ON THE
EFFECT OF TEMPERATURE
IN CAUSING
REFLEX ACTIONS,

AND ON THE INFLUENCE,
AS A REMEDY, WHICH IT THENCE
DERIVES.

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It may be stated as a principle, that wherever physical irritation operates in occasioning reflex actions, temperature will avail also; and I have generally found that the latter has the greater efficacy, probably because it affects a larger extent of surface, and therefore more incident nerves are stimulated at one time.

The various muscular actions which temperature originates, when applied to the cutaneous or mucous membranes, are very numerous; some of them are amongst the most familiar of events, but are not the less worth considering on that ground. The fact that a dash of cold water will recover a person from a state of syncope is a beautiful and important truth; and it is in great measure owing to our knowledge of it that that singular phenomenon strikes us with no terror, though it bears so exact a similitude to death. The remedy is always at hand and ever efficacious. It is applied, and in a moment, breathing, and with it consciousness, the action of the senses, the power of volition, the expression of life are restored entirely.

In coma succeeding to convulsion the use of this measure will sometimes be equally striking in its result. A short time since I was called to a child whom a fit had left perfectly insensible; indeed, there was no sign of life; not the slightest respiratory movement was visible; no pulse could be detected, and the features were pale and deathlike. The respiratory, circulatory, and cerebral functions, and all the signs of animation, were instantly renewed by cold affusion. Here it may be inquired whether life would have been preserved had not respiration been provoked either in this or some other manner? Would the patient have rallied if left to himself, with bystanders looking on with consternation and doing nothing, because ignorant of what to do? Do not convulsions oftener end fatally than is supposed from no efficient stimulus being had recourse to when they bring on insensibility? Coma, though it may result from functional causes as well as from organic change or injury, is never to be regarded as a light occurrence; and when attended by a cessation of the respiration and circulation, it must be viewed as a temporary, too easily convertible into a permanent death. The mechanism of the body may be unim-

paired, but who can restore its action after a too long rest?

In narcotic poisoning, also, the same application is indicated urgently, but here it must be perseveringly repeated, not relinquished on a little trial. The great source of danger clearly consists in the blood being no longer duly oxygenated, through deficient or temporarily suspended breathing. The brain, therefore, becomes doubly influenced,—primarily, by the narcotic, secondly, by venous blood. In an instance which I witnessed under the care of Mr. West, of Tunbridge, occurring in an infant who had accidentally swallowed a large quantity of opium, and was so affected by it that there was the completest coma, a pallid countenance, livid lips, and fearful pauses in the respiration and circulation, this remedy was given a fair trial. No sooner was it used than inspiration followed, and scarcely was it desisted from ere it became needful to resort to it again. Friction was had recourse to at intervals, that the warmth of the surface might be preserved. A sort of artificial respiration was kept up until natural breathing returned, and the cerebrum awoke from its lethargy. The nerves of the skin were made to play that part, which under ordinary circumstances the vagi nerves perform (through the stimulus of carbonic acid), and so life was continued, and a perfect recovery ensued.

In cases where prussic acid has been administered, and the frame is influenced by that deadly poison, a valuable auxiliary will be found in cold affusion, to chlorine, ammonia, artificial respiration, &c.; Herbst, Orfila, and others, speak highly of its powers.

In the cases of persons to all appearance dead, heat and cold are powerful measures in arousing the respiratory system; but they are not to be regarded as substitutes for other methods of resuscitation, so much as allies to them. The *first* remedy at hand must be put in force immediately; there must be no wavering. It has been somewhat humorously remarked by Dr. Fothergill, in regard to the comparative value of inflation by the mouth and bellows, that the former is preferable (among other reasons) “as the bellows may not be at hand.”

The value of temperature in congenital asphyxia is admitted universally; one dash of cold water will suffice sometimes to excite breathing where it is delayed.

I think that most physiologists must concur with Dr. Marshall Hall in the opinion that the *first* act of inspiration in the newborn infant is excited through the fifth and spinal nerves, by the impression of the cold air. In breech presentations the hand of the person assisting in the delivery may primarily produce it, from being of a temperature lower than the foetus. It was remarked by Dr. Heming that an infant which did not respire when born, breathed directly the

bedclothes were lifted up. And I have noticed movements in paraplegic limbs occasioned by their sudden exposure to the cool atmosphere, a fact which assists greatly in throwing light upon this subject. But we know that cold water readily excites inspiratory acts, and on this account, simply, it would be reasonable to conclude that cold air can do the like. Does not the same principle act in both cases, however different the medium? Cold, heat, tickling, friction, artificial inflation, &c., may become the first excitors of respiration, as the case may be; but the process is not occasioned, as that great authority, Müller, has imagined, through the impression of arterial blood on the medulla oblongata, for this view (as Dr. Hall remarks) inverts cause and effect; nor is ever "the first respiratory act *purely mechanical*, resulting from the change of position which the child undergoes at birth," as the able author of "Animal Physiology"* has affirmed.

The cold douche has been used commonly to impress the respiratory muscles in epilepsy, and it has been especially recommended in the puerperal form of it by Dr. Denman. Applied before the convulsion it may avert it; during it, it may hasten its departure. What is the rationale of its action in these cases? May it not prevent the closure of the glottis by the full and frequent inspirations it produces? or counteract and sometimes overcome the strong efforts of expiration which mark the convulsions by causing an antagonistic action of the respiratory muscles?

Cold acts upon the uterus like a charm, and in cases of flooding has saved the lives of many women. I have found it efficacious in retention of the placenta, and think that its application would sometimes make needless the introduction of the hand. The alternate action of cold and heat has been ingeniously used by my friend Mr. Simpson to occasion uterine action before delivery. The case in which he tried it was one of puerperal convulsions, in which there was a cessation of the parturient pains. He first used cold only, and found it very effective for a time, but the skin became chilled by its continued application, and it would act as an excitant no longer. "Accordingly," he says, "warm flannels were applied to restore the temperature, and then cold water was used again with decided effect." This is an example of the good result of distant degrees of temperature; in vain are heat and cold applied separately in some instances, where their alternate action would avail. Dr. Marshall Hall well observes, in relation to the nearly asphyxiated infant, "The important point to be considered is, that it is not the mere application of cold, but the sud-

den application of *cold* to a *warm* surface, which is the effectual means of exciting respiration. It is the *sudden alternation*." The success of temperature in Mr. Simpson's case should induce other practitioners to give it a trial where labour lingers. Perhaps it would be beneficial where it would be criminal rashness to administer the ergot, which, though a most valuable remedy when it is prescribed with judgment, has been shamefully misused.

The operation of cold as an excitor of the expulsor fibres of the bladder, has been most interestingly illustrated by Dr. Currie, in his "Medical Reports." "My friend, Dr. Ford, has mentioned to me the case of Mr. C—, of Bristol, who was instantly relieved of an obstinate stricture of the bladder, of thirty hours' duration (during all which time not a drop of water had been passed), by placing his feet on a marble slab, and dashing cold water over the thighs and legs. The effect was instantaneous; the urine burst from him in a full stream, and the stricture was permanently removed. The common remedies, particularly opium and bleeding, had been tried in vain." Facts this kind have been noticed by several other observers.

Cold will act similarly upon the rectum; when applied to the scrotum it contracts the cremaster. In a patient of Dr. Wm. Budd cold water was expelled with force upon being injected into the bladder. The first act of suction may be induced by it, as Dr. Marshall Hall has showed. It is said by Professor Müller that "contractions of the iris are produced by drawing cold water into the nostrils."*

Heat and cold are admirable tests of the excess or failure of the excito-motory power. They can be also used remedially where physical irritation is far less effective in calling it into play.

I have many times observed that temperature excites convulsive movements in paralytic limbs, where volition is extinct altogether. Sensation may be present or absent in such instances, but it has no more concern in producing the motions in the one case than in the other. The effect is often correspondent to the degree of temperature applied. In a case of hemiplegia, occurring in a child five years old, in which voluntary motion was entirely lost, sensation remaining, I noticed that the application of heat and cold alike produced reflex actions. The hand was immersed in water at the temperature of 90°, 120°, and 140°. In the first case no muscular movement was perceived; in the second there were forcible spasmodic actions; in the third they were still more violent. Dashing cold water on the face and chest occasioned convulsive movements of

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* See Dr. Baly's Translation of his Physiology, p. 614.

the paralytic limbs. In paraplegia, where no sensation could be transmitted to the brain, nor any volition from it, I have had occasion to remark the most lively reflex actions produced by temperature. The same phenomena have been witnessed by many physicians and physiologists. Their dependence on the spinal marrow and non-connection with the brain is illustrated by the following simple experiment.

Experiment 1.—I divided the spinal cord of a frog, midway between the origins of the brachial and sacral nerves. On immersing the feet in water, of about the temperature of 160°, they were violently and convulsively retracted. The brain, of course, had nothing to do with the causation of these movements. It will be seen that they depended on the spinal marrow, for on destroying this by introducing a fine wire into the vertebral canal, the muscles of the lower limbs lost their tonicity, and could no longer be provoked to contraction as before. Such a result would have been anticipated by any one who comprehends the nature of the reflex functions, and is acquainted with the experiments with which Dr. Marshall Hall has so abundantly and convincingly illustrated it. But I must call attention to another experiment which interestingly illustrates the effect of heat upon the nervous and muscular systems, premising that heat and cold are terms which are relative to the temperature of the being to which they are applied, and in making experiments this must be borne in mind.

Experiment 2.—I decapitated an eel, and excited quick and forcible spasmodic movements in its body, by placing it in water at the temperature of 120°. They were similar to those writhings which are sometimes seen in portions of this fish when they are fried, and which the ignorant think are the consequences of feeling and indications of suffering. I observed gaspings in the separated head, which ceased after awhile; these, I imagine, would not have been renewed had the head been suffered to remain at rest. I now introduced my finger into the mouth, and pushed it to the posterior part of it, but failed to excite the act of deglutition which would have followed had the excito-motory principle been vigorous, just as it occurs in the apoplectic patient when food, unconsciously to him, is conveyed backwards to the pharynx. It struck me that I could restore the reflex actions by the use of warmth, and therefore I put the head into water of about the temperature of 90°. Then there happened frequent and energetic gaspings, and the act of deglutition could be induced *by the same stimulus which was perfectly fruitless previously to the immersion.* This experiment appears to demonstrate the power of warmth as a restorative of the reflex function, in a striking manner; and here temperature operated, without

doubt, through that same principle by which it excites in cases of asphyxia, empties the bladder, and contracts the uterus.

Volition counteracts the action of cold and heat upon the true spinal system, as it does that of other stimuli. The circumstances under which they operate most fully are when it is interrupted, as in a paralytic limb; or when it is quiescent, as in a comatose patient. But the result of the antagonism which exists so evidently between the will and the excito-motory principle is the harmonious and normal action of the muscular system, which becomes deranged, not only from those excesses and disorders of the reflex function, whose source is in the cord, but also from others which primarily depend on the annihilation of cerebral influence. I have formerly treated of this part of the subject more at length.*

Lastly, I would say a word on the action of temperature, when the surface exhibits an undue excitability. A fit of epilepsy has been occasioned by washing the hands in cold water. There are diseases in which man, like a sensitive plant, starts from a touch. A movement in the very air which surrounds him is sufficient to occasion a fearful paroxysm. Both in the treatment of tetanus and hydrophobia the *sudden* application of cold must be avoided; it must be applied *continuously*, if used at all, that it may act as a sedative and not an excitant. The temperature should be preserved as equally as possible, nor should the patient be touched thoughtlessly with a cold hand, for such is the power of trivial irritants, that he sometimes beholds an insect with terror, lest it should alight upon him.

Oxford, April 22, 1843.

EPIDEMIC JAUNDICE.

ICTERUS of an epidemic character appeared in the south of France towards the end of the year 1841. At Chasselay-on-the-Saône, some miles north of Lyons, many persons became affected, after a few days of dense fog, with a general sense of lassitude and uneasiness, anorexia, and precordial anxiety; and some patients experienced violent pains in the epigastrium and right hypochondriac region. Yellowness of the surface supervened these symptoms, accompanied in those most painfully affected with disturbance of the digestive organs, though without fever; but in others it was not attended with any embarrassment of the general health. In all, however, the fæces were clay-coloured, and the urine charged with the colouring matter of bile. Among the persons affected was one child of four years old, but the major part of them consisted of adults.

* LANCET, Jan. 11, 1840.