Researches

ON

THE TETRACHLORIDE OF CARBON AS AN ANÆSTHETIC.

BY

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SOME short time ago, Mr. Fisher, a manufacturing chemist at Trowbridge, to whom I am not personally known, was kind enough to forward to me a liberal supply of a fluid, which he called tetrachloride of carbon, requesting me to experiment with it, in the expectation of finding it a substance which might supersede the use of chloroform. This I at once did sufficiently to enable me to form an opinion of its value; and gave the result in a lecture to my clinical class last week. These experiments I had intended to carry somewhat further, and illustrate with observations, founded on some hundreds of experiments, made with nearly fifty different substances almost twenty years ago, and which then appeared as an essay, in the volume of *Transactions* of our Association for 1849. (Amongst the substances I then tried was a liquid, called by the manufacturer chloride of carbon.) As, however, I perceive observations have appeared upon the effects of this new liquid, which is called the tetrachloride of carbon, in which the liquid is being recommended as a safe and effectual anæsthetic, I think it proper, as my experiments upon it lead to a different opinion of its value from what other experimenters have arrived at, at once to publish them, as in my hands it has proved anything but an effectual or a safe anæsthetic.

I would mention that, unless the tetrachloride have been supplied by the same maker, it is likely that the fluids, though having the same name and possessing the same general characters, may not be chemically the same; for I believe the exact composition of the several compounds of chlorine and carbon is not only not well ascertained, but the stability of them not fully determined. Nineteen years ago, I was desirous of trying the action of the chlorine and carbon compounds, and found reason to think, not only that those supplied by different makers under the same name were not precisely the same fluids, but that chemical writers were not agreed as to the number of atoms in each compound. That which I then used as the chloride of carbon, or protochloride, I found to be a safe and pleasant anæsthetic, but in no respect superior to chloroform, and not equal to the chloride of olefant gas (Dutch liquid), or the bromide of ethyl. I had some reason for suspecting that one person supplied me with a fluid under this name, which was an admixture of chloroform with a little alcohol.

Dr. Snow also experimented on a fluid which he called the bichloride of carbon, a term then not to be found in Turner's or Fownes' *Chemistry*. In the former work, the dichloride of carbon is spoken of as a crystalline fibrous substance, and, therefore, not applicable as an anæsthetic from its non-volatility, even supposing its chemical composition be otherwise satisfactory, which is possible. The conclusion

to which I came on this chloride of carbon was: "The chloride is a safe, and not unpleasant, anæsthetic; in action not dissimilar to chloroform or the chloride of olefant gas; but not, I think, quite so powerful as either of these. Should it be found to answer, it will be valuable, as being the cheapest of all fluids which have yet been proposed—at least, such as are likely to be used." (*Transactions of Provincial Medical and Surgical Association for 1849.*)

This tetrachloride is now said to be the bichloride of former days, and to be composed Cl^4C^1 . Mr. Fisher gives me the specific gravity as 1.61, with a boiling point of 171° ; which does not quite correspond with Fownes. Its vapour is very heavy. The fluid is not very inflammable; is not affected by acids or alkalies; and, in action upon India-rubber, gutta-percha, the removal of grease and dirt from gloves, silk, and other fabrics, much resembles benzole.

No. 1. May 14th, 1867. A half-grown kitten was placed in a 200 cubic inch jar, with thirty minims of the tetrachloride of carbon; the jar not being quite closed. In one minute, it appeared giddy, and looked wildly about, but without distress; the pupils became greatly dilated. In two minutes, it was very unsteady, and fell down; the heart beating quickly. In three minutes, it was nearly insensible and without stupor. At four minutes, it was taken out unable to stand; it immediately began to recover. At five minutes, it could crawl, but tumbled over, and was not insensible. At six minutes, it could walk pretty well, and began to purr. At ten minutes, it appeared quite well and very happy, seeking to be noticed; it played, but was weak.

No. 2. The same kitten, in half an hour, being quite well, was put into the same jar, with forty minims of the tetrachloride of carbon, and kept in for six minutes. The effects were of the same character, but more intense. For nearly two minutes, it was insensible to pain, but not in a stupor. It was longer in recovering than in the former experiment; and was very unsteady in walking, as though drunk. It tried most persistently to get to the fire. As with most animals experimented upon with the various substances I have tried, the hind-legs were more affected, and longer in recovering, than the fore-legs. In twenty minutes, it was in a natural condition. There was slight, but only slight, shivering; no distress; and afterwards the creature was in a very contented, placid condition, and disposed to sleep. The following day, the cat was sick, purged, and unable to eat. On the next, it was well; but looked thin for three or four days afterwards.

No. 3. A young adult, but rather small, cat, had one drachm of the tetrachloride given to her on a thin fine linen handkerchief (as in man). She struggled very hard against it. In one minute, she was insensible to pain, but not altogether unconscious; in two minims, she was recovering. Twenty minims more were given, which occasioned renewed violent struggling against it; she at once became insensible, but almost as soon recovered. Twenty minims more were given; it again became insensible and quiet, but, on being let loose, it attempted savagely to bite and get away, but could not walk. Twenty minims were put on the cloth, and this was lightly laid over the head. The cat was now slightly convulsed and groaned hard, and passed both feces and urine involuntarily; became flaccid and wholly unconscious; both circulation and respiration ceased. Artificial respiration was adopted; the door was set open, and the cat laid in a draught, when it began to breathe as though it would recover, but after eight or ten involuntary and spasmodic inspirations these suddenly ceased, and no efforts could restore respiration. The whole of the muscles became excessively flaccid,

and the pupils widely dilated. I think the heart ceased to beat before respiration stopped. It was quite dead in eleven minutes from the first giving of the tetrachloride.

Post mortem examination, twenty-four hours after death; weather being cool. All the muscles very rigid, and natural in colour. Head and brain not congested; blood of a natural arterial colour; lungs pink in colour, rather, but not excessively, congested; right ventricle, auricle, and the vena cava, were greatly distended with dark soft blood; left ventricle and auricle empty and contracted; liver dark and congested; other abdominal and pelvic viscera natural; bladder empty.

No. 4. A seven weeks' old rabbit was put into a jar with thirty minims of tetrachloride of carbon. No effect for one minute, when it tried to escape. These attempts became weaker until three minutes, when it cried in distress, and became weaker and fell on its side, but did not become insensible. Taken out at five minutes, it laid helpless on its side, but was not insensible to pain nor unconscious. At eight minutes, it could sit in a natural position, but would not move, and was dull and sleepy. At ten minutes, if made to move, it could just walk; pupils contracted. At fifteen minutes, it had recovered its strength and activity. It was well next day.

No. 5. Same sized rabbit was put into the same jar with thirty minims of the tetrachloride of carbon. It was affected in a similar manner to the last, but rather more quickly. Taken out in six minutes, though unable to move, it was never insensible, and was dull, sleepy, and helpless, in a like manner, but for a longer period. Its respirations and pulsations of heart were, as nearly as could be counted, 160 per minute; both were very feeble. It was longer in recovering than No. 4. It was well next day.

No. 6. Same sized rabbit was put into the same jar, with forty minims of the tetrachloride. It was at once affected, cried, and tried hard to escape; then sat asleep, but not insensible. In three minutes, again cried and tried to escape, and fell flat down; but still was not insensible in four minutes and a half. In six minutes, it was taken out, having lain perfectly still, but breathing; it was now perfectly insensible, in fact, nearly dead; for it immediately ceased to breathe, and never moved afterwards. The pupils were contracted, but at death became dilated. Respiration and heart's action ceased together.

Post mortem examination in half an hour. Lungs, rather, but not much, pink; no congestion; they collapsed freely. Heart flaccid; but both right cavities distended with natural coloured blood; left auricle contained a little blood, not much; left ventricle none. Abdominal viscera natural; bladder and rectum empty. Brain quite natural; no congestion. Twelve hours after death—limbs not greatly contracted nor firm; heart rather soft, but little blood in it; lungs collapsed; no vascularity in bronchial mucous membrane.

No. 7. Same rabbit as No. 4, quite recovered, several days after previous experiment. The right hind-leg, up to above the heel, was put into a bottle containing four drachms of tetrachloride of carbon. It instantly cried and struggled, as though in acute pain. It was kept in ten minutes, nearly the whole of which time it cried loudly and struggled hard. When taken out, it moved the limb well. However, there was a great contrast between the sensitiveness of the two limbs; the left instantly felt a prick; but the right was repeatedly punctured through without the animal's moving, though, if roughly squeezed, it appeared to feel a little. The skin was not very red; but the limb appeared to be shrunk and dried up. In an hour, the foot was hot, becom-

ing swelled, and was quite as sensitive, if not more so, than the other. Twenty-four hours afterwards, there was but little difference in the two legs, though certainly the one immersed was not so sensitive as the other one, though it was hotter. Subsequently the skin became inflamed, and the whole of the hair came off, leaving the integument bare, red, and very sensitive. In ten days, though perfectly bare and smooth, the skin appeared natural, and the limb was used as the other.

No. 8. A same sized rabbit was put into a 1000 cubic inch jar, with thirty minims of the tetrachloride of carbon, by which it was hardly affected in five minutes. Forty minims were added; it attempted to escape, cried as in distress, then became weak and sleepy, fell upon its side, with very hurried respiration and some muscular movements. In eight minutes, it was taken out perfectly flaccid and insensible, from which condition it never recovered in the least.

No. 9. A same sized rabbit was put into the same jar, which was not covered up, with forty minims of the tetrachloride of carbon. It gradually became sleepy, as the others, and fell on its side. In three minutes, it cried out frequently. In five minutes, it was taken out in a helpless condition, perfectly flaccid; but it was not, and had not been, insensible. Blood was taken before the experiment from one ear, and after it was taken out. Under the microscope, no difference in the corpuscles was perceptible. The puncture was felt. In fifteen minutes, the creature began to recover, and was soon able to move about. The ears, which before the experiment were cool, became during it quite hot—certainly above the natural standard. That the capillaries are largely dilated, is shewn by the fact, that very little blood was obtained from an incision into the ear previous to the experiment; a similar incision being made on its being taken out, the bleeding was very free.

On breathing the tetrachloride of carbon myself, I found its vapour warm, sweet, rather aromatic, strongly reminding me of chloroform and Dutch liquid, somewhat of the bromide of ethyl, and very slightly of the bisulphuret of carbon, but this only in the very faintest degree. At first it was rather irritating to the bronchial membrane, but not afterwards. There was a sensation of heat all through the system, and a feeling of distention, with a full pulsation in the head and limbs, great muscular lassitude and indisposition to move, and sleepiness, with a sort of passive wish to proceed with the inspiration, but as if even this were too much trouble. Through the effects disappeared, this indisposition for bodily or mental exertion and the feeling of heat in the limbs continued for some time. After these in a great degree had passed off, in about an hour and a half after, I felt a full and hot sensation in the head, sinking and nausea at the stomach, and a failing in the action of the heart, which became weak and not more than forty-eight per minute, with great lassitude in the limbs. The heart soon partially, but not entirely, recovered itself. There was great disinclination to move, so that, though it was one o'clock, it required an effort to go to bed. This was followed by a bad night, with little continuous sleep till morning. I lay half dreaming, with a hot skin, a swimming feeling in the head, nausea at the stomach, a very dry tongue sticking to the palate, a taste of the tetrachloride, and a weak pulse, with a feeling like sea-sickness, restlessness, with a disinclination to move. I doubted whether I should be able to get up, or eat; but, when I did rise, I soon forgot these feelings, and felt well all day.

These experiments, I think, show that the tetrachloride of carbon, as an anæsthetic to be used in

practical medicine, is certainly inferior to several others which we possess, and that it is not likely to supersede the use of them. That it possesses decided anæsthetic properties, is certain; which indeed, if the first proposition in the essay before referred to be true, as I fully believe it to have, by the experiments there related in detail, been proved to be, we should *a priori* anticipate; but it would appear, even in this respect, to be inferior to the three other fluids which I have named: chloroform, the chloride of olefant gas, and the bromide of ethyl; while it is much less manageable than any of them, and far more dangerous, particularly than the two latter substances; for, if an animal be not fully under the influence of it, the creature is not rendered unconscious, nor insensible to pain; while, if it be so, it is very likely never to recover them. The boundary between insensibility and death appears to be so narrow and ill defined as in practice not to be capable of regulation. When once the dose of any of these agents is such that the heart ceases to beat or air to be inspired, I believe death to be imminent. Beyond exciting a continuation of these two functions (and whatever will do this is valuable), I have no faith in anything which has been suggested. In my opinion, we have no antidote for an overdose of any anæsthetic, and no remedy, except the exhalation of it from the blood as this is brought into contact with the atmospheric air.

Hence the importance of choosing that substance which is the most manageable, the least inimical to the peripheral terminations of the nerves, and is the most rapidly removed from the blood. For that this class of substances act rather locally upon the terminal nerve-fibres, than, as many good physiologists assert, solely upon the central nervous mass is, in addition to the fact of their acting solely upon the part of a living animal to which they may be directly applied, strongly confirmed by the increased heat which is felt in the most distant parts of the body, as in the rabbit's ears, and the much freer flow of blood which the capillaries then give out when the fluid has been absorbed by blood and thus carried to them. No change appears to be effected in the blood itself by the inhalation of these agents. So far as I am able to judge, it is the mere carrier of them.

I perhaps may state that I think it probable the tetrachloride of carbon will be found useful, when the diluted vapour is cautiously inhaled, in certain cases of relaxed bronchial membrane, which often are the sequela of more acute attacks, and which so persistently remain in changeable weather. When I inhaled it, I was annoyed by this condition, every morning expectorating three or four lumps of carbonaceous mucus, and some during the day. Since the inhalation, this has altogether disappeared, and the little irritation of the membrane has also gone.

THE MATER MISERICORDIÆ HOSPITAL in Dublin, was established by the Irish Sisters of Mercy in 1861. The idea of its creation originated with the Sisters, who were so willing to undertake the task of nursing the sick that they gave £10,000 towards its expenses, and then set themselves to work to raise more money for the same purpose by begging, and succeeded in collecting £17,000. Their own living does not cost the hospital a single shilling, and we learn, on the authority of the Government Inspector of Hospitals, that it is kept scrupulously clean; that its ventilation and all other internal arrangements seem admirable; the patients are admitted without any recommendation other than the fitness of the case for admission, and that the hospital promises, when completed, to be one of the finest in Europe.—*London Review*.

CASES OF DUODENAL PERFORATION.*

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CASE II. On the evening of June 18th, a lad, aged 19, was admitted into the hospital in a state of partial collapse, and alleged to be suffering from retention of urine. This is the substance of his history. On the 16th, he joined in a cricket match, and in the evening, after his return home, felt sick, feverish, and otherwise uncomfortable. On Sunday, he was better; attended to some school duties during the afternoon, and after supper took a short walk without fatigue. During the night he was very restless and slept little. On Monday, he became quite ill, vomited frequently, and was seen by a doctor. It was then found that he had passed no urine since the previous day. He was, therefore, put into a warm bath; but as it brought no relief, and as the lad seemed to be getting worse, he was in the evening sent to the hospital and admitted.

The patient's only complaints on admission, were sickness, with occasional vomiting, pain in the right side of the abdomen, and shortness of breath. The face was shrunk, dusky, and anxious, the pulse very quick and just perceptible; the skin cold, and covered at parts with a clammy sweat. Pressure made in the right hypochondrium increased the abdominal pain; the bowels had been moved rather freely before admission. By means of a catheter, easily introduced, the bladder was found empty. By order of the assistant on duty, some brandy-mixture was administered to the patient, and he was placed in a warm bath. Whilst immersed in the water, he expressed himself much relieved. After fifteen minutes he was removed from the bath, and, whilst being dried by the porter, suddenly fainted and died.

Necropsy. Abdomen flat; a small quantity of grumous fluid in the peritoneal cavity; visceral and parietal peritoneum intensely red from capillary injection and extravasation; a portion of the small end of the stomach and of the first part of the duodenum were glued to the under surface of the liver by a mass of lymph. On carefully examining this adhesion, a minute opening was found, which led into the cavity of the duodenum; and, when the bowel was laid open, a small ulcer was seen, in the base of which perforation had occurred. The ulcer, situated about an inch and a half from the pylorus, was about the size of a sixpence, had thick red rounded margins, and a whitish granular base. The whole mucous membrane of the duodenum was intensely vascular. Brunner's glands were enlarged, and a few of them, stuffed with a cheesy looking compound, were ulcerated at their most projecting parts.

With the exception of a few flakes of lymph on the under surface of the liver, and the presence of an ascaris in the stomach, no other disease was discovered in the abdominal organs; no ascaris was noticed in the peritoneal sac.

The right cavities of the heart were gorged with blood; the left empty. A nearly decolorised tough laminated clot lay in the pulmonary artery, and extended for a considerable distance along its branches, but farther on the right than on the left side; the valves and orifices were healthy.

The apex of the right lung adhered firmly to the walls of the chest. Near the summit was found a mass of softening yellow tubercle, about the size of a filbert;

* Continued from page 662 of JOURNAL for June 8th.