ETHYL CHLORIDE

AS A GENERAL ANAESTHETIC.

Thesis for the Degree of M.D., (Edin.)

By

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Ethyl Chloride is used both as a local and as a general anaesthetic. In this paper it is intended to consider it in its uses as a general anaesthetic. It is proposed to discuss it under the following headings:--

1. Chemistry,
2. History as a general anaesthetic.
3. Physiology.
4. Conclusion arrived at by the writer from the published literature and from his own personal experience.

I have to thank the writers, whose works I have largely availed myself of. In particular my obligations are due to Drs Parker and MacCardie, to the former for his advice and help in the first few cases I anaesthetised, and to the latter for his aid in obtaining the latest literature on the subject.

1. Chemistry:

Ethylchloride was first obtained in the 15th century by Basil Valentine, a Benedictine Friar, who describes its preparation thus: "This, I also say, that when the spirit of common salt unites with the spirit of wine and is distilled three times it becomes sweet and loses its sharpness."

In 1648 Glauber speaks of it in describing strong hydrochloric acid.

In 1739 Pott showed it could be got by the action of spirit of wine on butter of arsenic or antimony. In 1767 Woulfe got what he called hydrochloric ether by the aid of muriatic acid on wine. The true properties of ethyl chloride were first pointed out by Colin and Robriquet.

It is prepared by passing hydrochloric acid gas over a boiling solution of spirit of wine, to which zinc chloride has been added; the gas is completely absorbed and when the liquid has become saturated ethyl chloride is evolved, the action going on till the whole of the alcohol has been converted.

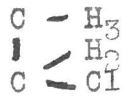
It is purified by distillation, liquefaction, and second distillation, finally being frozen.

The action may be expressed thus:--

$C_2H_5OH + HCl. = C_2H_5Cl. + H_2O$

Ethyl/

Ethyl Chloride may be described as a colourless, mobile liquid, having a peculiar and pleasant odour and a sweetish, burning taste. Its chemical formula is C_2H_5Cl. or written constitutionally:



It does not solidify at -29°C., it boils at 12.5° (Reynault). At 0° it possesses a specific gravity of 0.9214. Its vapour density is 2.219 (Thenard). It is but slightly soluble in water, though dissolving readily in alcohol, strong spirit taking up half its weight. It is easily combustible, burning with a luminous green-mantled flame.

For purposes of anaesthesia the drug is stored in graduated glass tubes, holding 50 cc., having a capillary outlet at one end, which is closed by a stopper, working on a spring.

Through the capillary opening a fine jet of the liquid is forced by the increased pressure in the tube caused by the warmth of the hand. An extreme degree of cold is produced by the evaporation of this fine spray.

2. History as a General Anaesthetic:

In June 1895 Carlson, a dentist of Gothenburg, was using ethyl chloride as a spray to produce local anaesthesia for a tooth extraction, when to his surprise/

prise complete anaesthesia supervened. This occurred in two cases, the patients stating they felt nothing.

In February 1896 Thiesing, a dentist of Hildesheim, published similar results to Carlson. He made preliminary experiments in animals and then used it for man.

Following on this Professor von Hacker instituted an enquiry into the subject at his clinic at Innsbrück.

Dr Ludwig published the results of the first 66 narcoses, but the subject was more deeply investigated by Dr G. Lotheissen in the same clinic. He published his paper on the subject in 1898. In 1899 Dr J. Weissner, an Army Surgeon at Innsbrück, published the results of 400 cases. In 1900 Fritz König of Berne wrote a thesis on the subject, describing also physiological experiments. Ruegg of Basle and Polosson of Lyons also investigated the subject.

In England the first to draw attention to ethyl-chloride as a general anaesthetic was Dr W. J. MacCardie, who translated Dr Lotheissen's two papers, which appeared in the Birmingham Medical Review of January and December 1900. He also cited the results of his own cases in the Lancet of July 20th and March 9th, 1901.

As/

As Lotheissen was the first to really investigate the subject, I propose to give a short resume of his work.

Lotheissen's Work:

His first paper gives his experiences in 130 cases: his conclusions agree in the main with subsequent observers. His second paper is entitled "Risks of Ethyl Chloride Narcosis."

Lotheissen first administered the drug by the sprinkling method with an Esmarc's Mask. The first case was that of a young girl who had a whitlow - the slightest movement of her finger causing great pain.

He describes the case thus, "We were surprised that after one minute without a vestige of preceding excitation, full anaesthesia had set in, and the operation could be carried out without delay. Hardly had the mask been removed when the patient opened her eyes and after a few seconds was quite herself and would not believe that the operation had already been finished."

Lotheissen next used Juillard's ether mask, but gave this up later for Breuer's mask, which will be described later.

He considers the patient should be prepared as for any other general anaesthetic, though as the reflexes/

flexes are not lost, vomiting is not such a dangerous sequel as with other anaesthetics.

Anaesthesia was rapidly induced, the patient usually being ready in from 1 to 1½ minutes. The stage of excitation was either absent or slight in most cases. In only about 13 per cent. of the 130 cases was any excitation worthy of mention recorded.

When narcosis had occurred there was complete analgesia, although the corneal and pupillary reflexes were fully preserved. The pulse and respiration were noted in all cases, the pulse usually becoming rather slower; the respirations on the other hand were increased. Cyanosis was only seen in three cases. Vomiting occurred in 18 cases.

Awakening is very rapid, usually in about one to two minutes. In most cases the operations were of a minor character, lasting from 5 to 10 minutes, usually - the longest being 25 minutes.

Muscular relaxation being absent, it was unsuitable for cases where muscular rigidity was inconvenient. The urine was always tested before and after operation; in no case was albumen found subsequently: in cases where there was albumin before the administration of the drug, there was no increase.

The ages of the patients varied from 1½ to 72.

Lotheissen in his second paper enters into the subject of the risks of ethyl chloride narcosis. these/

these I propose to take up later. In this paper he records 850 cases, including many major operations, such as gastrostomies, colostomies, radical operations for hernia, breast amputations, amputations of extremities, resection of ribs and also reductions of fractures and dislocations.

It may be well here to briefly mention the experiences of other observers.

Dr Wiessner in a paper describing his experiences in 400 cases, recommends ethyl chloride in cases of poor circulation, fatty degeneration of the heart, pulmonary disease, and shock resulting from injury or loss of blood, where the use of ether and chloroform seem inadvisable. He has used it in major operations successfully. He thinks there is great scope for its use in field hospitals.

Dr Ware of New York says it is seen at its best in children. He records 5 per cent of failures due he thinks, in the first place, to a prolonged period of excitation and secondly to muscular rigidity. Muscular rigidity is not seen in children.

Dr Polosson read a paper at Lyons in 1900 giving his experiences in 200 cases.

P. Gires has used it extensively as a general anaesthetic for teeth extraction; he gives the period/

period of available anaesthesia after the removal of the mask as 25 seconds to 2 minutes. He recommends that the patient be fasting and in the recumbent position, but does not insist upon this.

Dr MacCardie of Birmingham has had considerable experience of the drug and speaks very highly of it. He has collected statistics of 626 English cases.

Dr Marshall of Liverpool records 46 cases, mostly for teeth extraction; only two cases were failures. He considers there is less haemorrhage when ethyl chloride is used, probably due to its local effect. In his cases the upright position in the dental chair was always used and most of the cases had no preliminary preparation for an anaesthetic.

Dr Rose of Bristol records 100 cases, chiefly for operations about the mouth and throat. He has had no dangerous sequelae.

Dr Parker of Wolverhampton records 130 cases with, at the start, a few failures; but in cases in which in the light of later experience, he would not give the drug.

Dr Mackie of Nottingham has used it in intranasal surgery with most excellent results. He records 48 cases. In no case has he had any anxiety or seen any dangerous symptom. He states that with one application of the mask, anaesthesia lasts from

two/

two to three minutes. He also states the advantage of being able to use the upright position, and the small amount of haemorrhage due to the anaemia produced by the drug, the anaemia however, soon passes off and violent haemorrhage may ensue.

Dr Fromaget states, in the Presse Medicale, that more than 100 patients have been operated on by him under this anaesthetic, chiefly ophthalmic cases.

Dr Matthes has reported on some cases from Professor Rosthorn's clinic, and is of opinion that ethyl chloride may be recommended for minor gynaecological operations.

Dr Rohn has used it extensively in Professor Pick's dermatological clinic at Prague.

Ethyl chloride has been used frequently as an antecedent to ether and chloroform, more particularly the former.

Dr Tuttle of New York has written a paper on ethyl chloride as a preliminary to ether in the New York Medical Record, where he records its use in 50 cases. He says the time occupied has been less than that required with nitrous oxide as an antecedent to ether. He has had no accidents and no alarming symptoms. He states that the amount of ether required subsequently is lessened.

Ethyl chloride has also been used as an antecedent/

ent to chloroform, but hardly seems called for, as chloroform narcosis is not unpleasant in its earlier stages, like that of ether.

3. Physiology:

First of all the physiological effects on animals will be considered, and secondly the physiological effects on man.

(a) Physiological Effects on Animals:

In 1867 Richardson anaesthetised a rabbit with the vapour of ethyl chloride, obtained from a solution of it in ether, and found when the rabbit died distension of the right side of the heart and engorgement of the lungs.

In 1879 the Glasgow Committee of Anaesthetics showed that in rabbits ethyl chloride produced rapid general anaesthesia; in one case the rabbit became asphyxiated, and in the other general convulsions ensued.

In 1892 Wood and Cerna of Pennsylvania said that in dogs there was marked lessening of the pulse rate and lowering of arterial blood pressure, with increased frequency and depth of respiration.

Later experiments did not accord with these, and observations in man showed that there was no question of lowering of blood pressure, but that the pulse/

pulse actually becomes fuller.

In 1897 Schleich made experiments, but as the animal was put in a glass jar with no valves and then anaesthetised, the experiments were useless from a practical point of view.

In 1898 Ruegg of Basle made experiments on rabbits, the ethyl chloride being led through a canula directly into the trachea.

Then if the drug was inhaled without the admixture of air, i.e. as a concentrated vapour, spasmodic breathing occurred; at the same time the main blood pressure was considerably increased with a slower pulse rate; in other words there was a vagus stimulation. Then again, the blood pressure gradually fell if the action of the concentrated vapour ceased.

An animal was killed by a narcosis of 35 minutes, to which concentrated vapour was administered towards the end. Another animal was narcotised for 25 minutes without harm. With a concentrated vapour muscle spasm and opisthotonos occurred.

Ruegg concludes thus:--

1. If after muscular spasm and widening of the pupil (the threatening forerunners of medullary paralysis) the inhalation be at once stopped, the animal always promptly awakes and comes round.

2. The/

2. The blood pressure curve during the inhalation of the diluted vapour, indicates vascular widening, while that taken during in-breathing of the concentrated vapour, indicates increased heart action or vascular narrowing.

3. Opisthotonos is sometimes observed. In animals a superficial narcosis can be sustained for some time without harm if a sufficiently diluted vapour be used.

A concentrated vapour kills by asphyxia in a short time.

Lastly Ruegg showed that there is in the early stages widening, and later on narrowing of the blood vessels of the brain.

In 1899 Kemp in America observed in animals stertor and dyspnoea, tremors and spasmodic contractions of the leg muscles.

In 1899 Fritz König of Berne made experiments on rabbits and monkeys. The blood pressure in the carotid artery was recorded by Ludwig's Kymograph and the vagi were exposed in the neck for section or stimulation as required. In rabbits he found the administration of ethyl chloride caused tonic spasms in the muscles of the limbs, salivation, nystagmus and exophthalmos; the respirations were increased and frequently became spasmodic in type.

Monkeys/

Monkeys, on the other hand, took the anaesthetic well, the above phenomena being absent. When diluted vapour was used the blood pressure was maintained. In a few cases there was some lowering of blood pressure, probably resulting from some vagus stimulation of central origin, as shown by the fact that when both vagi were divided in the neck, the blood pressure remained high till the end of the experiments.

If the vapour were too much concentrated, a fatal lowering of blood pressure resulted, with paralysis of respiration, this latter condition only occurred in rabbits, whilst monkeys were unaffected, thus they appear to have greater powers of resistance.

In 1900 Lebet of Berne found that on injecting a saturated solution of ethyl chloride in blood serum into the jugular vein of a rabbit, the blood pressure was raised. A second injection caused a fall and after a third injection the pulse became very irregular.

(b) Physiological Effects on Man:

The effects of the drug on man seem to follow the above experiments very closely. Dangerous symptoms were not so readily produced in monkeys as in other animals, and they seem to occur still less frequently in man.

1. Respiratory System.

Respirations are in most cases deep and considerable quicker. There is as a rule no cough, cyanosis or stertor. A few cases of stertor have occurred. Several cases of asphyxia have been noted by different administrators.

Seitz of Constance reports three cases which may be briefly alluded to.

In one case ether narcosis was tried and as after 35 C.C. had been used in a quarter of an hour without anaesthesia being produced, ethyl chloride was poured on. After an inhalation of half a minute and 3 C.C. of Ethyl Chloride had been used, asphyxia occurred, which was relieved in two minutes by artificial respiration.

In this case, it seems probable that the asphyxia was due to a cumulative action. Seitz reports two other cases, one after 3 c.c. of ethyl chloride had been used, and the other, after awaking from a narcosis of 15 minutes, in which 6 c.c. of ethyl chloride had been used.

Both cases were soon relieved by the induction of artificial respiration.

Two cases of asphyxia are mentioned by Drs Respinger and Ruegg of Basle - these again seemed to/

to be due to a too concentrated vapour.

Dr Martin Ware reports a case of asphyxia in a girl afflicted with extensive adenoids, who was being operated on for cellulitis. The symptoms passed off and the use of the drug was continued and administered again on a subsequent occasion, when more incisions were required.

Ethyl Chloride seems to have no irritating effect on the lungs, either, when in a healthy, or, in a pathological condition.

I have personally used it and seen it used in patients suffering from phthisis, bronchitis and empyema.

Several of the empyema patients were exceedingly ill, having marked dyspnoea with displacement of the heart due to the effusion.

They were cases in which one hesitated to give chloroform, but they took ethyl chloride extremely well.

2. Circulatory System.

As a rule from nervousness there is at first an increase in the rate of the pulse, but when the drug has had time to act, there is usually a distinct slowing of the pulse, in a few cases it becomes extremely slow.

There/

There is little or no alteration in volume and tension.

Cases of cardiac syncope have occurred and these may be briefly noted. Seitz reports the case of a weakly, anaemic man, who since his 14th year had fainted at any excitement.

He, after an otherwise uneventful narcosis, observed syncope, which was not relieved by artificial respiration, but recovered after complete inversion and subsequent artificial respiration.

Seitz thinks it a sign in favour of ethyl chloride that the patient came round after,he says, "the heart had ceased beating for fully three minutes."

Dr Lotheissen reports a fatal case of syncope at Innsbrück. The patient was a day labourer aged 41, who had for several years suffered from an ulcer of the leg, for which it was proposed to do a plastic operation.

Narcosis had laster three minutes, when the blood became very dark. The patient, who was a very strongly built man and a heavy drinker, had a minute before shown violent excitation.

Corneal and pupillary reflexes were absent when cyanosis appeared. The mask was at once removed.

At/

At the same time there were severe spasmodic muscular contractions of the jaws and limbs. The patient, as a result, only breathed by starts; his pulse was still distinctly palpable although it could not be counted because of the muscular tension.

All at once the pulse stopped, artificial respiration was begun; this was kept up for more than an hour, while subcutaneous injections of camphorated oil were given and galvanisation of the phrenic nerves tried, all to no avail.

The time from the commencement of the narcosis till the fatal event was about three minutes, about 10 c.c. of ethyl chloride having been sprayed on the mask, but not nearly all had been used.

Post mortem there was found hypertrophy of the heart with fatty degeneration of the muscle, marked sclerosis of the coronary arteries, and in less degree the same in the aorta.

In the heart and large veins, the blood was bright red and fluid, no clots being present. There were no ecchymoses on either the pleura or the pericardium; the lungs were oedematous.

It is hard, in this case, to say exactly what was the cause of death.

Was/

Was it due to an overdose of ethyl chloride acting on a weak heart? Or was it due to syncope in a diseased and badly nourished heart following on the violent struggling which had taken place?

It seems more probable that the latter explanation is the correct one.

J. Spengler from Professor Kocher's clinic mentions the death of a man, 27 years old, who died after an operation performed under ethyl chloride.

No further information being obtainable, we can hardly consider this as a death under ethyl chloride.

MacCardie reports a death from cardiac syncope occurring 1¼ hours after a seven minutes operation under ethyl chloride.

The patient had, however, recovered rapidly from the anaesthetic and was the subject of numerous internal morbid conditions so that there is no reason at all to attribute death to the anaesthetic. MacCardie also reports a case of faintness following ethyl chloride narcosis.

I have had among my own cases one of faintness following the administration of this drug. The patient was a young woman of 25 who had a painful whitlow. She had had no sleep for two nights previously/

viously and was feeling weak and rather faint before the anaesthetic was administered. For about an hour after coming round from the anaesthetic when she attempted to sit up, she felt faint, but at the end of that time she was able to walk upstairs to her bedroom.

Considering the previous history of the case, the subsequent faintness can hardly be put down to the effect of the drug entirely.

The drug has been administered to many patients with heart affections of varying character with excellent results.

3. Alimentary System.

As a rule, if the narcosis lasts only a few minutes, there is no vomiting, even though the patient has had a good meal a short time before anaesthesia, but if the operation be of longer duration, vomiting is fairly frequent.

As a rule vomiting stops as soon as the patients are round from the anaesthesia. MacCardie reports a case of vomiting for 36 hours, but exactly the same happened when chloroform was administered a few months later. One of my patients kept on vomiting for 6 hours after operation.

4. Vaso-Motor System.

The face almost immediately becomes flushed from dilatation of the capillaries, accompanying this are slight dilatation of the pupils and fall of blood pressure.

This would appear as if there were some early selective action on the sympathetic nerve.

5. Corneal and Pupillary Reflexes.

There is early loss of the lid reflex, but as a rule the corneal reflex is not lost at all.

In some children there is complete loss of corneal reflex, while in others it is transient.

The pupil usually dilates a little at first, but soon becomes contracted and remains so.

6. Muscular Relaxation.

Is rarely obtained except in children and people debilitated by disease. Struggling may occur even though there be complete analgesia.

Opisthotonos has occasionally occurred. Two cases are reported by Respinger and one each by Seitz, Marshall and Parker.

All these cases were alcoholics; Marshall's case was under the influence of alcohol at the time of the administration.

In/

In alcoholic cases Lotheissen gives hypodermic injections of heroin with marked success.

7. Psychical Effects.

There is not more struggling with this drug than with other anaesthetics and the duration of the struggling is certainly shorter.

But Ethyl chloride seems to be as great an offender on the moralsense as either Nitrous oxide or ether.

Marshall was accused twice in his 49 cases of indecent assault.

Two of my cases suffered from delusions, a man, aged 20, who was to have had his feet wrenched, got up off the table and became very abusive and said "he would not have that said of him", no one in the room had been speaking.

He refused to have any more anaesthetic, the delusion lasting for a few minutes.

The patient comes round from the anaesthetic with extraordinary rapidity; within from one to three minutes after the mask has been removed he can answer questions, however long the narcosis may have been.

Many cases go to sleep after the mask has been removed and remain so until roused.

The Mortality.

There appears to have been only the one authentic death recorded by Lotheissen.

Up to about September of 1901, 4,130 cases had been recorded on the Continent and in America; there must have been many since.

Dr MacCardie has collected statistics of 626 English cases, with no serious incident in narcosis, except the case with prolonged vomiting, referred to previously.

The large proportion of operations were in Minor Surgery and of short duration, therefore there is hardly enough data at present to compare the case mortality with that of other anaesthetics.

4. Personal Experience.

I propose now to give a resumé of my own personal experience in the administration of the drug in 121 cases.

In 80 cases ethyl chloride was the only anaesthetic given.

In 38 cases it was given as a preliminary to ether, and in 3 cases as a preliminary to chloroform. The ages of the patients varied from 15 months to 64 years and the operations performed were almost equally varied in character.

I/

I commenced by using Breuer's mask which is a modification of Clover's ether inhaler.

It consists of a rubber face-piece, enclosing an air chamber, which has an inlet and outlet, guarded respectively by spring valves. Over the inlet is fixed a hollow metal globe. There is an opening in the globe through which the ethyl chloride is sprayed.

It is well to have inside the globe a piece of gauze to facillitate the spraying process. To introduce this piece of gauze the globe is made in two hemispheres, the one fitting tightly inside the other.

Latterly, in children, I have used an arrangement suggested by Dr Codd, consisting of a Barth's Nitrous oxide valve apparatus, to one end of which is attached the metal globe of a Breuer's inhaler, and to the other end, an ordinary celluloid face piece.

With this apparatus which is very simple and easy to clean, one can use any size of face piece. For the cases in which I used ethyl chloride as an antecedent to other, I used Barth's nitrous oxide valve apparatus with the Breuer's globe attached, fitting these on to the Clover's inhaler.

When/

When giving ethyl chloride alone, the mask is placed over the patient's mouth and nose so that no air can get in except through the valve. Then about 2 c.c. of ethyl chloride are sprayed into the globe and more added as required - about 5 or 6 c.c. are required to produce anaesthesia which occurs in from 1½ to 2½ minutes.

Most patients when anaesthetised required from 1 to 1.5 c.c. per minute to keep them in that condition.

When giving ethyl chloride as an antecedent to ether, ethyl chloride was given alone for about one minute, the patients being nearly narcotised, then the ether was gradually turned on in the usual way - thus a combination of ethyl chloride and ether was given until the indicator pointed to either "3" or "Full" ether being given, when the ethyl chloride apparatus was removed and the ether bag put in its place.

I found this method satisfactory in every way and consider ethyl chloride a much better antecedent to ether than nitrous oxide.

The patients never became cyanosed, as sometimes happens with nitrous oxide and ether; struggling was less frequent, in fact there were only four cases of struggling of any severity.

Dr/

Dr Tuttle considers that less ether is used but I cannot say that I found that to be the case.

The patients were deeply anaesthetised in from 3 to 5 minutes.

As an antecedent to chloroform, ethyl chloride seems hardly called for as chloroform when administered properly is not an unpleasant drug to inhale. Vomiting is recorded in 17 cases, though occasionally inconvenient, it is of short duration.

There were two absolute failures, the one a nervous young girl who struggled very much and the other a young man who had delusions and got up off the table.

The longest anaesthesia was 69 minutes.

Struggling was noted on 10 occasions. They were either alcoholic or very nervous patients.

But there were many manifestly alcoholic patients who took the drug very well.

In no case did any alarming symptoms develop. For children, the anaesthetic seems peculiarly suited.

To sum up, I think ethyl chloride may take a prominent place among anaesthetics on the following grounds:-

1. Its portability and comparative cheapness as compared to nitrous oxide.

2. The rapid induction and elimination of anaesthesia.

3. The absence of any depressing effect on the heart.

4. The absence of any irritating effect on the lungs or kidneys.

5. The absence of sequelae.

6. Most important, its apparent safety when given with care.

The drug is contra-indicated in most major operations, and operations requiring absolute muscular relaxation.

I have always used the drug supplied by the Société Chemique des Usines du Rhone and registered by them as Kélène. It is stated to be a pure preparation of ethyl chloride.

The following is a list in more detail of my cases in which ethyl chloride was the sole anaesthetic.

Age	Sex	Disease or Operation	Time to produce anaesthesia	Amount used.	Duration of Anaesthesia	General Condition of patient.	Remarks.
3½	M.	Cervical Abscess.	1 minute.	8 c.c.	5 minutes	Full stomach.	Vomited his previous meal.
2 9/12	M.	Circumcision.	1½ "	15 c.c.	10 "	Good	Good anaesthesia.
9	F.	Cellulitis of Leg.	1½ "	16 c.c.	8 "	"	" "
9	F.	Dressing Leg.	1½ "	14 c.c.	12 "	"	" "
51	F.	Cellulitis of Leg.	2 "	11 c.c.	6 "	"	" "
12	F.	Periostitis of Arm.	2 "	12 c.c.	5 "	Nervous.	Struggled a good deal at first.
48	M.	Cellulitis of Hand.	2½ "	30 c.c.	13 "	Alcoholic.	Struggled at times.
13	M.	Feet Wrenched.	1 "	5 c.c.	5 "	Good.	Good anaesthesia.
5	F.	Skin Grafting.	1½ "	14 c.c.	16 "	"	" "
17	F.	Suppurating Bursa Patella.	1 "	8 c.c.	9 "	"	" "
3	M.	Sounding Bladder.	1½ "	8 c.c.	5 "	"	" "
6	F.	Incisions in Leg.	2 "	5 c.c.	5 "	"	The same patient had to be reanaesthetised.
6	F.	" " "	1 "	6 c.c.	10 "	"	
3	M.	Skin grafting.	3 "	9 c.c.	8 "	"	Mask very large for the face.
30	F.	Suppurating Bursa Patella.	4 "	30 c.c.	11 "	Very nervous.	Struggled at first.
17	F.	Incisions in Arm.	2½ "	7 c.c.	5 "	Nervous.	Good anaesthesia.

Age	Sex	Disease or Operation	Time to produce anaesthesia	Amount used.	Duration of Anaesthesia	General Condition of patient.	Remarks.
1 7/12	M.	Cervical abscess.	¾ minute.	3 c.c.	10 minutes.	Good.	Good anaesthesia.
14.	M.	Abscess of Leg.	2 "	15 c.c.	12 "	Nervous.	Vomited.
21	F.	Teeth Extraction.	2 "	5 c.c.	3 "	Good.	Anaesthesia 1½ minutes after removal of mask.
20	F.	Incisions in hand.	1 "	5 c.c.	3 "	"	Good anaesthesia.
13	F.	Popliteal Abscess.	3 "	24 c.c.	16 "	Nervous.	Readministered.
13	F.	To put leg on splint.	1 "	10 c.c.	6 "	"	
21	M.	Lupus.	2 "	7 c.c.	2½ "	Good.	Good anaesthesia.
21	F.	Adenoids.	2 "	10 c.c.	1½ "	Naso-pharynx stuffed up.	Vomited blood after.
6	F.	Cervical Abscess.	2 "	5 c.c.	4½ "	Full stomach.	Vomited food.
5	M.	Cervical Abscess	1½ "	7 c.c.	7 "	Good	Vomited.
3	M.	Meatotomy.	1 "	11 c.c.	14 "	"	Good Anaesthesia.
16	F.	Exploration of Wrist.	2 "	35 c.c.	33 "	"	Vomited after.
43	F.	Tenotomy.	2 "	12 c.c.	12 "	Nervous.	Struggled.
10	M.	Examination of Bladder.	1½ "	14 c.c.	12 "	Full stomach.	Vomited.
23	F.	Mammary Abscess.	3 "	10 c.c.	9 "	Good.	Good anaesthesia.
9	F.	Scraping ulcers.	2 "	7 c.c.	9 "	"	" "
2	F.	Skin grafting.	1½ "	9 c.c.	11 "	"	" "
15	F.	Excision of Joint.	3 "	25 c.c.	28 "	Nervous	Vomited twice.
18	F.	Dressing Ear.	3 "	10 c.c.	5 "	Very Nervous	Vomited & came round.

Age	Sex	Disease or Operation.	Time to produce anaesthesia	Amount used.	Duration of Anaesthesia.	General Condition of patient.	Remarks.
5	M.	Popliteal Abscess.	2 minutes.	15 c.c.	13 minutes.	Good.	Good anaesthesia.
44	F.	Lipoma of Back.	3 "	25 c.c.	18 "	Nervous	The position was awkward.
4½	M.	Abscess.	½ "	5 c.c.	3 "	Good.	Good anaesthesia
17.	F.	Bullet in thigh.	2 "	8 c.c.	5 "	"	" "
11.	F.	Wrenching elbow.	2 "	7 c.c.	4 "	Nervous	Shouted, but anaesthetic.
4.	F.	Submaxillary abscess.	1½ "	6 c.c.	5 "	Good	Good anaesthesia.
4.	M.	"Setting" fracture.	1½ "	10 c.c.	5 "	"	" "
5.	M.	Inguinal abscess.	1½ "	5 c.c.	4	"	Vomited.
5.	M.	Abscess of Leg.	2 "	8 c.c.	5 "	"	Good anaesthesia.
23.	M.	Abscess of Leg.	2 "	10 c.c.	8 "	Waxy disease of kidney.	" "
5.	M.	Adenoids	3 "	7 c.c.	1½ "	Good.	" "
2.	M.	Tenotomy.	1 "	5 c.c.	6 "	"	" "
23.	F.	Bursa Patella.	3 "	16 c.c.	12 "	Very nervous	" "
4.	M.	Tubercular abscess.	2 "	10 c.c.	8 "	Good.	" "
6.	M.	Septic Arthritis of knee.	3 "	30 c.c.	31 "		Struggled at first. Vomited.
2.	F.	Skin grafting.	1 "	6 c.c.	6 "	Good.	Good anaesthesia.
3.	M.	Dressing knee.	3 "	12 c.c.	13 "	"	" "
4.	M.	Abscess.	3 "	10 c.c.	6 "	"	Struggled a little.

Age	Sex	Disease or Operation.	Time. to produce anaesthesia.	Amount used	Duration of anaesthesia.	General Condition of patient.	Remarks.
25	F.	Whitlow.	3 minutes	10 c.c.	10 minutes.	Nervous and weak.	Felt faint for one hour after.
3 3/12	M.	Prolapse of Rectum.	3 "	35 c.c.	38 "	Some food in stomach.	Vomited twice.
20.	M.	Wrenching feet.		3 c.c.		Good.	Got up with delusions.
17.	M.	Tenotomy.	2½ "	18 c.c.	14 "	"	Struggled a little.
3 3/12	M.	Removal of Stitches.	3 "	19 c.c.	17 "	"	Good anaesthesia.
9	F.	Adenoids	1½ "	6 c.c.	2 "	"	Vomited blood.
3½	M.	Cervical Abscess.	1 "	10 c.c.	11 "	Bronchitis & Measles.	Did not affect the lung condition.
26.	F.	Sub-phrenic abscess.	2½ "	53 c.c.	47 "	Nervous, Very ill.	Good anaesthesia.
44.	F.	Wrenching fingers.	2 "	10 c.c.	4 "	Alcoholic.	Shouted after.
54.	F.	Tumour of finger.	2 "	15 c.c.	12 "	Chronic Bronchitis	Did not affect the lung condition.
32	F.	Multiple abscesses	3 "	32 c.c.	28 "	Nervous.	Came round at times.
1 3/12	M.	Cervical abscess.	½ "	7 c.c.	3 "	Good.	Vomited.
40.	F.	Cellulitis.	1 "	15 c.c.	8 "	Alcoholic.	Good. Shouted going under.
3.	M.	"Setting" Fracture.	1 "	25 c.c.	20 "	Full stomach.	Vomited.
3.	M.	Abscess.	½ "	6 c.c.	9 "	Good.	Good anaesthesia.
4.	M.	Epispadias.	1½ "	58 c.c.	69 "	Full stomach.	Vomited, Good anaesthesia.
5.	M.	Adenoids.	1½ "	5 c.c.	1 "	Naso-pharynx choked up.	Came round just before operation completed.

Age	Sex	Disease or Operation.	Time to produce anaesthesia.	Amount used	Duration of Anaesthesia.	General Condition of patient.	Remarks.
14	F.	Adenoids.	2 minutes	8 c.c.	1½ minutes.	Good.	Good anaesthesia.
8	F.	Tonsils and Adenoids.	½ "	5 c.c.	2 "	"	" "
13.	M.	Adenoids.	2 "	7 c.c.	2 "	Very choked up.	" "
6.	F.	Empyema, Peritonitis.	1 "	15 c.c.	22 "	Very ill & weak	" "
10.	F.	Spinal Caries		6 c.c.		Very nervous.	Struggled too much
1 6/12	F.	Tubercular ankle.	1½ "	16 c.c.	13 "	Good.	Good anaesthesia.
20.	F.	Mammary abscess.	1½ "	22 c.c.	17 "	Very weak & anaemic.	" "
14.	F.	Whitlow.	1½ "	20 c.c.	16 "	Good.	" "
4.	M.	Cleansing Wounds.	1 "	8 c.c.	12	Very collapsed.	Vomited twice.
16	F.	Abscess of Jaw.	1½ "	16 c.c.	15 "	Good.	Good anaesthesia.

BIBLIOGRAPHY.

Carlson ..... Correspondenzbl. f. Zahnärzte Anfang. 1895.

Theising ..... Deutsche Monatsschr. f. Zahnheilkunde, April 1896.

Roscoe & Schorelemmer Treatise on Chemistry.

Ludwig ..... Beitrage zur Klin. Chirurgie 1898.

Lotheissen ..... (a) Archiv. f. Klin.Chirurgie 1898.
(b) Münch. Med. Wochenschr. 1900.

Wiessner ..... Wiener Medic. Wochenschr. 1899.

MacCardie ..... (a) Birmingham Medical Review January and December 1900.
(b) Lancet, May 9th, July 20th 1901.

Spengler ..... Deutsche Zeitschrift f. Chirurgie 1896.

Tuttle ..... New York Medical Record, February, 1901.

Gires ..... Revue de Stomatologie, January 1900.

Fromaget ..... Presse Medicale, June 1901.

Mackie ..... (a) British Medical Journal, September 1901.
(b) Journal of Laryngol., Rhinol. and Otol., October 1901.

Richardson ..... Medical Times, December 1867.

Wood & Cerna ..... Dental Cosmos, July 1902.

Ruegg ..... Zahnärzte Runschau, Berlin, 1898.

König ..... "Uber Aethylchlorid Narcose". Berne 1900.

Lebet ..... "Sur les effets physiologiques du Chlorine d'ethyle", Berne 1901.

Ware ..... (a) New York Medical News, August 1901.
(b) New York Medical Record, April 1901.

Seitz ..... (a) Zahnhärtze Rundschau, October 1899.
(b) Deutsch. Zahnärtze Wochenschrift, 1900.

Vogué ..... Archiv. de Stomatologie et Journal de l'Anesthesie, Sept. 1900.

Hewitt ..... "Anaesthetics and their Administration".

Parker ..... St. Bart's Hospital Journal, November 1901.

Marshall ..... Liverpool Med. Chir. Journal, Sept. 1901.

Rose ..... Bristol Med. Chir. Journal, March 1902.

Matthes ..... Prager Medinische Wochenschr. 1899.

Schleich ..... "Schmerzlose Operationen", 1897.

Kemp ..... New York Medical Journal, December 1899.