

## **On galvanism.**

### **Contributors**

Ure, Andrew, 1778-1857.

### **Publication/Creation**

[London] : [publisher not identified], [1890] (London : Baines & Scarsbrook.)

### **Persistent URL**

<https://wellcomecollection.org/works/rzwwadbw>

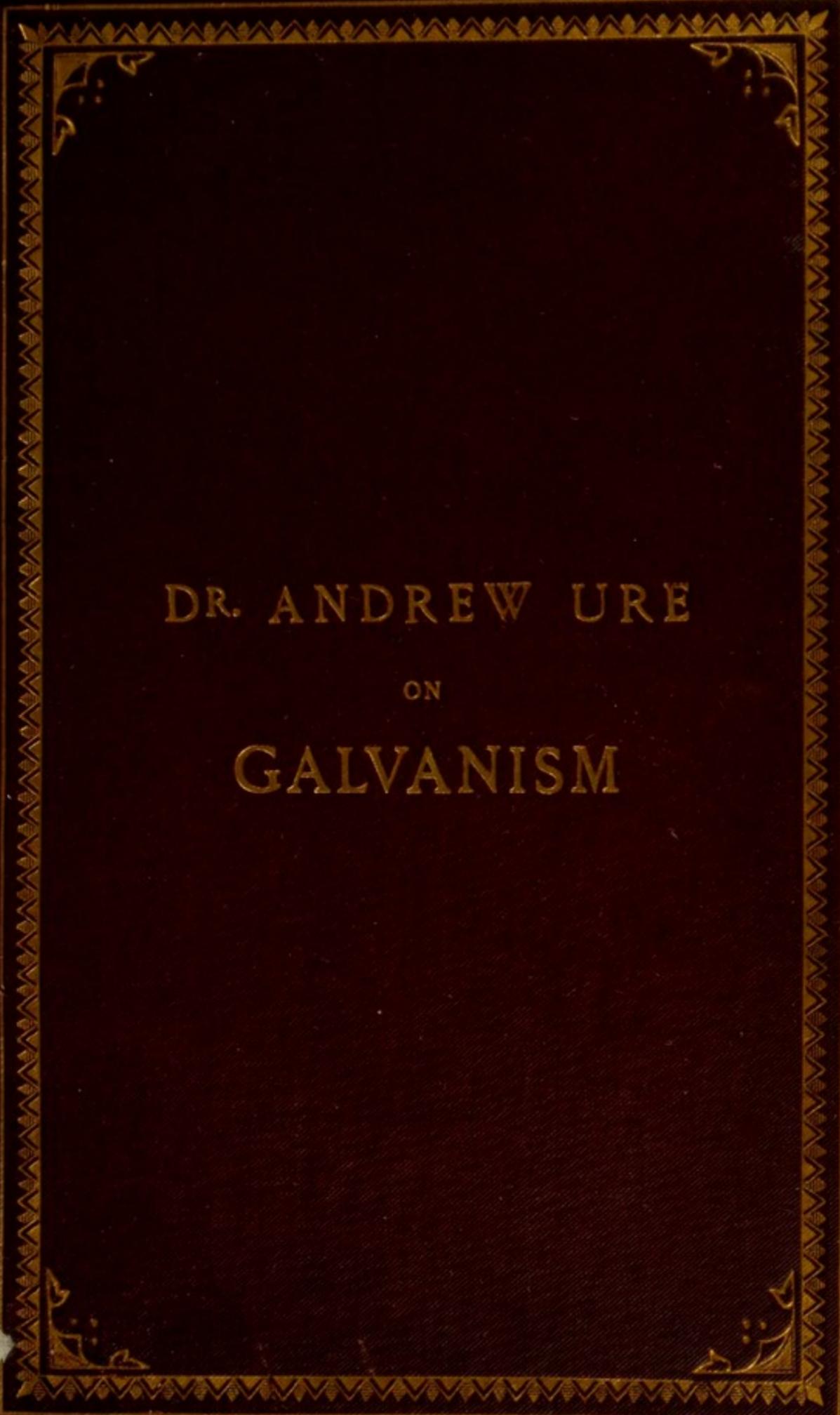
### **License and attribution**

This work has been identified as being free of known restrictions under copyright law, including all related and neighbouring rights and is being made available under the Creative Commons, Public Domain Mark.

You can copy, modify, distribute and perform the work, even for commercial purposes, without asking permission.



Wellcome Collection  
183 Euston Road  
London NW1 2BE UK  
T +44 (0)20 7611 8722  
E [library@wellcomecollection.org](mailto:library@wellcomecollection.org)  
<https://wellcomecollection.org>



DR. ANDREW URE  
ON  
GALVANISM



22102353724


Med

K35515



D<sup>r</sup> Priestley

from N. H. M.



Digitized by the Internet Archive  
in 2016

<https://archive.org/details/b28132312>





DR. ANDREW URE

(*F.R.S.—M.G.S.—M.A.S., London—M. Acad., N.S.*

*Philad.—S. Ph. Soc. N. Germ.—Hanov.—*

*Mulii., &c., &c., &c.)*

ON

## GALVANISM.

An Extract from his “Dictionary of Chemistry.”



FOR PRIVATE DISTRIBUTION.



LONDON.

20662



14796 972

WELLCOME INSTITUTE LIBRARY	
Coll.	welMOmec
Call No.	
	WL

# "GALVANISM."

EXTRACT FROM DR. URE'S "DICTIONARY OF  
CHEMISTRY."

*A Narrative of his remarkable Galvanic  
Experiments.*

DR. URE writes: "The following article is chiefly extracted from a paper, which was read by me at the Glasgow Literary Society, December 10th, 1818, and published in the *Journal of Science and the Arts*, of the following January. I have now subjoined a few further observations on the application of Voltaic Electricity to the resuscitation of the suspended functions of life."

Convulsions accidentally observed in the limbs of dead frogs originally suggested to

Galvani the study of certain phenomena, which from him have been styled Galvanic. He ascribed these movements to an electrical fluid, or power, innate in the living frame, or capable of being evolved by it, which he denominated animal electricity. The *Torpedo*, *Gymnotus*, and *Silurus Electricus*, fish endowed with a true electrical apparatus, ready to be called into action by an effort of their will, were previously known to the naturalist, and furnished plausible analogies to the Philosopher of Bologna. Volta, to whom this science is indebted for the most brilliant discoveries on its principles, as well as for its marvellous apparatus, justly called by his name, advanced powerful arguments against the hypothesis of Galvani. He ascribed the muscular commotions, and other phenomena, to the excitation of common electricity, by arrangements previously unthought of by the scientific world; merely by the mutual contact of dissimilar bodies, metals, charcoal, and

animal matter, applied either to each other, or conjoined with certain fluids. And at the present day, perhaps the only facts which seem difficult to reconcile with the beautiful theory of electromotion, invented by the Pavian Professor, are some experiments of Aldini, the nephew of the original discoverer.

In these experiments, neither metals nor charcoal were employed. Very powerful muscular contractions seem to have been excited, in some of the experiments, by bringing a part of a warm-blooded, and of a cold-blooded animal, into contact with each other; as the nerve and muscle of a frog, with the bleeding flesh of the neck of a newly-decapitated ox.

In other experiments, the nerves and muscles of the same animal seem to have operated Galvanic excitation. And again, the nerve of one animal acted with the muscle of another. He deduces from his experiments

an inference in favour of his uncle's hypothesis : that a proper animal electricity is inherent in the body, which does not require the assistance of any external agent for its development. Should we admit the reality of these results, we may, perhaps, venture to refer them to a principle analogous to Sir Humphrey Davy's pile, or Voltaic circuit, of two dissimilar liquids and charcoal. This part of the subject is, however, involved in deep obscurity.

Many experiments have been performed, in this country and abroad, on the bodies of criminals, soon after their execution. Vassili, Julio, and Rossi, made an ample set, on several bodies decapitated at Turin. They paid particular attention to the effect of Galvanic electricity on the heart, and other involuntary muscles : a subject of much previous controversy. Volta asserted, that these muscles are not at all sensible to this

electric power. Fowler maintained, that they were affected; but with difficulty and in a slight degree. This opinion was confirmed by Vassili; who further showed, that the muscles of the stomach, might thus also be excited. Aldini, on the contrary, declared, that he could not affect the heart by his most powerful galvanic arrangements.

Most of the above experiments were however made, either without a voltaic battery, or with piles, feeble in comparison with those now employed. Those indeed, performed on the body of a criminal, at Newgate, in which the limbs were violently agitated; the eyes opened and shut; the mouth and jaws worked about, and the whole face thrown into frightful convulsions, were made by Aldini, with, I believe, a considerable series of voltaic plates.

A circumstance of the first moment, in my opinion, has been too much overlooked, in

experiments of this kind,—that a muscular mass, through which the galvanic energy is directly transmitted, exhibits very weak contractile movements, in comparison with those which can be excited by passing the influence along the principal nerve of the muscle. Inattention to this important distinction, I conceive to be the principal source of the slender effects hitherto produced in such experiments on the heart, and other muscles, independent of the will. It ought also to be observed, that too little distinction has been made between the positive and negative poles of the battery ; though there are good reasons for supposing, that their powers on muscular contraction are by no means the same.

According to Ritter, the electricity of the positive pole augments, while the negative diminishes the actions of life. Tumefaction of parts is produced by the former ; depression by the latter. The pulse of the

hand, he says, held a few minutes in contact with the positive pole, is strengthened; that of the one in contact with the negative is enfeebled; the former is accompanied with a sense of heat; the latter with a feeling of coldness. Objects appear to a positively electrified eye, larger, brighter, and red; while to one negatively electrified, they seem smaller, less distinct, and bluish:—colours, indicating opposite extremities of the prismatic spectrum. The acid and alkaline tastes, when the tongue is acted on in succession by the two electricities, are well known, and have been ingeniously accounted for by Sir Humphrey Davy, in his admirable Bakerian Lectures. The smell of oxymuriatic acid, and of ammonia, are said by Ritter, to be the opposite odours, excited by the two opposite poles; as a full body of sound and a sharp tone are the corresponding effects on the ears. These experiments require verification.

Consonant in some respects, though not in all, with these statements, are the doctrines taught by a London practitioner, experienced in the administration of medical electricity. He affirms, that the influence of the electrical fluid of our common machines in the cure of disease, may be referred to three distinct heads. First, the form of *radii*, when projected from a point positively electrified; secondly, that of a star, or the negative fire, concentrated on a brass ball; thirdly, the Leyden explosion. To each of these forms he assigns a specific action. The first acts as a sedative, allaying morbid activity; the second as a stimulant; and the last has a deobstruent operation, in dispersing chronic tumours. An ample narrative of cases is given in confirmation of these general propositions. My own experience leads me to suppose, that the negative pole of a voltaic battery gives more poignant sensations than the positive.

But, unquestionably, the most precise and interesting researches on the relation between voltaic electricity and the phenomena of life, are those contained in Dr. Wilson Philip's Dissertations in the Philosophical Transactions, as well as in his Experimental Inquiry into the Laws of the Vital Functions, more recently published.

In his earlier researches he endeavoured to prove that the circulation of the blood, and the action of the involuntary muscles, were independent of the nervous influence. In a late paper, read in January, 1816, he showed the immediate dependence of the secretory functions on the nervous influence.

The eighth pair of nerves distributed to the stomach, and subservient to digestion, were divided by incisions in the necks of several living rabbits. After the operation, the parsley which they ate remained without alteration in their stomachs ; and the animals,

after evincing much difficulty of breathing, seemed to die of suffocation. But when in other rabbits, similarly treated, the galvanic power was transmitted along the nerve, below its section, to a disc of silver, placed closely in contact with the skin of the animal, opposite to its stomach, no difficulty of breathing occurred. The voltaic action being kept up for twenty-six hours, the rabbits were then killed, and the parsley was found in as perfectly digested a state as that in healthy rabbits fed at the same time ; and their stomachs evolved the smell peculiar to that of a rabbit during digestion. These experiments were several times repeated with similar results.

Hence it appears that the galvanic energy is capable of supplying the place of the nervous influence, so that, while under it the stomach, otherwise inactive, digests food as usual. I am not, however, willing to adopt the con-

clusion drawn by its ingenious author that the "identity of galvanic electricity and nervous influence is established by these experiments." They clearly show a remarkable analogy between these two powers, since the one may serve as a substitute for the other. It might possibly be urged by the anatomist, that as the stomach is supplied by twigs of other nerves, which communicate under the place of Dr. Philip's section of the *par vagum*, the galvanic fluid may operate merely as a powerful stimulus, exciting those slender twigs to perform such an increase of action, as may compensate for the want of the principal nerve.

The above experiments were repeated on dogs, with like results; the battery never being so strong as to occasion painful shocks.

The removal of dyspnœa, as stated above, led him to try galvanism as a remedy in asthma. By transmitting its influence from

the nape of the neck to the pit of the stomach, he gave decided relief in every one of twenty-two cases, of which four were in private practice, and eighteen in the Worcester Infirmary. The power employed varied from ten to twenty-five pairs.

The general inferences deduced by him from his multiplied experiments are: that voltaic electricity is capable of effecting the formation of the secreted fluids when applied to the blood in the same way in which the nervous influence is applied to it; and that it is capable of occasioning an evolution of caloric from arterial blood. When the lungs are deprived of the nervous influence, by which their function is impeded, and even destroyed, when digestion is interrupted, by withdrawing this influence from the stomach, these two vital functions are renewed by exposing them to the influence of a galvanic trough. "Hence," says he, "galvanism

seems capable of performing all the functions of the nervous influence in the animal economy; but obviously it cannot excite the functions of animal life, unless when acting on parts endowed with the living principle."

These results of Dr. Philip have been recently confirmed by Dr. Clarke Abel, of Brighton, who employed, in one of the repetitions of the experiments, a comparatively small, and in the other a considerable degree of galvanism. In the former, although the galvanism was not of sufficient power to occasion evident digestion of the food, yet the efforts to vomit, and the difficulty of breathing, constant effects of dividing the eighth pair of nerves, were prevented by it. These symptoms recurred when it was discontinued, and vanished on its re-application. "The respiration of the animal," he observes, "continued quite free during the experiment," except when the disengagement

of the nerves from the tin-foil rendered a short suspension of the galvanism necessary during their re-adjustment." "The non-galvanised rabbit breathed with difficulty, wheezed audibly, and made frequent attempts to vomit." In the latter experiment, in which the greater power of galvanism was employed, digestion went on as in Dr. Philip's experiments. Jour. Sc. ix.

M. Gallois, an eminent French physiologist, had endeavoured to prove that the motion of the heart depends entirely upon the spinal marrow, and immediately ceases when the spinal marrow is removed or destroyed. Dr. Philip appears to have refuted this motion by the following experiments:—Rabbits were rendered insensible by a blow on the occiput; the spinal marrow and brain were then removed, and the respiration kept up by artificial means; the motion of the heart and the circulation, were

carried on as usual. When spirit of wine, or opium, was applied to the spinal marrow or brain, the rate of the circulation was accelerated.

These general physiological views will serve, I hope, as no inappropriate introduction to the detail of the galvanic phenomena exhibited here (in Glasgow) on the 4th of November, in the body of the murderer Clydesdale; and they may probably guide us to some valuable practical inferences.

The subject of these experiments was a middle-sized, athletic, and extremely muscular man, about thirty years of age. He was suspended from the gallows nearly an hour, and made no convulsive struggle after he dropped; while a thief, executed along with him, was violently agitated for a considerable time.

He was brought to the anatomical theatre of our university in about ten minutes after

he was cut down. His face had a perfectly natural aspect, being neither livid, nor tumified; and there was no dislocation of his neck.

Dr. Jeffray, the distinguished Professor of Anatomy, having on the preceding day requested me to perform the galvanic experiments, I sent to his theatre with this view, next morning, my *minor* voltaic battery, consisting of 270° pairs of four-inch plates, with wires of communication, and pointed metallic rods with insulating handles, for the more commodious application of the electric power. About five minutes before the police officers arrived with the body, the battery was charged with a dilute nitro-sulphuric acid, which speedily brought it into a state of intense action. The dissections were skilfully executed by Mr. Marshall, under the superintendence of the Professor.

Exp. 1.—A large incision was made into

the nape of the neck, close below the *occiput*. The posterior half of the *atlas vertebra* was then removed by bone forceps, when the spinal marrow was brought into view. A profuse flow of liquid blood gushed from the wound, inundating the floor. A considerable incision was at the same time made in the left hip, through the great gluteal muscle, so as to bring the sciatic nerve into sight; and a small cut was made in the heel. From neither of these did any blood flow. The pointed rod connected with one end of the battery was now placed in contact with the spinal marrow, while the other rod was applied to the sciatic nerve. Every muscle of the body was immediately agitated with convulsive movements, resembling a violent shuddering from cold. The left side was most powerfully convulsed at each renewal of the electric contact. On moving the second rod from the hip to the heel, the knee being previously bent, the leg was thrown

out with such violence as nearly to overturn one of the assistants, who in vain attempted to prevent its extension.

Exp. 2.—The left *phrenic nerve* was now laid bare at the outer edge of the *sternothyroideus* muscle, from three to four inches above the clavicle; the cutaneous incision having been made by the side of the *sternocleido-mastoideus*. Since this nerve is distributed to the diaphragm, and since it communicates with the heart through the eighth pair, it was expected, by transmitting the galvanic power along it, that the respiratory process would be renewed. Accordingly, a small incision having been made under the cartilage of the seventh rib, the point of the one insulating rod was brought into contact with the great head of the diaphragm, while the other joint was applied to the phrenic nerve in the neck. This muscle, the main agent of respiration, was

instantly contracted, but with less force than was expected. Satisfied, from ample experience on the living body, that more powerful effects can be produced in galvanic excitation, by leaving the extreme communicating rods in close contact with the parts to be operated on, while the electric chain or circuit is completed by running the end of the wires along the top of the plates in the last trough of either pole, the other wire being steadily immersed in the last cell of the opposite pole, I had immediate recourse to this method. The success of it was truly wonderful. Full, nay, laborious breathing, instantly commenced. The chest heaved, and fell, with the relaxing and retiring diaphragm. This process was continued without interruption, as long as I continued the electric discharges.

In the judgment of many scientific gentlemen who witnessed the scene, this respiratory

experiment was perhaps the most striking ever made with a philosophical apparatus. Let it also be remembered, that for full half-an-hour before this period, the body had been well-nigh drained of its blood, and the spinal marrow severely lacerated. No pulsation could be perceived meanwhile at the heart or wrist; but it may be supposed, that but for the evacuation of the blood—the essential stimulus of that organ—this phenomenon might also have occurred.

Exp. 3.—The supra-orbital nerve was laid bare in the forehead, as it issues through the supra-ciliary *foramen*, in the eyebrow; the one conducting rod being applied to it, and the other to the heel, most extraordinary grimaces were exhibited every time that the electric discharges were made, by running the wire in my hand along the edges of the last trough, from the 220th to the 270th pair of plates: thus fifty shocks, each greater than the preceding one, were given in two seconds.

Every muscle in his countenance was simultaneously thrown into fearful action; rage, horror, despair, anguish, and ghastly smiles, united their hideous expression in the murderer's face, surpassing far the wildest representations of a Fuseli or a Kean.

At this period several of the spectators were forced to leave the apartment from terror or sickness, and one gentleman fainted.

Exp. 4.—The last galvanic experiment consisted in transmitting the electric power from the spinal marrow to the ulnar nerve, as it passes by the internal condyle at the elbow; the fingers now moved nimbly, like those of a violin performer; an assistant, who tried to close the fist, found the hand to open forcibly, in spite of his efforts. When the one rod was applied to a slight incision in the tip of the fore-finger, the fist being previously clenched, that finger extended instantly; and from the convulsive

agitation of the arm, he seemed to point to the different spectators, some of whom thought he had come to life.

About an hour was spent in these operations.

In deliberating on the above galvanic phenomena, we are almost willing to imagine, that if, without cutting into and wounding the spinal marrow and blood-vessels in the neck, the pulmonary organs had been set a playing at first, (as I proposed) by electrifying the phrenic nerve, (which may be done without any dangerous incision), there is a probability that life might have been restored. This event, however little desirable with a murderer, and perhaps contrary to law, would yet have been pardonable in one instance, as it would have been highly honourable and useful to science. From the accurate experiments of Dr. Philip, it appears that the action of the diaphragm and lungs is indispensable

towards restoring the suspended action of the heart and great vessels, subservient to the circulation of the blood.

It is known that cases of death-like lethargy, or suspended animation, from disease and accidents, have occurred, where life has returned, after longer interruption of its functions than in the subject of the preceding experiments. It is probable, when apparent death supervenes from suffocation with noxious gases, &c., and when there is no organic læsion, that a judiciously-directed galvanic experiment will, if anything will, restore the activity of the vital functions. The plans of administering voltaic electricity, hitherto pursued in such cases are, in my humble apprehension, very defective. No advantage, we perceive, is likely to accrue from passing electric discharges across the chest, directly through the heart and lungs. On the principles so well developed by Dr. Philip, and now illustrated on Clydesdale's body, we should

transmit along the channel of the nerves, that substitute for nervous influence, or that power which may perchance awaken its dormant faculties. Then, indeed, fair hopes may be formed of deriving extensive benefit from galvanism ; and of raising this wonderful agent to its expected rank among the ministers of health and life to man.

I would, however, beg leave to suggest another nervous channel, which I conceive to be a still readier and more powerful one, to the action of the heart and lungs, than the phrenic nerve. If a longitudinal incision be made, as is frequently done for aneurism, through the integuments of the neck at the outer edge of the *sterno-mastoideus* muscle, about half way between the clavicle and angle of the lower jaw ; then, on turning over the edge of this muscle, we bring into view the throbbing corotid, on the outside of which the *par vagum*, and great sympathetic nerve, lie

together in one sheath. Here, therefore, they may both be directly touched and pressed by a blunt metallic conductor. These nerves communicate directly or indirectly with the phrenic; and the superficial nerve of the heart is sent off from the sympathetic.

Should, however, the phrenic nerve be taken, that of the left side is the preferable of the two. From the position of the heart, the left phrenic differs a little in its course from the right. It passes over the *pericardium*, covering the *apex* of the heart.

While the point of one metallic conductor is applied to the nervous cords above described, the other knob ought to be firmly pressed against the side of the person, immediately under the cartilage of the seventh rib. The skin should be moistened with a solution of common salt, or what is better, a hot saturated solution of sal ammoniac, by which means, the electric energy will be more effectually

conveyed through the cuticle so as to complete the voltaic chain.

To lay bare the nerves above described, requires, as I have stated, no formidable incision, nor does it demand more anatomical skill, or surgical dexterity, than every practitioner of the healing art ought to possess. We should always bear in mind, that the subject of experiment is at least insensible to pain; and that life is at stake, perhaps irrecoverably gone. And assuredly, if we place the risk and difficulty of the operation in competition with the blessings and glory consequent on success, they will weigh as nothing with the intelligent and humane. It is possible, indeed, that two small brass knobs, covered with cloth moistened with solution of sal ammoniac, pressed above and below, on the place of the nerve, and the diaphragmatic region, may suffice without any surgical operation; it may first be tried.

Immersion of the body in cold water accelerates greatly the extinction of life arising from suffocation; and hence less hope need be entertained of recovering drowned persons after a considerable interval, than when the vital heat has been suffered to continue with little abatement. None of the ordinary practices judiciously enjoined by the Humane Society should ever on such occasions be neglected. For it is surely culpable to spare any pains which may contribute, in the slightest degree, to recall the fleeting breath of man to its cherished mansion.

My attention has been again particularly directed to this interesting subject, by a very flattering letter which I lately received from the learned Secretary of the Royal Humane Society.

In the preceding account, I had accidentally omitted to state a very essential circumstance relative to the electrization of

Clydesdale. The paper indeed was very rapidly written, at the busiest period of my public prelections, to be presented to the Society as a substitute for the essay of an absent friend, and was sent off to London the morning after it was read.

The positive pole or wire connected with the zinc end of the battery was that which I applied to the nerve; and the negative, or that connected with the copper end, was that which I applied to the muscles. This is a matter of primary importance, as the following experiments will prove.

Prepare the posterior limbs of a frog for voltaic electrization, leaving the crural nerves connected, as usual, to a detached portion of the spine. When the excitability has become nearly exhausted, plunge the limbs into the water of one wine glass, and the crural nerves with their pendent portion of spine into that of the other. The edges of the two glasses

should be almost in contact. Then taking a rod of zinc in one hand, and a rod of silver (or a silver teaspoon) in the other, plunge the former into the water of the limbs' glass, and the latter into that of the nerves' glass, without touching the frog itself, and gently strike the dry parts of the metals together. Feeble convulsive movements, or mere twitching of the fibres, will be perceived at every contact. Reverse now the position of the metallic rods, that is, plunge the zinc into the nerves' glass, and the silver into the other. On renewing the contact of the dry surfaces of the metal now, very lively convulsions will take place; and if the limbs are skilfully disposed in a narrowish conical glass, they will probably spring out to some distance. This interesting experiment may be agreeably varied in the following way, with an assistant operator. Let that person seize, in the moist fingers of his left hand, the spine and nervous cords of the prepared frog; and in those of the right hand,

a silver rod ; and let the other person lay hold of one of the limbs with his right hand, while he holds a zinc rod in the moist fingers of the left. On making the metallic contact, feeble convulsive twitchings will be perceived as before. Holding still the frog as above, let them merely exchange the pieces of metal. On renewing the contacts now, lively movements will take place which become very conspicuous, if one limb be held nearly horizontal, while the other hangs freely down. At each touch of the voltaic pair, the drooping limb will start up, and strike the hand of the experimenter.

It is evident, therefore, that for the purposes of resuscitating dormant irritability of nerves, or contractility of their subordinate muscles, the positive pole must be applied to the former, and the negative to the latter. I need scarcely suggest that to make the above experiments analogous to the condition of a warm-blooded animal, apparently dead, the

frog must have its excessive voltaic sensibility considerably blunted, and brought near the standard of the latter before beginning the experiments. Otherwise that animal electroscope, incomparably more delicate than the gold leaf condenser, will give very decided convulsions with either pole.















