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TWO CASES

OF

POISONING BY THE RESPIRATION OF CARBONIC ACID GAS,

WITH A FATAL ISSUE IN ONE, AND RECOVERY IN THE OTHER.

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The particulars of the two following cases appear to me not less interesting than instructive, whether we regard their practical importance, or their bearing in a medico-legal point of view.

W. H—, aged 23, and A. M—, aged 24, both gardeners in the employment of a gentleman in this neighbourhood, retired as usual to their bothy or sleeping apartment, at nine o'clock on the evening of Monday, the 16th November 1846. They had previously partaken of supper, which consisted of porridge and milk,—both were quite sober, in good health, and of robust constitution. The bothy which they occupied, was a small out-house, in a corner of the garden, having two sides formed by the garden walls; it was only nine feet square, with a sloping roof, descending so low as to be less than six feet from the floor. There were five small windows in the room, all perfectly air-tight, the largest of which, the only one that could be opened, consisted of only four small panes of glass. The door also fitted very closely. There was no regular fire-place in this small room, which was heated by means of a stove during the winter. The stove was lighted that afternoon at 4 o'clock, and no more fresh coals were added; the fire did not burn very quickly, and seldom or never required to be mended. The stove, in general, smoked for some time after a fire was made; it had been lighted only twice this season, the previous occasion being about a fortnight before.

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When the men entered the room there was no smoke or smell, and they continued reading for an hour before going to bed. W. H— retired to bed about a quarter of an before A. M—, and when the latter got in he observed the door of the stove open, and nearly all the coals bright red; at this time, as far as he remembered, no smoke was issuing from the stove. W. H— lay down with his face to the wall, at the back of the bed, and fell asleep much sooner than usual. He, in general, lay on his back. A. M— lay down also with his face towards the wall, at the front of the bed, nearest the stove, and lay awake for some time, but as far as he recollected, not nearly so long as he was accustomed to do. He never could sleep, ever since he remembered, unless his face was turned to the front of the bed; he lay down, generally, with his face towards the back, but always turned himself towards the front before he fell asleep. There extended from the top of the bed along its side to the bottom, a shelf fully a foot broad, raised about three feet above that part of the bed upon which W. H— lay.

The men did not make their appearance at work next morning. They were seen in bed by a servant about 7 o'clock a.m.; but she seems to have observed nothing to excite any suspicion. She saw them again at 9 a.m., and also at half-past 9, when, in consequence of her attempts to awake them having proved unsuccessful, suspicions of danger were excited, and I was immediately sent for. On my arrival I found the door had been locked on the inside, which I instantly ordered to be burst open. During the time this was doing, I looked through one of the small windows, and saw them lying in bed, one apparently dead, the other slightly moving one of his arms. The air in the room seemed to be tinged with a pale bluish colour, quite different from its usual transparency. As soon as the door was broken up, I went in, but was compelled to come out again, in consequence of the powerfully suffocating odour of the air. I caused the largest window to be opened, and then I entered. W. H— was lying on his back, his face and lips perfectly pale, his eyelids closed, the eyes somewhat sunk; there was an immense quantity of frothy mucus over the lower part of the nose, mouth, and extending down to the chest; the arms were folded across the abdomen, the thumb was turned into the palm of the hand, and the fingers were closely folded over it. The posterior aspect of the neck was quite livid. The bed-clothes did not seem to have been discomposed or tossed about in the least degree. I was informed by the person who requested my professional attendance, and who first gave the alarm, that he observed the "froth working out of W. H—'s mouth." I was, therefore, anxious to give him every assistance in my power. I removed the frothy matter from his mouth, and dashed some cold water on his face, to endeavour to rouse him, but without effect, no sign of life being perceptible. On shaking him, he felt quite cold and stiff, the skin over the anterior part of the body was quite pale, but upon the posterior part exceed-

ingly livid; the pupils were very much dilated. The mouth was open, and filled with sanguineo-serous fluid. Perceiving from the state he was in, that it was useless to attempt any restorative measures with him, I immediately directed my attention to the other man. A. M— was lying nearly in the same position, afterwards described by him as that in which he lay down; the head and neck were slightly inclined forwards,—he was moving one of his arms gently up and down, as if endeavouring to remove something from his breast; his respiration was very noisy, short, slow, and irregular, but not stertorous; the pulse was slow, weak—scarcely perceptible, very irregular, and intermitting. His face was pale and bloodless, as were also the lips; the eyelids were closed, the pupils dilated, and the eyes quite fixed—the mouth and teeth were firmly closed. The whole surface of the body was cold and pale. The extremities, but particularly the arms, were excessively rigid. One of his hands grasped the bed-clothes, and in both the thumb was turned into the palm of the hand. He had drawn the bed-clothes partly off himself, the left hip, thigh, and part of the leg being uncovered. He gave a slight sigh when some water was thrown on his face, and was immediately afterwards carried out and placed in a sitting posture before a large fire; he was then quite insensible and comatose. The whole surface of the body, but more particularly the left thigh, continued for many hours to exhale a strong odour, similar to that of the room. The treatment may be summed up very shortly.

Application of External Heat.—The heat of the body being very much diminished, it was of great importance that it should be restored as speedily as possible; and much difficulty was experienced, both in its restoration and maintenance. The means principally used, were the following:—The immersion of as much of the body as possible in hot water, hot fomentations, hot bottles to the chest and abdomen,—frictions with warm cloths, the position of the body close to the fire, and a plentiful supply of blankets and warm coverings.

Venesection.—This was had recourse to three times, in order to relieve the congested and oppressed state of the circulating and respiratory organs. The blood flowed very slowly, was thin in consistence, and exceedingly dark in colour. After standing for twenty-four hours, it presented a very soft, flabby, and nearly black coagulum. The appearance of the blood in each of the cups varied very much: in some it was frothy, in others cupped; in some the serum was clear, in others, sanguineous; and in all, the proportion between the crassimentum and serum varied from one quarter to three quarters of the whole quantity. After the bloodletting, the pulse increased in frequency, regularity, and strength; the respiration became more free and natural, though still noisy, from the mucus in the trachea and bronchi; but the abstraction of blood had little or no effect on the comatose symptoms. The face also

assumed a more natural colour and appearance, and the muscles began to lose their excessive rigidity. These favourable changes, however, gradually disappeared, and it was only by having recourse to repeated bleedings, that their restoration was effected.

Sinapisms.—Sinapisms were applied to the chest, abdomen, spinal column, and calves of the legs; but from the state of the skin, some of them acted very slightly, though they were kept on an unusually long time; he appeared to be quite unconscious of their application.

Stimuli.—When he was first discovered, the power of swallowing was completely gone, and the mouth and teeth were so close, as to prevent anything being given him;—by degrees the muscles of the jaw became more relaxed, but it was only after several hours of unremitting attempts, that deglutition was so far restored, that I could get him to swallow the smallest possible quantity of stimulating fluid. This was of marked benefit to him: it raised the pulse, and the respiration became much easier; it also for a time removed a quantity of viscid mucus which had begun to collect in the mouth and throat, and which considerably impeded the respiration. I made frequent endeavours to excite vomiting, by tickling the fauces with a feather, so as to effect its entire removal; these, however, were all but unsuccessful.

Cold Affusion.—This was repeated at short intervals to the face, and also to the head, and was of great service in rousing him.

Stream of Fresh Air.—The window and door of the room were kept almost constantly open, and whenever the current of cold air reached the face, there was always a long and deep inspiration. The expired air had very much the same odour as that in the apartment where he had slept. Besides the remedies above mentioned, the chest, sides, and abdomen, were occasionally rubbed with strong linimentum ammoniæ; and attempts were also made to rouse him by shaking, talking loud, and the application of ammonia to the nose.

Autopsy in the Fatal Case.—The inspection took place 30 hours after the body was taken out of the room. The external appearance of the body was that of a stout, healthy, young man. The face was pale and placid, the lips bloodless, and the whole countenance bore the same expression as when he was first discovered. The skin over the whole anterior aspect of the body was pale, and seemed as if it were shrunk and dry, with only a faint bluish line here and there, marking the course of the subcutaneous blood vessels; but upon the posterior and depending parts it was of a deep livid colour. The muscles, in general, were stiff, but those of the arms so much so, that they resisted strong attempts to flex them. The abdomen was very tympanitic, and the integuments were of a slightly greenish colour. On laying open the thoracic cavity, the lungs were found completely gorged with blood, very dark in colour, and quite fluid, intermixed here and there with a

quantity of air, which seemed principally to occupy the exterior part of the lung. The trachea and bronchi were filled with frothy sanguineo-mucous fluid, and the bronchial mucous membrane was slightly injected with blood. It was exceedingly difficult to press out the air or the blood from the lung, and when this organ was incised, it gave to the knife a feeling of solid resistance, quite different from its ordinary elastic and emphysematous feel. There was a small quantity of sanguineo-serous effusion in each pleural cavity, and the pleura costalis seemed to have a higher colour than natural. The pericardium was slightly injected with blood, and it was empty. The right side of the heart was full of blood, dark in colour, and very fluid; the heart itself seemed to be smaller and softer than usual. The valves were a little more injected than natural, but otherwise it presented no unusual appearance. After the heart and lungs were removed from the body, the aorta, and both venæ cavæ discharged a large quantity of dark and perfectly fluid blood into the cavity of the chest, no portion of which was coagulated in the least degree. The stomach was, if anything, a little more injected than in its natural state. It contained a large quantity of air, and also a quantity of porridge in a completely undigested state. The liver was of a very dark colour, quite tinged with blood; it was of a larger size than usual, and the venæ cavæ hepaticæ were quite empty. The gall-bladder was empty, and collapsed, and of a dark brown colour. The spleen was of a darker colour than usual, and of its natural size. The kidneys were very much injected with black blood. The mesentery was of a dark colour, in large patches every here and there, and very much injected in some places. The omentum, especially at the greater curvature of the stomach was of very dark brown colour. The intestinal canal was very tympanitic, particularly in the iliac portion; it contained very little feculent matter, and the mucous membrane was of a natural colour, but in the colon the membrane was of a pale bluish tinge, as were also the contents of the gut at that part. The bladder was very much injected at its fundus, and contained about a pint of urine. On removing the cranial integuments, a large quantity of blood flowed from each incision. The skull was very thick, and the deploe was exceedingly vascular, large drops of blood oozed for some time from it. The dura mater was very much injected with blood, so much so, that when held between the eye and the light it seemed one red mass. The sinuses also were completely filled. There was considerable sub-arachnoid effusion of a semi-gelatinous consistence, especially on the superior and posterior surface of the brain. The veins of the pia mater were distended. At the base of the brain there was little or no serous effusion; but the circle of Willis, and the anterior and posterior spinal veins were quite turgid, and poured out their contents when cut. On exposing the centrum ovale of Vicq D'Azyr, the whole medullary and cineritious parts of the brain brought into view, instantly be-

came covered with small points of blood; the centrum ovale of Vieussens also exhibited the same appearance, and the commissura magna also was of a more red and injected appearance than natural. On cutting into the lateral ventricles, about one drachm of serum was found in each. The tela choroidea was of a brighter colour, and much larger than natural; there was also a small quantity of serum in the third ventricle. The remaining portions of the brain exhibited a natural appearance, with the exception of the exterior being more vascular than usual. The cerebellum was also a little more vascular than what is generally seen; but so soft, that upon being gently pressed with the fingers, it gave way in all directions. The whole spinal cord was, if anything, of a softer consistence than is generally found, and there were no effusions of blood or serum in any part of it.

Owing to the almost universal use of open fire places instead of stoves, in sleeping-rooms in this country, cases of poisoning by the inhalation of carbonic acid gas, happily, are of rare occurrence; and in most of the instances where this has happened, the sufferers have been so long exposed to its influence, that the fatal effects of this noxious vapour have usually arisen long before their situation has been discovered, or even suspected. The cases just now under consideration, where the carbonic acid gas proved fatal to the one and not to the other of the persons exposed, are particularly interesting. We here have two individuals of nearly the same age, equally healthy, sober, regular in their habits, and of similarly robust constitutions; both following the same occupation, and both, in short, as nearly alike in every respect as could be conceived; equally exposed to the vapour of the carbonic acid (perhaps the survivor more so from sleeping nearest to the stove), and yet it proved fatal to the one and not to the other. No explanation can be given of the more rapidly hurtful effect in the one individual than in the other, unless it be connected with the deceased having been more exposed as he lay on his back, with the shelf before described, but a short distance above him. It is impossible, I believe, to state, with any degree of certainty, at what period the gas proved fatal to the deceased, or, in other words, how long he had been dead before the door was burst open. From the body being quite cold and stiff, and all the depending parts quite livid, it is very probable that life had been extinct for a considerable time. Orfila, indeed, states, that if the body of a person suffocated by a non-respirable gas, or by strangulation, be cold and stiff, we may be certain that more than twelve hours have elapsed since death. In the cases just now under notice, both persons were under the gaseous influence for the same length of time, viz. twelve hours and a half, from 10 p.m., when they retired to bed, till half-past 10 a.m., when they were taken out of the room, on the supposition that the gas began to take effect on them when they went

to bed, or even before, as seems probable from what will be immediately stated.

As indicating the deterioration of the air in the small room, from these two men sleeping in it, and the effect of that deterioration on them without its being increased by a lighted stove, I may mention, that A. M— told me that the deceased and he always felt the air of the room close and unpleasant in the morning, that they allowed the window to remain open all day to ventilate it, and only shut it at night when they went to bed, and also that they had often awoke in the morning with a bad taste in their mouths to such an extent, as compelled them to have recourse to rinsing for its removal. It appears exceedingly probable that the atmosphere of the room must have been highly charged with carbonic acid gas shortly after they entered it; and that it began to act on them soon after they fell asleep, or even before they went to bed seems likely, first, from the circumstance of A. M—, having vomited a quantity of porridge soon after he had been taken out of the room, and which appeared not to have undergone any change during the fourteen hours it had been in his stomach, the particles being quite entire, and as fresh as if they had been recently swallowed; and, secondly, from a considerable quantity of porridge having been found in the stomach of W. H—, which had undergone little or no change, though, according to the experiments and observations of Dr Beaumont of the United States, porridge is digested, and removed from the stomach in the course of from one to two hours. Thus the gas seems to have had the effect of paralyzing the activity of the stomach, and of retarding or destroying the function of digestion. As an additional proof of the speedy effect of the gas on them, I may add, that they both fell asleep much sooner than usual, and also, that M— was found lying nearly in the same position in which he lay down, not even having had time to turn, as he says he was in the habit of doing.

I may also state, that the air of the room was so powerfully impregnated with the nauseous odour of the gas, as to be quite discernible by the nasal organs as well as discoverable by chemical re-agents, ten days afterwards, notwithstanding that the door and window had been kept constantly open, and likewise, that the bed-clothes and bedding were so saturated as to evolve the same peculiar odour, so strongly as to occasion to the persons who washed them severe sickness and faintness.

It seems very probable, that in many, if not almost every case of fatal poisoning by carbonic acid gas, the transition from life to death must have been attended with little or no struggling or suffering; and in cases such as the one now related, where there has been no symptom of sickness, no urinary or feculent discharges, no contortion of the muscles of the face, or unusual position of the extremities, and more especially, when the bed-clothes have not been in the least degree ruffled or discomposed, we are justified in

coming to the conclusion, that the fatal moment has not been attended either with pain or uneasiness.

The only other point I consider worthy of notice is, the state in which the thumb and fingers of both patients were. I have already mentioned that the thumb was turned inwards to the palm of the hand, and the fingers folded closely over it. This particular state is pathognomonic of cerebral irritation and effusion, and is constantly met with and regarded as a fatal symptom in the hydrocephalus of children and infants. I may also add, that I have seldom or never seen a well marked case of hydrocephalus or even of cerebral irritation and effusion, which was not accompanied by this symptom.

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