quite cold) will draw his hand suddenly away as if burnt. He will perform any actions suggested to him such as fishing, boxing, kite flying &c. He will also stiffen himself out if ordered.

minor operations can be easily and painlessly performed.

Before awakening the patient one should impress on him that when he awakes he will feel quite warm, and comfortable and will remember nothing of a painful nature.

To awake him all that is necessary is to say sharply "Awake" some times as well simply blowing on the face. He then starts up, rubs his eyes and returns to his natural state. Sometimes he is able to recall the part or whole of what has occurred as one remembers a dream; generally it is a perfect blank. I have heard of one or two unfortunate occurrences taking place when it has been practised by ignorant people; but have never seen anything of an alarming character occur in any of my experiments.

Case Female aged 24 of medium height and size, dark hair pale complexion operation removal of two upper molar teeth. She sat in the dental chair and I induced hypnotic sleep (after gaining her consent) by placing my hand on her forehead and suggesting she should go fast asleep. Her head fell back and her body was relaxed, generally. I then suggested she should open her mouth widely, which she did. I then told the dentist he might operate he drew out one tooth, and finding no movement indicative of pain drew out the other one she remained perfectly still with her mouth open. I then told her to shut her mouth which she did, and then to awake and spit out the blood she did this and then asked "Have you pulled them both out"? She said she had felt no pain and did not know where they were pulled out.

a few months after this the same patient returned to have

another tooth extracted; I hypnotised her again and the same dentist extracted the tooth painlessly as before; she had felt no ill effect after the previous time.

In conclusion I will say that I have given as faithfully as I can the experience that I have had in my practice of Anaesthetics.

(d = and.)

Sydney W. Haynes.

The End