Observations on animal electricity : in explanation of the metallic operation of Doctor Perkins / by John Vaughan, M.P.M.S. ; fellow of the Medical Society of Delaware.

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OBSERVATIONS

ON

Animal Electricity.

IN

EXPLANATION

OF THE

METALLIC OPERATION

OF

Doctor Perkins.

BY

JOHN VAUGHAN, *M. P. M. S.*

FELLOW OF THE MEDICAL SOCIETY OF DELAWARE.

"*Who ſhall decide, when Doctors diſagree?*"

DRYDEN.

WILMINGTON—FROM THE OFFICE OF THE DELAWARE GAZETTE, BY W. C. SMYTH.

1797.

(No. 1.)

District of Delaware. } *ss.*

BE IT REMEMBERED, That on the twenty-first day of July, in the twenty-second year of the Independence of the United States of America, JOHN VAUGHAN, of the said district, hath deposited in this Office, the Title of a Book, the Right whereof he claims as Author, in the words following, viz. " OBSERVATIONS ON ANIMAL " ELECTRICITY, IN EXPLANATION " OF THE METALLIC OPERATION OF " DR. PERKINS, BY JOHN VAUGHAN, " &c." in conformity of an Act for the Encouragement of Learning, by securing Maps, Charts, and Books, to the Authors and Proprietors of such Copies, during the times therein mentioned.

I DO CERTIFY, That the above is a true Copy of the Record thereof. IN TESTIMONY whereof I have hereunto set my hand and affixed the seal of the district aforesaid, this twenty-first day of July, in the twenty-second year of the Independence of the United States of America.

L. S.

JOHN CONWAY, Clk.
Delaware District.

TO THE

AMERICAN PHILOSOPHICAL SOCIETY.

Gentlemen,

IN preliminating the following pages to the literati of America, I neceſſarily feel all that diffidence due to ſuperior knowledge, and to the patrons of that grade of exiſtence, in which I am but in embryo! I however beg the privilege of declaring, that my embarraſſment is conſiderably leſſened, by a conſciouſneſs that my appeal is made to the liberal and candid:—it is their indulgence alone, that I am ambitious to merit. The true philoſopher ever holds the balance of equity, with an unbiaſſed hand, and diſcriminates impartially between truth and error. The objects to which I ſolicit your attention, are the ſublime and intricate ſubjects of Animal Electricity, and Dr. Perkins' Metallic Operation. The former is yet too much involved in the myſtic garb of nature; and the latter is likely to form a new era in the healing art. Both of theſe are pleaſing objects of purſuit to the inquiſitive philoſopher, who is ever anxious to cultivate and mature e'en a hydra-germ of nature.

The heterogeneous contents of the following pages, (though crude and undigeſted) may perhaps excite

the attention of your expanſive minds to the further conſideration, and not improbably to the elucidation of this highly intereſting ſubject. Should I be ſo fortunate, as to have ſuggeſted a ſingle idea, or made a compilation of facts that may reflect the leaſt gleam of light thereon—I doubt not but it will flouriſh under your auſpices. And the moſt prominent feature in the character of a philoſopher induces me to hope, that your cenſure will be mild—though your deciſion may be founded on a tenacity for truth.

I am,

Gentlemen,

With the moſt profound reſpect,

Your moſt obedient humble ſervant,

THE AUTHOR.

LETTER

FROM

JAMES TILTON, M. D.

PRESIDENT of the MEDICAL SOCIETY of the STATE of DELAWARE, &c. &c.

To the AUTHOR.

DEAR SIR,

I am very glad that you have at length overcome the reſtraints of diffidence, by giving us your thoughts on Electricity, in explanation of Dr. Perkins' metallic operation.

That ſome general principle exiſts, which gives the metals a powerful influence on the Animal Œconomy, is now acknowledged by Philoſophers, the moſt candid and beſt qualified to judge of this matter. Even Meſmer, *in his application of the metals, was patronized by the ableſt Phyſicians of Germany; until he covered and obſcured thoſe ſimple facts, which ſhould have been improved for the benefit of Society, with a pile of empirical frauds, that had no object beyond the accumulation of money. Inſtead of involving* Perkins *in the diſgrace of* Meſmer, *I apprehend we ought*

rather to contraſt the honeſt man *with the* rogue: *for without art or affectation,* Dr. Perkins *barely diſcloſes uſeful facts, by means the moſt ſimple & eaſy. It muſt be confeſſed, however, that many reject our general principle. Like infidels to the Goſpel, they admit of no myſteries, and refuſe to believe what they do not comprehend. Others who acknowledge that a general principle pervades the Animal Œconomy, on which the metals have influence, nevertheleſs, diſpute about what this notable power may be. Both theſe claſſes of men ought to thank you. To the one you may give a reaſon they did not apprehend; and the other ſhould wiſh for the beſt account known or well underſtood. For my own part, I frankly confeſs I ſhall be ſatisfied with the principle of* ELECTRICITY, *until the phenomena are better explained by means of ſome other.*

By publiſhing to the World the thoughts which you have digeſted and arranged on Animal electricity, and the manner in which it explains the metallic operation, you will at leaſt invite diſcuſſion, and may profit with the reſt of your brethren, by the event.

With great reſpect, I am,
Dear Sir,
Your friend and humble ſervant,

JAMES TILTON.

Wilmington,
July 20, 1797.

To JAMES TILTON, M. D.

PRESIDENT of the MEDICAL SOCIETY

OF

DELAWARE, &c. &c.

DEAR SIR,

I hope you will permit me to expreſs the gratification I feel, in receiving your approbation to the contents of the following pages. The uniform liberality and candor, with which you have ever treated the ſubject on which they are founded, demands not only an unfeigned acknowledgment, in gratitude, from me; but merits a tribute of reſpect from every friend to ſcience.

That you may long continue our profeſſional patron, is the ſincere wiſh of

Your much obliged friend,

and moſt obedient, humble ſervant,

THE AUTHOR.

Chriſtiana,
July 21, 1797.

OBSERVATIONS

ON

Animal Electricity.

NOTHING has been ſo great an obſtacle to the advancement of Medical Science, as the partiality and obſequious regard which the generality of Phyſicians of all ages have paid to great authorities. For whilſt they diſregard the teſtimony of their ſenſes, and indolently aſſent to things on the credit of others, they remain paſſive dupes to their own credulity, and ſeldom examine whether they are right or wrong. An error thus admitted, is reluctantly corrected, and becomes the copious ſource from which numberleſs falſe opinions flow.

There are perhaps but few that are not diffident in deviating from principles eſtabliſhed by men of general erudition, whoſe geniuſes were qualified to interrogate nature with ſucceſs :— But an error once diſcovered ſhould be immediately corrected, in oppoſition to the *ipſe dixit* of all the dogmatiſts of ſeventeen centuries.— Man by nature poſſeſſes a *niſus formativus*, and

is as prone to novelty and inveſtigation, as the earth is to revolve from ungovernable laws of nature. Yet, there are few diſcoveries in the healing art but what meet with tumultuous oppoſition, from the congregated legions of prejudice, ignorance and ambition. Some nominal philoſophers diſbelieve every propoſition that does not accord with the infallible doctrines of their immaculate anceſtors; and others are ſo extremely illiberal, as to diſcard every new principle in which they can have no claim to intereſt. A glaring example of the latter we have, in the degrading denunciations of the Engliſh philoſophers, when the illuſtrious Dr. Franklin's diſcovery of the identity of Lightning and Electricity was firſt delivered to the world. A ſecond, no leſs true, we have in the diſcovery of Dr. Perkins' Metallic Operation, which will like the former ariſe triumphant amidſt the counter, but futile, vociferation of prejudice and ignorance. Some reject the latter, becauſe they were not the inventors. Others queſtion the teſtimony of their ſenſes, becauſe they cannot explain the *modus operandi* thereof, by referring it to the good old doctrines of Van Helmont, Doleus, or Stahl. Yet the happy day is perhaps not far diſtant, when envy muſt fall a ſacrifice to truth, and behold this problem accounted for, on a native law of the animal œconomy.

That the bodies of animals poſſeſt a fluid analogous to electricity, had long been ſuſpected by Phyſiologiſts and other ſpeculative philoſophers. The matter long reſted however on

pure conjecture alone, and the apparent intricacy of the ſubject depreſſed the hopes of the boldeſt experimenters. But accident not unfrequently does more for the real advancement of ſcience, than boaſted art and genius are able to accompliſh. It was accident that firſt ſuggeſted to the celebrated *Gallileo*, the conſtruction of that optical inſtrument denominated the teleſcope. It was accident that firſt led the immortal *Newton* to the original conception of that principle of gravitation, by which he afterwards explained with ſuch facility the movements and exquiſite balance of the material univerſe. It was alſo accident—that firſt ſuggeſted to the ingenious and induſtrious *Galvani*, the mode of experimenting with effect on the ſublime and intricate ſubject of Animal Electricity. " Whilſt Profeſſor *Galvani* was engaged in diſſecting a frog, in a room where ſome of his friends were amuſing themſelves with an electrical-machine, one of them drew a ſpark from the conductor, at the ſame inſtant that the profeſſor touched one of the nerves of the animal. In an inſtant the whole body of the frog was ſhook by a violent convulſion. The profeſſor was aſtoniſhed at the phenomenon, and believed it owing to his having wounded the nerve. To aſſure himſelf whether this was really the caſe or not, he pricked it with the point of his knife; he then touched the nerve with the inſtrument as at firſt, and ordered a ſpark to be taken from the machine; on which the contractions were renewed. The experiment was repeated a third

time, but the animal remained motionleſs.—However, upon perceiving that he held his ſcalpel by the handle, which was of ivory (a bad conductor) he changed it for a metallic one, and re-excited the movements, which he conſtantly failed of doing whilſt uſing an electric ſubſtance. After having made a number of experiments with the electrical machine, he reſolved to proſecute the ſubject with atmoſpherical electricity. With this view he raiſed a conductor upon the roof of his houſe, from which he brought an iron wire into his room, to this attached metal conductors, connected with the nerves of the animals deſtined to be the ſubjects of his experiments, and to their legs he tied wires which reached the floor.—Conſiderable movements were obſerved in the animals whether of cold or warm blood whenever it lightened. Theſe preceded thunder, and correſponded with its intenſity, and even took place when any ſtormy cloud paſſed over the apparatus. With ſimilar views he ſuſpended frogs on metal hooks fixed in the ſpine of the back, upon the iron railing of his garden; ſeveral times he remarked that theſe animals contracted, and appeared to receive ſhocks.—At firſt he conceived the movements were owing to changes in the atmoſphere, but a more ſcrupulous examination undeceived him.—Having placed a prepared frog upon an iron plate in his room, and happening with his diſſecting forceps to preſs it againſt the plate, he obſerved the movements to take place. This experiment ſucceeded with all metallic bodies,

but more particularly well with ſilver; non-conducting ſubſtances were not proper for it. From this period our author began to ſuſpect the animal poſſeſſed an electricity of its own; and in this ſuſpicion he confirmed himſelf, by a ſeries of experiments coincident in the reſult. And no ſooner had Profeſſor *Galvani* publiſhed to the world his experiments on animal electricity, than their fame diſpread ſwift as the intangible fluid they regarded. Dr. *Valli*, an *Italian* phyſician, was the firſt that co-operated with the celebrated *Galvani*, in inveſtigating that animal fluid the exiſtence of which had been ſo long ſuſpected, but ſo lately realized by actual experiment. After repeating the experiments of his predeceſſor, and inſtituting a ſeries of experiments ſufficiently tedious and lengthy, Dr. *Valli* conceives himſelf unequivocally authorized to conclude, that the animal fluid of *Galvani*, was entirely the ſame with the ſubtle matter of electricity. This concluſion he alledges to be the ſpontaneous and neceſſary reſult of the following poſitions, which he delivers as ſubſtantiated and confirmed by actual experiment:

" 1ſt, Subſtances which conduct electricity, are conductors likewiſe of the nervous fluid."

" 2dly, Subſtances which are not conductors of electricity, do not conduct the nervous fluid."

" 3dly, Non-conducting bodies, which acquire by heat the property of conducting electricity,

preſerve it likewiſe for the nervous fluid."

" 4thly, Cold, at a certain degree, renders water a non-conductor of electricity, as well as of the nervous fluid."

" 5thly, The velocity of the nervous fluid is as far as we can calculate, the ſame with that of electricity."

" 6thly, The obſtacles which the nerves under certain circumſtances oppoſe to electricity, they preſent likewiſe to the nervous fluid."

" 7thly, Attraction is a property of the electric fluid, and this property has been diſcovered in the nervous fluid."

Having enumerated and detailed the foregoing arguments, the Doctor, in an effuſion of triumph ſubjoins, " We here ſee the greateſt analogy between theſe fluids; nay, I may even add, the characters of their identity." As an additional ſupport to the ſame opinion, Dr. *Valli* adduces the peculiar and ſtriking phenomena exhibited by the *Torpedo*, the *Gymnotus*-electricus, the *Silurus*, &c. which he ſuppoſes to proceed from a fluid in every reſpect the ſame with that diſcovered in frogs by the profeſſor of anatomy at *Bologna*. In ſucceſſion to Dr. *Valli*, Mr. *Fowler* entered the liſt of philoſophers, in inveſtigating the ſublime but intricate ſubject of Animal Electricity. And to uſe his own words, " After," ſays he, " a great variety of experiments of which it would be unneceſſary here to relate more than the reſult, I found, that I could not excite in an

animal the appearances deſcribed by *Galvani*, with any ſubſtances whatever, whether ſolid or fluid, except the metals: and that the mutual contact of two metals with each other, ſo far as I was able to determine, was in every caſe neceſſary to the effect." And after finiſhing a ſeries of experiments, a ſeries ſufficiently numerous and diverſified for the eſtabliſhment of general principles, Mr. *Fowler* favours us with the following concluſions reſpecting the nature of the nervous fluid. When having ſtated a few analogies between the animal fluid of *Galvani*, and that of the *Torpedo*, &c. he then reverſes the compariſon and lays down ſeveral points of what he terms eſſential difference, not only between the two preceding fluids, but alſo between the fluid of *Galvani*, and the matter of electricity. "This influence," ſays he, (referring to the nervous fluid of animals) differs both from that of the *Torpedo*, &c. and from electricity, in producing no ſenſation (in man at leaſt) at all ſimilar to that of an electrical ſhock. They however produce a diſagreeable ſenſation, even in frogs, independent of that which muſt neceſſarily ariſe from irritation and muſcular contraction." But the moſt important and characteriſtic difference which I have yet diſcovered between this new influence and electricity, conſiſts in their effects upon the contractile powers of animals. Electricity has a tendency to deſtroy that power upon which contraction depends; whereas the metals have in all my experiments had the directly oppoſite effect. "Oxygene is, ſo far as I know, the

only ſtimulus in nature, whoſe effects are at all analogous.* The difference here mentioned by Mr. *Fowler*, is in my opinion merely owing to the various degrees of the powers applied, and not to any ſpecific or elementary difference in the powers themſelves. The electrical ſhock is injurious and deleterious from exceſs, but in caſes of diminiſhed mobility from paralyſis, contuſion, &c. it is not only a ſalutary but an invaluable ſtimulis, and happily fitted to reſtore the contractile powers of the ſyſtem.—From whence then ariſes this eſſential difference deſcribed by Mr. *Fowler?* It may be anſwered, that electricity is a ſalutary ſtimulis when applied in a proper degree, and injurious from exceſs alone.† Which is far from proving it to be naturally a noxious principle: for the whole claſs of natural and healthy ſtimuli, as, oxygenous gas, heat, animal food, exerciſe, ſpiritous liquors, &c. are not only injurious from exceſs, but will alſo impair the contractile powers of the ſyſtem. To illuſtrate this ſubject a little farther, I will preſent the reader

* *The effects of oxygene on the ſyſtem is ſo clearly illuſtrated in Dr.* Beddoes' *Eſſays on Pthiſis Pulmonalis, &c. that it is unneceſſary to take notice of it at preſent, further than to mention that he proves it to be the principle of irritability of the muſcular fibre.*

† *The ingenious Dr.* Abildgaard *has deprived fowls of all ſenſation and motion, by paſſing violent ſhocks through their heads; and re-animated them, by gentle ſhocks paſſed through the heart and lungs.*

with two of Mr. *Fowler*'s experiments, in his own words:

EXPERIMENT 1.

" I divided (ſays he) the ſciatic nerve of one leg, and tied the crural artery of the other in a large frog. Scarcely any blood was loſt in doing either. Two days after this, I ſtrangled it. During the firſt twenty-four hours, the leg in which the nerve had been divided, appeared to contract with the moſt vigour; after this period, the difference between them became more doubtful; but the contractions were at no time ſtronger in the leg whoſe artery was tied, than in that whoſe nerve was divided.

EXPERIMENT 2.

" The ſame operations were performed on a large female frog full of ſpawn. Four hours afterwards ſhe was covered by a male, who had been treated in a ſimilar manner. I mention this circumſtance, as it tends to prove, that the pain occaſioned by the operation, was probably not ſo great as to produce much fallacy.

" On the day following, ſhe had ſpawned, and on the ſixth day from the operation ſhe was ſtrangled. When laid upon a plate of zinc, and excited by means of a rod of ſilver, the contractions were found extremely feeble in the leg whoſe artery had been tied, and ceaſed altogether in about twenty-four hours after her death.

" In the leg whoſe nerve had been divided, they appeared as vigorous as they uſually are in legs to which no injury had been previouſly done, and continued excitable upwards of two days after they had ceaſed to be ſo in the other."

To account for the difference in the reſults of thoſe experiments, it is only neceſſary to conſider the principles upon which the contraction of muſcles depends; *i. e.* irritability and nervous energy. The firſt is more particularly the *vis muſcularis*, and ſupplied by the blood; the latter is the exciting cauſe of muſcular motion, and ſupplied by the nerves. Both principles ſuffer exhauſtion, and require continual renovation. In Experiment 1ſt, a difference was perceptible only in the firſt twenty-four hours; but in Experiment 2d, the leg whoſe nerve had been divided, continued excitable two days longer than that whoſe artery had been tied. In the firſt caſe the leg whoſe artery had been tied, was but partially deprived of its irritability, and conſequently remained ſuſceptible of its natural agent, though ſupplied by art. But in the ſecond caſe, during the abſtention of ſix days, its irritability was nearly exhauſted, and its contractions could of neceſſity be but very feeble, and of ſhort duration. Motion in animate matter depends on two principles abſtractedly diſtinct, yet practically connected. Firſt, a certain fitneſs, or capacity of being moved in the body to be put in motion; and, 2dly, the power of giving motion

in the agent or moving body. The blood furniſhes muſcles with irritability and nutrition, which completes their capacity, or prediſpoſition to be put in motion, upon the action of the *vis nervea*, whether the latter is applied thro' the medium of the nerves themſelves, or by the application of metals. But to enter a little further into the principles of muſcular motion, we find three powers eſſentially combined in conſtituting the mobility of muſcles. Firſt, Elaſticity; ſecondly, Irritability; and thirdly, Nervous Energy. The firſt may be imputed to attraction, or its effect, which is coheſion. Coheſion is that wonderful property impreſſed on matter, by which its elementary particles when they approach each other to a certain degree, termed by philoſophers its ſphere of attraction, ruſh into contact; and remain in that ſtate unleſs ſeparated by a force ſuperior to that of their attraction. Thus both ſolids and fluids do to a certain degree reſiſt the diſunion of their parts, and are capable of reſtoring their fibrils to their natural ſtate, when ſtretched or over-diſtended by a force ſuperior to that of coheſion. This elaſticity reſides in all the ſolids, but in different degrees; and being independent of the ſtate of the nerves, is termed the elaſticity of the dead fibre. The term, dead fibre, is made uſe of to diſtinguiſh certain properties ariſing from mere coheſion or mechaniſm, from thoſe that depend on the vital principle.

The *vis inſita* or irritability, is that principle by which the muſcular fibres when irritated oſcillate, contract towards the middle, becoming

by this means ſhorter and thicker, and alternately withdraw themſelves from the middle with a degree of velocity that eludes calculation.—Muſcles when dead or extracted from the bodies of living animals, retain this power a much ſhorter time than that of the dead force. * The principle of nervous energy exiſts in ſuch various degrees in different parts of the muſcular ſyſtem, that it would extend this paper to the ſize of a folio volume, to ſpecify the particular degrees thereof, in the diverſified motions of the Animal Œconomy. I ſhall therefore only take a curſory view of its offices in voluntary and involuntary motion. In the former, this energetic principle is the immediate and exciting cauſe of muſcular motion. When an impreſſion is made on the ſentient extremities of the nerves, it is immediately communicated to the brain, which reacting, produces thought, and a conſequent determination of the will; and when any part is determined by the will to be put in motion, the nerves in conſequence of a voluntary impreſſion on the ſenſorium, execute this function by ſurcharging the muſcles of the part with electricity. They, as natural electrics, can only retain a certain degree of electricity; and when more is forced into them by volition, it is of neceſſity diſcharged at their extremities in the muſcles. Thus the various

* *Dr.* Valli *informs us, that immerſion in water uniformly deſtroys the excitability of muſcles within four hours; whereas in an ordinary way, they retain it twenty-four hours.*

paſſions of the mind often afford us melancholy ſpecimens of a phyſical neceſſity being connected with our moral faculty, in producing convulſions, palpitations of the heart, aſphyxia, and not unfrequently death itſelf.

Involuntary motion is alſo dependant on the nervous energy, as the action of the heart, lungs, &c. and if a nerve is divided, the dependant part ſuffers emaciation; and the action of the arterial ſyſtem is diminiſhed, even by a compreſſion of the brain. Muſcles of involuntary motion, have fewer nerves than thoſe ſubſervient to volition, their original formation is different, and the coating and exciter, ſays Dr. *Valli*, does not produce the leaſt motion in them. Hence their different movements may very rationally be imputed to their different degrees of electricity. Voluntary muſcles require a large number of nerves, and a ſtrong charge of electricity to act in obedience to the will; while the latter require but few nerves, and a ſmall degree of this principle, to enable them to perform their more paſſive functions. The actions of the latter are however, more uniform, and conſequently their electricity exiſts but in one degree; while that of the former is poſitive and negative, and undergoing changes commenſurate with their actions. There are alſo mixed motions in the human ſyſtem, the cauſes of which are much more myſterious. On one hand there are examples of muſcles, which, for the moſt part are obedient to the will; yet in certain caſes refuſe to obey its commands.—There are alſo inſtances of muſcular functions,

which though naturally in ſubordination to the will, being performed without a conſcioufneſs of the mind. We often move our limbs when aſleep. And we have accounts of ſomnambuliſts, that not only walk, but dance and perform feats of agility in their ſleep, which they were incapable of doing when awake. Perhaps thoſe phenomena muſt be imputed to the re-action of the ſenſorium, which is excited by the imagination waking up and exhibiting before it, the image of an active and cuſtomary ſtimulus. There alſo are a few of the functions of our bodies, over which the will of itſelf has no controul, may notwithſtanding be excited and brought into action when the imagination and paſſions of the mind, act in concert with the will: aſſiſted by the plaſtic power of cuſtom. An aſtoniſhing ſpecimen thereof we have in Colonel *Townſend*, who poſſeſſed, like the ſnail and tadpole, a power of ſuſpending the action of the heart and arteries at pleaſure. But in what manner the will obtains this power, when aſſiſted by paſſion and cuſtom, I refer to the metaphyſician to determine. For I conceive that when a problem is traced to its connection between the mind and body, it has arrived to the *ultimatum* or *ne plus ultra* of phyſiological inveſtigation. There however is reſerved for the phyſiologiſt, a taſk equally difficult, in accounting for the ſpontaneous motions of the animal ſyſtem; as that of the heart from the operation of foreign ſtimuli, independent of its native ſtimulus the blood, aliment, air, &c. ſtimulate the ſtomach and primæ

viæ, urine the bladder, light the iris, &c. For the performance of ſpontaneous motion, the application of foreign ſtimuli are generally requiſite; though tranſitory ſpontaneous motions ariſe alſo from an irregular tranſmiſſion of the electroid fluid. Whenever the nerves feel a ſtimulus, the electrical fluid is excited, and its effects are manifeſted in the production of motion; and when the ſtimulus is withdrawn or ceaſes to act, another effect is produced, which is relaxation. The latter, though generally an indirect effect, (or perhaps more ſtrictly a negative condition) may notwithſtanding be directly produced by the action of certain powers denominated ſedatives; among which the *nicotiana* is probably the moſt unequivocal. In a caſe of incarcerated hernia, in which all manual attempts towards reduction were ineffectual, my worthy preceptor, Dr. *Currie*, of *Philadelphia*, concluded, that the operation alone could prevent immediate death. He directed an ounce of the *nicotiana* to be given in decoction *per injectione*; but the nurſe inattentively gave a quarter of a pound. And a ſhort time after when we returned to perform the operation, we found our patient to all appearances expiring. The Doctor, whoſe heart was never a ſtranger to ſympathy, was not a little diſtreſſed to find his patient apparently dying from the negligence of his nurſe. The event was however fortuitous. On examining the hernia, the diſtention and ſtricture were completely removed, and the protruded inteſtine was eaſily reduced without the pain

of a hazardous operation. The patient was perfectly reſtored by the aid of proper cordials.

A ſecond example of the ſedative power of tobacco I experienced myſelf. Having, from the free uſe of diluting liquids and inattention, brought on a mechanical iſchuria, I tried opium, fomentations, &c. but to no effect.—When in extreme pain, I had recourſe to a ſegar for amuſement, by which an unexpected nauſea was excited, ſucceeded by a relaxation of the ſphincter veſicæ, and an involuntary efflux of urine. Fear, which is alſo a ſedative power, will not only produce ſpontaneous convulſions or palpitations of the heart, but even death, or eventual relaxation. This viſcus is the moſt ſuſceptible of ſpontaneous motion, and will continue to act for ſome time after it is taken out of the body.

I have frequently taken out the hearts of frogs, turtles, &c. and obſerved attentively their actions. They will contract and dilate, *ſua ſponte*, for ſome time, and then ceaſe; when they may be again excited to contract, by lacerating them with a wooden or other pointed inſtrument. But when they become no longer excitable by theſe means, they may be re-excited to contract, by the irritation of a metallic inſtrument. I once obſerved a ſimilar phenomenon in an amputated leg; one of the crural muſcles contracted upon being irritated with the point of a ſcalpel. The experiment was then tried with a pointed wooden inſtrument, but to no effect. Yet on irritating it a ſecond time with the ſcalpel, it contracted

once or twice. Hence the application of metals, is one of the beſt and moſt delicate teſts for aſcertaining the leaſt poſible degrees of muſcular irritability. After having become wholly inſenſible to the impreſſions of all other ſtimuli, they may be re-excited, on the application of their native ſtimulus.

Mr. *Fermin*, Dr. *Prieſtly*, Sir *Charles Linæus*, and others, obſerve that metals are the beſt conductors of Animal Electricity, and that ſome metals are better conductors than others. Water and wood are conductors of both animal and natural electricities. Thoſe facts if conſidered impartially, certainly afford us the moſt unequivocal teſts of the analogy of Natural and Animal Electricity. But Mr. *Fowler* obſerves that the relation of Natural and Animal Electricity is the moſt equivocal in man. It however would be irrational and unphiloſophical to ſuppoſe, that nature had furniſhed ſuch a variety of animals, and even ſubjects of the inſect tribe, (for example the glow-worm) with this truly dignified property, and withheld it from the nobleſt and moſt perfect animal in the creation. Yet it muſt be admitted that the *Gymnotus*, &c. poſſeſs this property in a ſtronger degree than man. * But this does not imply a

* *Hominal Electricity may, notwithſtanding its extra modification, be rendered obvious to the ſenſes, by a very ſimple experiment. If a piece of zinc is placed on the tongue ſo that one end projects out of the mouth, and one end of a ſilver probe be placed in the internal canthus of the eye—when the inſe-*

converſe to the foregoing doctrine of gradual relationſhip. For though nature is uniform in her general law of concatenation, throughout animation, yet we find her as various in her organic modifications, as ſhe is in her nominal products. Therefore we cannot aſſign any cauſe (connected with her laws of creation) why the electricity of the human ſyſtem ſhould not be more particularly modified, than that of the *Gymnotus*, &c. Wood and water are conductors of the latter, but not of the former; at leaſt it is not yet aſcertained. And though we cannot with preciſion, ſay why nominal electricity ſhould be ſuſceptible of metals only, yet the fact is inconteſtible, and ſanctioned by the experiments of thoſe gentlemen aforementioned, whoſe veracity is unqueſtionable. It is alſo futher ſubſtantiated, by the diſcovery of Dr. *Perkins'* Metallic Inſtruments for removing pains, and topical affections. The Dr. obſerved to me, that he had made trial of all the various metals, but none are as effectual as thoſe of which his tractors are compoſed. This diſcovery is as important in the healing art, as it is novel in the ſcience of Phyſiology, and all that remains to illuſtrate the efficacy thereof, is a rational and philoſophical demonſtration of the principle itſelf, and an explanation of the *modus operandi*, on the eſtabliſhed laws of the Animal Œconomy. This however, is conſidered problematical by ſome, and by others it is

rior point of the probe is brought into contact with the zinc, an evident flaſh is produced.

poſitively diſcarded. Yet to ceaſe from inquiry, becauſe we are ſometimes miſtaken, is no greater proof of wiſdom, than to deſiſt from walking becauſe we ſometimes ſtumble. And if we only take an impartial view of the operations of nature herſelf, and attend diligently to the analytical inveſtigations of the aforementioned experimentaliſts on this ſublime ſubject, I think the ſceptic himſelf muſt admit, that the principle of nervous energy is a modification of electricity. As ſenſation is dependant upon this energy, a pleaſurable ſenſation, on what may be termed a natural or healthy degree thereof; then certainly pain or ſuperſenſation, can only depend on an accumulation of the electroid fluid, or extra degree of energy in the part affected. On this principle the problem admits of eaſy ſolution; namely, that the metals being ſuſceptible of this fluid, conduct the extra degree of energy to parts where it is diminiſhed, or out of the ſyſtem altogether, reſtoring the native law of electric equilibrium. The particular affections in which this operation is the moſt effectual, are chronic rheumatiſms, as lumbago, ſciatica, &c. odontalgia, otalgia, cephalalgia, phlegmons, cynanchies, opthalmias, pleuritic pains, ſpaſmodic cholics, burns and ſcalds, paronychiæ, contuſions, atonic gout, ſpontaneous hemorrhages, herpes, eryſipelas, &c. with many other topical affections, which might be enumerated if neceſſary.*

* *Dr. Elijah Perkins, of Philadelphia, informed me that in bilious caſes, ſuch as choleras, &c. in*

The inſtruments ſhould be carried to ſome diſtance from the part affected, along the courſe of the larger nerves; and in obſtinate or fixed pains of long ſtanding, the friction ſhould be continued until a ſlight inflammation is excited; but in eryſipelas, and other ſuperficial inflammations, the friction ſhould be very light on the inflamed part, and principally confined to the edges of the tumor. In removing pains from the head, the hair ſhould be perfectly free from pomatum or other adipoſe ſubſtances; and all parts on which the operation is performed ſhould be free from ſweat, oils, &c. In pleuriſies, cholics, &c. a diaphoreſis not unfrequently ſucceeds the operation, and ſometimes

which the uſual remedies had failed, he has effectually removed the diſorder at the ſtomach, and reſtrained the vomiting in at leaſt three caſes out of four, by operating with the tractors on the region of the ſtomach and liver. He further informed me, that he has cured periodical fevers by operating on the ſpine during the exacerbation.

It is to me not improbable, but electricity is the proximate cauſe of fever; the opinions on that ſubject are many and confuſed; and it is perhaps reſerved for ſome fortunate phyſiologiſt to decide the controverſy, by bringing this conjecture to the teſt of experiment.

Electricity is already proved by philoſophers, to be concerned in almoſt all natural phenomena, and on examining further it may poſſibly be found to be, the primum mobile *of nature, both animate and inanimate.*

faintineſs is produced, by the ſudden abſtraction of nervous energy. In a caſe of cephalalgia, if the pain is confined to the fore part of the head, it is immaterial whether the hair is pomatumed or not. A few days ſince, I awoke with a moſt rending head-ache, unaccompanied with fever, I delayed the operation ſome hours, on account of my hair being pomatum'd, but the pain became ſo inſupportable (and all the uſual applications failing) that I reſolved to make trial of the tractors, as the pain was for the moſt part in my forehead. After the operation had been continued a few minutes on my forehead, and the back of my neck, I was perfectly relieved from pain, and have remained ſo ever ſince.

It is argued by ſome, (who are oppoſed to the Metallic Operation) that the efficacy of the tractors depend merely on a counter irritation produced by friction. I would aſk thoſe dogmatiſts how metallic friction cures burns, or topical inflammations? Does not the leaſt impreſſion on an inflamed part produce pain; and would not friction augment the evil? Phlegmons, and ſome other topical inflammations, may often be removed, by exciting a counter irritation with bliſters, &c. which reſtore the equilibrium of the nervous fluid. But bliſters ſeldom anſwer any valuable purpoſe in local inflammations, accompanied with exceſſive action of the arterial ſyſtem, until the fever is previouſly diminiſhed. Neither will the Metallic Proceſs ſucceed ſo well in the acute, as in the chronic rheumatiſm, while the febrile

action remains inordinate.* This ſhews a correſpondence in effect, but the modes of operation are diametrically oppoſite. The former is by an indirect, organic proceſs; the latter by a direct and ſpecific operation. And all pretenſions towards identity, are precluded by the diverſity in their effects, on burns and phlegmons, as beforementioned. Phlegmons, and other topical affections, are owing to an internal or external irritation on the nerves of a particular part; by means of which, the veſſels of the part are alſo brought into action, and not unfrequently the whole vaſcular ſyſtem acts in concert, from a ſympathetic harmony primævally eſtabliſhed.

Spontaneous Hemorrhages, are thoſe which depend on a local exceſs of tone or electricity,

* *The partial ſucceſs of the metallic operation in febrile diſeaſes, may be rationally imputed to the limited mode of operating. For as fever is a univerſal diſorder, the* modus medendi, *muſt be general alſo.*

When local remedies are uſed in fevers, a general effect is contemplated by bringing the ſyſtem into ſympathetic action. Thus bliſters will frequently procure a criſis in continued fevers, when the uſual internal remedies have failed. And as there is often a ſpaſtic contraction of the capillary veſſels in continued fevers, the metallic operation would probably procure a ſalutary diaphoreſis, if extended over the ſurface, or even applied along the ſpine and thorax.

denominated (by the illuſtrious *Cullen*) a hemorrhagic effort.

Herpes, are the product of a morbid or exceſſive excitement in the veſſels of the cutis; the encruſtation is formed by exceſſive action. The metals remove this inordinate action, by abſtracting the extra degree of electricity. Corroſive lotions deſtroy the morbid action by corroſion, and induce or reſtore the condition for healthy action.

Burns. The ſtimulus of heat produces inflammation, by exciting and accumulating the electroid fluid.

Epilepſy is owing to an irregular diſtribution of the nervous fluid, and an accumulation thereof in the muſcles affected with ſpaſm. That this is the fact, is obvious from the preternatural ſtrength of epileptics.

Pain, is merely an accumulation of electricity, in a particular part; and the ſubſequent ſtate of eaſe is obtained by abſtracting the extra degree of ſenſibility. Hence the frequent faintings in parturition, cholics, &c. are to be imputed to a diminution of nervous energy.

In chronic pains connected with idioſyncraſy or dependant on habit, ſo that the orgaſm of the part is injured, or a mal-conformation induced by nature or accident, the Metallic Proceſs cannot be expected to ſucceed.

When ſuppuration has taken place, the tractors muſt be conſidered as mere palliatives.—This operation ſhould never be performed on the back, during the exiſtence of the catamenia. Beſides thoſe caſes in which the tractors have

already been found ſucceſsful, future experience will probably develope many others, in which the Metallic Operation will prove equally efficacious. This operation will alſo, in all probability, ſucceed better in ſome perſons than in others. For example:

Many people are remarkable for an extreme luſtre in their eyes, ſome are ſo much electrified naturally as to ſhew evident ſigns of it when a ſenſible electrometer has been applied to them, and others have manifeſted an extreme ſenſibility of even the ſmalleſt degree of electricity, inſomuch that they would be affected by a flaſh of lightning, though ſo remote that the thunder could not be heard. All this evinces that electricity ſo far from being noxious, bears a very active and ſalutary part in the Animal Œconomy, which will probably lead to more important reſearches on this intereſting ſubject, and incite future travellers to explore the remaining *terra incognita*,

F I N I S.