O'BSERVATIONS

P. 16 \$1.

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 difagree?" DRYDEN.

WILMINGTON-FROM THE OFFICE OF THE DELAWARE GAZETTE, BY

W. C. SMYTH.

1797.

Mary Street

(No. 1.)

District of J. J.

BE IT REMEMBERED, That on the twenty-firft day of July, in the twenty-fecond year of the Independence of the United States of America, JOHN VAUGHAN, of the faid diffrict, 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. FERKINS, BY JOHN VAUGHAN, "&c." in conformity of an Act for the Encouragement of Learning, by fecuring Maps, Charts, and Books, to the Authors and Proprietors of fuch Copies, during the times therein mentioned.



410074

I DO CERTIFY, That the above is a true Copy of the Record thereof. IN TESTIMONY whereof I have hereunto fet my hand and affixed the feal of the diffrict aforefaid, this twenty-first day of July, in the twenty-fecond year of the Independence of the United States of America.

> JOHN CONWAY, Clk. Delaware Diffrict.

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TO THE

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AMERICAN PHILOSOPHICAL SOCIETY.

Gentlemen,

IN preliminating the following pages to the literati of America, I neceffarily 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 embarrassiment is confiderably leffened, by a confciousness 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 unbiaffed hand, and diferiminates impartially between truth and ervor. The objects to which I folicit your attention, are the fublime and intricate fubjects of Animal Electricity, and Dr. Perkins' Metallic Operation. The former is yet too much involved in the myflic 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 philofopher, who is ever anxious to cultivate and mature e'en a bydra-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 confideration, and not improbably to the clucidation of this highly interesting subject. Should I be jo fortunate, as to have suggested a single idea, or made a compilation of facts that may refiest 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 consure will be nil! though your decision may be founded on a tenacity for truth.

I am,

Gentlemen,

With the most profound respect,

Your most obedient humlle fervant,

THE AUTIIOR.

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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 reftraints of diffidence, by giving us your thoughts on Electricity, in explanation of Dr. Perkins' metallic operation.

That fome general principle exifts, which gives the metals a powerful influence on the Animal (Economy, is now acknowledged by Philofophers, the most candid and best qualified to judge of this matter. Even Mestmer, in his application of the metals, was patronized by the allest Physicians of Germany; until he covered and obfeured those simple facts, which should have been improved for the benefit of Society, with a pile of empirical frands, that had no object beyond the accumulation of money. Influent of involving Perkins in the diffrace of Mestwer, I apprehend we ought.

rather to contrast the honest man with the rogue : for without art or affectation, Dr. Perkins barchy discloses useful facts, by means the most simple & cafy. It must be confessed, bowever, that many reject our general principle. Like infidels to the Gofpel, 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, neverthelefs, difpute 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 with for the best account known or well underflood. For my own part, I frankly confels I shall be fatisfied with the principle of ELECTRICITY, until the phenomena are better explained by means of fome other.

By publifing 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 refpect, I am, Dear Sir, Your friend and humble fervant,

> > JAMES TILTON.

Wilmington, July 20, 1797. To JAMES TILTON, M. D.

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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 pation, is the fincere with of

Your much obliged friend,

and most obedient, bumble fervant,

THE AUTHOR.

Christiana, July 21, 1797.}

OBSERVATIONS

O N

Animal Electricity.

NOTHING has been fo great an obffacle to the advancement of Medical Science, as the partiality and obfequious regard which the generality of Phyficians of all ages have paid to great authorities. For whilft they difregard the teftimony of their fenfes, and indolently atient to things on the credit of others, they remain paffive dupes to their own credulity, and feldom examine whether they are right or wrong. An error thus admitted, is reluctantly corrected, and becomes the copious fource from which numberlefs falfe opinions flow.

is as prone to novelty and investigation, as the earth is to revolve from ungovernable laws of nature. Yet, there are few difcoveries in thehealing art but what meet with tumultuous oppofition, from the congregated legions of prejudice, ignorance and ambition. Some nominal philosophers difbelieve every proposition that does not accord with the infallible doctrines of their immaculate anceftors; and others are fo extremely illiberal, as to difcard every new principle in which they can have no claim to intereft. A glaring example of the latter we have, in the degrading denunciations of the English philosophers, when the illustrious Dr. Franklin's difcovery of the identity of Lightning and Electricity was first delivered to the world. A fecond, no lefs true, we have in the difcovery of Dr. Perkins' Metallic Operation, which will like the former arife triumphant amidst the counter, but futile, vociferation of prejudice and ignorance. Some reject the latter, becaufe they were not the inventors. Others queftion the testimony of their fenses, becaufe 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 diftant, when envy must fall a facrifice to truth, and behold this problem accounted for, on a native law of the animal æconomy.

That the bodies of animals poffeft a fluid analogous to electricity, had long been fufpected by Phyfiologifts and other fpeculative phiiofophers. The matter long refted however on

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pure conjecture alone, and the apparent intricacy of the fubject depretfed the hopes of the bolleft experimenters. But accident not unfrequently does more for the real advancement of science, than boafted art and genius are able to accomplish. It was accident that first fuggested to the celebrated Gallileo, the construction of that optical inftrument 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 fuch facility the movements and exquifite balance of the material universe. It was also accident-that first fuggefted to the ingenious and industrious Galvani, the mode of experimenting with effect on the fublime and intricate fubject of Animal Electricity. "Whilft Profeffor Galvani was engaged in diffecting a frog, in a room where fome of his triends were amufing themfelves with an electrical-machine, one of them drew a fpark from the conductor, at the fame inftant that the professor touched one of the nerves of the animal. In an initant the whole body of the frog was fhook by a violent convulfion. The professor was astonished at the phenomenon, and believed it owing to his having wounded the nerve. To affure himfelf whether this was really the cafe or not, he pricked it with the point of his knife; he then touched the nerve with the inffrument as at first, and ordered a fpark to be taken from the machine; on which the contractions were renewed. The experiment was repeated a third

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time, but the animal remained motionlefs .--However, upon perceiving that he held his fcalpel by the handle, which was of ivory (a bad conductor) he changed it for a metallic one, and re-excited the movements, which he conftantly failed of doing whilft using an electric substance. After having made a number of experiments with the electrical machine, he refolved to profecute the fubject with atmofpherical electricity. With this view he raifed 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 defined to be the fubjects of his experiments, and to their legs he tied wires which reached the floor .--Confiderable movements were obferved 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 formy cloud paffed over the apparatus. With fimilar views he fulpended frogs on metal hooks fixed in the fpine of the back, upon the iron railing of his garden; feveral times he remarked that thefe animals contracted, and appeared to receive flocks .--At first he conceived the movements were owing to changes in the atmosphere, but a more ferupulous examination undeceived him. -Having placed a prepared frog upon an iron plate in his room, and happening with his diffecting forceps to prefs it against the plate, he obferved the movements to take place. This experiment fucceeded with all metallic bodies,

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but more particularly well with filver; nonconducting fubitances were not proper for it. From this period our author began to fufpect the animal poficifed an electricity of its own; and in this fufpicion he confirmed himfelf, by a feries of experiments coincident in the refult. And no fooner had Profeffor Galvani published to the world his experiments on animal clectricity, than their fame difpread fwift as the intangible fluid they regarded. Dr. Valli, an Italian phyfician, was the first that co-operated with the celebrated Galvani, in inveftigating that animal fluid the existence of which had been fo long fuspected, but fo lately realized by actual experiment. After repeating the experiments of his predeceffor, and inftituting a feries of experiments fufficiently tedious and lengthy, Dr. Valli conceives himfelf unequivocally authorized to conclude, that the animal fluid of Galvani, was entirely the fame with the fultle matter of electricity. This conclufion he alledges to be the fpontaneous and neceffary refult of the following politions, which he delivers as fubfiantiated and confirmed by actual experiment :

- " 1ft, Substances which conduct electricity, are conductors likewife of the nervous fluid."
- " 2dly, Subflances 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,

preferve it likewife for the nervous fluid."

- " 4thly, Cold, at a certain degree, renders water a non-conduor of electricity, as well as of the nervous fluid."
- " 5thly, The velocity of the nervous fluid is as far as we can calculate, the fame with that of clectricity."
- " 6thly, The obftacles which the nerves under certain circumftances oppofe to electricity, they prefent likewife to the nervous fluid."
- " 7thly, Attraction is a property of the electric fluid, and this property has been difcovered in the nervous fluid."

Having enumerated and detailed the foregoing arguments, the Doctor, in an effusion of triumph fubjoins, " We here fee the greatest analogy between these fluids; nay, I may even add, the characters of their identity." As an additional fupport to the fame opinion, Dr. Valli adduces the peculiar and firiking phenomena exhibited by the Torpedo, the Gymnotus-clectricus, the Silurus, &c. which he fuppofes to proceed from a fluid in every refpect the fame with that difcovered in frogs by the profeffor of anatomy at *Bologna*. In fucceffion to Dr. *Valli*, Mr. *Fowler* entered the lift of philofophers, in inveftigating the fublime but intricate fubject of Animal Electricity. And to use his own words, "After," fays he, "a great variety of experiments of which it would be unneceffary here to relate more than the refult, I found, that I could not excite in an

animal the appearances defcribed by Galvani, with any fubstances whatever, whether folid or fluid, except the metals : and that the mutual contact of two metals with each other, fo far as I was able to determine, was in every cafe neceffary to the effect." And after finishing a feries of experiments, a feries fufficiently 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 flated a few analogies between the animal fluid of Galvani, and that of the Torpedo, &c. he then reverfes the comparifon and lays down feveral points of what he terms effential difference, not only between the two preceding fluids, but alfo between the fluid of Galvani, and the matter of electricity. " This influence," fays he, (referring to the nervous fluid of animals) differs both from that of the Torpedo, &c. and from electricity, in producing no fenfation (in man at least) at all fimilar to that of an electrical fhock. They however produce a difagreeable fenfation, even in frogs, independent of that which must necessarily arife from irritation and mufcular contraction." But the most important and characterific difference which I have yet difcovered between this new influence and electricity, confitts in their effects upon the contractile powers of animals. Electricity has a tendency to deftroy that power upon which contraction depends; whereas the metals have in all my experiments had the directly oppofite effect. "Oxygene is, fo far as I know, the

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only fimulus in nature, whole 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 fpecific or elementary difference in the powers themfelves. The electrical fhock is injurious and deleterious from excefs, but in cafes of diminished mobility from paralysis, contufion, &c. it is not only a falutary but an invaluable ftimulis, and happily fitted to reftore the contractile powers of the fystem .--From whence then arifes this effential difference defcribed by Mr. Foreler? It may be anfwered, that electricity is a falutary ftimulis when applied in a proper degree, and injurious from excels alone.+ Which is far from proving it to be naturally a noxious principle: for the whole clafs of natural and healthy ftimuli, as, oxygenous gas, heat, animal food, exercife, fpiritous liquors, &c. are not only injurious from excefs, but will alfo impair the contractile powers of the fystem. To illustrate this fubject a little farther, I will prefent the reader

* The effects of oxygene on the fystem is so clearly illustrated in Dr. Beddoes' Effines on Pthis 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 frucks of all fenfation and motion, by paffing violent shocks through their heads; and re-animated them, by gentle shocks passed through the heart and lungs.

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

EXPERIMENT I.

" I divided. (fays he) the fciatic nerve of one leg, and tied the crural artery of the other in a large frog. Scarcely any blood was loft in doing either. Two days after this, I ftrangled it. During the firft twenty-four hours, the leg in which the nerve had been divided, appeared to contract with the moft vigour; after this periol, the difference between them became more doubtful; but the contractions were at no time ftronger in the leg whofe artery was tied, than in that whofe nerve was divided.

EXPERIMENT 2.

"The fame operations were performed on a large female frog full of fpawn. Four hours afterwards fhe was covered by a male, who had been treated in a fimilar manner. I mention this circumftance, as it tends to prove, that the pain occafioned by the operation, was probably not fo great as to produce much fallacy. "On the day following, fhe had fpawned,

"On the day following, fhe had fpawned, and on the fixth day from the operation fhe was ftrangled. When laid upon a plate of zinc, and excited by means of a rod of filver, the contractions were found extremely feeble in the leg whofe artery had been tied, and ceafed altogether in about twenty-four hours after her death.

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" In the leg whofe nerve had been divided, they appeared as vigorous as they ufually are in legs to which no injury had been previoufly done, and continued excitable upwards of two days after they had ceafed to be fo in the other."

To account for the difference in the refults of those experiments, it is only necessary to confider the principles upon which the contraction of muscles depends; i. e. irritability and nervous energy. The first is more particularly the vis muscularis, and fupplied by the blood; the latter is the exciting caufe of mulcular motion, and fupplied by the nerves. Both principles fuffer exhauftion, and require continual renovation. In Experiment 1st, a difference was perceptible only in the first twenty-four hours; but in Experiment 2d, the leg whofe nerve had been divided, continued excitable two days longer than that whofe artery had been tied. In the first case the leg whose artery had been tied, was but partially deprived of its ir-ritability, and consequently remained fusceptible of its natural agent, though fupplied by art. But in the fecond cafe, during the abstention of fix days, its irritability was nearly exhausted, and its contractions could of neceffity be but very feeble, and of thort 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 mo-tion; and, 2dly, the power of giving motion

in the agent or moving body. The blood furnifhes mufcles with irritability and nutrition, which completes their capacity, or predifpofition to be put in motion, upon the action of the vis nervea, whether the latter is applied thro' the medium of the nerves themfelves, or by the application of metals. But to enter a little further into the principles of mulcular motion, we find three powers effentially combined in conflituting the mobility of muscles. First, Elafticity; fecondly, Irritability; and thirdly, Nervous Energy. The first may be imputed to attraction, or its effect, which is cohefion. Cohefion is that wonderful property imprefied on matter, by which its elementary particles when they approach each other to a certain degree, termed by philosophers its fphere of attraction, rufh into contact; and remain in that ftate unlefs feparated by a force fuperior to that of their attraction. Thus both folids and fluids do to a certain degree refift the difunion of their parts, and are capable of reftoring their fibrils to their natural state, when stretched or over-diftended by a force superior to that of cohefion. This elatticity refides in all the folids, but in different degrees; and being independent of the state of the nerves, is termed the classicity of the dead fibre. The term, dead fibre, is made use of to diffinguish certain properties arifing from mere cohefion or mechanifm, from those that depend on the vital principle.

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The vis infita or irritability, is that principle by which the mufcular fibres when irritated ofcillate, contract towards the middle, becoming

by this means fhorter and thicker, and alternately withdraw themfelves from the middle with a degree of velocity that eludes calculation .--Nufcles when dead or extracted from the bodies of living animals, retain this power a much fhorter time than that of the dead force. * The principle of nervous energy exifts in fuch various degrees in different parts of the mufcular fystem, that it would extend this paper to the fize of a folio volume, to specify the particular degrees thereof, in the diversified motions of the Animal Economy. I shall therefore only take a curfory view of its offices in voluntary and involuntary motion. In the former, this energetic principle is the immediate and exciting caufe of mufcular motion. When an impreffion is made on the fentient extremities of the nerves, it is immediately communicated to the brain, which reacting, produces thought, and a confequent determination of the will; and when any part is determined by the will to be put in motion, the nerves in confequence of a voluntary impression on the fenforium, execute this function by furcharging the mulcles 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 neceffity difcharged 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.

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paffions of the mind often afford us melancholy fpecimens of a phyfical neceffity being connected with our moral faculty, in producing convultions, palpitations of the heart, afphyxia, and not unfrequently death itfelf.

Involuntary motion is allo dependant on the nervous energy, as the action of the heart, lungs, &c. and if a nerve is divided, the dependant part fuffers emaciation; and the action of the arterial fystem is diminished, even by a comprettion of the brain. Mufcles of involuntary motion, have fewer nerves than those subfervient to volition, their original formation is different, and the coating and exciter, fays Dr. Valli, does not produce the least motion in them. Hence their different movements may very rationally be imputed to their different degrees of clectricity. Voluntary muscles require a large number of nerves, and a ftrong charge of electricity to act in obedience to the will; while the latter require but few nerves, and a fmall degree of this principle, to enable them to perform their more passive functions. The actions of the latter are however, more uniform, and confequently their electricity exifts but in one degree; while that of the former is politive and negative, and undergoing changes commenfurate with their actions. There are alfo mixed motions in the human fystem, the caufes of which are much more mysterious. On one hand there are examples of mufcles, which, for the most part are obedient to the will; yet in certain cafes refuse to obey its commands .--There are alfo inftances of mulcular functions,

which though naturally in fubordination to the will, being performed without a confcioufnefs of the mind. We often move our limbs when affeep. And we have accounts of formambulifts, that not only walk, but dance and perform feats of agility in their fleep, which they were incapable of doing when awake. Perhaps those phenomena must be imputed to the re-action of the fenforium, which is excited by the imagination waking up and exhibiting before it, the image of an active and cuftomary ftimulus. There also are a few of the functions of our bodies, over which the will of itfelf has no controul, may notwithftanding be excited and brought into action when the ima- . gination and paffions of the mind, act in concert with the will: affifted by the plaftic power of cuftom. An aftonishing specimen thereof we have in Colonel Townfend, who possessed, like the fnail and tadpole, a power of fufpending the action of the heart and arteries at pleafure. But in what manner the will obtains this power, when affifted by paffion and cuf-tom, I refer to the metaphyfician 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 phyfiological inveftigation. There however is referved for the physiologist, a task equally difficult, in accounting for the fpontaneous motions of the animal fystem; as that of the heart from the operation of foreign ftimuli, independent of its native ftimulus the blood, aliment, air, &c. ftimulate the ftomach and primæ

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viæ, urine the bladder, light the iris, &c. For the performance of fpontaneous motion, the application of foreign filmuli are generally requifite ; though transitory fpontaneous motions arife alfo from an irregular transmission of the electroid fluid. Whenever the nerves feel a ftimulus, the electrical fluid is excited, and its effects are manifested in-the production of motion; and when the ftimulus is withdrawn or ceafes to act, another effect is produced, which is relaxation. The latter, though generally an indirect effect, (or perhaps more strictly a negative condition) may notwith-standing be directly produced by the action of certain powers denominated fedatives; among which the nicotiana is probably the most unequivocal. In a cafe 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 nurfe inattentively gave a quarter of a pound. And a fhort time after when we returned to perform the operation, we found our patient to all appearances expiring. The Doctor, whofe heart was never a stranger to fympathy, was not a little distressed to find his patient apparently dying from the negligence of his nurfe. The event was however fortuitous. On examining the hernia, the diffention and stricture were completely removed, and the protruded inteffine was cafily reduced without the pain

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of a hazardous operation. The patient was

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perfectly reflored by the aid of proper cordials. A fecond example of the fedative power of tobacco I experienced myfelf. Having, from the free use of diluting liquids and inattention, brought on a mechanical ifchuria, I tried opium, fomentations, &c. but to no effect .---When in extreme pain, 1 had recourfe to a fegar for amufement, by which an unexpected naufea was excited, fucceeded by a relaxation of the fphincter veficæ, and an involuntary efflux of urine. Fear, which is also a fedative power, will not only produce ipontaneous convultions or palpitations of the heart, but even death, or eventual relaxation. This vifcus is the most fusceptible of spontaneous motion, and will continue to act for fome time after it is taken out of the body.

I have frequently taken out the hearts of frogs, turtles, &c. and obferved attentively their actions. They will contract and dilate, fua sponte, for fome time, and then ceafe; when they may be again excited to contract, by lacerating them with a wooden or other pointed inftrument. But when they become no longer excitable by thefe means, they may be re-excited to contract, by the irritation of a metallic instrument. I once observed a fimilar phenomenon in an amputated leg; one of the crural mufcles contracted upon being irritated with the point of a fcalpel. The experiment was then tried with a pointed wooden inftru-ment, but to no effect. Yet on irritating it a fecond time with the fealpel, it contracted

once or twice. Hence the application of metals, is one of the beft and moft delicate tefts for afcertaining the leaft pofible degrees of mufcular irritability. After having become wholly infenfible to the imprefions of all other ftimuli, they may be re-excited, on the application of their native ftimulus.

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Mr. Fermin, Dr. Priefly, Sir Charles Linaus, and others, obferve that metals are the beft conductors of Animal Electricity, and that fome metals are better conductors than others. Water and wood are conductors of both animal and natural electricities. Those facts if confidered impartially, certainly afford us the most unequivocal tefts 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 fuppole, that nature had furnished fuch a variety of animals, and even fubjects of the infect tribe, (for example the glow-worm) with this truly dignified property, and withheld it from the nobleft and most perfect animal in the creation. Yet it must be admitted that the Gymnotus, &c. poffefs this property in a flronger degree than man. * But this does not imply a

* Hominal Electricity may, notwithstanding its extra modification, be rendered obvious to the sense, 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 inseconverse 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 the is in her nominal products. Therefore we cannot affign any caufe (connected with her laws of creation) why the electricity of the human fystem 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 afcertained. And though we cannot with precifion, fay why nominal electricity should be fusceptible of metals only, yet the fact is inconteftible, and fanctioned by the experiments of those gentlemen aforementioned, whofe veracity is unquestionable. It is alfo futher fubftantiated, by the difcovery of Dr. Perkins' Metallic inftruments for removing pains, and topical affections. The Dr. obferved 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 difcovery is as important in the healing art, as it is novel in the fcience of Phyfiology, and all that remains to illustrate the efficacy thereof, is a rational and philosophical demonstration of the principle itfelf, and an explanation of the modus operandi, on the established laws of the Animal (Economy. This however, is confidered problematical by fome, and by others it is

rior point of the probe is brought into contact with the zine, an ewident flash is produced.

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politively difcarded. Yet to ceafe from inquiry, becaufe we are fometimes miftaken, is no greater proof of wildom, than to defift from walking becaufe we fometimes flumble. And if we only take an impartial view of the operations of nature herfelf, and attend diligently to the analytical investigations of the aforementioned experimentalifts on this fublime fubject, I think the sceptic himself must admit, that the principle of nervous energy is a modification of electricity. As fenfation is dependant upon this energy, a pleafurable fenfation, on what may be termed a natural or healthy degree thereof; then certainly pain or fuperfenfation, 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 eafy folution; namely, that the metals being fusceptible of this fluid, conduct the extra degree of energy to parts where it is diminished, or out of the fystem altogether, reftoring the native law of electric equilibrium. The particular affections in which this operation is the most effectual, are chronic rheumatifms, as lumbago, fciatica, &c. odontalgia, otalgia, cephalalgia, phlegmons, cynanchies, opthalmias, pleuritic pains, fpalmodic cholics, burns and scalds, paronychiæ, contusions, ato-nic gout, spontaneous hemorrhages, herpes, eryfipelas, &c. with many other topical affections, which might be enumerated if neceffary.*.

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* Dr. Elijab Perkins, of Philadelphia, informed me that in bilious cafes, fuch as choleras, &c. inThe infiruments fhould be carried to fome diffance from the part affected, along the courfe of the larger nerves; and in oblinate or fixed pains of long flanding, the friction thould be continued until a flight inflammation is excited; but in eryfipelas, and other fuperficial inflammations, the friction flould be very light on the inflamed part, and principally confined to the edges of the tumor. In removing pains from the head, the hair thould be perfectly free frem pomatum or other adipofe fubflances; and all parts on which the operation is performed flould be free from fweat, oils, &c. In pleurifies, cholics, &c. a diaphorefis not unfrequently fucceeds the operation, and fometimes

which the ufual remedies had failed, he has effectually removed the diforder at the flomach, and reflrained the womiting in at least three cafes out of four, by operating with the tractors on the region of the flomach and liver. He further informed me, that he has cured periodical fevers by operating on the fpine 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 perhaus referved 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. faintinefs is produced, by the fudden abstraction of nervous energy. In a cafe 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 fince, I awoke with a most rending head-ache, unaccompanied with fever, 1 delayed the operation fome hours, on account of my hair being pomatum'd, but the pain became fo infupportable (and all the ufual applications failing) that I refolved 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 fo ever fince.

It is argued by fome, (who are oppofed to the Metallic Operation) that the efficacy of the tractors depend merely on a counter irritation produced by friction. I would alk those dogmatifts how metallic friction cures burns, or topical inflammations? Does not the leaft impreffion on ar inflamed part produce pain; and would not friction augment the evil? Phlegmons, and fome other topical inflammations, may often be removed, by exciting a counter irritation with blifters, &c. which reftore the equilibrium of the nervous fluid. But blifters feldom anfwer any valuable purpose in local inflammations, accompanied with excellive action of the arterial fystem, until the fever is previoufly diminifued. Neither will the Mctallic Process fucceed fo well in the acute, as in the chronic rheumatifm, while the febrile

action remains inordinate.* This thews a correfpondence in effect, but the modes of operation are diametrically oppofite. 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 veffels of the part are also brought into action, and not unfrequently the whole vafcular fystem acts in concert, from a fympathetic harmony primevally eftablished.

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

* The partial fuccefs of the metallic operation in ' febrile difeafes, may be rationally imputed to the limited mode of operating. For as fever is a univerfal diforder, the modus medendi, must be general alfo.

When local remedies are used in fevers, a general effect is contemplated by bringing the system into sympathetic action. Thus blishers will frequently procure a crifts in continued fevers, when the usual internal remedies have failed. And as there is often a spattic contraction of the capillary welfels 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 exceffive excitement in the veffels of the cutis; the encruftation is formed by exceffive action. The metals remove this inordinate action, by abftracting the extra degree of electricity. Corrofive lotions defiroy the morbid action by corrofion, and induce or reftore the condition for healthy action.

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

Epilepfy is owing to an irregular diffribution of the nervous fluid, and an accumulation thereof in the mufcles affected with fpafm. That this is the fact, is obvious from the preternatural ftrength of epileptics.

Pain, is merely an accumulation of electricity, in a particular part; and the fubfequent ftate of eafe is obtained by abftracting the extra degree of fenfibility. Hence the frequent faintings in parturition, cholics, &c. are to be imputed to a diminution of nervous energy.

In chronic pains connected with idiofyncrafy or dependant on habit, fo that the orgafin of the part is injured, or a mal-conformation induced by nature or accident, the Metallic Procefs cannot be expected to fucceed.

When fuppuration has taken place, the tractors must be confidered as mere palliatives.— This operation should never be performed on the back, during the existence of the catamenia. Besides these cafes in which the tractors have already been found fuccefsful, fature experience will probably develope many others, in which the Metallic Operation will prove equally efficacious. This operation will alfo, in all probability, fucceed better in fome perfons than in others. For example:

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Many people are remarkable for an extreme luftre in their eyes, fome are fo much electrified naturally as to fhew evident figns of it when a fenfible electrometer has been applied to them, and others have manifefted an extreme fenfibility of even the finalleft degree of electricity, infomuch that they would be affected by a flafh of lightning, though fo remote that the thunder could not be heard. All this evinces that electricity fo far from being noxious, bears a very active and falutary part in the Animal Œconomy, which will probably lead to more important refearches on this interefting fubject, and incite future travellers to explore the remaining *terra incognita*,

FINIS.