ON THE ELEMENT THAT KILLS IN CHLOROFORM,
AND OTHER ALLIED CHEMICALS.*

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OF all deaths, the quickest are those which follow the total arrest of circulation, where the action of the heart is first stopped. Next in rapidity are those that follow the total arrest of respiration. Death from prussic acid is a fearful example of the first; from drowning and strangling of the second. By prussic acid, death is instantaneously produced; in drowning and strangling, life is never prolonged beyond three minutes. Death from heart-affection is apparently easily explained; but why die from the exclusion of air? Let us imagine a person in full vigour and life, brought up dead from the water. Not a finger has touched him; not a drop of his blood has been shed; no poison has polluted his blood; yet he is dead, and three minutes ago he was full of lusty life. Why has he died? His organisation is still perfect. The reply, I expect, is, that he died because there was no arterial blood to circulate, oxygen having been excluded long enough to kill. In heart-disease the answer will be, that there was no heart-power to circulate the blood, although it was still arterial and pure. All this is plain enough.

We will now take up chloroform, ether, olefiant gas, and alcohol, with their varieties, in which I shall include all the compounds of carbon, whatever name may represent them, such as chloral, etc. Those chemicals are introduced into blood either as liquids or as gases; it matters but little now. In considering their chemistry, we find them richly charged with carbon in subtle solution. The little oxygen, hydrogen, or chlorine, that they contain, simply play the part of solvents to the carbon, and, as far as killing goes, can play no part.

There are two elements brought into play in their application; viz., the introduction of carbon, and the gradual exclusion of oxygen and nitrogen, carbon being retained on the one hand whilst it is being introduced on the other.

By excluding air, we can arrive at death without the aid of any other agent. By introducing carbon, we can reach the same point without calling upon strangling to help us. This is precisely what we accomplish in giving any of those subtle solutions of carbon, either as liquids or as gases. We gradually exclude the air and as gradually introduce the compound till we reach a given point, at which the blood is fully saturated with it, the agency of those two powers being put into force. It matters but little how we effect our aim; all that is wanted to complete our object is carbon, in sufficient quantity to overpower the brain and its functions. Drowning and strangling would answer our purpose quite as well as any of the chemicals in use, only we cannot as yet manage such dangerous agents with as much safety as we could wish. Moreover, they are painful modes, and never likely to be employed.

Of all our agents the pleasantest is chloroform, which, whilst killing, indulges the victim with the pleasant delusions of a happier life, and engages the respiratory organs at the same time in their usual work; thus throwing the whole living system off its guard, which, although apparently rejoicing in life, is in reality slowly dying. This is truly a happy death. The introduction of any of these compounds through the stomach produces the same effects.

Alcohol and chloral are well-known agents, capable of intoxicating and even killing by introducing carbon too suddenly and in excess. To remove their effect, oxygen must be called to our aid, which, gradually combining with the elements of the intoxicating substance, at last expels the overcharge in the form of carbonic acid, water, etc.

Having exhausted the compounds of carbon, and proved their terrible powers of stupifying and killing, we shall take up those possessed of the same power, and which yet contain no carbon. This is a paradox. Here, you will say, a difficulty arises, a barrier rears its head, over which one will not very easily pass. I can see none. We have looked on the fearful rapidity with which drowning and strangling kill. In what does their power consist? Simply in excluding air. We give a gas, such as nitrous oxide, nitrogen, or any other respirable gas—even hydrogen, and we will not even despise carbonic acid—the results are precisely the same; they kill with a rapidity that might be measured by the quantity of air allowed to mix with the gas used—in fact, we amuse the lungs and throw them off their guard whilst preventing the oxidation of the circulating carbon. This is much more pleasant than drowning, but equally fatal.

In nitrous oxide and carbonic acid we have compounds satisfied with their chemical conditions; therefore, neither the carbon nor oxygen are brought into play. They simply exclude atmospheric oxygen, thus

leaving the "killing" to the accumulating carbon. Flame, in ceasing to live in carbonic acid, simply dies for want of oxygen, not because carbonic acid is present, which, if it were to decompose, would yield sufficient oxygen to maintain combustion. An animal perishes in carbonic acid for the same reason. Chloroform has no advantage over carbonic acid except that its carbon is probably not free: I say probably, as there is no certainty.

Cause of Death.—It is not the detention of carbonic acid that kills, but the presence of carbon in some peculiar state, and unoxidised. The small quantity of carbonic acid which the last inspiration creates, even if taken up by the blood and not imprisoned in the air-cells, would be too little to kill, granting it had the power. Death is really caused by paralysis of the heart. In every instance of death in rabbits, the circulation first failed, beginning in the ears; danger was always plainly visible there; and when chloroform was further given to the complete arrest of circulation, death always ensued. On *post mortem* examination, the heart was found to beat, but not with sufficient vigour to empty its chambers. No blood seemed to pass through the lungs to the left chambers. There was an idle action, simply from the fact that the blood went home to die—viz., to the venous system, whose head-quarters is the right side of the heart and lungs. The last inspiration, shallow and superficial as it is, may be taken as a measure of the last stream poured out from the left ventricle to complete the circle for the last time, and then to stop for ever. The heart fails, because highly carbonised blood cannot maintain the vigour of the nervous system. The moment circulation ceases, respiration comes to a dead stand; to recommence the old work, circulation must take the initiative; respiration follows. This is the ordained order. With stagnant blood there can be no breathing. A newly born child breathes because his blood circulates: no human power could command a single breath had that function entirely ceased.

We now can understand why artificial respiration so often fails: in truth, we begin where we ought to end. Blood can only be oxidised in circulation; no amount of oxygen could tell upon the small quantity stagnant in the lungs—a proportion infinitely too small to rouse the nervous system even were it to move forwards. The first step towards life the heart must make; the second the lungs will take.

Indications of death are pallor and white lips; circulation has failed or is failing; a flushed or dark countenance is safe. Breathing you need not notice; it cannot go wrong. As long as the circulation is right, the first step to death is made by the circulation, the second by the respiration.

How to avert the impending death is the next question. There may still be a little arterial blood in the lungs and left side of the heart. There is just one chance: pour it into the brain by hanging the head down. If the brain respond, all is safe; the heart resumes its labours and the lungs answer to the call; and, unless we succeed in rousing the brain by the little arterial blood which the vessels may still hold, the case is hopeless.

It is impossible to manufacture arterial blood without oxygen; and it is not possible to get air to tell upon the whole volume of blood unless we can insure its circulation; and it cannot circulate without the heart's permission, and the heart will not act till the nervous system is able to command it, and until the blood gets rid of its overcharge of carbon. Artificial respiration is useless, and is a loss of time till the circulation resumes its labours.

Dragging out the tongue is an idle occupation; the mouth is not the passage for air. The glottis cannot be closed by a dead tongue and retracted epiglottis. The only instances of its closure are attended by congestion of face and brain, and not by pallor and empty vessels. Observe the face in epilepsy, in drowning and strangling, convulsions, stammering and choking from spasms, or by intruding morsels or liquids. The glottis is never closed, only whilst swallowing; no amount of stupor shuts it, and even in death it is always open; in fact, that is its normal condition, excepting in those diseases just named.

To me it is a question yet to be decided whether we could not shorten convulsions by keeping open the glottis if means could be devised. Stammering is always relieved by preventing its spasmodic closure, by keeping a marble in the mouth, by drawling, or by intonation of speech, as singing or reading poetry.

SUMMARY.—No time should be lost in artificial respiration, dragging out the tongue, etc.; but the brain should be roused by hanging down the head. There can be no harm in artificial respiration; it may be carried on at the same time. The cases appended all prove the value of this plan. It is also applicable to drowning, and to all the other causes of death just enumerated.

I append a few cases illustrative of the treatment recommended.

CASE 1.—A stout woman, aged 50, had her breast removed for cancer. Whilst we were securing the arteries, the circulation suddenly

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stopped. She was to all appearance dead—no pulse, no breathing, no colour, but a ghastly white. At this critical moment I struck away all the pillows, and, with aid, laid her on the floor, her head lower than her body. Her lips became red, and in time she breathed, and by degrees recovered. There was no attempt at artificial respiration, nor was the tongue drawn out.

CASE II.—A young and healthy peasant girl had her leg amputated, to improve a bad stump left by mortification of her foot and lower third of leg, caused by typhus fever. We were dressing it, when suddenly bleeding ceased. She had been neglected by the chloroformist, who left the handkerchief too near to her nostrils. She was breathless, pulseless, and pallid. Her head was raised on a block and pillow for the operation, which I struck boldly away; her head fell with an audible noise on the table; at that moment the lips reddened, the face flushed, she breathed, and was safe.

CASE III.—A lady, young and healthy, took chloroform to have a tooth extracted. Pallor at last followed, accompanied with the usual signs of death from chloroform. This was early in my experience of chloroform, and I was much frightened. She was laid down, her head lowered, and by and bye her lips showed signs of life, breathing returned, and she was saved.

CASE IV.—A man aged about 56, delicate, and worn by long suffering, had his thigh amputated. Whilst the wound was being dressed circulation ceased, and he was apparently dead. His head was hung down over the table, and he soon recovered like all the others.

CASE V.—An infant, whilst under chloroform for the removal of a naevus, became alarmingly pale, and apparently died. So much had been said about artificial respiration and dragging the tongue out, that we tried it, and thereby lost time; it failed entirely; we then resorted to our old plan. The child was literally hung upside down, till the lips grew red, and all was safe.

CLINICAL MEMORANDA.

SUDDEN DECREASE IN THE FREQUENCY OF THE PULSE DURING DISEASE AS A SIGN OF APPROACHING CEREBRAL COMPLICATION.

DISEASES of the brain, from the insidious manner in which they often approach, and from the great difficulty which exists of recognising them in their earliest stages, together with that of making an accurate diagnosis, even when we know them to be present, demand very close and careful observation on the part of the physician. I wish, therefore, to draw attention to a point which I observed in the three cases related below, viz., that during the course of diseases in which the pulse usually ranges high, a sudden diminution in its frequency took place some time before brain-complication could be recognised by any other signs. I have no doubt this may be known to many members of the profession; but, from the fact that it is not mentioned in any of the text-books on the subject with which I am acquainted, I think it has not been taken as much notice of as it deserves, for I consider that it will in many cases serve as a very material aid towards a prognosis.

In January, 1868, I was asked to prescribe for D. M., a letter-carrier, aged 45, who had for some time been labouring under an attack of pulmonary phthisis. The disease ran its usual course for some time, cavities having formed in both lungs, until suddenly on the 20th of June the pulse, which up to this had ranged from 100 to 108, fell to 74, and continued between 74 and 80 until the 16th of November, when headache followed by squinting set in. Coma and death closed the scene.

The second case was one of strumous diarrhoea in a child, aged 8, in which the pulse was constantly above 100 until two days before the manifestation of the symptoms of meningitis, when it fell to 76.

But the case which made most impression on me was the following. On the 29th of last month I received a note from a medical man requesting me to visit his child, aged 7, whom he had sent to Newcastle for change of air, and of whom he gave the following history. In January last he had measles; when recovering from this disease, he was attacked by gastric fever, which confined him to bed for five or six weeks; on partially recovering from this he had an attack of bronchitis, and now his chief disease was gastric irritability. On my visit next day I met his father, who told me that a sudden change had taken place in the little patient's pulse: during his other illnesses it had always been above 100, but on the previous day he found it reduced to 82. Having the two previous cases in mind, I told him that we must examine the patient carefully for head-symptoms. We found him lying quietly, breathing naturally, and not showing any sign of brain-disease except the vomiting, which appeared to be gastric. Next day, under the use of fluid magnesia and milk, the vomiting had disappeared. The pulse was 82,

regular and full; the tongue still coated. On the following day the same state of matters existed, except that the patient appeared more listless and complained slightly of the light, but his pupils acted naturally. On the following morning at two o'clock delirium set in, followed by coma, and death on June 12th.

I do not mean to convey that we can always connect the slowness of the pulse and the cerebral disease as clearly as in these cases, but I am convinced that in many cases the symptom will prove to be all that I claim for it, *an aid to prognosis*.

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HERPES FRONTALIS, GIVING RISE TO CONTAGIOUS ERYSIPELAS.

A MAN aged 51 was admitted into St. Mary's Hospital on June 28th. A week previously he had begun to have a feeling of fulness in the head, and four days before an eruption had appeared on the right side of the forehead and head, attended with severe pain. The affected part then began to swell and become red; and, on admission, the head and face presented a marked erysipelatous appearance, especially on the right side; both eyes were swollen up; there was still much pain in the head; no high fever; temperature, 98.2 deg. The case was one of herpes frontalis, but complicated with so much erysipelatous inflammation of the affected region and surrounding parts as to obscure the real character of the attack. The redness and swelling gradually subsided, leaving scattered scabs over the right side of the forehead and scalp, as far back as the parieto-occipital suture, which, on falling, exposed small deep clean cut, irregular cicatrices, perfectly characteristic of herpes. Fortunately, the nasal branch of the ophthalmic nerve had not been affected, and thus the eye was spared; a single minute vesicle only making its appearance at the lower edge of the cornea.

The interest of the case, however, consists in the fact that erysipelas spread from the patient in the ward. This conclusion, at any rate, seems to be warranted by the fact that, whereas there was no erysipelas in any part of the hospital, nor had been for some time, three cases appeared in the wards within a few days of this man's admission. Apparently, therefore, herpes frontalis (an eruption consequent upon nerve-disturbance) gave rise to inflammation of an erysipelatous character, which was communicated by contagion to others—that is, there was generation of a communicable or contagious disease. It is worthy of remark that the time in which the herpes ran its course was not prolonged. The treatment consisted of good feeding and large doses of muriated tincture of iron.

I remember to have seen the skin supplied by the supraorbital branch of the fifth nerve, on one side remarkably atrophied; it was thin, shining, and almost devoid of sensibility, the change being attributed by the medical attendant to erysipelas. Cicatrices, such as those described above, however, showed it to have been consequent upon herpes frontalis; and it is not improbable that a similar result may follow in this case.

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REPORTS

OF

MEDICAL AND SURGICAL PRACTICE IN THE HOSPITALS OF GREAT BRITAIN.

NOTES ON THE TREATMENT OF GANGLION IN THE SCOTCH HOSPITALS.

EDINBURGH ROYAL INFIRMARY.

MR. SPENCE long since abandoned the old plan of bursting or breaking up the swelling by force; it almost uniformly failed to effect a cure. The cyst gave way at its weakest point, and the contents were diffused, and the tumour disappeared at the time; but the irritation produced seldom sufficed to obliterate the secreting cyst, and the swelling soon reappeared. Mr. Spence's general procedure in the smaller swellings (as at the wrist) is to use a strong double-edged needle (an old-fashioned cornea-needle), introduce it subcutaneously into the cyst, and move it freely about in all directions, so as to tear up the cyst as completely as possible; he next applies a firm compress over the part for a day or two, and then a fly-blister is applied. This method Mr. Spence finds sufficient in ordinary cases. In larger cysts, or where the contents are fluid (as in those connected with the hamstring tendons in the popliteal space), he draws off the contents with a trocar and cannula, and injects tincture of iodine. This method rarely, if ever, fails in such cases; but it is not generally applicable, or rather very rarely