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### Aldini's Experiments with Galvanism

From Giovanni Aldini, *An Account of the Late Improvements in Galvanism, with a series of curious and interesting experiments . . . ; to which is added an Appendix, containing the Author's experiments on the body of a malefactor executed at Newgate* (London: Cuthell and Martin, 1803). Illustrations included.

Extracts:

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Plates are taken from a copy in the Library of Congress.

Giovanni Aldini visited London in 1803, where he carried out public demonstrations of Galvanism, including the experiments on a corpse obtained from Newgate described in the Appendix. His later researches, described in *General Views on the Application of Galvanism to Medical Purposes* (London, 1819), placed greater emphasis on the medical aspects of Galvanism, such as its uses in reviving those apparently dead, as in cases of drowning ("suspended animation").

1. Preface

<P 1>

A just tribute of applause has been bestowed on the celebrated Professor Volta for his late discovery; and I have no desire to deprive him of any part of that honour to which he is so justly entitled; but I am far from entertaining an idea that we ought, on this account, to neglect the first labours of Galvani. Though these two philosophers pursued different routes, they concurred to throw considerable light on the same points of science, and the question now is, to determine which of them deduced the most just consequences from the facts he observed; and then to ascertain whether the facts established by Galvani lead to the theory of Volta, or whether those discovered by Volta are connected with the theory of Galvani. For my part, I am of opinion that these two theories may serve in an eminent degree to illustrate each other.

Last year Professor Volta announced to the public the action of the metallic pile. I here propose to exhibit, according <P 2> to the

principles of Professor Galvani, the action of the animal pile.

Such is the plan I have conceived in order to reconcile the systems of these two illustrious philosophers: it forms the object of the present work, which is divided into three parts. In the first I shall exhibit the action of Galvanism independently of metals, and explain some of its general properties. The second will contain experiments on the power of Galvanism to excite the vital forces. In the third I shall propose some useful applications of it to medicine, and explain the principles on which the new medical administration of Galvanism is founded. To render the work as methodical as possible, I have endeavoured to arrange the experiments in such a manner that they may serve as proofs to a series of general propositions, which, it is hoped, will be of use to physiology and to the doctrine of animal economy.

## 2. Experiments with animals

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### PART THE FIRST. OF THE NATURE AND GENERAL PROPERTIES OF GALVANISM.

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#### PROPOSITION I.

Muscular contractions are excited by the development of a fluid in the animal machine, which is conducted from the nerves to the muscles without the concurrence or action of metals.

#### EXPERIMENT I.

Having provided the head of an ox, recently killed, I thrust a finger of one of my hands, moistened with salt water, into one of the ears (Plate I, fig. 1.), at the same time that I held a prepared frog in the other hand, in such a manner that its spinal marrow touched the upper part of the tongue. When this arrangement was made, strong convulsions were observed in the frog; but on separating the arc all the contractions ceased.

This experiment will succeed still better if the arc be conveyed from the tongue of the ox to the spinal marrow of the frog. This method was found to be exceedingly convenient for trying the effect of Galvanism on several calves.

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#### EXPERIMENT I[I].

Having provided the trunk of a calf, I conveyed the arc from the muscles of the abdomen to the spinal marrow of a frog, prepared and arranged in the usual manner. The frog seemed much affected, and the contractions were exceedingly violent when the arc was composed of a chain of different persons, united together by the hands moistened with salt

water.

#### EXPERIMENT III.

I connected, by means of one chain of moisture, the heads of two or three calves, and observed that by this combination the force of Galvanism was exerted with more energy: a frog, which was not affected by touching one head, experienced violent contractions when applied to a series of several heads connected together.

#### EXPERIMENT IV.

I think it proper here to mention a very curious observation which I made lately at Paris, in company with professor Huzzard, and in the presence of the Commissioners of the National Institute. On applying the spinal marrow of a prepared frog to the cervical muscles of a horse's head, separated from the body, no muscular contractions took place; but if, at the same time, another person touched with his hand, & moistened by a solution of muriate of soda, the spinal marrow of the horse, convulsions were always produced in the frog, though there was no communication between the persons, except that formed by the floor on which they stood.

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#### PROPOSITION II.

The Galvanism excited, in the preceding experiments, is not owing to the communication nor the transfusion of the general electricity, but to an electricity peculiar to animals, which acts a very distinguished part in animal economy.

#### EXPERIMENT I.

Having placed the trunk of a calf (Plate I, fig. 2.) on an insulated table, I made a longitudinal incision in the breast, in order to obtain a long series of muscles uncovered. I then arranged two insulated persons in such a manner that the one with a finger, moistened with salt water, touched the spinal marrow of the calf, while the other applied the spinal marrow of a frog to the muscles of the trunk. Every time this arc was formed, muscular contractions were produced in the frog. When the two persons let go each other's hands, the contractions ceased. I repeated the experiment, with the same success, on the insulated head of an ox, conveying the arc from the spinal marrow of the frog to the tongue. Frogs were as violently affected when the experiment was made with the insulated trunks of different kinds of birds.

This experiment, in my opinion, affords a decisive proof that the Galvanic fluid is peculiar to the animal machine, independently of the influence of metals, or any other foreign cause. In these experiments, indeed, we have some animal machines, so combined that the result is strong contractions in the frog. All the bodies were insulated; and, therefore, it cannot be supposed that the contractions were occasioned by the direct influence of that general principle, which pervades every body in nature. Hence it is evident, whether it be ascribed to the action of the animal chain, formed by the arms of the persons, or to the animal pile, formed by the trunk of the calf, that we shall still be obliged to

acknowledge the action of the principle which belongs to the organization of the animal machine, without having any dependence on metals.

To prove in the animal body the existence of a principle which philosophers can by certain means excite and direct at pleasure in their experiments, is a matter of greatest importance; though the manner in which it is put in action by nature, however wonderful, is unknown to us. Here then we have developed a very energetic fluid, capable of transmission, and deriving its origin from the action of the animal forces; since the parts of the bodies separated from the common reservoir of general electricity have still of themselves the faculty of reproducing it, and of causing it to circulate in [a] manner proper for exciting muscular contractions.

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#### PROPOSITION III.

Galvanism develops itself in a powerful manner, independently of metals, by means of the human animal machine.

#### EXPERIMENT I.

If you hold in your hand, moistened with salt water, the muscles of a prepared frog, and apply the crural nerves to the tip of your tongue, you will immediately see violent contractions produced in the frog. All suspicion of any stimulant exerting an action in this case, may be removed by repeating the experiment with the frog held in the dry hand: the muscular contractions will then cease, unless the action of Galvanism in the frog, or in the animal machine, be uncommonly powerful; in which case contractions may be produced without establishing an arc from the nerves to the muscles.

#### EXPERIMENT II.

I held the muscles of a prepared frog in one of my hands, moistened with salt water, and brought a finger of the other hand, well moistened, near to the crural nerves. When the frog possessed a great deal of vitality the crural nerves gradually approached my hand, and strong contractions took <P 9> place at the point of contact. This experiment proves the existence of a very remarkable kind of attraction, observed not only by myself, but also by those whom I requested to repeat the experiment.

#### EXPERIMENT III.

The above experiment requires great precision in the preparation, and a considerable degree of vital power in the frog. I have been informed by Professor Fontana, in a letter lately received from him, that this phænomenon depends on very delicate circumstances, which he proposes to explain. He assures me, at the same time, that he has twice seen the nerve attracted, in this manner, by the muscle. Being desirous to render this phænomenon more evident, I formed the arc, by applying one of my hands to the spinal marrow of a warm-blooded animal, while I held the frog in the other, in such a manner that the crural nerves were brought very near to the abdominal muscles. By this arrangement the attraction of the nerves of the frog became very sensible. I performed this experiment for the first

time, at Oxford, before Sir Christopher Pegge and Dr. Bancroft, and repeated it in the anatomical theatres of St. Thomas's and Guy's hospitals.

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#### EXPERIMENT IV.

I made the same observations on the body of a man as I had before made on the head and trunk of an ox. Having obtained the body of an executed criminal, I formed an arc from the spinal marrow to the muscles, a prepared frog being placed between, and always obtained strong contractions without the aid of a pile, and without the least influence from metals. I obtained the same result, in a certain degree, from the bodies of men who had died a natural death.

#### EXPERIMENT V.

Let four or more persons hold each other by the hands, moistened by a solution of muriate of soda, so as to form a long animal chain. If the first hold in his hand the muscles of a prepared frog; and if the last, at the other end of the chain, touch the spinal marrow or the crural nerves, contractions will be produced: if the animal chain be broken, the contractions will immediately cease. I performed this experiment, making the animal chain to consist of two persons, before the Galvanic Society at Paris, and in Mr. Wilson's anatomical theatre, Windmill-street.

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#### PROPOSITION IV.

Muscular contractions can be excited, under certain conditions, without establishing a continued arc from the nerves to the muscles.

#### EXPERIMENT.

Having obtained the body of an executed criminal, I caused the biceps muscle to be laid bare, and brought near to it the spinal marrow of a prepared frog. By these means contractions were produced in it much stronger than I had ever obtained in warm-blooded animals. I repeated the experiment, being myself insulated, and observed no signs of contraction. The same phenomena were exhibited with the head of an ox, which possessed an extraordinary degree of vitality.

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#### PROPOSITION V.

The effects of Galvanism, in the preceding experiments, do not depend on the action of any stimulant, which occurs in performing the experiments, and ought not to be confounded with the effects of that action.

#### EXPERIMENT I.

In the experiment of the frog applied to the uncovered biceps muscle of the body of the malefactor, if any other body be made to touch the frog it will remain motionless. This proves that the contractions produced in the frog do not arise from the impulse of the mere contact of the spinal marrow with the muscle of the human animal machine.

#### EXPERIMENT II.

To remove still further all suspicion of the action of stimulants, in the preceding experiments, I prepared two frogs, and connected the extremities of one with the spinal marrow of the other. I then held in my hand the extremities <P 13> of one of the frogs, and applied the spinal marrow of the other to the uncovered muscles of the head of an ox, which possessed a great degree of vitality. By these means contractions were produced in both the frogs. It is evident, in this experiment, that the force of the stimulant, if there were any, might act on the second frog, but not on the first.

### 3. Relation of Galvanic fluid to the vital powers

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PART THE SECOND.  
ON THE INFLUENCE WHICH GALVANISM HAS ON THE  
VITAL POWERS.

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To conduct an energetic fluid to the general seat of all impressions; to distribute its influence to the different parts of the nervous and muscular systems; to continue, revive, and, if I may be allowed the expression, to command the vital powers; such are the objects of my researches, and such the advantages which I propose to derive from the action of Galvanism.

The discovery of the Galvanic pile by the celebrated Volta has served as a guide to enable me to obtain the most interesting results; and to these I have been conducted by numerous researches and a long series of experiments. I have examined the whole range of nature, and the grand family of animals has afforded me the means of making observations, highly interesting to physiology, on the whole economy of the vital powers. My experiments on this subject I shall divide into two Sections.

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#### SECTION I.

Galvanism applied to various quadrupeds, birds, and other warm-blooded animals.

#### EXPERIMENT I.

The head of an ox, recently killed, was subjected to the action of a pile (Plate II. fig. 1.) composed of fifty plates of copper and zinc, separated, as usual, by small pieces of pasteboard moistened with a solution of muriate of soda. Having moistened one of the ears with the same solution, by means of a syringe, I introduced into it one extremity of a metallic wire. I then formed an arc with this wire to the summit of the pile, and by means of another wire made communication between the bottom of the pile and the nostrils. When the apparatus was applied, the eyes were seen to open, the ears to shake, the tongue to be agitated, and the

nostrils to swell, in the same manner as those of the living animal, when irritated and desirous of combating another of the same species.

I then moistened both ears with salt water, by the same method as before, and inserted into each an extremity of one of the arcs. When the Galvanism was communicated, <P 55> the movements already described were reproduced; but they appeared to be much more violent.

#### EXPERIMENT II.

A pile composed of a hundred pieces of silver and zinc (Plate II. fig. 2.) being employed, the tongue issued from the mouth four inches, and re-entered it an inch, on each application of the arc; notwithstanding the resistance opposed by the teeth which pressed against it: so that after four or five applications of the arc it was entirely restored to its usual situation.

I repeated this curious experiment several times at Bologna and Turin, and lately at London before their Royal Highnesses the Prince of Wales, the Duke of York, the Duke of Clarence, and the Duke of Cumberland, who seemed to be much interested in my researches. I showed them that the tongue returned without being touched, merely by forming an arc between distant parts, such as the spinal marrow and the cervical or nasal muscles. A person who held the extremity of the tongue with a pair of pincers felt the effort it made to return every time the Galvanism was applied.

#### EXPERIMENT III.

With the same apparatus I suspended from the extremity of the conducting arc the posterior half of a frog, <P 56> by bending the iron wire at right angles into a small elbow; and then, instead of making the tongue touch the extremity of the arc, I brought it into contact with one of the paws of the frog, while the other extremity of the wire rested on the summit of the pile.

When this arrangement was made, I not only obtained the same contractions in the head of the ox, but I observed also that when the paw of the frog ceased to be in contact with the tongue, it was attracted by the latter, which produced in it oscillations, so that it formed a kind of Galvanometer; for the thighs of the small animal diverged more or less according to the intensity of the fluid which passed through them, and were restored to their former position when the paw of the frog and the tongue of the ox were again brought into contact. These oscillations continued about six minutes.

Suspecting, however, that the crural nerves might have some share in this phenomena, independently of the pile, I cut the nerves, and under similar conditions I obtained the same results.

#### EXPERIMENT IV.

Being desirous to repeat the above experiments on the heads of other oxen, and on those of sheep and lambs, varying the pile, both in regard to its nature and the number of pieces, I constructed three piles of twenty-five, fifty, and <P 57> a hundred and twenty pieces of silver and zinc. The results, however, differed from the preceding only in the

greater or lesser intensity of the contractions, according as one or the other apparatus was applied to the same animals. I remarked in particular, that the combination most favourable to muscular contractions is obtained, when the arc is established from the ears to the spinal marrow. In this case the eye is so much affected, that the eye-lids open entirely while the eye-ball turns round, and projects somewhat from its socket, as sometimes happens in the most violent madness.

#### EXPERIMENT V.

Having provided an ox recently killed, the head of which was not cut off, I formed an arc from one ear to the other, interposing the pile. The immediate result was a commotion so violent in all extremities of the animal, that several of the spectators were much alarmed, and thought it prudent to retire to some distance. I then cut off the head, and formed an arc from the spinal marrow, first to the diaphragm, and then to the sphincter ani. In the first case, the diaphragm experienced violent contractions; in the other I obtained a very strong action on the rectum, which even produced an expulsion of feces.

#### EXPERIMENT VI.

To give more extent to my experiments, I thought it proper <P 58> to repeat them on lambs, chickens, and other warm-blooded animals; and without enumerating such phenomena as are common, I shall only observe, that the tongue, which was projected beyond the lips, again returned to the cavity of the mouth, after several applications of the arc, as was the case of the second experiment. The movements of the ears and eye-lids were stronger than in the other parts. Comparative anatomy must explain why this phenomenon, so striking in animals of this kind, is not observed in man.

#### EXPERIMENT VII.

The observations which I have made on the Galvanism of the pile excited my curiosity so much, that I was induced to try some comparative experiments by means of common electricity. With this view I placed an iron wire in each ear of a lamb, and discharged through it twice in succession a Leyden flask, the two coatings of which were in communication with the wires applied to the ears. By these means I obtained contractions, but weaker than those produced by the pile; and I always observed the same result in other warm-blooded animals.

#### EXPERIMENT VIII.

Having repeated the same experiments on live chickens, I found, to my great surprise, notwithstanding the weakness of their organization, that they sustained with firmness the <P 59> strongest shocks, communicated several times, with a pile composed of fifty plates of silver and zinc. Though apparently dejected, and almost on the point of expiring, as soon as I interrupted the action of the pile, they fluttered their wings, and seemed to congratulate themselves on their escape from danger.

The curiosity natural to a philosopher induced me to subject these birds to anatomical dissection, that I might examine what effects had been

produced on the animal machine by these convulsions. The principle phenomena which I observed were extravasated blood in the muscles; a derangement of the humours in different parts; the intestines removed from their usual seat, and thrown towards the pelvis. At some future period, I purpose to examine how long these animals are capable of living under the continued action of Galvanism, applied to them in different ways.

#### EXPERIMENT IX.

I applied the Galvanic action to a pullet just killed, forming an arc from one of the ears to the other. When this arrangement was made, I observed contractions not only in the feet, but also in the wings and the whole animal machine. The same phenomena were produced by the same means in two other pullets. I combined the different parts of these three pullets in such a manner, that the head of the second was joined to the foot of the first, and <P 60> the head of the third to the head of the second. An arc being then formed to the two extremities of this chain of animal parts, I was much pleased to see the three pullets move their wings and their feet at the same time.

#### EXPERIMENT X.

The results of the preceding experiments led me to examine the power of an arc formed by animal moisture. For this purpose, having connected the head of two oxen, (Plate II. fig. 3.) by bringing near each other the sections of the neck, I established an arc from the summit of the pile to one of the ears of one head, and another from the base of the pile to one of the ears of the other. When this arrangement was made, I observed that both the heads exhibited evident signs of muscular contractions.

#### EXPERIMENT XI.

The trunks of two calves being united by the sections of the neck, and the arc being established by the interposition of the pile from the anus of the one to that of the other, both the trunks received, at the same time, a commotion, but not very violent. I repeated this experiment on the trunks of two lambs, but with more striking results, as all the extremities and muscles experienced violent convulsions. A glass vessel, employed for the experiments, which stood on the <P 61> table, was overturned by one of the extremities, and thrown a distance of two feet. I tried other combinations, but the contractions were weaker.

#### EXPERIMENT XII.

Having sawn open the skull, I directed the action of the pile to different parts of the brain, in the same order as they occurred in the course of anatomical dissection. All these parts appeared to be affected by Galvanic force; but its action was stronger on the corpus callosum and the cerebellum. The same result nearly was obtained, when I repeated the experiment on the heads of different calves and lambs.

#### EXPERIMENT XIII.

The heart of an ox, removed from the body, being exposed to the action of Galvanism, though the pile was very powerful, exhibited no signs

of muscular contraction. I repeated the same experiment on the heart of an ox, without removing it from the body, and on the hearts of several dogs, one arc being applied to the spinal marrow, while the other touched sometimes the surface of the heart, and sometimes penetrating into its substance; but with the same result: no muscular convulsions were produced.

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EXPERIMENT XIV.

I prepared some frogs: and having waited till the motion of the ventricles of the heart had become very slow, and almost imperceptible, I communicated to them the Galvanic influence, and it appeared to me that some movements were produced in the ventricles. I repeated the experiment lately on the heart of a rabbit, and with the same success. I could not observe any decided motion in the ventricles: but I remarked that the Galvanic power exercised a strong action on the auricles.

EXPERIMENT XV.

Without taking into consideration the differences in the action of Galvanism on the heart, according to the different applications and the different kinds of animals subjected to the experiment, I observed, that after this muscle lost its susceptibility to the action of Galvanism, the other muscles still retain it in a very high degree. This effect is very striking in regard to the heart and the muscles of oxen and dogs; and this corresponds with what has been stated by the Commissioners of the French National Institute in their Report. Speaking of the anomalies found in this respect in the heart, they conclude that it is at any rate certain that this organ loses, in a very short time, and much sooner than the other muscles, the faculty of being agitated by Galvanism.

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EXPERIMENT XVI.

All the observations I was able to make on the involuntary muscles will be found in the same Report, from which the following is an extract: "Dr. Grapengeisser says, that he saw the vermicular motion of the intestines increased by the action of Galvanism in a living subject, whose large intestines protruded beyond the abdomen, in the consequence of a scrotal hernia. Professor Aldini made us observe the same effect on the intestinal canal of a dog. We perceived also very evident contractions in a portion of the stomach, separated from the animal. We saw the auricles of the heart contract; but never found this to be the case with the ventricles."

EXPERIMENT XVII.

As I found it difficult, in the course of my travels, to obtain large animals for my experiments, a desire of prosecuting my researches induced me to be satisfied with such small animals as were easiest to be procured. I therefore declared war against the dogs, which exhibited the same phenomena as oxen, and with the greatest energy, as may be seen by the following extract from the before-mentioned Report of the Commissioners of the French National Institute: "The head of a dog being cut off, Aldini

subjected it to the action of a strong pile, by which means the most frightful convulsions were produced. The mouth opened, the teeth gnashed, the <P 64> eyes rolled in their orbits; and, if the imagination had not been restrained by reason and reflection, one might have almost believed that the animal was restored to life, and in a state of agony."

#### EXPERIMENT XVIII.

The head and trunk of a dog, separated from each other, and placed in such a manner as to leave an interval of about a foot between them (Plate II. fig. 4.), were made to move simultaneously by applying the Galvanic action to one of the ears, and to a small incision made in one of the extremities of the trunk. I saw the same effect produced in a public sitting held at Hôpital de la Charité at Paris. In this case, the distance between the head and the trunk was a foot and a half.

#### EXPERIMENT XIX.

In the preceding experiments, it is always necessary that the part of the table which forms the interval between the head and trunk should be moistened with salt water, or some other conducting fluid. Considered in this point of view, the head and trunk mutually form an arc which conducts the Galvanic action; so that the contractions excited at the same time do not depend on the particular organization of the animals subjected to experiment. This I confirmed by producing simultaneous contractions in the trunk of a dog combined with the head of a rabbit, and vice versa.

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#### EXPERIMENT XX.

At the School of Medicine at Paris, in presence of the Commissioners of the French National Institute, and of Professor Huzard, I tried the action of Galvanism on a horse which had been killed by the insufflation of air into the jugular veins. The trunk exhibited no extraordinary motion; but the head was violently agitated. A very sensible gnashing of the teeth was produced, and all the muscles performed, in a surprising manner, the same motion as is exerted during the time of mastication. There was even a visible excretion of the saliva. Of the heads hitherto tried, that of the horse exhibited the most violent motion by the action of Galvanism.

#### EXPERIMENT XXI.

Having performed this series of experiments, it was necessary that a comparison should be made, *ceteris paribus*, between the action of those stimulants proposed by the celebrated Haller, and the means here used to excite the action of Galvanism. For this purpose I employed a head weakened to such a degree that it was no longer sensible to the action of the Hallerian stimulants applied to the muscles and nerves, and then to the different parts of the <P 66> brain laid bare, and separated one from the other. I tried the action of the sulphuric and nitric acids, and the effect of the bistouri, but without ever producing the smallest contraction in warm-blooded animals: on the other hand, the action of Galvanism, on these parts, in the above state, occasioned very powerful muscular

contractions.

#### 4. Experiments on human bodies after death

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##### SECTION II.

Experiments made on human bodies after death.

From the experiments already described, one might by analogy conjecture what effect the action of Galvanism would produce on that noble being man, the sole object of my researches. But to enable philosophers to judge with more certainty respecting the effects of this wonderful agent, it was necessary to adhere to certain conditions, and to apply it immediately after death. The bodies of persons who had died of disease were not proper for my purpose; because it is to be presumed, that the development of the principle which occasions death destroys the elasticity of the fibres, and that the humours are changed from their natural to a corrupted state. It was therefore necessary to obtain the human body while it still retained, after death the vital powers in the highest degree of preservation; and hence I was obliged, if I may be allowed the expression, to place myself under the scaffold, near the axe of justice, to receive yet bleeding bodies of unfortunate criminals, the only proper subjects for my experiments. In consequence of an application made for that purpose, I obtained from Government the bodies of two brigands, who were decapitated at Bologna in the month of January 1802. As both these <P 68> individuals had been very young, and of a robust constitution, and as the parts exhibited the utmost soundness, I entertained strong hopes of obtaining the happiest results from my proposed researches. Though accustomed to a more tranquil kind of operations in my closet, and little acquainted with anatomical dissections, the love of truth, and a desire to throw some light on the system of Galvanism, overcame my repugnance, and I proceeded to the following experiments.

##### EXPERIMENT XXII.

The first of these decapitated criminals being conveyed to the apartment provided for my experiments, in the neighbourhood of the place of execution, the head was first subjected to the Galvanic action. For this purpose I had constructed a pile consisting of a hundred pieces of silver and zinc. Having moistened the inside of the ears with salt water, I formed an arc with two metallic wires, which, proceeding from the two ears, were applied, one to the summit and the other to the bottom of the pile. When this communication was established, I observed strong contractions in the muscles of the face, which were contorted in so irregular a manner that they exhibited the appearance of the most horrid grimaces. The action of the eye-lids was exceedingly striking, though less sensible in the human head than in that of an ox.

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##### EXPERIMENT XXIII.

Having established an arc from the top of the left ear, and then from the bottom of that ear to the tongue, drawn about an inch without the mouth, contractions were observed in the face, and the tongue sensibly returned into the mouth. I then touched the upper and lower lips, and obtained contractions, which were remarkable chiefly in all the muscles of the left part of the face; so that the mouth appeared as if distorted by a partial kind of palsy. On the first application of the arc, a small quantity of saliva was discharged from the mouth.

#### EXPERIMENT XXIV.

I caused the head to be shaved exactly above the parietal protuberance on the right side; and having moistened the integuments, armed with silver and zinc, I established a communication by means of the pile between the parietal bone and one of the ears. I obtained contractions, but weaker than those observed when arcs were formed according to the different methods already described.

#### EXPERIMENT XXV.

Having formed an arc from the ears to different parts of <P 70> the face, moistened with a solution of muriate of soda, such for example as the nose and forehead, I always observed violent contractions. But the contractions were stronger when, instead of the first-mentioned pile, I employed another consisting of fifty plates of copper and zinc. I even decreased the number of plates, in order that I might try, in the course of the experiments, the different degrees of activity which the pile would exhibit.

#### EXPERIMENT XXVI.

The head of the other criminal being brought to me after I had employed about half an hour in these experiments, I repeated them on the second head, and found the results to be analogous to those before obtained. But the contractions produced in the second head were stronger in consequence of its greater vitality: the vitality of the first seemed to have been nearly exhausted.

#### EXPERIMENT XXVII.

Being desirous to examine, according to the principles of Galvani, the power of the arc of animal moisture in warm-blooded animals, I recollected that I had several times observed simultaneous convulsions produced by these means in two frogs, and recently in the heads of two oxen, the arc being conveyed from one to the other in different ways.

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I placed the two heads in a straight line on a table, in such a manner that the sections of the neck were brought into communication merely by the animal fluids. When thus arranged, I formed an arc from the pile to the right ear of one head, and to the left ear of the other, and saw with astonishment the two heads make horrid grimaces; so that the spectators, who had no suspicion of such a result, were actually frightened. It was however observed, that the convulsions excited in the heads disposed in this manner, were not so strong as those produced when I

performed the experiment on each head separately. It is certain that, in this experiment, the arc of animal moisture supplies the place of a continuation of the nervous and muscular fibres.

#### EXPERIMENT XXVIII.

Having tried the effect of Galvanism on the exterior part of the head, I proceeded to examine the phenomena exhibited by the interior organs when treated in the same manner. I therefore removed the upper part of the cranium by a section parallel to its base, uncovered the pia mater, and established an arc from one of the ears to the medullary substance. On the application of the arc strong convulsions were observed in the face. While preparing the brain for my experiments, I remarked that, in dividing the muscles of the forehead, at each stroke of the dissecting knife, very strong contractions, which continued after the dissection <P 72> was finished, were excited in the muscles of the face. I was informed that this is an uncommon phenomenon in anatomical dissections; and therefore I shall leave it to the anatomists to determine whether it was occasioned, either in whole or in part, by the preceding action of the pile.

#### EXPERIMENT XXIX.

Having separated the lobes of the brain, I applied the arc to the corpus callosum, to the ears or to the lips, and found that the whole osseous box and the muscles of the face were violently agitated. Some of the spectators even imagined that the corpus callosum itself was affected by a particular convulsion; but it is possible that this emotion was owing to a mechanical impulse which shook the whole head. New experiments will, therefore, be necessary before any thing further can be said in regard to this observation.

#### EXPERIMENT XXX.

Having carried the dissection to the olfactory nerves, and even to the crossing of the optic nerves, I formed an arc from these parts to the lips and the eyes, and obtained contractions, but very weak in comparison of the preceding. I observed that on touching the optic nerves with one of the arcs no sensible convulsions were produced in the eye-lids.

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#### EXPERIMENT XXXI.

This mutilated head, which had been so long the subject of observation, was united by the plane of the section to that of the other criminal, which had not been subjected to anatomical dissection. I then applied two arcs, making one of them to communicate with the summit of the pile and the right ear of one head, and the other with the bottom of the pile and the left ear of the second head. Both heads experienced contractions similar to those described in the 27th experiment; but in the head which had already been employed they appeared to be weaker.

#### EXPERIMENT XXXII.

After these experiments on the head, I proceeded to the trunk of the second criminal, which I conceived to be most proper for my purpose.

I think it necessary here to observe, that the body had been

exposed for about an hour, in an open court, where the temperature was two degrees below zero. The muscles of the fore-arm and the tendinous parts of the metacarpus being laid bare, an arc was established from those muscles to the spinal marrow. In consequence of this arrangement, the fore-arm was raised, to the great astonishment of those who were present.

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EXPERIMENT XXXIII.

Having established an arc between the biceps muscle of each arm, which I had laid perfectly bare, I obtained similar contractions, but somewhat weaker than in the preceding case.

EXPERIMENT XXXIV.

Having laid bare the tendons of the fingers, on the back of the hand, I established an arc between that region and the spinal marrow, and obtained strong contractions in the fingers and in the whole hand.

EXPERIMENT XXXV.

Proceeding to the lower extremities, I formed an arc from the spinal marrow to the vastus internus, vastus externus, sartorius, and other muscles, and obtained strong contractions in all these muscles. Having removed the arcs and the pile, the muscles retained a small oscillatory motion, which continued for ten minutes. I observed the same phenomenon in the muscles of the neck, when I established an arc between the spinal marrow and the various other parts of the trunk.

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EXPERIMENT XXXVI.

Having applied the arc to the spinal marrow and the uncovered muscles of the under part of the tarsus of the right foot, the extensor muscles of all the toes, and particularly of the great toe, experienced very sensible contractions. I repeated the experiment with the arc applied, not to the spinal marrow, but to the uncovered muscles of the thigh, employed in the preceding experiment, and found the contractions to be much stronger. In like manner, the muscles of the soles of the feet, when I established an arc between them and the muscles of the thigh, manifested much stronger contractions than when the arc extended to any other distant part.

EXPERIMENT XXXVII.

Having examined the force of the contractions, when the arcs were applied to the surface of the muscles of the extremities, I tried what effect would be produced by introducing them into their substance. In this case, the energy of the contractions was much increased.

EXPERIMENT XXXVIII.

After trying the action of Galvanism on the extremities I <P 76> resolved to examine the trunk. With this view, having established an arc from the spinal marrow to the muscles of the diaphragm, I obtained very sensible contractions every time the arc was applied.

EXPERIMENT XXIX.

I then caused the thorax to be opened, that I might try the effects

of Galvanism on the most important of all muscles, the heart. The pericardium having been detached, I applied the conductor to the principal organ of life, and I even caused it to be opened, to examine whether there existed in any of its folds some fibre susceptible of oscillation; but my researches were fruitless. This insensibility ought, perhaps, to be ascribed to the want of a certain degree of heat and animal moisture, not to be found in the body two hours after death. It will, therefore, be proper to repeat this experiment, taking care to observe those conditions which may be necessary to ensure its success.

#### EXPERIMENT LX.

In the preceding experiment I observed that the diaphragm contracted, and that the blood, which after this phenomenon I supposed to be coagulated, flowed on the contrary from the vena cava inferior, and the jugular veins, the moment the arc was applied, and appeared of a bright red <P 77> colour. Is there reason to conjecture that, though great contractions cannot be produced, it is possible to excite in the interior parts of the heart some oscillations analogous to those which I observed in the muscles of the thigh and neck? This question can be determined only by new experiments.

#### EXPERIMENT XLI.

I observed in these experiments, that the more the points of contact of the arc with the biceps muscle were multiplied, the more the motion of the arm was extended; especially when care was taken to insulate the muscle by removing the integuments, and surrounding it with a wire bent in the form of a ring. Having applied arcs to the biceps muscle on each arm, I was much surprised to see the fore-arm and hand of each extremity, where the before-mentioned ring was placed, rise quickly to the height of about six inches.

#### EXPERIMENT XLII.

I repeated the experiment, forming the arc from the biceps muscle of the fore-arm to the spinal marrow. By these means contractions so violent were excited, that the anterior part of the arm, the whole of which lay extended in a horizontal position, rose seven inches above the plane of the table. Having placed on the palm of the hand a metallic body, such as a piece of money, the hand at first <P 78> supported it for a little time; but at a certain degree of elevation it projected it to some distance. I then substituted for the piece of money a pair of iron pincers, about half a pound in weight; but at the highest degree of elevation the contractions ceased, and the pincers fell. I observed that the weight with which the hand was loaded, diminished the elevating power of the arm very little. It may be proper to remark, that the last two experiments were performed an hour and a quarter after the execution, and those on the lower extremities almost two hours.

If this experiment were speedily repeated, in order to take advantage of the highest degree of vitality, loading the hand with different weights in succession, till the motion of the hand should be

totally impeded, I am of the opinion that an estimate might be formed of the elevating force, according to the different degrees of vitality.

In the preceding experiments I have omitted certain observations, which did not agree with those made on other warm-blooded animals. But my silence deranges no theory; and, besides, facts not sufficiently confirmed would have led me into physiological discussions of little utility, as these points can be determined only by new experiments.

It is painful to a philosopher to reflect, that this doubts cannot be cleared up until new victims shall fall under the sword of justice; but the hope that his researches may lead <P 79> to some new discovery beneficial to mankind, in a physiological point of view, lessens in a certain measure the disagreeable sensations excited by these melancholy scenes. . . .

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These gentlemen, in whose presence I performed my principal experiments, having pursued my method after my departure, made some observations which may be of great use to physiology. They had before entertained strong doubts whether the heart was susceptible of the Galvanic action, by means of simple armatures applied to the different parts of that muscle; and such irregularity had been observed in the results, that it appeared difficult to determine the question. I was therefore exceedingly happy that I had had an opportunity of exciting in others a desire to make new researches in regard to this point, of so much importance. Professors Vassalli, Giulio, and Rossi repeated and modified my experiments on the heart in such a manner, that they obtained in a man, and warm-blooded animals, contractions similar to those which I had observed only in cold-blooded animals. I wait for a detailed account of these experiments, as well as others made on decapitated criminals,\* which <P 89> were subjected to my processes. The bodies were removed to the larger hospital; and notwithstanding the long period which had elapsed between time of the execution and that when the experiments were performed, they observed almost the same phenomena.

The observations made on this criminal, that the vital powers exist so long in the body after death, induces me to hope that I shall be able to obtain similar results by the application of my method, in common cases of suspended animation. But when employed for this laudable purpose it should be modified in such a manner as to render unnecessary those operations which are so painful to humanity. On this account, I have invented a method by which muscular contractions may be produced without the least incision or separation of the muscles. It is so combined, that it cannot be rejected by the most rigorous medical jurisprudence.

EXPERIMENT LVII.

In order to try the vital force existing in the human body after death, I immersed the hand in a solution of muriate of soda, and established an arc, one of the extremities of which is made to pass round the fore-arm, while the other is brought into contact with the bottom of

the pile. I adapt to the extremity of another an elastic probe, which is applied to one of the ears, moistened by means of a <P 90> syringe with the same solution, and connect the other extremity of the arc with the summit of the pile. By this arrangement various contractions, [a]ccording to the different degrees of vitality in the bodies, are observed, sometimes in the fingers, sometimes in the hand, and sometimes in the whole arm. The fingers bend, and move in a sensible manner; and sometimes the whole of the fore-arm proceeds towards the breast. The importance of this method for determining the duration of the vital powers after death may be readily comprehended. Should means be found hereafter to make further discoveries in regard to this interesting point, physiologists may be able to determine with certainty those cases when interment ought to be retarded; and those where the good of society requires that every possible means of resuscitation should be employed. In the larger hospital of Bologna, I made several observations on this subject; and remarked in particular, how much the nature of the disease contributes, *ceteris paribus*, to produce a difference in the duration of the muscular contractions. I tried the case of death produced by putrid fevers, by pleurisies, by wounds in the pericardium, by the scurvy, and by the consequences of parturition; and I found a great difference in the degrees of vitality, according to the circumstances of the disease, the age and temperament of the individual; which confirms me in the opinion I entertain, that these experiments, if long continued without intermission by able physiologists, might be of the greatest benefit to medicine.

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These researches are not an object of mere curiosity; they seem to open an extensive field for promoting the welfare of the human race, and may be of service in cases of apparent death, occasioned by the alteration of the brain, and sometimes in cases of asphyxia. Various learned academies are entitled to great praise for having turned their attention to this subject, and for having already recommended different stimulants as proper for being used on such occasions. But I must take the liberty of requesting that in similar cases the action of Galvanism may be tried, by employing the new method here proposed. It is of great importance that the means of affording relief to the sufferings of mankind should be multiplied, and especially in cases in which the old system of medicine presents to us so few resources. In the mean time I conceive it may be useful to make some trials on animals thrown into a state of asphyxia [in] different ways. These researches may lead to valuable discoveries, and produce some light to direct us in our attempts to save the lives of men. If the encouragement I have received from the medical and philosophical world, in general, induces others to pursue the same path, it will give me great satisfaction. Galvanism is yet in its infancy; and when we reflect on the slow progress which many other branches of science have made, and how long they remain almost stationary before the full importance of them was known, it would be presumption to set bounds to that which is the

subject of the present work. For my part, I spared no pains during my short stay at Paris to exhibit my method, and <P 92> to make it publicly known. Dr. Pinel assisted at my experiments with the utmost zeal, and was witness to muscular contractions excited in the body of an old woman, who had died of malignant putrid fever. The interest which he took in my researches induced me to communicate to him several plans I had formed for giving relief to some of those unfortunate beings committed to his skill and beneficent care in the Hôpital des Foux. I pointed out to him some particular cases where the individuals, in consequence of a deep rooted melancholy, were reduced almost to a state of idiotism, and in which Galvanism seemed likely to be attested with the greatest benefit. In the last public sitting of the Institute of Bologna, at which I was present, I announced the complete cure of two lunatics performed in the Public Hospital, in the presence of many medical pupils, and with the assistance of the professors who superintend that establishment, and who are now employed in confirming my method on other patients. I am well aware that two cures are not sufficient to make operations of this kind be admitted as general remedies; but they ought to encourage physicians to prosecute this subject in order to ascertain how far Galvanism can be considered as of utility in such cases, and to endeavour by their labours to fill up the vacuity which still exist[s] in this part of medicine. I am ready to acknowledge that great caution ought to be employed in performing such experiments; and for this reason I purpose, in the third part of this present work, to lay before the reader the reflections and observations of various ingenious men who <P 93> have made this department of Galvanism an object of their researches.

##### 5. Appendix. Experiments on the body of a man executed at Newgate

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An account of the Experiments performed by J. ALDINI on the  
Body of a Malefactor executed at Newgate Jan. 17th 1803.

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##### INTRODUCTION

The unenlightened part of mankind are apt to entertain a prejudice against those, however laudable their motives, who attempt to perform experiments on dead subjects; and the vulgar in general even attach a sort of odium to the common practice of anatomical dissection. It is, however, an incontrovertible fact, that such researches in modern times have proved a source of the most valuable information, in regard to points highly interesting to the knowledge of the human frame, and have contributed in an eminent degree to the improvement of physiology and anatomy. Enlightened legislators have been sensible of this truth; and therefore it has been wisely ordained by the British laws, which are founded on the basis of

humanity and public benefit, that the bodies of those who during life violated one of the most sacred rights of mankind, should after execution be devoted to a purpose which might make some atonement for their crime, by rendering their remains beneficial to that society which they offended.

In consequence of this regulation, I lately had an opportunity of performing some new experiments, the principal object of which was to ascertain what opinion ought to be formed of Galvanism as a means of excitement in cases of asphyxia and suspended animation. The power which exists in the muscular fibre of animal bodies some time after all other signs of vitality have disappeared, had been before examined according to the illustrious Haller's doctrine of irritability; but it appeared to me that muscular action might be excited in a much more efficacious manner by the power of the Galvanic apparatus.

In performing these experiments, I had another object in view. Being favoured with the assistance and support of gentlemen eminently well skilled in the art of dissection, I proposed, when the body should be opened, to perform some new experiments which I never before attempted, and to confirm others which I had made above a year ago on the bodies of two robbers decapitated at Bologna.

To enlarge on the utility of such researches, or to point out the advantages which may result from them, is not my object at present. I shall here only observe, that as the bodies of valuable members of society are often found under similar circumstances, and with the same symptoms as those observed on executed criminals; by subjecting the latter to proper experiments, some speedier and more efficacious means than any hitherto known, of giving relief in such cases, may, perhaps, be discovered. In a commercial and maritime country like Britain, where so many persons, in consequence of their occupations at sea, on canals, rivers, in mines, are exposed to drowning, suffocation, and other accidents, this object is of the utmost importance in a public view, and is entitled to every encouragement.

Forster, on whose body these experiments were performed, was twenty-six years of age, seemed to have been of a strong, vigorous constitution, was executed at Newgate on the 17th of January 1803. The body was exposed for a whole hour in a temperature two degrees below the freezing point of Fahrenheit's thermometer; at the end of which long interval it was conveyed to a house not far distant, and, in pursuance of the sentence, was delivered to the College of Surgeons. Mr. Keate, master of that respectable society, having been so kind as to place it under my direction, I readily embraced that opportunity of subjecting it to the Galvanic stimulus, which had never before been tried on persons put to death in a similar manner: and the result of my experiments I now take the liberty of submitting to the public.

Before I conclude this short introduction, I consider it as my duty to acknowledge my obligations to MR. CARPUE, lecturer on anatomy, and MR.

HUTCHINS, a medical pupil, for <P 192> the assistance they afforded me in the dissection. I was also much indebted to MR. CUTHBERTSON, an eminent mathematical instrument maker, who directed and arranged the Galvanic apparatus. Encouraged by the aid of these gentlemen, and the polite attention of MR. KEATE, I attempted a series of experiments, of which the following is a brief account.

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#### EXPERIMENT I.

One arc being applied to the mouth, and another to the ear, wetted with a solution of muriate of soda (common salt), Galvanism was communicated by means of three troughs combined together, each of which contained forty plates of zinc, and as many of copper. On the first application of the arcs the jaw began to quiver, the adjoining muscles were horribly contorted, and the left eye actually opened.

#### EXPERIMENT II.

On applying the arc to both ears, a motion of the head was manifested, and a convulsive action of all the muscles of the face: the lips and eyelids were also evidently affected; but the action seemed much increased by making one extremity of the arc to communicate with the nostrils, the other continuing in one ear.

#### EXPERIMENT III.

The conductors being applied to the ear, and to the rectum, excited in the muscles contractions much stronger than in the preceding experiments. The action even of those <P194> muscles furthest distant from the points of contact with the arc was so much increased as almost to give an appearance of re-animation.

#### EXPERIMENT IV.

In this state, wishing to try the power of ordinary stimulants, I applied volatile alkali to the nostrils and to the mouth, but without the least sensible action: on applying Galvanism great action was constantly produced. I then administered the Galvanic stimulus and volatile alkali together; the convulsions appeared to be much increased by this combination and extended from the muscles of the head, face, and neck, as far as the deltoid. The effect in this case surpassed our more sanguine expectations, and vitality might, perhaps, have been restored, if many circumstances had not rendered it impossible.

#### EXPERIMENT V.

I next extended the arc from one ear to the biceps flexor cubiti, the fibres of which had been laid bare by dissection. This produced violent convulsions in all the muscles of the arm, and especially in the biceps and the coraco brachialis even without the intervention of salt water.

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#### EXPERIMENT VI.

An incision having been made in the wrist, among the small filaments of the nerves and cellular membrane, on bringing the arc into

contact with this part, a very strong action of the muscles of the fore-arm and hand was immediately perceived. In this, as in the last experiment, the animal moisture was sufficient to conduct the Galvanic stimulus without the intervention of salt water.

#### EXPERIMENT VII.

The short muscles of the thumb were dissected, and submitted to the action of the Galvanic apparatus, which induced a forcible effort to clench the hand.

#### EXPERIMENT VIII.

The effects of Galvanism in this experiment were compared with those of other stimulants. For this purpose, the point of the scalpel was applied to the fibres, and even introduced into the substance of the biceps flexor cubiti without producing the slightest motion. The same result was obtained from the use of caustic volatile alkali and concentrated <P 196> sulphuric acid. The latter even corroded the muscle, without bringing it into action.

#### EXPERIMENT IX.

Having opened the thorax and the pericardium, exposing the heart in situ, I endeavoured to excite action in the ventricles, but without success. The arc was first applied open the surface, then in the substance of the fibres, to the carneë columnë, to the septum ventriculorum, and lastly, in the course of the nerves by the coronary arteries, even with salt water interposed, but without the slightest visible action being induced.

#### EXPERIMENT X.

In this experiment the arc was conveyed to the right auricle, and produced a considerable contraction, without the intervention of salt water, but especially in that part called the appendix auricularis: in the left auricle scarcely any action was exhibited.

#### EXPERIMENT XI.

Conductors being applied from the spinal marrow to the fibres of the biceps flexor cubiti, the gluteus maximus, and the gastrocnemius, separately, no considerable action in the muscles of the arm and leg was produced.

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#### EXPERIMENT XII.

The sciatic nerves being exposed between the great trochanter of the femur and the tuberosity of the ischium, and the arc being established from the spinal marrow to the nerve divested of its theca, we observed, to our astonishment, that no contraction whatever ensued in the muscles, although salt water was used at both extremities of the arc. But the conductor being made to communicate with the fibres of the muscles and the cellular membrane, as strong an action as before was manifested.

#### EXPERIMENT XIII.

By making the arc to communicate with the sciatic nerve and the gastrocnemius muscle, a very feeble action was produced in the latter.

#### EXPERIMENT XIV.

Conductors being applied from the sciatic to the peronæal nerve, scarcely any motion was excited in the muscles.

#### EXPERIMENT XV.

The sciatic nerve being divided about the middle of the thigh, on applying the conductors from the biceps flexor cruris <P 198> to the gastrocnemius, there ensued a powerful contraction of both. I must here observe that the muscles continued excitable for seven hours and a half after the execution. The troughs were frequently renewed, yet towards the close they were very much exhausted. No doubt with a stronger apparatus we might have observed muscular action much longer; for, after the experiments had been continued for three or four hours, the power of a single trough was not sufficient to excite the action of the muscles: the assistance of a more powerful apparatus was required. This shows that such a long series of experiments could not have been performed by the simple application of metallic coatings. I am of the opinion that, in general, these coatings, invented in the first instance by Galvani, are passive. They serve merely to conduct the fluid pre-existent in the animal system; whereas, with the Galvanic batteries of Volta, the muscles are excited by the influence of the apparatus itself.

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From the above experiments there is reason to conclude:

I.

That Galvanism exerts a considerable power over the nervous and muscular systems, and operates universally on the whole of the animal economy.

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II.

That the power of Galvanism, as a stimulant, is stronger than any mechanical action whatever.

III.

That the effects of Galvanism on the human frame differ from those produced by electricity communicated with common electrical machines.

IV.

That Galvanism, whether administered by means of troughs, or piles, differs in its effects from those produced by the simple metallic coatings employed by Galvani.

V.

That when the surfaces of the nerves and muscles are armed with metallic coatings, the influence of the Galvanic batteries is conveyed to a greater number of points, and acts with considerably more force in producing contractions of the muscular fibre.

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VI.

That the action of Galvanism on the heart is different from that on the other muscles. For, when the heart is no longer susceptible of

Galvanic influence, the other muscles remain still excitable for a certain time. It is also remarkable that the action produced by Galvanism on the auricles is different from that produced on the ventricles of the heart, as is demonstrated in Experiment the tenth.

VII.

That Galvanism affords very powerful means of resuscitation in cases of suspended animation under common circumstances. The remedies already adopted in asphyxia, drowning, &c. when combined with the influences of Galvanism, will produce much greater effect than either of them separately.

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To conclude this subject, it may be acceptable to the reader to have a short but accurate account of the appearances exhibited on the dissection of the body, which was performed with the greatest of care and precision by Mr. Carpue.

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"The blood in the head was not extravasated, but several vessels were prodigiously swelled, and the lungs entirely deprived of air; there was a great inflammation in the intestines, and the bladder was fully distended with urine. In general, upon viewing the body, it appeared that death had been immediately produced by real suffocation."

It may be observed, if credit can be given to some loose reports, which hitherto it has not been in our power to substantiate, that after a man had been for some time suspended, means were employed with a view to put an end to his sufferings.

From the preceding narrative it will be easily perceived, that our object in applying the treatment here described was not to produce re-animation, but merely to obtain a practical knowledge how far Galvanism might be employed as an auxiliary to other means in attempts to revive persons under similar circumstances.

In cases when suspended animation has been produced by natural causes, it is found that the pulsations of the heart and arteries become totally imperceptible; therefore, when it is to be restored, it is necessary to re-establish the circulation throughout the whole system. But this cannot be done without re-establishing also the muscular powers which have <P 202> been suspended, and to these the application of Galvanism gives new energy.

I am far from wishing to raise any objections against the administration of the other remedies which are already known, and which have long been used. I would only recommend Galvanism as the most powerful mean hitherto discovered of assisting and increasing the efficacy of every other stimulant.

Volatile alkali, as already observed, produced no effect whatever on the body when applied alone; but, being used conjointly with Galvanism, the power of the latter over the nervous and muscular system is greatly increased: nay, it is possible that volatile alkali, owing to its active

powers alone, might convey the Galvanic fluid to the great with greater facility, by which means its action would become much more powerful in cases of suspended animation. The well known method of injecting atmospheric air ought not to be neglected; but here, likewise, in order that the lungs may be prepared for its reception, it would be proper previously to use Galvanism, to excite the muscular action, and to assist the whole animal system to resume its vital functions. Under this view, the experiments of which I have just given an account, may be of great public utility.

It is with heartfelt gratitude that I recall to mind the politeness and lively interest shown by members of the <P 203> College of Surgeons in the prosecution of these experiments. Mr. Keate, the master, in particular proposed to make comparative experiments on animals, in order to give support to the deductions resulting from those on the human body. Mr. Blicke observed that on similar occasions it would be proper to immerse the body in a warm salt bath, in order to ascertain how far it might promote the action of Galvanism on the whole surface of the body. Dr. Pearson recommended oxygen gas to be substituted instead of the atmospheric air blown into the lungs. It gives me great pleasure to have an opportunity of communicating these observations to the public, in justice to the eminent characters who suggested them, and as an inducement to physiologists not to overlook the minutest circumstance which may tend to improve experiments that promise to relieve the sufferings of mankind.