A familiar analysis, of the fluid capable of producing the phenomena of electricity and galvanism; or combustion. With some remarks on simple galvanic circles / [Matthew Yatman].

A FAMILIAR ANALYSIS,

OF THE FLUID

CAPABLE OF PRODUCING THE PHENOMENA OF

ELECTRICITY AND GALVANISM; OR COMBUSTION.

WITH SOME

REMARKS

ON

SIMPLE GALVANIC CIRCLES,

AND THEIR INFLUENCE

UPON THE VITAL PRINCIPLE OF ANIMALS.

ILLUSTRATED BY THE

THEORIES AND EXPERIMENTS

OF

GALVANI, GARNET, DAVY, YOUNG, THOMSON,

&c. &c.

By MATTHEW YATMAN, Esq.

"Quid verum atque decens curo et rogo, et omnis in hoc sum."

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AND ALL BOOKSELLERS.

1810.

To the Right Honourable, Honourable, &c. the President and Vice Presidents of the Royal Humane Society.

My Lords & Gentlemen,

Having been some years a Subscriber to the Humane Society, I take the liberty of submitting a Plan for your consideration, which, I presume, will prove congenial with the views, as well as explanatory of the principles and practice, of this truly Christian Institution; the success and perpetuity of which, I most ardently wish.

I have the honour to be,

My Lords, and Gentlemen,

Your obedient Servant,

MATTHEW YATMAN.

Chelsea, Dec. 9,
1809.

ERRATA.

Page 15, line 7, *for* mandates, *read* mandate.
27, 7, *for* respect of sound, *read* respect to sonnd.
28, 7, *for* or *read* and.
36, 5, *for* of *read* to.
37, 3, from bottom. *for* Hypocrates, *read* Hippocrates.
44, 1, after the word "fluid," *add* [water]
64, 19, *for* dcawn, *read* drawn.
68, 9, *for* 1708, *read* 1798.
69. 2, *for* was, *read* were.

PREFACE.

THIS Work being intended chiefly for the information of those who are not thoroughly acquainted with the subjects here described, is rendered as comprehensible, and as brief, as the occult nature, the novelty, and the great variety of matter it contains would admit.

An earnest desire to explain, and thereby vindicate, some facts highly interesting to Society, has induced the Author to combine the theories and experiments of the most able Philosophers and Chemists, relative to what were formerly called the elements, and their affinities. Some compounds formed, and effects produced, by different combinations, and collisions, of those elements, tending to evince the infinite wisdom and goodness of the Creator, displayed in the simple undeviating laws of nature.

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A

FAMILIAR ANALYSIS,

&c. &c.

Chapter I.

OF THE GENERAL NATURE OF THE "ELECTRICAL INFLUENCE."

"THE Electrical Influence" is the grand principle of attraction, the anima mundi, the vital principle by which all nature is animated and regulated.

The word is derived from electrum, amber. It was originally applied to describe that power which amber acquires by friction, of attracting feathers, straws, and other light substances. It being afterwards observed, that resin, glass, &c. acquire the same power by being rubbed, the word electricity has since been applied, generally, to describe this and various other pheno-

mena, in whatever substance they were observed or excited; as vitreous electricity, resinous electricity, atmospherical electricity, the electricity of metals, and of animals, (the vital principle), or galvanism.

Electrical phenomena are produced in different substances by chemical changes taking place, caused by the action of one or more of the following elements, or imponderable substances.

Chapter II.

CALORIC OR HEAT.

Caloric is the separating principle, in opposition to attraction. The peculiar forms of aggregation in bodies, are said to depend upon the different agencies of these two powers. Caloric is not a *mere quality* of matter; it is considered as an imponderable substance, sui generis, existing in space, and diffused through the pores of ponderable substances, in a certain quantity, called latent heat; because in that state it is not perceptible, but it is capable of being rendered perceptible in bodies, and of being communicated from

from one substance to another, in the form of "radiant heat," as that from a fire, &c. The laws of its communication constitute the laws of temperature, which is said to be high, or low, as bodies are capable of communicating, or of receiving heat.

All substances exist either in the solid, fluid, or aeriform state; and, as they are made to receive or to communicate heat, they expand or they contract proportionally. By the addition of heat, solids become fluids, and fluids become gasses,* or elastic vapours.

Water, when heated, is thrown into steam, or gas, the elastic force of which, when confined, is shewn by the powers of the steam engine.

On the contrary, by diminishing this repulsive power, gasses become fluids, and fluids become solids.

When steam parts with its heat, it condenses into water, and water becomes ice when the heat is sufficiently diminished.

Metals,

* The term Gas denotes the greatest repletion of a substance with heat, called Saturation, consequently the widest separation of its particles.

Metals, by the expansive power of heat, become fluid, and by parting with this separating principle, they resume their solid form.

Mr. Davy says, "the chemical changes in "substances connected with the production of "the greatest quantities of radiant heat, are, "first, the absorption of oxygen gas, by the "substances in and from which caloric is se-"parated."

These substances are then said to be oxided.

The different modes by which caloric is excited and separated from substances producing these "chemical changes," are

First, By the simple action of light.

Secondly, By the action of oxygen upon bodies that have a strong affinity to it. When phosphorus is exposed to the air, it attracts oxygen so strongly, and parts with its caloric in such density, that it not only becomes luminous, but combustion takes place.

Thirdly, By collision, or friction of solids. When

When a flint is stricken against steel, particles of fire are driven from it sufficient to ignite tinder, gun-powder, &c.

Two pieces of dry wood may be rubbed together until they take fire. This happens to the axletrees of carriages, &c. when they are not sufficiently greased to diminish the friction.

" By heat, as a natural agent, most of the " new combinations and decompositions of sub- " stances are produced, by which they are ren- " dered capable of organisation, and of becom- " ing parts of living beings."—Davy.

This is shewn by the effects of a bird sitting upon eggs for a certain time, in producing living animals endowed with a certain form, action, and intellect, from the fluids contained in the eggs. If the bird neglects this duty at all, no young ones are produced. Some birds (the ostrich) leave their eggs in the warm sand (in hot climates), the warmth of the sand having the same prolific effect. " In wisdom hast thou made them all !"

A certain degree of heat is equally necessary for

for the production of plants from different seeds. Seeds are the eggs of plants. This proves the analogy existing between the animal and vegetable system.

Chapter III.

LIGHT.

Mr. Davy says, "Two opinions have been "formed concerning Light, *in its visible state.* "First, It has been supposed to be produced by "the *rectilinear motion* of a peculiar substance. "Secondly, It has been considered *as the un-* "*dulatory motion* of an elastic medium extended "through space."

On the first theory, light must travel at the rate of two hundred thousand miles in one second of time, without any impulse perceptible even by the delicate nerves of the eye.

Dr. Young supports the second opinion, and says, that Sir Isaac Newton declared his theory of light incomplete without it.

Ferguson was of the same opinion, and he justified it by the production of light, in the midst of darkness, by the collision of flint against steel, whereby the place is illuminated for the moment. "Let there be light!" It prepares the weakness of our intellects for the comprehension of the above divine mandates: it harmonizes with the theory of sounds produced by the vibration of substances communicated to the air: it is also consonant to the latent and the radiant states of caloric.

Darkness seems to be the "latent" (invisible) or imperceptible state of light, analogous to black in colours, which is produced by substances which *absorb* all the rays of light, as *white* is, by those bodies which *reflect* all the rays in an equal degree.

Mr. Davy says, "Light is produced during "a number of chemical operations." Again, "Light is produced by the collision of different "substances; but this phenomenon is probably, "in general, dependant either on the *excitation* "*of combustion*, or of *electricity*,"

The truth and the value of this remark will be proved in the subsequent chapters.

The

The particles of light are capable of separation, and also of condensation. Of separation, by a triangular oblong body of glass, called a prism, into seven different coloured rays, which Mr. Davy calls red, orange, yellow, green, blue, indigo, violet. The particles of light may be separated also by a double concave glass lens, in proportion to its degree of concavity. The light of the sun may be condensed by refraction through a double convex glass lens, (or by reflection from a concave glass or metallic polished speculum) into a focus or point of intense light, which, if it is directed to a dark-coloured inflammable substance, will separate caloric, and excite oxidation and the chemical changes, sufficiently to produce combustion, more or less violent, in proportion to the quantity of light condensed, the degree of condensation, and the nature of the substance on which it acts.

The analogy of condensed light separating caloric, and of intense heat exciting light, is very remarkable.

Mr. Davy says, "one of the most common "effects of light, is the expulsion of oxygen gas "from bodies with which it is loosely com-"bined." This will be seen in the next chapter.

Chapter IV.

OXYGEN.

Oxygen is a Greek word, signifying the acid principle, or base.

"When oxygen is called the acidifying princi-
"ple, or base, it is not meant to affirm that it pos-
"sesses the *properties* of an acid; all that can be
"intended is, that it exists, as a component part,
"in the greater number of acids."—Thomson.

Oxygen has the strongest tendency to combination (affinity) of all simple substances. Oxidation implies the exertion of that tendency; and the substance it combines with is said to be oxided. When copper or iron are exposed to damp air they attract this acid principle and become oxided or rusted. When oxygen is saturated with caloric, it is expanded into an invisible elastic vapour, called oxygen gas; discovered by Dr. Priestley, and called by him dephlogisticated air.

Oxygen gas constitutes the vital part of atmospheric air. It eminently supports animal life, as well as combustion, neither of which can continue without a constant supply of it.

Oxygen gas is supplied to the atmosphere by the leaves of plants. Dr. Priestley observed, in 1770, that plants, in certain circumstances, emitted oxygen gas; and Ingenhousz, very soon after, discovered that this gas was emitted by the leaves of plants, when they are exposed to the *bright light of day.*

Another most important office is performed by the leaves of vegetables, demonstrative of the wisdom and goodness that appointed it. They absorb a noxious vapour from the air, called carbonic acid gas.

This gas is produced in the atmosphere by the respiration of animals, and by combustion; it consequently is always floating in the atmosphere, of which it constitutes about an hundreth part.

Carbonic acid gas is, *literally,* the gas which escapes during the combustion of wood, or charcoal;

coal; but it is also formed by animal respiration and general combustion.

If a person (having closed his nostrils) inhales, and exhales, the air of a glass vessel, open at one end only, a few times, into and from his lungs to the vessel; the air of that vessel will lose its oxygen, and the vessel will contain only carbonic acid gas, and azotic gas.

The same happens when a glass jar, inverted over a pneumatic tub of water, has a lighted taper put under it, the taper will soon be extinguished; and a fresh lighted taper put under either of these vessels, inverted over water, will be extinguished immediately.

But if a small branch of a plant, which has been gathered even sufficiently long for its leaves to *begin* to appear curled and faint (but not dead), be put under either of these vessels (inverted in water), in about half an hour the leaves begin to resume a *fresh* and lively appearance; and a lighted taper put under the vessel will *now* burn as long as it will in the same quantity of fresh air: a proof of the restoration of oxygen gas and of the absorption of carbonic acid gas, which

which forms a chief part of the support of vegetables.

Was it not for the emission of oxygen gas from the leaves of vegetables, the air of the atmosphere would soon have been rendered unfit for the existence of the animal part of the creation, and the carbonic acid gas produced by them, seems equally necessary for the support of vegetables.

The economy of this divine plan is as wonderful as any part thereof. It proves that nothing is made in vain, or any thing superfluous.

Chapter V.

AZOT.

This substance was called Azot, because it is so destructive to animal life; (it is equally unfit for combustion) until it is mixed with oxygen gas, with one-fourth or one-fifth of which it forms atmospheric air. With a larger proportion of oxygen it forms nitric acid, on which account it

is

is called by some Nitrogen. It may as well be called *aerogen*.

Azot, saturated with caloric, forms azotic gas; combined with hydrogen gas, it forms volatile alkali; and with different earths it produces fixed alkali: on which theory Dr. Garnet seems to have pointed out the most truly characteristic name, in his Account of Oxygen Gas and Azotic Gas. "The latter is composed of caloric "and a particular base capable of becoming "solid, called azot. This substance united to "different bases forms alkalies; and hence may "be looked upon as a real alkaligen or alkalising "principle, in opposition to oxygen, the prin-"ciple of acidity. The atmosphere, therefore, "is an immense reservoir of the principles of "acidity and alkalescency, without being *itself* "either acid or alkaline."

This is a most ingenious observation and worthy of its author.

On the same principle the combination of acids and alkalies form salts, which are called neutral, because they are *neither* acid or alkaline.

Chapter VI.

HYDROGEN.

Hydrogen signifies the principle, or base, of water. It seems to be a combination of caloric separated (by various processes) from metals, or other substances, with oxygen.

Pure hydrogen is too fugitive, or its affinity to caloric is too strong, for it to be met with as a separate substance, which the following most valuable theory of Dr. Garnet amply accounts for:

"Pure hydrogen is capable of being attracted, by conductors of electricity, *immediately as it is produced,* in the form of the electrical fluid. If it is *not immediately* so drawn off, it becomes saturated with caloric, and forms hydrogen gas, which is incapable of being attracted by any conductors of electricity, and is, besides, possessed of very different properties to pure hydrogen."

Hydrogen gas has some properties similar to azotic

azotic gas. No animal can breathe hydrogen gas half a minute without feeling giddiness, loss of muscular power, suffocation, and even death, if it continue therein. But if hydrogen gas be mixed with about one-third its quantity of oxygen gas, it may be breathed without inconvenience.

Hydrogen gas was formerly called "inflammable air," "phlogiston," "the fire-damp in mines," which frequently produces violent combustion upon the approach of a flame of candle, &c. particularly in coal-mines.

If fifteen parts of hydrogen gas, be mixed with eighty-five of oxygen gas, in a close vessel, inverted over quicksilver, in a pneumatic apparatus, and an electrical spark be conveyed to it, violent combustion ensues, and a quantity of water is produced, equal to the weight of the two gasses.

If a phial be filled with hydrogen gas, and a flame be brought to the mouth of the phial, the gas in contact with the air takes fire, and it will burn gradually until all the gas is consumed. The water formed in this experiment is gradu-

ally

ally dissipated by the heat (as it is produced) in steam, which is absorbed by the surrounding air.

Hydrogen and hydrogen gas are formed in mines, &c. from the decomposition of water, acids, &c. by metals, and other substances, which become oxided, caloric is separated, and the chemical changes take place; whence also arise the electrical phenomena of earthquakes, the production of water, combustion, &c.

Hydrogen gas being specifically lighter than common air, rises into the higher regions of the atmosphere, where, combining with oxygen gas, in storms of lightning, those electrical discharges produce combustion in this oxidated hydrogen gas, and form those torrents of rain which frequently occur at those times.

It is probable that all water is formed (even in the bodies of animals) by electrical discharges acting upon oxidated hydrogen gas.

For the artificial production of hydrogen gas, the following extracts from Thomson's Chemistry, are well worth attention, on account of their

ana-

analogy to the production of the electrical fluid, by oxidation of metals in different ways:

" It is usual to procure hydrogen gas, by dis-
" solving *zinc in diluted sulphuric acid*; the gas
" thus obtained is as pure as any which can be
" procured."

In another place he says, " Put fresh iron
" filings, quite free from rust, into a glass phial
" with two mouths to it, with one end of a
" crooked glass tube luted into one of its
" mouths; insert the other end of this glass
" tube, beneath a glass jar filled with water and
" inverted into a pneumatic tub; then pour, by
" the other mouth of the phial, a quantity of
" *sulphuric acid, diluted with four times its quan-*
" *tity of water*, upon the iron filings, and in-
" stantly close up the mouth of the phial. The
" mixture immediately effervesces violently, and
" a vast quantity of hydrogen gas is produced,
" which rushes through the tube and fills the
" jar." The water is, of course, depressed from
" the jar into the tub.

Mr. Davy says, " When iron and silver *form*
" *a circle* with diluted muriatic acid, hydrogen

" gas is not only evolved from the water," (with which the acid is diluted,) " in contact with the " *iron*, but from that in contact with the silver " also."—*See the Simple Galvanic Circles.*

Dr. Garnet says, " If a piece of *zinc* be put " into water, no change will take place; but if " a piece of silver be put *along* with it," *(in contact,)* " the zinc will immediately oxidate, and a " current of electricity will pass through the " silver."

This will be found to be exactly one of Mr. Davy's perfect simple galvanic circles; and thus concludes the chapter on hydrogen with the production of the electrical fluid, and of hydrogen gas, from two different perfect galvanic circles (by oxidation), formed each of a more and a less oxidable metal in contact with each other, and connected at the same time with an oxidated fluid. One of these fluids is water, containing muriatic acid, the other, water containing atmospheric air.

Chapter VII.

THE ELECTRICAL FLUID.

The Electrical Fluid is supposed to be diffused through space, and to pervade all substances, *in a certain quantity*, in which it is capable of remaining *in a latent state*, until it is disturbed by various causes. How analogous is this, to what has been observed of heat, light, and air, with respect of sound?

Mr. Davy says, "The electrical fluid has been "supposed to originate from the agencies of one "specific body; which opinion has been eluci- "dated by Dr. Franklin, Mr. Æpinus, and Mr. "Cavendish; and it is equal to the solution of "all the phenomena."

And is it not confirmed by the following theory of Dr. Garnet? "What the electrical fluid "is, we are ignorant; some galvanic experi- "ments have led me to suppose it to be *hy- "drogen*, which, when pure, or perhaps in

"a different

" a different state, may be capable of passing " through the pores of solid bodies, in the form " of electricity".

Compare this with the mode by which this fluid is obtained in the machine, by the friction of glass, upon the amalgam of zinc, and mercury, (a more or a less oxidable metal) minutely blended together by melting and powdering, then made into a paste with grease, and spread on the cushions of the machine, which are in close contact with the glass, thus forming a complete simple circle with the surrounding atmospheric air.

When the machine is put into action the friction of the glass upon the amalgam, produces the chemical changes; it separates caloric from the zinc, which becomes oxided; the separated caloric combines with the oxygen of the air, and forms *hydrogen*, which is drawn off immediately from the non-conducting glass, by the points of the prime conductor " in the form of the electrical fluid."

If this hydrogen is not immediately so drawn off, or if it is not drawn off *as freely* as it is produced,

duced, what remains becomes saturated with caloric, and forms hydrogen gas, in sufficient quantity to produce giddiness, loss of muscular power, and fainting in some people, when they are near a powerful machine while in action, unless a current of air is admitted, which obviates this effect by oxidating this hydrogen gas, as it does the same gas produced *any other* way. The author felt this faintness, &c. frequently upon himself, while turning his own machine, long before he found the cause of it in Dr. Garnet's observation.

Electrical Conductors.

Electrical Conductors are divided into two classes; first, perfect conductors, charcoal and the metals; secondly, imperfect conductors, viz. the fluid acids, water, steam, wood, animal and vegetable substances.

It is of essential consequence to state, that there are also two kinds of metallic conductors, which produce extremely different and nearly opposite effects from each other: one kind are blunt conductors; they are generally brass rods, or thick wires, terminating in blunt round ends, or with brass or wooden balls. These both attract,

tract, and they convey this fluid from, or to, a short distance only, accompanied with an impulse or shock, and frequently with a spark of light, attended with a crack or noise, (where the circle is not completely in contact) proportioned to the quantity of fluid conveyed, &c.

The other kind are *pointed conductors,* most commonly made of brass wires, terminating in sharp points. These both attract, and they convey the electrical fluid, from and to a distance, gradually, in a thin stream, which, feeling like cool air, (from the machine,) is called aura electrica. This frequently is luminous. It is without any impulse; on which account metallic pointed conductors are often put to the tops of ships and buildings, to evade the fury of lightning.

The distance at which these pointed conductors will *act* depends much on the degree of their acuteness; for a sharp needle may be *seen* to draw, or to convey, the luminous fluid a much greater distance to, or from, the machine, than a blunt wire will.

Non-conductors.

"Among the non-conductors of electricity, are

" are glass, resin, wax, amber, sulphur, phos-
" phorus, the dry gasses, and all substances con-
" taining earths only, or alkaline substances."—
Davy.

It is necessary here to compare the nature of glass with the other non-conducting substances, most of which are called electrics perse, because they are susceptible of the chemical changes, by which they afford the electrical fluid to conducting substances connected with them, which thus become positively electrified; these non-conductors being themselves negatively electrified thereby.

But glass, not being susceptible thereof, (at least by friction), acts merely as a non-conducting exciter of this fluid, from more oxidable substances (as from the metals in the amalgam), whereby the glass, and the conductors connected with it, become positively electrified, while the substances, which part with this electrical fluid are said to be negatively electrified. " The " cushions and the conductors in contact with " them" (the metals in the amalgam), " be-
" come negatively electrified, and a conductor
" placed near any part of the glass, which is not

in

" in contact with the cushions, becomes posi-
" tively electrified."—Davy.

This is proved by the prime conductor and any conductors applied to it.

When globes or cakes of resin are used in the same manner, (instead of glass), " electricity " is likewise excited. But in this case the cus-
" hions and their conductors" (the metals in the amalgam), " become *positively electrified,* " and the prime conductor and the other con-
" ductors, negatively."—Davy.

Hence arose, perhaps, the confused idea of " the two electricities," viz. positive electricity, and negative electricity. " *These indeed seem*" to be of opposite natures, from the above and other experiments, with excited glass, and excited resin. But it is only to superficial observers that they *so appear*.

The following aphorisms of Mr. Davy will perfectly *explain* this seeming difference, proving it to be only the two opposite states of " The " Electrical Fluid," positive, or negative; the partial presence, or absence, thereof.

" Bodies,

" Bodies, when actively electrified, are either " in the Positive, or the Negative state: when in " the Positive, they are supposed to contain " *more* than their natural quantity of electrical " influence; and when in the negative state, " *less.*"—Davy.

The other golden maxim renders it perfectly convincing, and, at the same time, it explains the mode by which these positive and negative states take place.

" The electrical fluid is capable of existing " in states of *redundancy,* and of *deficiency,* in different parts of the same substance."

This aphorism, which contains a volume of information, is most clearly proved by the non-conducting substance, glass. Glass proves also, that neither more, nor less, than the quantity of electrical influence ordained by nature can exist in any substance; although it may be contrived to be arranged " in states of redundancy, and " of deficiency, in different parts of the sub-" stance."

As glass can receive no addition to its natural

quantity of electrical fluid in any part: metallic coatings and conductors are applied partially thereto; whereby as much electrical fluid may be *conveyed from some parts* of the glass, as can be received by *other parts* of it, to which other coatings or conductors are applied.

This we have already taken notice of in our remarks upon the points of the prime conductor of the electrical machine applied to the glass plate or cylinder when in action, which, without this application, could not form the electrical fluid, but hydrogen gas.

So it is well known that, on this principle, plates of glass, glass phials, jars, and batteries, are partially coated with tin foil on the inside as well as the outside, and a metallic conductor is placed on the inside of the jars, &c. by which a certain quantity of electrical fluid may be conveyed from the machine to the inside of this jar, &c. when placed upon a table, or any conducting substance (within a proper distance of the machine) connected with the ground, whereby as much electrical fluid is conveyed from the outside of the jar, &c. by means of the external coating.

coating, and other conductors, as can be received on the inside from the machine.

Of Insulation.

When any substance is put upon a thick plate of glass, resin, or other non-conducting substance, or upon a wooden stool with glass legs to it, it is well known that its electrical communication with the ground is thereby cut off, and it is said to be *insulated.*

If an electrical jar, properly coated, is put upon an insulating stool, with glass legs to it, you cannot charge it at all, because it is insulated; but if you apply a wire, connected with the ground, to the conductor connected with *the inside of the jar*, you may charge the *outside* of the jar (instead of the inside) from the machine, with as much fluid as the inside of the jar is enabled to part with, by means of the conductor connected with the ground.

In either of these cases the equilibrium, or equal diffusion of the electrical fluid (it is well known) may be restored again to all parts of the jar, &c. by forming a circle with a single conductor (or a connected chain of conductors) between

tween the parts of the jar positively charged, and the negative part, at the same instant. The moment this circle is complete, the discharge of the fluid takes place from the positive or redundant parts of the negative or deficient part; and every link of this negative conducting chain feels the shock produced thereby at the same instant.

When a person is to be negatively electrified, he is placed in a chair situated upon a large stool, with glass legs to it, whereby he becomes insulated, and he either holds in his hand a conductor connected with the machine, or it is fastened to the chair in which he sits, whereby, when the machine is in action, a person standing on the ground, may, by applying a *blunt* or a *sharp*-pointed metallic conductor, draw either sparks, or a continued stream of the electrical fluid, from any part of this insulated person, an equal portion of which is supplied to him by the machine.

Mr. Davy says, "Electricity is capable of "being excited by the action of *different con-* "*ducting substances, on each other*; but the "modes of this excitation, and its *general con-*

"*nexion*"

" *nexion*" (not *universal*) " with chemical " changes, constitute a science which has hither- " to been distinguished from *common electricity*, " by the name of GALVANISM."—*See Negative Simple Circles.*

N.B. The more these chemical changes are investigated, the more clearly it will appear that they always accompany the *formation* of this fluid, or *positive electricity*, by whatever mode it is produced.

CHAPTER VIII.

GALVANISM.

MR. DAVY completes his definition of this most wonderful, interesting, and useful science, thus: "Galvanism relates to the phenomena both " Chemical and electrical, produced by the *con-* " *tact* of *different* conductors of electricity, form- " ing a perfect circle with each other."

This is like one of the aphorisms of Hypocrates; simple, comprehensive, convincing, and not to be contradicted.

PERFECT

Perfect Conductors.

Charcoal and the metals are the perfect conductors, as in the electrical machine But the metallic conductors, are divided by Mr. Davy into two different kinds of *more oxidable* metals, and *less oxidable* metals.

And these may be formed *into plates, or points,* analogous to the *blunt,* and the sharp pointed conductors, of the electrical machine, and capable of producing the same difference of effects as will be shewn.

Imperfect Conductors.

The imperfect conductors are oxidated fluids, as Atmospheric Air; Water, containing either atmospheric air, or oxygen; or sulphuric, nitric, or muriatic acid; the Blood in living animals Oxidated in respiration; Substances containing oxidated fluids; Living Animals, or Parts of living animals.

Simple Galvanic Circles..

Society are deeply indebted to Mr. Davy for the precision with which he has described these arrangements, which are worthy of the minutest inves-

investigation and closest inspection, as they explain the nature of this wonderful science, as well as that of the animal vital principle; the laws by which the vital principle operates, and by which it is regulated; and which also conduce to its restoration, or equilibrium, when it is deranged or *disordered*, either plus or minus.

Mr. Davy says, "For the formation of a per-"fect galvanic circle, *at least two conductors* of one class, and *one* of another, are required."

This will appear to be, in some cases, two perfect conductors (metals,) and *one* imperfect conductor; an oxidated fluid; as in Dr. Garnet's experiments with the zinc, when put together with silver into *water*, for sending a stream of electrical fluid through the silver: or they may complete the same simple circle when applied in contact to the skin of a living animal, as will be shewn.

Mr. Davy completes his description of the *perfect simple circle*, thus: "And they must be "so disposed, that the conductors of *one class* "may be in contact with each other, in *one* or "*more points*; at the same time that they are connected

" connected *in other distinct points*, with the con-
" ductor of the other class."

Mr. Davy then gives the following Table of different (more oxidable, and less oxidable) metals, and of oxidating fluids (or substances containing them,) wherewith this first class of simple perfect circles may be formed.

The author has only transcribed a part of Mr. Davy's First Table; sufficient to elucidate the structure, and the action, of *this class* of simple circles upon the animal vital principle.

More oxidable metal.	Less oxidable metals.	Oxidating fluids, &c.
Zinc.	Gold, or Silver, or Copper, or Quicksilver.	Atmospheric air, or water containing atmospheric air, oxygen, sulphuric, nitric, or muriatic acid, or substances containing oxidated fluids, living animals, or parts of living animals.

Mr. Davy says, " When the tongue is made
" part of a simple circle, an acid taste is per-
" ceived; and when the *eye* is connected with it,
" a flash of light is produced."

When a small plate of zinc is put on the upper

upper surface of the tongue, and a piece of silver to the under part of the tongue at the same time, a simple circle is *partly* formed, but it cannot *act* until it is *completed*, by bringing the other parts of these metals, which are out of the month, into contact; or by applying a third metal to these external parts to connect them; the chemical changes, then, *immediately*, take place, producing a heat on the tongue, and a saline metallic taste, occasioned by the electrical fluid passing from the zinc through the imperfect conductor, the tongue, to the silver, as in Dr. Garnet's experiment with water.

If, while the plate of zinc is applied to the tongue, you put a piece of silver to the inside of your upper lip, or the inside of your nose, the moment you complete the circle by bringing the other parts of these two metals into contact, while thus applied, you will perceive an appearance, like a flash of light *(if the place be dark)* from the impulse of the fluid, (however otherwise *imperceptible*), upon the optic nerves; the eye, as Mr. D. observes, in that case, forming part of the circle: a blow on the eye often produces this appearance of light.

The electrical fluid being thus actually produced "by the contact of different conductors forming a perfect circle," the author thinks this may very properly be called the *positive* simple galvanic circle; in distinction to another class of simple circles, *where no chemical changes are produced,* called the *negative* simple circle; because the fluid is not *formed,* it is only transferred from a part of an animal, &c. *positively* charged therewith to a negative conducting part, as in the experiment of producing equilibrium between the positive and negative parts of the charged electrical jar, by application of a single negative conductor, (or connected chain of conductors,) forming a perfect circle therewith.—*See the Negative Circles.*

Mr. Davy says, "When the galvanic sti-
" mulus is applied to the nerve and the muscle
" attached to it, which have been just separated
" from the body of a living animal, muscular
" contractions are produced."

These muscular contractions the author has frequently produced by applying a plate of zink, the size of half a crown, *wetted with water,* to the

the cheek and breast of a live flounder laid upon his back, upon a table, or some conducting substance, and a small piece of silver to his belly, at a small distance from the zinc; the Animal lay quiet, (the circle not being complete) until he applied a third metal to the edges of the others; the chemical changes then instantly took place, and the animal was thrown into spasms by the passage of the electrical fluid from the zinc to the silver.

If he applied the zinc *dry,* no convulsions were produced, or if he applied two plates of *the same metal,* no effects were perceived. These circumstances prove that these spasms were not excited by the mere mechanical weight, or irritation, of the metals, but that they were the consequence of oxidation, &c. produced by completing this positive simple circle. The same spasms have been produced in a flounder, a few minutes after its entrails were taken out, before the vital principle *was quite extinct.*

The voltaic pile (as well as the galvanic trough) is a *compound* galvanic circle, formed of a number of plates of more and less oxidable metals in contact with each other, and connected

at

at the same time with an oxidated fluid. But their *action* is precisely on the same principles as that of the simple positive circles, only in a greater degree.

The galvanic trough consists of a number of plates of zinc, and of copper, alternately arranged in contact, and connected at the same time with water, containing *one fourth its quantity of sulphuric acid;* oxidation, &c. and the electrical fluid are produced here also as soon as a complete circle is formed with a negative conducting object, by means of conductors, applied to the extreme plates of copper and of zinc at each end of the trough; otherwise *hydrogen gas* must be evolved. For if we compare this operation with Mr. Thomson's experiment for the production of hydrogen gas, in the pneumatic apparatus, from the oxidation of zinc by means of the *same acid,* diluted with the same quantity of water, where the chief difference seems to be, there being no electrical conductors in the pneumatic apparatus, to convey any pure hydrogen off in the form of the electrical fluid, as soon as it is produced, shall we not be convinced of the truth thereof, as well as of Dr. Garnet's observation

on

on the capability of hydrogen to form either the electrical fluid, or hydrogen gas, according to the above circumstances?

Second Class
of
Simple Galvanic Circles.

Mr. Davy then gives a second table of galvanic circles, composed of *one perfect conductor*, connected with *two imperfect conductors*.

The two imperfect conductors in this table, are different fluids; one of which he calls, "An Hydrogenated Alkaline Sulphuret." The other, "A Solution of Nitrous Acid, Oxygenated Muriatic Acid, &c."

But as Mr. D. does not mention either how the experiments are conducted, or what effects are produced thereby, the author will content himself with a circle formed upon the general outline of this second table, viz. one perfect conductor, forming a circle with two (or more) connected

nected imperfect conductors, *i. e.* different parts of an animal.

Negative Simple Circles.

As this circle is quite the reverse of the *first*, or *positive* class, in *its construction*, so it is in its *effects*, and the consequences resulting therefrom. It produces no chemical changes, consequently no fluid. It only conducts it *from* a part positively charged therewith to the negative conducting parts of a substance.

Fortunately Galvani's experiment is exactly descriptive of the construction, action, and effects of this negative simple circle on the animal vital principle.

Galvani having laid bare a nerve and a muscle in the leg of a live frog, applied a metallic conductor to both; as soon as this circle was complete, he observed spasmodic contraction in the muscle, occasioned by the plus of electrical influence, suddenly conveyed from the positive nerve, to the negative muscle.

This

This experiment is a most valuable basis of theory; it proves the value and the truth of the capability of the electrical fluid to reside in states of redundancy and deficiency, in different parts of a living animal. The torpedo is another proof. At the same time it manifests the affinity and the obedience of this vital principle of motion, &c. to the common laws of electricity.

This vital principle has long been acknowledged as the "Nervous Fluid," "the Animal Spirits, &c." It is the active and passive link of sympathy, connecting the mind with the body; whereby the various impressions, made by external objects on the different organs of sight, hearing, smell, taste, and touch, are communicated to the mind, raising those sublime and refined ideas in the imagination of man, which so eminently distinguish him from the brute part of the creation; and by which sympathy of nerves he is enabled to express the emotions and sentiments thus, or otherways, excited; the strongest proofs of which are shewn by the different modes of elocution, vocal and instrumental music, painting, sculpture, &c.

Can there be a subject more worthy of our admiration

admiration and gratitude? Is it not one of the richest sources of Natural Theology?

This sympathy is also the source by which animal action and motion, both voluntary and involuntary; the circulation of the blood, the vascular energy, and all the vital functions are conducted and regulated.

This is proved by the sympathy acknowledged to subsist between the stomach and the head, the skin, and various parts; when the stomach is loaded the head is affected; the gout is frequently repelled from the feet to the stomach; medicines which nauseate the stomach, produce perspiration on the skin. It is from this sympathy that many medicines produce their effects on gout, &c. in the distant parts.

This electrical vital principle is allowed to be prepared, at least, in the lungs of animals, by the atmospheric air, inhaled in respiration, producing oxidation on the iron contained in the blood, returning by the veins, black and exhausted, to the lungs. The oxygen of the air excites the chemical changes, and the oxidated blood is sent from the lungs to the heart, bright

and

and florid, whence it is sent again by the arteries all over the body, for the nourishment, support, and renovation thereof, as well as for the purpose of supplying the different secretions made by the liver, kidnies, &c. a part of this oxidated blood, is sent directly from the heart to the brain, which is supposed to separate this electrical principle, and to distribute it by the nerves which originate in the brain and spinal marrow; and which, branching therefrom, like so many conducting wires, in infinite number and minuteness, perforate every internal part of the body as well as the muscular external parts; and they terminate internally on every surface; of the mouth, throat, lungs, stomach, and its membranes, bladder, blood vessels, the viscera, &c. and externally on the true skin, (which is only covered by the thin conducting membrane, the scarf skin,) in such number, that you cannot apply the point of a needle to it, without covering several, and thereby forming *a negative galvanic circle*, capable of acting through this conducting membrane, upon the positive nerves, and thereby occasionally drawing off any plus of this principle therefrom; or of remedying an occasional deficiency, when the positive circle is applied.

This corresponding sympathy of nerves is the foundation of the re-animating processes of the Humane Society; it leads also to a very important and useful part of this work, the application of these pointed conductors, forming simple galvanic circles, as described, towards the correction of local *redundancy*, or *deficiency* of the vital moving principle, producing, or accompanying, various *disorders*, properly so called.

For if an equal and regular distribution of this vital principle produces health, with vigour and activity of mind and body; we may conclude that derangement, or irregularity thereof, may produce, or accompany, various complaints.

When spasms of the muscles arise, we conclude that the nervous energy of the part is too great, and we find the negative points frequently beneficial in drawing off that increased energy, in harmony with the sedative medicines which may be given at the same time, acting on the nerves of the stomach, When, on the contrary, a part becomes *paralytic*, we conclude that the nervous energy of that part is deficient; and the galvanic stimulus, excited by the friction of the positive circle of zinc and silver points on the part

part, is attended frequently with the greatest success.

Spasm and palsy are the opposite extremes, produced by the redundancy or deficiency of the vital moving principle, which affects the nervous, the vascular, and the muscular systems, in various degrees; proportioned to its excess or deficiency.

The wisdom of the physician is shewn by discovering whether the above is the primary cause; or only a symptom, or consequence of others.

The utility of the electrical machine in many cases, is universally acknowledged, but its *importability*, or difficulty of being moved, with the trouble in cleaning it, and keeping it *in order*, have caused medical electricity to be too much laid aside; according to the declaration of medical professors thereof.

These pointed conductors possess all the milder powers of the machine, and they act precisely on the same regular theory; they may be kept in a toothpick case, and may be made for a few shillings each pair.

As the Society to which this Book is most respectfully dedicated, have saved the lives of so many, by stimulating and reviving this vital principle, when it was, to all appearance, *totally extinct,* and the persons quite dead; the Author is emboldened to lay before them his ideas of extending their truly *Christian scheme* to the smaller, though frequently not less fatal, derangements of it, in Palsy, Dropsy of the Chest, Mortification of Parts, &c. by a particular modification of the Simple Galvanic Circles described in this Treatise; the only difference consisting in the *form* of the perfect conductors, and the *mode* by which they are made to *act,* upon the imperfect conductor, the Scarf Skin; either positively, or negatively, according to their different arrangements, and as the case seems to require.

The positive circle of conductors, made by the Author's directions, was formed thus:

A plano convex pointed conductor was formed of pure zinc, about three inches and a half long, nearly one quarter of an inch wide at the broadest end of the flat surface, which terminated in an oval; gradually decreasing in size to the other

other end, which terminates in a point; sharp, but smooth, that it may not *scratch* the skin which it is to be drawn in contact with. This is the more oxidable perfect conductor of the circle.

Another pointed conductor was formed of silver, perfectly similar in shape to that of zinc; this is the less oxidable perfect conductor of the circle.

When these two different pointed conductors are bound with their flat surfaces together, their points parallel, and they are applied to the skin, so *that both points may touch it, at the same time,* do they not form a compleat positive simple galvanic circle, according to Mr. Davy's own definition?—"A more and a less "oxidable metal, in contact with each other, "in *one* or *more points,* and connected *in other* "*distinct points* with the imperfect conduc- "tor," the skin of the animal or person to whom they are applied.*

The

* Compound positive pointed Conductors may be formed of several points of zinc, and of silver, connected together, to be used where a greater degree of galvanic stimulus is required, than is supplied by the simple circle of *one* zinc, and *one* silver pointed conductor.

The mode in which oxidation and the chemical changes are produced in them, is exactly similar to that by which those changes are excited in the electrical machine, in infinitely larger quantity, by the friction of the glass plate, &c. on the larger surfaces of the amalgam.

But the friction of these galvanic points is assisted by the separating quality of the *heat* of the part upon which they are drawn in contact with the conducting scarf-skin, and surrounded by the same oxidating fluid, the atmospheric air, which completes the simple circle, and yields its oxygen in both cases alike. Is this enthusiasm—*imagination*—or is it plain reasoning?

If a person puts the flat surface of the broadest end of the zinc conductor upon his tongue: and the silver one, within side of his upper lip, he will perceive a faint flash, or appearance of light in his eyes, (if he is in a dark place) as soon as he brings the other ends of these instruments into contact, or connects them together at the same time, by a third metal.

Considering the small surface of zinc oxided in this experiment, the production of the electri-

cal

cal fluid thereby in sufficient density to make this impression on the optic nerves, is the more remarkable, and sufficient to convince any liberal, disinterested, *unprejudiced* person, of *the great probability at least,* that the friction of these points upon the warm skin, may likewise have the effect of producing this fluid *in quantity proportioned to the surface oxided*; and that, by continuing the operation for a length of time, and repeating it at intervals, a certain effect may be obtained.

The author here subjoins a few remarkable instances of the galvanic effects which have been produced within these eight years, under his own inspection, (*truth,* not *novelty,* being his object) sufficient to prove the great advantages which society might derive, from an encouragement of of these pointed galvanic circles, as a topical assistant to medicine, in the most desperate and hopeless cases; and even after internal medicines have been tried in vain.

The pointed conductors used in the following cases, are described in the specification of the patent, to be composed of the following, more or less oxidable metals:

One

One is said to be made of	The other of
Zinc,	Platina,
Copper,	Silver,
Gold.	Iron.

The proportions of the several metals are not mentioned, but the arrangement is obviously similar to Mr. Davy's first table of more and less oxidable metals, forming, when in contact, a perfect simple positive galvanic circle, (as described by him) with a living animal, or part thereof.

It is to be remarked, that the quantity of zinc, in the positive conductor, is not sufficient to produce the appearance of light, when applied to the tongue, the other to the upper lip, and the circle completed by bringing them into contact at the same time in the dark. But the following cases will prove what happy effects were produced by the friction of this simple circle of points upon the skin, in Palsy, Dropsy of the Chest, Mortification of the Foot, &c.

Palsy.

Mary Scott, aged about sixty, in Chelsea Workhouse, had been afflicted with palsy in her arm

arm and hand, and contractions in her fingers, for eleven years. The author directed a person* to draw these galvanic points (bound together) in contact with the skin, from her forehead, backwards, over her head, down the spine of her neck, thence across her shoulder, and down the inside of her arm, to the ends of her fingers, for half an hour, twice every day. By continuing this practice for a fortnight, she had recovered the use of her arm and hand, so far as to make up some linen for the matron of the house. By persevering some weeks longer she was so completely cured, that she was appointed a nurse to the house. This is attested by a letter of thanks from the churchwardens, &c. of the time, to the author.

Dropsy in the Chest.

A man had for some years a dropsy in his chest, for which he had taken medicines, without any relief; this galvanic circle of points was drawn from above his breast down to his hips over the stomach in various directions in contact with the skin for half an hour: this was succeeded by a most plentiful discharge of urine, which continued

* The porter.

continued to flow, at intervals, the whole day; and he *imogined* his breathing was relieved. Continuing the same operation every day, the same discharge continued, and the oppression of his breath was proportionably lessened. In about three weeks continuance of this practice the urinary discharge abated as the disorder decreased; and in a few weeks longer perseverance in the application of these points, he was entirely cured. If we can compare this cure with the acknowledged theory of dropsy, there is nothing mysterious which a person of liberal education and *mind* cannot comprehend in the removal thereof.

Dropsy is said to be caused by a loss of tone (this vital principle) in the absorbing vessels, whence the parts become loaded with watery humours, which ought to be taken up by them, and transmitted to the intestines, kidnies, and skin, whence they are sent out of the body by perspiration, urine, &c. In this case we see the topical galvanic stimulus, restored this power in an eminent degree.

Mortification.

Mortification of parts is likewise caused by a want of energy of this vital principle, causing a stagnation

stagnation, and consequently a corruption of the humours of the parts affected,

A woman had a broken chilblain in her foot in a state of mortification; it succeeded a white swelling in the knee of the same leg. The foot was swelled, the ulcer black, and so painful that she could not set her foot upon the ground: she had been applying poultices and ointments. She washed the grease from her foot, and these galvanic points were drawn gently, in contact, with each side of the ulcer, the whole length of her foot, for half an honr that night; the next morning she said that whilst these points were drawn upon her foot, and for an hour and a half afterwards she was *in an agony of pain,* but that the ulcer had *discharged a great deal* since. This was observed to be a very good sign. She used the points twice a day, with the same effect, for two days longer, when the author desired her to try whether the points of compasses would not do as well: she said that whilst the compasses were drawn on her foot she felt *no pain or effeat whatever*; but the moment the *other points* were applied, the pain returned. By persevering in the use of *the positive eircle* of points, about ten days longer, the discharge gradually decreased,

the

the pain went off, the skin resumed its colour, the ulcer was healed, and she could walk as well as ever.

Surely the difference of effect produced by the different qualities of this *positive* circle of mixed metals, or the negative compasses, formed of one metal only, is as strongly marked as the difference between any two medicines of opposite qualities, when internally taken, can be, and as strongly demonstrative that these galvanic points *act* according to *a rational theory*.

A young woman had been for several years troubled with chilblains, which had broken, and left hard lumps on her feet. In November of the year 1804, her chilblains had returned, and were upon the point of breaking. The author lent her a pair of new patent points, which she drew round the edges of her chilblains for half an hour night and morning for three days, and her chilblains entirely disappeared: continuing the practice a week or more, the hard lumps dissolved also. The next year, her chilblains returning, the author lent her another *old pair* of instruments; she used these for four or five days, without any benefit. The author asked if she had been

been applying any ointment or grease to the foot; she said she had not. He then lent her the *sharp* pair, and they cured her as before in three days. Here we observe, that the blunt points could not, moreover they ought not, in point of theory, to produce the same effect as the sharper points.

In all the above cases, medicines of the stimulant and tonic kind, are given internally. Can there be *any objection* to the trial of this simple, easy, topical application, as an assistant in perfect harmony with those medicines? Seeing what effects have been produced by them, even when medicines were *not taken* at the same time.

Œdematous, or White Swellings, which frequently are accompanied with foul ulcers, on the legs of old people, (the poor in particular,) arising from scrophulous habits, and improper diet, would, in all probability, receive the greatest benefit from the use of this positive circle of zinc and silver points. The author laments that he has not had an opportunity to try them in these cases.

Negative Galvanic Circles.

Galvani's experiment is the foundation of this circle

circle, viz: A single metal forming a perfect circle with two different parts of a living animal. A metallic conductor applied to the bare nerve and the bare muscle of the leg of a live frog, which, by negatively translating the electrical vital principle with which the nerve was charged, suddenly, to the muscle, produced contraction or spasm therein.

This negative metallic conductor may be divided into any number of points; but these points must be all of the *same metal,* to prevent oxidation, and the formation of the electrical fluid.

Compasses, or a number of sharp pointed small silver wires bound together, with their points parallel, would be capable of acting on the points of the nerves terminating in the true skin, through the conducting medium of the scarf skin.

According to the established theory, inflammation, spasm, violent pain, &c. are caused by, or attended with, an increased energy of the vital principle, producing increased action, constriction, and irritation of the nerves, vessels, and muscles, &c. of the parts, as well as obstruction,

swelling,

swelling, redness, &c. thereof; these negative points produce the effect of *gradually drawing off* this increased energy. The effects of burns, and scalds, have been speedily removed by drawng the points of compasses, or scissors, on each ide of the part to the extremity of the limb.

A butcher, in the neighbourhood, had an nflamed sore throat, and quinsey. The throat vas so swelled and so painful that he could not wallow in the least; these galvanic points were lrawn over his throat, and down his arms, for alf an hour, when the inflammation, swelling, &c. were so reduced that he was able to eat and drink, to the surprise of his friends; and in three days continuance of this application, he was entirely cured.

Soon after this, another young man was attacked with the same complaint. He was recommended to try the same; but some *overwise* person persuaded his friends that the idea of a cure by such means was "too ridiculous;" and in three days he left a widow and infant to lament that they *had not* been absurd enough to use them.

A gentleman

A gentleman had been frequently disturbed from sleep by attacks of violent spasmodic hiccup, which distressed him very much. One night it was so violent that it shook his whole frame. He drew the negative points of compasses in contact with the skin, from above his breast down to his hips, in various directions, about an hundred times.* The complaint entirely ceased with this and did not return, as usual, that night. Violent erysipelatous inflammation has been removed in the course of a few days, from the eyes of a near relation of the author, which had resisted the prescriptions of one of the first physicians, five days, the disorder increasing until she was in very great danger. As soon as these points were drawn across the eye-lids down the cheek, neck, arm, and to the finger-ends, she declared she felt a warmth follow the points the whole way they were drawn; in the course of half an hours' continuance, she said, her head-ache was very much relieved. The next morning she was considerably better; and when these points were about to be applied, she desired they *might not be drawn across both her eyes*, it gave her such intolerable

* He frequently is attacked with this complaint, and he constantly is relieved from it by drawing these negative points in the manner described.

intolerable pain. N.B. Here was an absolute proof that she *felt* the effects of them. They were accordingly drawn about one quarter of an hour across each eye, and down the cheek, &c. separately; the relief she felt was extraordinary. The doctor said she was better. By two days continuance of this practice, she was so far recovered that the doctor was dismissed; and in the course of a month or six weeks, all inflammation was withdrawn. It is worthy remarking, in this case, that the disorder increased continually for five days, until these galvanic points were applied. She certainly continued the same medicines; but as they had no effect before, it is surely reasonable to conclude, that this topical application was the primary cause of the relief which she felt. There was no discharge of matter, or any thing which could be called a crisis that could account for this sudden relief, but the sense of heat following the metallic points, the whole way they were drawn. A friend of the author's died, on the fifth day, of the same complaint in the eyes and face; and there were very small hopes of this lady's recovery before these points were applied.

The Author candidly owns, that the descrip-

tion of the metallic composition of the Pointed Conductors (used in the preceding cures,) so similar to Mr. Davy's first table of Simple Galvanic Circles, is taken from the specification (if it can be so called,) annexed to the patent of the Tractors, which it is *by no means the author's wish to recommend*; the extravagant price demanded for them, and the complete mystery they were involved in, produced a contempt and ridicule of them at their first appearance, which could not have effected their total subversion, (as they have) if the galvanic arrangement had been openly stated, and the price more moderate.

It certainly is a most happy extension of the mode of exciting the electrical fluid from the metallic amalgam in the electrical machine by the friction of the glass, to the metallic pointed conductors thereof, when forming a circle with the animal skin; but it surely cannot be called an original invention.

The metals in this combination are most unphilosophically put together; the zinc and the gold, *i. e.* the most oxidable, and the least oxidable metal, are combined in the same instrument; and

and the printed directions for the application of these instruments, sufficiently prove the patentee was ignorant of their greatest powers.

" They are to be used *singly* in all cases."

" In all cases the tractors should be used " *alternately*, changing them in the course of " two or three minutes; if, however, as is some- " times observed, *one* be found to have greater " effect *than the other*, it should be continued."

" The complaints most subject to their in- " fluence, are, painful topical disorders, Rheu- " matism, Sciatica, Gout, Sprains, Bruises, " Burns, Scalds, Inflammations of the Eyes, " and of the Skin, Erysipelas, Tetters, Violent " Spasmodic Contractions, Locked Jaw, Cramp, " Pleurisy, &c. &c."

The Patentee takes no notice of their efficacy, or even their application, in Palsy, Dropsy, Mortification of Parts, or in any complaint where the vital energy is deficient; which is a convincing proof that he was ignorant of their powers in those dreadful maladies, when combined, and forming a positive galvanic circle.

Used

Used separately they can only act as negative pointed conductors, as any other metal will, and the sharper the point is the greater its negative power must be—from this must have arisen the accidental greater effect of *one* than the *other*.

The manner in which the purchasers of these instruments have since used them, can be nothing to the Patentee.

The specification of 1798 states, that they act on galvanic principles; that one is composed of zinc, copper, and gold, the other of iron, a *little platina*, and a *little* silver; without naming the proportionate quantities of each. Is this a specification sufficient to render the patent *valid?* If it were, the patent has not more than two years to run.

The grin, grimace, and ridicule, which accompanied the bare mention of these quack instruments, has ceased, having obtained its purpose.

And now the voice of truth, assisted by plain evident theory, confirmed by experience, claims the attention of society, to the simple pointed galvanic

galvanic circles, as a topical assistant to medicine; if the weaker combination of metals was capable of producing the happy effects already stated; surely as much may be expected from the more powerful combination of zinc and silver, (which flashes conviction in the eyes of those who apply them properly) in Palsy, Dropsy, Mortification of Parts, Oedematous Swellings, Scrophulous Glands; without entertaining greater expectation of their *universal success*, than is observed *in any one medicine*, or more contempt, if they sometimes fail.

The price the author has paid for his silver and zinc pointed conductors, is five shillings, but he understands that they can be made, on a great scale, under three shillings.

Their characters are so entirely different, in every point of view, from the tractors, that there can be no infringement of the patent right (if valid) by the sale of them. It would be just as hard, as if the sale of a particular preparation of antimony was prohibited by the patent of James's Powder.

Directions for using the Positive Simple Pointed Circles.

The more simple an operation is, the greater is the necessity that it be performed *accurately right in all its parts.* These instruments, like medicines, require great precision and attention in their application. In some cases also, a patient perseverance in their use, is equally necessary, as in medicine.

They must be kept clean and bright, and the points *properly sharp,* particularly the *silver (or copper) negative point;* because the strength of this negative action depends upon the degree of their acuteness. The zinc point may be more blunt, because it will afford more surface for oxidation by friction.

The parts over which they are drawn, must be clean, and free from ointment or grease, which is a non-conductor, and will prevent the action of these points.

They must always be drawn *from* the head, chest, stomach, &c. or from above the seat of the disorder, to the limbs, and even to the ends of the fingers,

fingers, or toes, where the disorder is violent, for fear of translation.

They may be joined, with their flat surfaces together, by a small circular bandage, which will *fit tight, at less than half their length,* as it will stretch.

They must be pressed firm into this bandage; with their points quite parallel, when they are used; the points must be applied horizontally to the skin, so that *both points* may touch the skin, at the same time, and thus form a perfect circle with it.

It is very probable that a want of attention to some of these necessary minutiæ, has produced a failure in their effects. For if these points are applied perpendicularly, so that the silver *point only* touch the skin, could there be any chance of oxidation taking place on the zinc?

Five or six hundred times drawing these instruments in contact with the skin (whatever the space) are generally sufficient for each operation.

They

They may be used under the clothes in bed, but the air should be admitted frequently, that oxidation may go on. Zinc is a brittle metal.

Of what infinite service may not these Simple Galvanic Circles prove (both negative and positive) in military, and other hospitals, poor-houses, &c. &c.?

Surely no regular medical man can object to them *now*, founded as they are, upon the theories of the first galvanists, as *philosophically* and as rationally as the theory of medicine is.

The author hopes the intention with which this work is published, will cover its imperfections. Convinced by eight years experience of the general utility of the medical part of the plan, he thought it his duty to present it, as it is, to the consideration and protection of the Society to which it is most respestfully dedicated.

He hopes the philosophical part may be of some use also.

Imperfect as it is, surely there is matter enough from the highest authorities, to draw the

the attention of those who are capable of improving this rough sketch to any extent.

Neither the ambition or the interest of the author are in the least concerned in the event. He will content himself with having performed what he conceived to be his duty, in applying the theories and experiments of others to useful purposes; and of displaying the powers of galvanism by the blessings arising to mankind therefrom, in the restoration of the vital principle to its proper state, when deranged, and the removal of disorders thereby, rather than by the spasms and agonies it is capable of producing in living animals; though these were highly useful, in displaying the nature of the animal vital principle, and its affinity to galvanism.

FINIS.

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