Observations on apparent death, from suffocation, by hanging or drowning : choke damp, produced by inhaling carbonic acid, or some other irrespirable exhalation, by a stroke of lightning or electricity, and by exposure to extreme cold : with directions for using the resuscitating apparatus, invented by the author, and general instructions for the recovery of persons from suspended animation / by Edward Welchman.

Welchman (Ed.)

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AND

BY EXPOSURE TO EXTREME COLD;

WITH DIRECTIONS FOR USING THE

RESUSCITATING APPARATUS,

INVENTED BY THE AUTHOR,

AND GENERAL INSTRUCTIONS FOR THE RECOVERY OF PERSONS FROM SUSPENDED ANIMATION.

BY

EDWARD WELCHMAN,

~~OF COLD SPRING, PUTNAM COUNTY, STATE OF NEW-YORK.~~

Member of the Royal College of Surgeons in London.

Albion, Edwards County, Ill.

LATEAT SCINTILLULA FORSAN.

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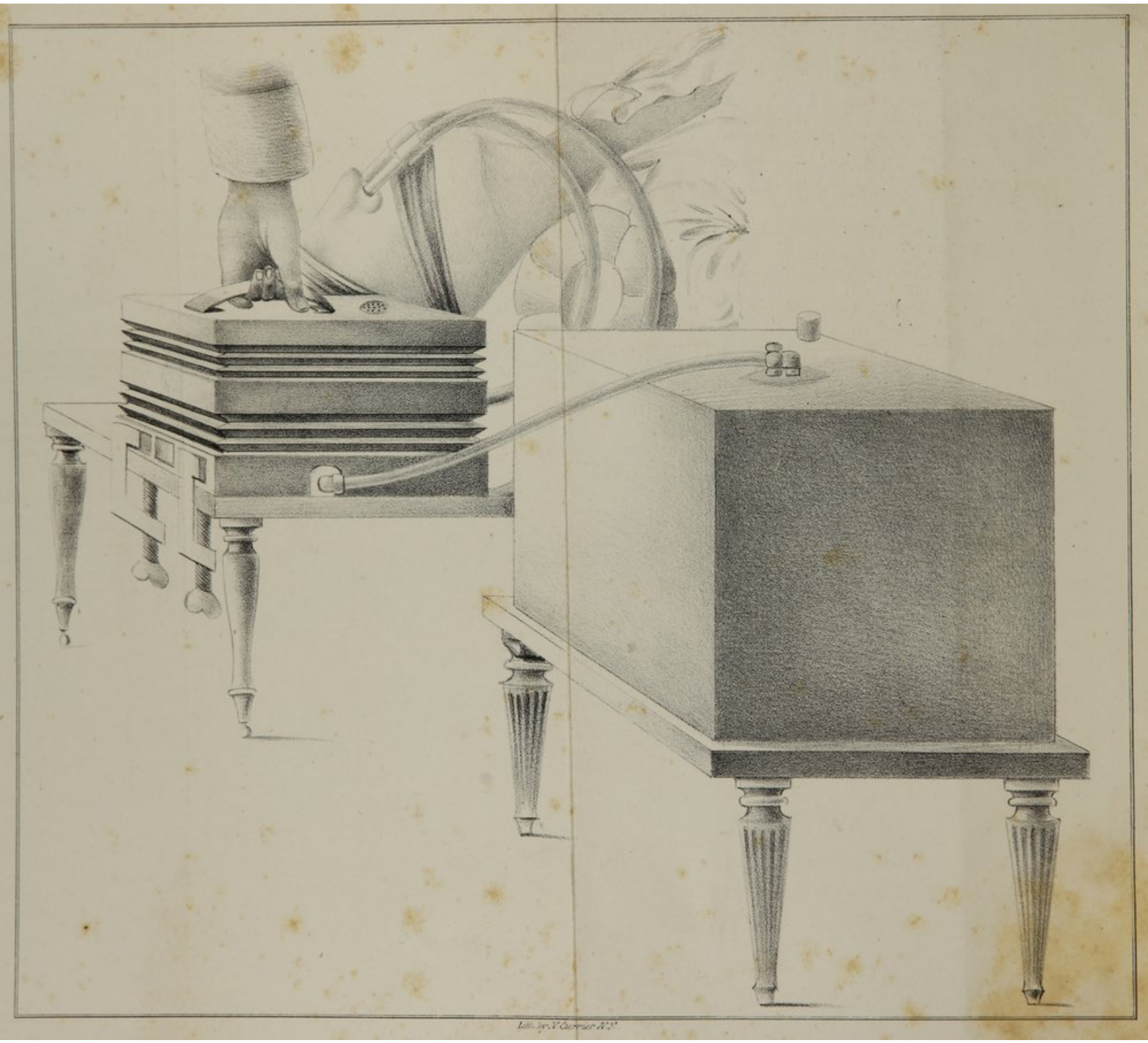
J. & H. G. LANGLEY, 57, CHATHAM-STREET.

1842.



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PREFACE.

The following observations, pointing out and explaining the means to be made use of in the resuscitation of asphyxiated persons, are intended to accompany and illustrate the use, and particular advantages, of my Resuscitating Apparatus, which consists of a double bellows, placed one above the other; the inferior one is for the purpose of inflating the lungs; the superior one for withdrawing the air previously introduced; thereby preparing the lungs for another inflation. Both of the bellows are filled at the same time, and by the same movement; the inferior one with atmospheric or other air; the superior one with air from the lungs. Both are discharged at the same time, and by the same movement. Thus, the method of using this Resuscitating apparatus consists simply in the alternate elevation and depression of the double bellows. To facilitate the operation of resuscitation, and for rendering fewer hands necessary, the instrument is fastened down to a table, so that one hand only may be employed in working the two bellows. The combination of the two bellows, and also the further combination of them, with a vessel for warming the air or airs introduced into the lungs, are the author's invention. The superiority of this Resuscitating apparatus, over those previously employed, will be apparent—in the use of the second bellows for extracting the carbonized air from the lungs; in the manner of effecting the same, and inflating the lungs again, so as to

resemble natural breathing; and in the saving of hands and of time in accomplishing the operation.

In collecting information on the subject of resuscitating asphyxiated persons, I have drawn largely from the works of Dr. Hooper, Dr. Mason Good, Dr. Copland, and Dr. Bostock; and from scattered remarks by Sir Benjamin Brodie, Dr. Marshall Hall, Dr. John Davy, Dr. Wardrop, Dr. Goodwyn, Dr. John Reid, and Charles T. Coathupe, Esq.

Observations on Apparent Death, from Suffocation, by Hanging or Drowning; Choke Damp, produced by inhaling Carbonic Acid, or some other irrespirable exhalation; by a Stroke of Lightning or Electricity; and by Exposure to Extreme Cold.

Apparent Death, in the common language of the medical profession, called suspended animation, and technically termed asphyxia, is that state in which the vital phenomena are suspended from some cause interrupting respiration, but in which life is not actually extinct, and may under favourable circumstances be restored.

In that variety of asphyxia, from hanging or drowning, the countenance is turgid and livid.

In asphyxia from choke damp, produced by inhaling carbonic acid, or some other irrespirable exhalation, the countenance is pallid.

In electrical asphyxia, produced by a stroke of lightning, or electricity, the limbs are flexible, the countenance is pale, and the blood is uncoagulable.

In frost-bitten asphyxia, produced by intense cold, the limbs are rigid, the countenance is pale and shrivelled.

In the first variety, from hanging or drowning, the immediate cause is suffocation, or a total obstruction to the breathing from a rigid spasm of the muscles of the glottis, in drowning and compression of the trachea in persons hung.* The face is

* Consequently the blood does not get decarbonized in the lungs, and the heart ceases to act for want of the proper arterialized blood in the coronary arteries.—See Sir Ben. Brodie's Experiments.—Phil. Trans. for 1811.

The first, and indeed the essential effect of submersion is to cut off the supply of oxygen from the blood, so that it can no longer undergo its appropriate

turgid with blood or of a livid hue. The countenance has often a semblance of apoplexy, as though there were congestion of blood in the head. But in apoplexy the respiration is always oppressed and generally stertorous, which is never the case in asphyxia; unless the exciting cause has only operated partially, and here the affection is in reality apoplexy, rather than asphyxia. In asphyxia, wherever we can trace any diseased action, the lungs are chiefly affected; in apoplexy, the brain. The immediate cause of asphyxia is occlusion of the larynx, and where this is partial, some apoplectic symptoms are generally observable. It is on this account that the faces of those who die by hanging are frequently more turgid, and the muscles give proof of more convulsive action. than the faces of those who die of drowning; for in the former case, from rigidity of the larynx, or from the rope not being properly applied, a small current of air is often admitted for some time. Whereas in the latter case of submersion the glottis instantly and rigidly contracts to prevent the entrance of water into the trachea; hence the gorged state of the lungs, the heart, and the larger vessels in the vicinity of the heart, and the livid hue of the countenance, in most cases of suffocation from drowning. To distinguish in which cases of asphyxia the breathing has been suddenly and completely suspended, or when the obstruction to breathing has been more gradual and incomplete, is important in relation to the abstraction of blood, hereafter to be spoken of in the treatment.

How long the living principle may, under these circumstances, remain attached to the animal frame, so as to admit of the resuscitation of the individual, has not been ascertained with any degree of accuracy, even to the present time; and there is very probably some diversity in this respect according to the varying degree of irritability in different individuals.* If the submersion

change; it is therefore carried into the coronary arteries in the venous state, and hence the heart loses its contractility, &c.—Bostock's Phys. Vol. II. p. 178.

* During a certain period of time the powers of life are merely suspended, but the parts not being irrecoverably injured, if the proper means be resorted to, the

have not exceeded five minutes, and no blow against a stone or other violence have occurred, recovery may generally be brought about without much difficulty. After a quarter of an hour recovery is not very common, and after twenty minutes or a half an hour, it is nearly hopeless. Of twenty-three successful cases stated in the first report of the establishment for the recovery of drowned persons at Paris, one had been three quarters of an hour under water; four half an hour, and three a quarter of an hour; the rest had been submerged for a shorter period. De Haen conceives that one in sixteen is no unfavourable average of the proportion that recover.

In the recuscitation of drowned persons, the two means on which we have principally to depend, are the regulated application of heat and artificial inflation of the lungs. The body should be quietly conveyed to a warm and dry place, where it should be stripped of its clothing, wrapped in a warm blanket, and placed on its back on a table, with the head, shoulders and chest a little raised. The room should be very freely ventilated and all persons whose attendance is unnecessary excluded. A bladder three-parts filled with warm water; or flannel bag of hot bran, ashes or sand, placed over the region of the stomach, and bottles of hot water applied to the feet. It is necessary, however, to be cautious in the application of heat, since, if too suddenly applied, or in too high a degree, it will immediately destroy the feeble vitality that remains.* A restoration of the functions of the lungs is, however, the most important object of all. The man-

action of the system may be restored. These means essentially consist in enabling the blood to undergo its specific change in the lungs, by introducing into them a quantity of air, containing the requisite proportion of oxygen, &c. &c.—Bostock's Phys. Vol. II. p. 180.

* We attempt to induce the contraction of the heart by the application of caloric to the surface of the body generally, by placing it in a warm medium, or by a topical application of it to the region of the stomach, or to any other part more particularly sensible to its influence. With the same intention we apply friction, and occasionally more powerful stimulants, such as the electric or galvanic shock transmitted through the heart to the diaphragm, &c.—Bostock's Phys. Vol. II. p. 183.

ner of accomplishing which is as follows,* viz: Fix the resuscitating instrument firmly to the table on which the patient is placed or if more convenient on another standing close to it. Those ends of the flexible tube marked (1) are to be screwed into the brass holes at one end of the instrument, observing to screw the longest tube into the upper hole. There are three pairs of black pipes, viz: one pair at each end of the instrument, and another under the han lle. The suitable size for the patient being selected, screw them on to the other ends of the flexible tubes, then insert one into each nostril, and if they do not fit accurately, they must be made to do so by wrapping a piece of linen round them. The patient's mouth being stopped by tying a handkerchief round the head, or by means of a mouth-piece contrived for the purpose, draw up the instrument and then press it down again. The drawing up of the instrument should be accompanied by pressure with the hand of an assistant over the pit of the stomach, who, with his other hand each time the instrument is depressed, is to press backwards and draw gently downwards towards the chest, that part of the wind pipe which lies a little below the chin, and which from its prominence in men, is commonly called Adam's apple.† The act of inflation should commence with a sudden and rather forcible pressure gradually diminishing. Each elevation and depression of the instrument should be performed in rather less time than common breathing,or about twenty times in a minute.‡ Great ad-

* By this we change the blood in the lungs from its dark or carbonized state to the scarlet or arterialized condition; and by the absorption of oxygen from the atmospheric air introduced, or where that gas is used by itself, we obtain an increase of temperature internally.—See Dr. John Davy on the theory of respiration.

By artificially introducing air into the lungs of an animal that has been apparently destroyed by interrupting the respiration, the blood is enabled to undergo its appropriate changes from the venous to the arterial state, which, in proportion as this change is effected, the contractility of the heart is restored.—The celebrated experiment of Vesalius.—Bostock's Phys. Vol. II. p. 174.

† Dr. Goodwyn.—Encyclopedia of Medicine.

‡ See Chs. T. Couthupe, Esq.—Philosophical Mag. for June, 1839; and Bostocks' Phy. Vol. II. p. 56.

vantage will be derived by warming the air introduced into the lungs. This is easily effected by filling the walls of the warm air vessel with hot water, and connecting the flexible tube attached to it, with the brass revolving apperture at the bottom of the instrument, on that side which is most convenient. In the case of oxygen gas being used instead of atmospheric air, the same flexible tube may be made the medium of communication between the gasometer and the instrument.

Having established artificial respiration, a surgeon should open one of the external jugular veins, and as this is recommended not to relieve any supposed congestion of the brain, but to disengorge the right cavities of the heart, he must encourage by every possible means (provided that no air be allowed to pass into the vein) the flow of blood from the *lower orifice*, and from the lower orifice alone, if he is anxious that much blood should not be drawn. In a case attended with apoplectic appearances, it might be advisable to take blood from the upper orifice, as soon as the living powers began to show themselves.*

While these operations are going on, other persons should be endeavouring to restore the warmth of the body by friction of the extremities with warm flannels and pressure of the muscles.†

The next thing the surgeon should be prepared to do, or direct the management of, is the use of voltaic electricity. The fluid should be transmitted along the course of the nerves of the respiratory muscles, as from the phrenic nerve in the neck towards the diaphragm, or the pneumo-gastric and great sympathetic nerves, immediately under the sterno-mastoid muscle, where they lie in one common sheath.‡ The application of voltaic electricity at the same time that it surprisingly increases the

* See Dr. John Reid, on the Effects of Venæsection in renewing and increasing the heart's action under certain circumstances.

† See Dr. James Wardrop's treatise on the nature and treatment of diseases of the heart, with some new views on the physiology of the circulation.

‡ See a lecture on the Nervous System, by Dr. Marshall Hall. Lancet, 3d March, 1838.

power of the muscles of respiration, appears rather to diminish the action of the heart. Therefore it would not be judicious to call in the aid of voltaic electricity before the action of the heart is somewhat restored, and then its use alternately with artificial respiration might be very serviceable. The surface of the body may be rubbed with ammoniacal or other stimulating liquids, and the vapours of ammonia applied to the nostrils. Stimulating injections, containing ammonia, brandy, or other spirits, have often been introduced with success into the rectum, and will be found most beneficial when administered moderately warm. It is also advisable to convey some cordial, as warm negus, volatile alkali, or the compound spirit of lavender, into the stomach by means of a canula or the stomach pump. With returning life, a spoonful or two of warm wine or wine and water, should be administered by the mouth, as soon as the power of swallowing s sufficiently restored; which should be shortly succeeded by a little light, warm, and nourishing food of any kind, with gentle laxative glysters, a well heated bed, and perfect tranquillity. These means are to be continued in a regular and steady manner either until natural respiration begins, or until they have been persisted in for at least six hours without any appearance of returning life, unless it can be ascertained that the body had been submersed three quarters of an hour or more.

The general principles of the remedial treatment here recommended, apply to most of the other varieties of asphyxia, or suspended animation. It may be observed, however, that in attempting the recovery of those who have been hanged, and particularly those who have inexpertly hanged themselves, bleeding from the upper orifice of the jugular veins may be more frequently found necessary than in the drowned, since in the former, as already explained, there is a greater tendency to apoplectic symptoms than in the latter; yet even here the quantity abstracted need not be large.

In asphyxia from *inhalation of irrespirable gases*, death in many cases takes place instantaneously; and consequently, the countenance, as well as the general surface of the body is pale

Yet as the gas is often in some degree diluted with atmospheric air, the circulation, and even the breathing, are occasionally continued for some time in a feeble and imperfect manner, and the asphyxy is united with symptoms of apoplexy, or genuine apoplexy takes place in its stead.

The direct effect of such gases, when in a concentrated state, is instantaneously to destroy the irritability and sensibility of the nervous system; of which we have frequent examples occurring in persons who incautiouly descend foul beer casks, or the shafts of mines. By what means, however, such exhalations, when they have entered the lungs, affect the nervous system so rapidly as to prove instantly fatal, is by no means easy to be explained. In the present case there seems to be not only a cessation of the action of the heart for want of its proper stimulus, no longer afforded by the lungs, as in hanging or drowning, but a total abolition of both sensific and motific power: and this as completely in one part of the frame as in another.*

The gases that are found most fatal are the carbonic acid, hydrogen, and several of a more compound kind, which are thrown forth from putrifying animal and vegetable substances, and especially from cemeteries on opening graves, in which the process of decomposition is proceeding rapidly.

The most common of these gases is the carbonic acid, which is chiefly found in close rooms, where charcoal has been burnt; at the bottom of large beer casks, or of wells, and in many natural cavities of the earth. Its weight prevents it from escaping readily, even when there is an accession of atmospheric air; and its want of smell, when pure, prevents it from being detected otherwise than by the effects. As it will not support flame, the common and easiest test where it is suspected to exist, is that of a lighted candle, which is well known to be extinguished immediately, if this gas be present in a quantity sufficient to be injurious to respiration.

* See Dr. John Davy's experiments on the blood in connection with the theory of respiration.

Azote and hydrogen, when pure, have probably as little smell as carbonic acid gas; but they are generally combined with other gases, sulphur, carbon, or phosphorus. Azote or nitrogen, formerly denominated phlogistic air, and sometimes mofette, is thrown forth largely during the decomposition of animal matter, and in a small degree during that of vegetable matter. In some gases of this kind a candle will burn freely.

Hydrogen issues also from fœcal matter and in combination with sulphur, phosphorus, and carbon, produces the chief part of the nauseating and putrid stench thrown forth from decomposing animal and vegetable substances. It is emitted in a much purer state from the sides of coal and metallic mines, and often exists in considerable abundance without being perceived by the nostrils.

The fumes of mercury, lead, and some other metalic substances, when highly concentrated, seem to produce effects not very dissimilar to those of carbonic acid.

The fumes of charcoal are generally inhaled in a diluted form, but they are still highly deleterious, and produce asphyxy more or less complete, according to their degree of concentration, and, in some cases, according to the degree of strength or weakness of frame of those who are exposed to them. We have a striking illustration of this in a case communicated by Dr. Babington, to the Medico-Chirurgical Society. Two persons had gone to bed in a room, the atmosphere of which was strongly impregnated with carbonic acid gas, arising from a charcoal fire kept up during the whole night. Now, according to the principles just stated, we ought here, from the dilution of the vapour, to expect that whatever tendency there might be to asphyxy would be united with a disposition to apoplexy: and such we find to have been the fact; for of these two persons, the youngest and less vigorous, a boy of thirteen, died apparently during his sleep, and without commotion; while the elder and more robust, a man of thirty-eight, was found, in the morning, between six and seven, in an apoplectic state, with a swollen

projecting tongue, suffused and prominent eyes, and laborious breathing.

The patient, if any degree of sensibility remain, should in this variety of asphyxia be freely exposed to the open air, instead of a heated atmosphere, as in the preceding; and if he can swallow, moderately stimulating drinks may be given. If insensible, cold water should be dashed on the face; aromatic vinegar or spirits of hartshorn applied to the nostrils, and stimulating injections given, as recommended under the first variety. The lungs should be artificially inflated, and if oxygen can be immediately procured, there is no objection to giving it a trial. A proper use of voltaic electricity is also, in many cases, found highly serviceable. No advantage, however, is likely to accrue from passing the electric aura across the chest, directly through the heart and lungs, which is a common practice. The fluid should be transmitted along the course of the nerves of the muscles of respiration, as from the phrenic nerve in the neck, towards the diaphragm, or from the pneumo-gastric and great sympathetic nerves, immediately under the sterno-mastoid muscle, where they lie in a common sheath. In Dr. Babington's case, the application of voltaic electricity surprisingly increased the power of the muscles of respiration, but appeared rather to diminish the action of the heart. It was hence used alternately with a forcible inhalation of oxygen gas, and various external stimulants. Venesection was tried, but does not seem to have been beneficial. The man recovered in a few days.

In the *third, or electric variety*, the system appears to be suddenly exhausted of all its nervous power, like a Leyden vial on the application of the discharging rod: in consequence the limbs are flexible, the countenance pale, and the blood uncoagulable. The mode in which the electricity is communicated is of little importance, for, if sufficiently powerful for the purpose, real or apparent death is instantly produced, whether the stroke flow from an electric battery or a voltaic trough; and every organ is equally exhausted of its vital power.

It is singular that while small doses of electricity prove a

powerful stimulus to the nervous functions, incaease the development of sensorial power, and augment the irritability of the muscles, a violent shock, as we have just seen, exhausts the nervous system instantaneously, and leaves the muscular fibres flaccid and insusceptible of stimulation. These singular effects are extended to the blood in both cases ; for its coagulability, or the firmness of its texture, is increased by the application of small doses of electricity, while the shock of lightning, which destroys the contractility of the muscles, render the blood loose and uncoagulable.

The general principle of medical treatment has been laid down under the first variety. Stimulants of the most active kind should be resorted to without loss of time ; but of all stimulants, that of electricity, or voltaism, seems to be especially called for in the present modification of asphyxy. It has not been tried to any great extent in the variety before us, on the human subject, but Abildguard, in the Transactions of the Copenhagen Medical Society, has related a few experiments on other animals, that are well worthy of attention. The experiments were principally made on cocks and hens. These were first asphyxiated, or apparently deprived of life, by a strong shock of electricity passed through the head ; and afterwards recovered by another shock, passed through from the chest to the back, the animal walking about as if nothing had happened. M. Abildguard does not say what interval he allowed between the shocks thus administered ; but he observed, that where no second shock was employed, the apparent was converted into real death ; for the animal, in no instance, showed any token of resuscitation; and he observed farther, that if the second shock were thrown through the head, like the first, instead of being directed from the chest towards the back, the same lifelessness continued, and no benefit whatever was produced.

In *frost-bitten asphyxy*, or that produced by intense cold, the limbs are rigid and the countenance pale and shrivelled. This variety is always preceded by an insurmountable desire to

sleep, which the utmost exertions of the will is unable to counteract. The sleep in most cases terminates in death.

For these symptoms it is easy to account. Cold, so long as the living power is capable of producing a reaction, is one of the most strenuous tonics we are possessed of, and the glow that accompanies the reaction is accompanied with a feeling of high health and vigour. But if it exceed this proportion, and no reaction ensues, the contraction of the vessels on the surface is converted into a rigid spasm; the blood is driven into the interior, and the surface must necessarily be pale. In this extremity of temperature, moreover, cold, instead of being a tonic, is a most formidable sedative; it carries off the heat of the body far more rapidly than it can be recruited, and effectually exhausts the system of its irritability and sensorial power. But such exhaustion is a cause of stupor or sleep, and a cause so cogent, that the will is in many cases entirely incapable of resisting it.

In applying remedial means to this modification of asphyxy, great caution is necessary respecting the employment of warmth, and particularly when the limbs are rigid from the effects of frost. In this last case it will be found most advisable to commence by immersing the body for a few minutes in a bath of cold sea water, or salted water, at the same time that the lungs are inflated with air, moderately warm, and the stomach and rectum excited by gentle stimulants; for it does not follow, that because the limbs and surface of the body are frozen, the central parts have suffered to the same extent. After a short immersion in sea-water, the body should be taken out, wiped perfectly dry, laid in flannel in a moderately warm room, and submitted to the friction of warm hands, several persons being simultaneously engaged in this process.