ON THE

OPERATION OF PHYSICAL AGENCIES

IN THE

FUNCTIONS

OF

ORGANIZED BODIES,

WITH

SUGGESTIONS AS TO THE NATURE OF CHOLERA.

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Believing that there is nothing so obscure in the phenomena of organization, which a thorough knowledge of the physical laws of matter would not tend to illuminate, I beg leave to solicit attention to certain facts and experiments, the importance of which does not seem to be generally appreciated, in reference to the great objects of our profession.

The data upon which I have endeavoured to trace out a theory, are not of my own observation; they are abridged from several respectable authorities,—and combined in the hope of directing the attention of others, better circumstanced than the writer for observation and experiment, to that chain of relations which connects the physical, physiological, and pathological sciences.

The brilliant modern discoveries in geology, chemistry, and physiology, all tend to dissolve those barriers which have so long separated and kept distinct the various departments of natural philosophy.

Human knowledge has always been divided into two kinds of facts,—namely, those which could be traced to natural causes, which were considered legitimate objects of investigation; and those which were supposed to depend on special causes, beyond the reach of science, into the nature of which it was deemed either a species of insanity or sacrilege to enquire. But the daring philosophy of modern times is gradually extending the boundaries of the former, at the expense of the

atter. The traveller on a dark night can only discern the position and relations of the objects immediately surrounding him; his beclouded vision can perceive no connection between the dim objects glimmering in the distance: he cannot tell whether they belong to earth or heaven; and his benighted soul is thus induced to ascribe them to supernatural agencies; but as the light of morning advances, as the range of his vision becomes more extended, he gradually discovers his position in relation to everything within the bounds of the horizon. Thus the progressive mind of man is redeeming natural phenomena from the dominion of ignorance; and it will continue to do so, until all the facts of nature, of which we can become cognizant, will ultimately arrange themselves into one grand system of natural philosophy; at least, such is the faith and hope of the writer.

The phenomena of organic life have always been considered infinitely mysterious and unapproachable. Not only the vulgar, but even the most learned men, have, up to a recent period, entertained this opinion —an opinion which has done much to retard the progress of physiology. The student of Nature has been prevented from entering the rich storehouse of physiological wealth, by discovering the word *vitality*, which indolence and empiricism have stamped upon its portals. But what can resist the power of the galvanic battery, the result of that electric frog-shiver, accidentally discovered by the wife of Galvani. The battery, indeed, has been well named, for there is no difficulty in physical or physiological science, which it does not seem likely to *batter down*.

The *British and Foreign Medical Review* for April, 1847, contains a critique on a work by Professor Matteucci, of the University of Pisa, on the physical laws of organic life. In speaking of endosmose and exosmose, the *Reviewer* says:—

"Every one admits that these currents are due to molecular attractions of the same nature with those concerned in the ordinary operations of capillarity: but in the alteration in the conditions, there is marked alteration in the results, and physical science has not yet succeeded in fully accounting for the phenomena. If

we say that the form of the blood corpuscles may be changed by endosmose*, we express in a concise way the fact, that if they be placed in pure water, or in diluted serum, there will be a passage of fluids towards their interior, which will distend, and even burst them, whilst, if they be placed in a solution of salt or sugar of greater density than their own contents, the chief current of fluid will take place in the opposite direction—and the blood corpuscles will be emptied. With the ultimate causes the physiologist has nothing to do, until physical investigation shall have determined them, which, we have the authority of Professor Matteucci for asserting, has not yet been effected. For, although it might not seem difficult to give a general explanation of the fact, that when two liquids of different densities are separated from each other, by a porous membrane, the more rapid current should be that of the rarer fluid towards the denser. There are many variations, and exceptional phenomena, for which no such general explanation is adequate to account:—for instance, when alcohol and water are employed, the principal current or endosmose is from the water towards the alcohol, although the latter is the less dense of the two. A fact still more difficult of explanation is the agency of sulphuretted hydrogen in immediately checking the process."

Now it will be my endeavour to prove;—1st, That *endosmose*, *exosmose*, secretion, absorption, imbibition, &c., are no other than modifications of capillary attraction. 2nd, That capillarity, cohesive attraction or affinity, are modifications of electrical attraction. 3rd, That electricity is a single element. 4th, That the Asiatic cholera is produced by a deficiency of electricity in the locality where the disease prevails, causing powerful currents from the sanguiferous system, towards the mucous membrane of the alimentary canal. And if I can satisfy the reader that those positions are sound, I shall likewise remove much of the difficulty referred to by the Reviewer; as well as assist in placing the treatment of cholera on a scientific basis. For many of the facts and experiments to which I will refer, I am indebted to Professor Draper's work, on the Physiology of Plants.

1st, It is well known, that when a solid body is part-

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*Endosmosis—The property by which a fluid passes through a membrane into a cavity. Exosmosis—The fluid passing outwards. These were formerly considered exclusively vital phenomena.

ly immersed in a liquid, the liquid is elevated or depressed around the sides of the solid, according to the liability of the latter to be, or not to be moistened by the former. Thus, if a glass rod be dipped in water, the liquid will be elevated immediately around it, whereas, if it be dipped into mercury the latter will be depressed. In the same manner, if a small tube, open at both ends, be plunged into a liquid, the latter will be raised or depressed to a degree proportioned to the smallness of the diameter of the tube; but if the tube exceed a quarter of an inch in diameter, the smallest possible elevation or depression of the liquid will take place. These phenomena will not be affected by the rarification or condensation of the atmosphere, but they will be modified by temperature, the variations diminishing with an increase of heat. There is one important fact to be borne in mind, which may thus be illustrated:—Water will be raised in a tube to a certain height, but if you take a tube of the same diameter, but shorter than the height indicated, then the water will be raised to the top, but it will not flow over unless means be adopted to remove the liquid as it rises to the upper extremity, with this latter condition, however, the water will continue to rise through the tube, as long as there is a supply. In the wick of a lamp this condition is provided by combustion, which carries off the oil which is raised to the flame by *capillary* attraction. So also in a spirit lamp, as long as the extinguisher is on, no evaporation can take place, but when removed, evaporation immediately commences, and by this all the alcohol may be dissipated. Again, if you take two vessels, one containing water, and the other alcohol, and passing between them a capillary tube filled with water, the water, as soon as it comes in contact with the alcohol, will be taken up and dissolved by the latter, so that there will be a constant flow of the water towards the alcohol. From these facts it will be understood how combustion, evaporation or solution, may produce a flow of liquid through a capillary tube, proportioned in rapidity to the dissolving power.

Several other substances, such as unglazed porcelain, alumina, slate, &c., as well as vegetable and animal tissues may all be considered as congeries of capillary tubes, seeing that they all imbibe liquids in the manner above described.

Bladder is easier moistened by water than by alcohol. Now, if you fill a bladder with alcohol and immerse it in water, it will be found, on the principle before stated, that the water will pass through the bladder more rapidly than the alcohol can escape, and by this means the bladder may be extended until it bursts.

"If litmus water be placed on one side of a piece of bladder, and alcohol on the other, the water will forsake the colouring matter, to pass through the bladder and unite with the alcohol.

"If ferrocyanide of potassa be tied up in a section of intestine, and immersed in a solution of proto-sulphate of iron,—Prussian blue will be deposited on the one side of the intestine, but not on the other.

"If a solution of oxalic acid be placed on one side of a membrane, and lime water on the other, clouds of insoluble oxalate of lime will form on the side of the lime water, but the other side will be pellucid.

"If a volume of nitrogen gas in a soap bubble, or under any suitable membrane, be exposed to atmospheric air—decomposition of that air will result, its oxygen passing through the membrane, to form atmospheric air with the nitrogen within.

"If a quantity of commercial alcohol be tied up in a bladder, and freely exposed to the air, the water in union with the alcohol will pass through the pores of the bladder, and gradually evaporate away, leaving the alcohol much stronger."

If, over the mouth of a cylindrical jar, a thin sheet of India rubber is tied, and the jar be exposed to an atmosphere of ammonia, or protoxide of nitrogen, in the course of a short time, by the ingress of the atmosphere, a pressure is created tending to rupture the membrane outwards. From these facts a most interesting theory of the circulation of sap in vegetables, and of the blood in animals, has been deduced. By this theory, the circulation of the blood in insects, fishes and cold-blooded animals, the development of acardiac monsters, the accumulation of blood on the right side of the heart in man after death, with many other phenomena unexplainable by any other theory, have been satisfactorily accounted for.

2nd, Assuming, then, that *endosmose*, secretion, absorption, imbibition, &c., are nothing but modifications of the phenomenon of capillary attraction, we will now enquire whether such phenomena can be explained by reference to general principles. It is by an answer to this question that we must establish the validity of our first position, *What is the cause of capillary attraction?*

"If a circular disc of glass be placed on the surface of mercury, it will adhere with a certain force, which may be measured by means of a balance; but the glass may be raised from the mercury, without bringing any particles of the latter along with it. If a disc of the same kind be placed on the surface of water, it will also adhere, and you cannot raise it again without raising some of the water likewise, *i.e.*, the glass will be wetted. Now there cannot be the least doubt that the same *cause* is in operation here, as that which produces pore-action, or capillary attraction; and from a series of experiments the following laws have been deduced:—

"1. If the force of attraction of the particles of a solid for the particles of a fluid, be not equal to half the cohesive force of the latter for each other, the fluids will refuse to pass through a pore of that solid substance, and in capillary vessels consisting of it, the fluid will be depressed below its hydrostatic level.

"2. If the force of attraction of the particles of a solid for those of a liquid exceeds half the force of the latter for each other, but is not equal to the whole force; the fluid will pass through pores formed of that solid substance, and in capillary vessels consisting of it, will rise above its hydrostatic level.

"3. If the force of attraction of the particles of a solid for those of a liquid exceed the whole cohesion of the latter, *chemical union ensues.*

"By tracing cohesive and capillary attraction to the same cause, much advantage is gained, because it simplifies physiological investigations.

"Let us suppose a plane of glass capable of being elevated by an insulating handle, to be resting on the surface of mercury, contained in an insulating vessel. Let the mercury be connected with an electrometer, by means of a wire. Now, as long as the glass plane and the mercury are in contact, the electrometer evinces no disturbance; but as soon as the plane is raised by the handle, electricity is instantly developed, and the gold leaves diverge. By employing another electroscope, it will be found, that the glass is positively, and the mercury negatively, electrified, which, I think, should be proof positive that electricity was the cause of their adhesion. A cause of attraction being thus developed, it would be very unphilosophical to seek for other agencies, especially where one so competent to produce all the effects is seen to exist.

"If the same experiment is performed, substituting water for

mercury, no electricity will be developed, and the reason is obvious—no separation has taken place between the glass and the water; the glass is wetted, therefore the particles of the water have only been separated from each other.

"This difficulty being dismissed, it would seem to follow, according to the hypothesis indicated by the foregoing experiments, —that if two solids adhere to a certain fluid, with forces differing in amount, they should develope, upon rupture, quantities of electricity, in the same ratio. As a general result, the balance and electrometer prove this to be the case. Bees' wax, which adheres to mercury, with much less force than gum lac, developes likewise much less electricity. Gum lac, which adheres less strongly than glass, likewise developes much less electricity—much depends, however, on the conducting power and other conditions of the substances employed. *Great variability in the results is often observed, even when the same materials are used at different times.* Gay Lussac found that it required a weight sometimes of 158, and sometimes 296 grammes to detach a certain disc of glass from mercury, depending on *causes for which he could not satisfactorily account.*" Does not such variability indicate the influence over such phenomena of that insidious, mighty, and all-pervading agent, with the general laws of which we have yet so much to learn?

"The best method of showing that the voltaic battery has entire control over capillary attraction, is to take a shallow vessel containing a quantity of mercury, and place upon it a drop of water. On making the drop communicate with the positive electrode of a battery, and the mercury with the negative, in a moment the drop loses its rounded form, and spreads out in a thin sheet on the metallic surface, completely wetting it, and *as the tension of the battery increases, the drop expands more and more in proportion to the number of plates employed.*

"Again—water will pass with great rapidity through a chink, the width of which is not more than half a millionth part of an inch, provided it can wet both sides of that chink,—but if that condition is not fulfilled, it fails to pass, even though the width should be increased to upwards of one hundred and forty-four times its former dimensions.

"If you take a glass tube, half an inch in diameter, and grind one end of it very exact,—place it on the surface of pure mercury, and pour water into the upper end, the water will not escape at the chink between the mercury and glass, because it does not wet the former; but if a platina wire be inserted into the tube and connected with the positive electrode of a battery, while the mercury, by means of another wire, is connected with the negative electrode, then the water will begin to flow through the chink, and spread on the mercury, until it gets below the wire which is inserted in the tube.

"In a tube small enough to exhibit capillary attraction, the same phenomena will take place, which proves that, under such

circumstances, the water is driven out by an active force, for, by breaking the galvanic circle, and by raising the tube a little from the mercury, the water will again rise by the force of capillary attraction.

"If two quanrities of water are separated from each other by a membranous partition, and one of them made positive and the other negative, all the water in contact with the positive pole will escape into the negative side, passing throuh the membrane by capillary attraction."

In those facts, I think, we have abundant evidence of the identity of the capillary and electrical forces, which will receive further confirmation in the consideration of the positions yet to be examined.

3rd, I believe electricity to be a single fluid.

There are three facts which form the basis, and must be taken into consideration, in all reasoning upon the nature of the electric fluid:—

First,—Two bodies positively electrified repel each other.

Second,—One body positively and another negatively electrified, attract each other.

Third,—Two bodies negatively electrified repel each other.

The theory of Dufay is, that there are two fluids,—the one positive, or vitreous; the other negative, or resinous. The particles of either fluid repel particles of the same kind, but they have a powerful attraction for those of the opposite electricity, and matter. By this hypothesis, the facts stated may be explained.

The Franklin theory asserts, that there is but one fluid, the particles of which repel each other, and possess a powerful attraction for matter. This doctrine explained the two first facts, but failed to afford a satisfactory reason for the third,—namely, how two balls deprived of electricity, could have a repelling influence upon each other. To obviate this difficulty, it has been supposed, that the simple particles of matter have as great an aversion to each, as the particles of electricity have for those of their own kind. I must confess, that the double theory seemed to me very unsatisfactory, and likewise less simple and natural than that of a single

electric fluid. I have also found, that some of the ablest writers who have supported Dufay were often compelled to speak, as if electricity was only one element. On the other hand, the repelling power, which was ascribed to *inert* matter, in order to render the single theory admissible, appeared to me still more objectionable; because I reflected, that if the particles of simple matter are capable of influencing each other at a sensible distance, it must be through some essential medium, and that medium might as well be considered another electricity as not, seeing that equal power was ascribed to it. Had it not been for this difficulty, in all probability, the double theory would never have been mooted.

It may be deemed presumption in me to offer any thing like an original idea, upon a subject which has occupied the attention of so many profound minds. Nevertheless, I cannot help being convinced, that truth will gain more by the independent thought of the humblest votary of science, than it will by the efforts of a superior intellect, who shelters himself within the pale of mere human authority—however exalted that authority may be.

I never could understand what some writers meant, when they spoke of electricity as being a mere "condition or property of matter." Therefore, I must presume that an agent capable of producing such wonderful results is *something*, and that something may as readily be known by the name of *electric fluid*, as by any other appellation. I will now state briefly my own ideas of this subtle agent.

I believe in the theory of a single fluid. I believe that it exists in combination with all bodies in a condensed and latent state, and in this state, is the cause of all cohesive and chemical attraction. The quantity of electricity evolved when a metal is under solution in an acid, being proportional to the dissolving process, is in perfect harmony with this idea. It exists also in a free state, having an attraction in different degrees, for every other kind of matter. In this state it may be the identical cause of gravitation. Bodies in their natural state, have

a capacity for receiving more or less of it upon their surfaces. A body with the greater capacity, will always be positive to another body with an inferior capacity, while in their natural state, and when their particles can be brought within the sphere of each other's influence, they will unite. I believe matter, *per se*, to be perfectly inert. All this will be acknowledged to be in perfect harmony with the principles of electrical science, according to the Franklin theory. But how is the third fact to be accounted for? Why do two balls negatively electrified, fly from each other, when brought together, suspended by silken threads? The answer is —*because they have no mutual attraction*, being denuded of free electricity, which gathers around all bodies in their natural state, *while there is an attraction* (gravitation if you will) *for the free electricity of the atmosphere and surrounding bodies, on all sides but that presented to each other*—thus, *they are not repelled by, but attracted from each other*. Why is mercury depressed around a glass rod that is plunged into it? It is not because the glass repels the liquid metal, but, according to the rule before adverted to, because the attraction of the liquid for the glass is not half the attraction of the particles of the liquid for each other. If you place a piece of ice in the focus of a concave mirror, which is reflected upon another mirror, in the focus of which a thermometer is placed, —why is the mercury depressed? Not surely, because cold is an active principle, like caloric, which raises the mercury when a heated ball is substituted for the ice. Any school-boy who had studied the mere rudiments of natural philosophy might inform the sages of the double theory, that the series of reflections, in those two cases, were quite the reverse of each other.

In my humble opinion, this simple difficulty in the Franklin theory has done much to retard the progress of electrical science. Kane, in his excellent work on the "elements of chemistry," treating of chemical affinity, says:—"Two bodies in combination, are like two pith balls which mutually adhere, but of which the attraction is permanent, from the electricities not being

discharged. How do these bodies acquire their oppositely excited state? and why, if their condition resembles that of ordinary electricity, do they remain combined when their opposite fluids might unite,—and neutralization being produced, all combination cease? These two questions have not yet been answered." So says Dr. Kane, and in my humble judgment they never can be answered by the double theory, under which he labours. By the more simple method his questions are not difficult to solve; but it is quite possible that my confidence in the matter may arise from the want of more extended acquaintance with the subject. But this same author, in page 199, gives me some encouragement in bringing forward the leading idea humbly contended for in this paper. He says:—"It is quite possible that hereafter some sublime generalization may embrace the phenomena of heat, of light and of electricity; of cohesion and gravity, as well as of chemical affinity, within one law, and indicate how by various modifications of *a single agent*, their separate peculiarities may arise." I have not the vanity to suppose that I will ever accomplish what the author thinks possible, still I am convinced, that in a scientific point of view, my cause is a noble one, however feebly I may be able to maintain it.

From the consideration of certain facts, to some of which I have already alluded, we are forced to the conclusion, that the simple physical power of capillary attraction is the cause of the passage of fluids through the smaller vessels and capillary tissues of the human body. I am disposed to think that too much power has been ascribed to the action of the heart, even in the general circulation of the blood. The idea has not originated with me, that the heart should be considered as a balancer, or an equalizer, between the arterial and venous systems, rather than a propeller of the sanguiferous current. Be this as it may, we know that sap is raised to the tops of the highest trees, without any *vis a tergo* in their roots. We know that in the living sponge, water is constantly entering the smaller

orifices, passing through channels and tubes, and ejected, with considerable force, from larger openings, without the least appearance of mechanical force. We know that in cold-blooded animals without hearts, the circulation of the blood is maintained. After some kinds of natural death in man, the arteries are emptied of their contents,—and sometimes urine has been poured out by the ureters, sweat by the skin, and other secretions have been discharged by their appropriate glands, long after the action of the heart has ceased.

That capillary attraction in vegetable and animal tissues, under certain conditions, is very powerful there can be no doubt. "In the month of April," says Doctor Draper, "I cut a vine which was growing wild, on the edge of a forest in Virginia, asunder, with one blow of an axe; the cut surface, which was about one inch and a half in diameter, exhibited its open vessels, from which there poured out an uninterrupted stream of ascending sap. In the course of 8 hours, there was collected of this fluid seventy ounces, and this is probably a far less quantity than would have been raised under circumstances where the leaves aided the spongioles, by their exhausting action."

There is such consentaneous action amongst the imponderable elements, that philosophers have long suspected that they are but modifications of the same energetic, all-prevading principle. Thus, by electric capillary attraction, sap is raised to the branches and leaves of trees, while light is performing an exhausting chemical process upon their surfaces,—"heat is also set free, and becomes latent in the various transmutations which take place, so that plants, like animals, have a temperature of their own, independent of external circumstances."

Mrs. Somerville in her physical geography says:—

"The quantity of electricity requisite to resolve a grain of water into its oxygen and hydrogen, is equal to the quantity of atmospheric electricity which is active in a very powerful thunderstorm; hence some idea may be formed of the intense energy exerted by the

vegetable creation, in the decomposition of the vast mass of water and other matters necessary for its sustenance; but there must be a compensation in the consolidation of the vegetable food,—otherwise a tremendous quantity would be in perpetual activity.—*There is reason to believe that electricity, excited by the power of solar light, constitutes the chemical vitality of vegetables.*"

If the experiments to which I have before referred can be relied upon, the inference which I have here placed in italics, in my opinion, has been fairly demonstrated. The quantity of electricity condensed in ordinary substances must be very great. The steam issuing from the valve of an insulated locomotive steam-engine produces seven times the quantity of electricity that an electrifying machine would do, with a plate three feet in diameter, and worked at the rate of 70 revolutions in a minute,—in short, it may be stated generally, that any thing which tends to destroy the molecular attraction of bodies, such as friction, pressure, heat, fracture, chemical action, &c., developes electricity.

Dr. Golding Bird, in a work lately published on Natural Philosophy, says:—"It is now an incontrovertable fact, that no physical change can possibly occur, without a disturbance of electric equilibrium, *and many processes of this character are going on in the human body.*"

"The electricity of the atmosphere," says Baron Humboldt, "whether considered in the lower regions or in the cloudy canopy aloft, viewed in its silent periodical diurnal progression, or in the brilliant and noisy explosions of the thunderstorm, stands in manifold relationship with all the phenomena of thermal distributions of atmospheric pressure and its disturbances,—of hydrometeors,—and apparently of the magnetism of the outer crust of the earth. *It exerts a most powerful influence upon the whole of the animal and vegetable world*; and this not merely through the meteorological precipitations, of watery vapor, of acids, or of ammoniacal compounds, which it occasions, but also immediately as the electrical force—*that force which excites the nerves or assists the circulation of the juices.*"

We have one striking example of the power that

electricity exercises over the circulation in man, in the fact, that capillary action continues for some time after death: unless the person has been killed by a *stroke of lightning*, or a severe blow upon the epigastrium. I am disposed to consider the great sympathetic as a receptacle for the electricity required for the organic functions of the system; something analagous to a Leyden jar, always charged, in order to regulate the supply of electricity to the several parts of the body as it is required. Does not this account for the derangement of the functions of the abdominal viscera, consequent upon intense excitement of the brain, which exhausts the reservoir, leaving the viscera without their natural stimulus?

The superhuman genius of Shakspeare seems to have appreciated the true philosophy of future, as well as of all past ages of the world's history:

"I could a tale unfold, whose lightest word,
Would harrow up thy soul; *freeze thy young blood;*
And make
Each individual hair to stand on end,
Like quills upon the fretted porcupine."

Upon this principle, it will readily be understood why fear is one of the most powerful auxiliaries to cholera, by reducing the *contractility* of the viscerial tissues, which, I have the authority of Carpenter for saying, is *purely a physical property.*

Is not one of the uses of the hair, by their sharp points, to carry off the superabundant electricity of the brain under excitement?

There may have been more philosophy in "Perkin's steel tractors" than what was generally ascribed to them.

Does it not also account for the arrest of the secretions, &c., after death, by a blow upon the epigastrium, when we suppose that the *jar* has been suddenly discharged by the concussion of the solar plexus. I advance this idea with diffidence for the consideration of the profession, many of whom have superior opportunities for testing its soundness.

Supposing some animal was killed by means such as would derange the nervous apparatus as little as possible, then, by suddenly crushing the semi-lunar ganglion, it would be seen what effect it would have upon the capillary action that would still be going on.

In summing up the evidence which I have already adduced, I think the conclusion is inevitable, that electricity is the grand cause of capillary currents in the physical, the vegetable, and the animal worlds.

According to the most approved philosophy of the present day, the earth may be considered a huge loadstone, with currents of electricity traversing its substance, as well as the atmosphere by which it is surrounded. These currents are excited by the thermal action of the sun upon the different substances of which the globe is composed. By the recent experiments of Mr. Fox, in the Cornish mines, such currents have been proved to exist in the crust of the earth; that their direction is *from east to west;* and that they are greatly influenced by the nature of the soil through which they pass, as well as by astronomical and geological causes beyond our research.

I am proud to observe that that real queen of women, Mary Somerville, maintains the theory of a single fluid. She says:—"There can be no doubt that all the phenomena of magnetism, like those of electricity, may be explained on the hypothesis of one etherial fluid: *a theory which accords best with the simplicity and general nature of the laws of creation.*" Professor Faraday has clearly proved, that statical, dynamical, thermal, and animal electricities, as well as magnetism, are *identical;* and that the difference in their quantities and intensities are quite sufficient to account for what were considered their separate qualities.

My own idea of magnetism is very simple; I believe that every magnetised body, whether it has been made so naturally or artificially, has the property of receiving at one end, and discharging from the other, a constant stream of electricity. I may be mistaken, but it appears to me that the "double theory" has prevented philosophers from arriving at truth in this matter.

There can be no doubt, however, that the magnetism of the earth is produced by the electric currents which are in circulation through its crust, and around its surface. In connection with this it may be stated that the

magnetic poles of the earth are constantly changing their position. Previous to the year 1660, it was observed that the needle pointed east of north. Since that time it verged to the west, as far as 24° 30". In the year 1818 it again turned, and it is now retrograding towards the north, at the rate of ten minutes *per annum*. It has also an annual, as well as a diurnal variation; the extent of which, taking one period with another, does not appear to be definite. These pendulous motions of the poles must depend upon causes, which are out of the scope of our investigation; nevertheless, they indicate that there must be great variations in the quantity and intensity of the electricity of the earth at different periods, and in different places, according to the position which the earth holds in relation to the sun at particular times. This is also proved to be the case by the most positive evidence.

Fourthly, I will now endeavour to trace out that chain of evidence by which I conceive Cholera to be dependent upon a deficiency of electricity in the locality where it prevails.

I think it will be generally admitted, that it would be hard to find a question upon which medical men have differed so much, as the contagiousness or non-contagiousness of Cholera. No doubt many facts have been adduced by the advocates of the former, in defence of their position; still the eccentric character of this disease has compelled them to adopt ground on which it would be difficult to distinguish them from their opponents. Dr. Holland, a contagionist, says:—

"If a virus can be transmitted from the body through a few feet of air, we are not entitled, from the partial experiments hitherto made, to set *any limits to the extent* to which, under favorable circumstances, it may be conveyed through the same, or other medium. Common reason here concurs with our actual experience of the transmission of the virus in certain diseases, in various ways and to remote distances."

The opinions of the non-contagionists may be summed up in the suppositions of Dr. Davy, an able prac-

titioner, who was in Ceylon when the disease was raging there. He says:—

"The cause of the disease is not any *sensible* change in the atmosphere, yet, considering the progress of the disease, its epidemic nature, the immense extent of country it has spread over, we can hardly refuse to acknowledge, that its cause, though imperceptible, though yet unknown, does exist in the atmosphere. *It may be extricated from the bowels of the earth*, as miasmata were formerly supposed to be;—it may be generated in the air;—it may have the property of radiant matter, and, like heat and light, it may be capable of passing through space unimpeded by currents: like *electricity*, it may be capable of moving from place to place in an imperceptible moment of time." Another writer says:—"The rapidity with which Yellow Fever and Cholera extend their influence is at variance with the doctrine of contagion, as founded on truth, analogy, and impartial observation."

Dr. Kennedy gives some account of the origin of Cholera in India, in the year 1817. He traces the origin of the disease to remarkable climatic changes that occurred in Bengal during that year. He alludes to the extreme uniformity and levelness of the country; *its excessive moisture*, from its multitudinous intersections by the branches of the Ganges, and from the swarms of tanks, or artificial ponds, created by the dictates of blind superstition, and the agricultural necessities of the country. The rainy season begins about the middle of June, and continues during the four succeeding months. In the year 1817, by the month of August, the measure of rain which had descended *was one-third greater than the common quantity*, and, a short time after, in different and distant parts of the Province, having no mutual intercourse with each other, an aggravated type of Cholera broke out.

It is well known, that a vast quantity of electricity is raised from the earth by evaporation, but, *during that year, in Bengal, in order to carry off the additional quantity of water which fell, one-third more than the*

average quantity of electricity would be abstracted from the earth: hence the currents passing through the crust of the earth from east to west would be proportionably diminished; and the succulent roots, vegetables, fruit, &c., growing on the soil through which such currents passed, would be left negative to a proportionate degree. Did not the extra amount of sickness produced by Cholera afterwards, on an average, bear some proportion to the increase of rain in the above instance? I do not state this circumstance because I consider it essential to my theory of Cholera, but because it seems to present at least one reasonable cause for the variations in the electric currents, a general fact which, I think, has been sufficiently demonstrated already; although its application to the subject on hand has yet to be considered.

If Cholera be really produced by the cause which I have supposed, then it will appear that those modifying conditions and circumstances that affect the electric fluid, must also have an influence upon the progress and general characteristics of the disease. Now, as far as I have been able to learn, the analogy appears to be complete. The electric current travels from east to west,—so does Cholera.

Evaporation carries off electricity to the upper regions of the atmosphere, and of course it must favour the disease. By all experience, Cholera prevails most in low, damp, marshy regions, where evaporation is increased.

Moisture is among the best conductors of electricity. Cholera generally travels along the shores of seas, lakes and rivers. Messrs. Jameson and Scott remark, that "troops in India, marching in cool and dry weather, enjoy a considerable immunity from the disease." Does not the Editor of the *British and Foreign Medical Review* make a blind grasp at the idea advanced in this paper, when he says, in reviewing Dr. Kennedy's work?

"That moisture, *per se*, is not powerful in spreading the disease, may be presumed from the retardation of the virus by seas and broad rivers, but it does not fol-

low from this that moisture *may not be one of the conditions which is necessary to constitute the peculiar condition of the air necessary for the rapid development. It is certainly in this direction that we look for some probable elucidation of the unknown laws of the choleric virus.*"

The following extract from an editorial in this journal, vol. 4, page 219, is authority to which it gives me pleasure to refer, in support of this position :—

" A careful examination of all the evidence with reference to the origin and progress of the cholera, discloses this important fact, that a humid atmosphere, wet and sultry weather, and marshy situations, are peculiarly adapted to its development. Exceptions will undoubtedly be found to the complete truthfulness of this observation, but in its main features the observation will hold good, and may be safely acknowledged as a rule. In 1817, the summer was a peculiarly rainy one at Jessore, and the city itself is surrounded by marshes. In 1846, Dr. Thom of the 86th regiment, stationed at Curachee, observes that ' the thermometer stood at from 98 deg. to 104 deg. Fahrenheit, and the quantity of moisture was greater than I ever saw in any part of the world, at any season, the dew point being at 83 deg., and the thermometer in the shade being at 90 deg., the lowest range ; even this gives 12.19 grains of vapour in each cubic foot of air ;' and he further shows that the quantity of rain which fell was unusually great. When the epidemic raged in Burmah, Dr. Parke observes,—' during its progress, it attacked chiefly or exclusively the towns and villages situated in low and marshy places, on the banks of rivers and shores of the sea.' In India and Hindostan, it was observed to prevail most frequently with southerly or easterly winds, which favoured moisture, and, as a general rule, we may observe, that this excessive moisture was either a prelude to, or an accessary of its appearance, as witnessed by Dr. Prout, during its existence in England, in 1831-2 ; and, wherever it has prevailed, this fact is notorious, that the most marshy situations, the worst drained localities, have been espe-

cially selected as the sites of its greatest virulence. Whether all this induces a cause of malarial origin, of *electrical atmospheric disturbances*, or whether this state of the atmosphere predisposes to the generation of animalculæ or fungoid causes of the disease, is a matter of little moment, as regards the lesson obviously taught. Although exceptions are to be found of its prevalence in dry and arid situations, yet they are too few to invalidate the above position as the rule."

Volcanic regions are peculiar for their electrical phenomena, arising I suppose from the little effect which electricity has upon the soil, originating in lava. From several accounts that I have read, Cholera seems to have been peculiarly virulent in such localities.

Limestone must be favourable to the conduction of electricity, from the porosity of its texture, and the consequent water which it contains. A letter published in the *Boston Daily Advertiser*, some few months ago, from Dr. C. L. Jackson, states, that the cities situated on limestone or tertiary soils, have always suffered most severely from this scourge; while the primary or granitic regions have never been visited to any considerable extent. It never has visited the granite countries of Switzerland, or Tyrol, in Europe, while it followed the calcareous districts around. And since it did not occur in the primary districts of Maine, New Hampshire, Vermont and Massachusetts; while it did follow the calcareous formation through Canada and New York, and along the Mississippi, Dr. Jackson infers, that *the calcareous soil or water has much to do with the production of the disease.*

I am of opinion that the profession has been misled respecting the cause of Cholera, by looking too exclusively to the atmosphere, as the source of the disease. A distraction of ideas seems also to have arisen from the use of the terms "predisposing," and "exciting cause." Not that I suppose these terms to be always improperly implied in speaking of Cholera, but from all that I have been able to learn, I am induced to believe that every case of Asiatic Cholera has resulted from something that the individual had taken into his stomach. Before entering on this subject, however, I may mention one predisposing cause which, during the prevalence of Cholera, is peculiarly dangerous: that is, an irritable state of the bowels, to which some people are liable. This may arise from a defect of the contractility of the intestinal capillaries, so as to give the ingesta of

the canal *too direct an influence upon the serum of the blood;* or, according to the electric theory, it may arise from a constitutionally *negative* condition of this portion of the system.

Dr. Bell, in a lecture published in this journal in February last, uses the following language :—" The facts alluded to all display the general pervasion of something unknown, which influences the *physical*, as well as the *animal world*, but is wholly beyond the power of man to stay, and did time permit, others might be added still more convincing, bearing upon the change observable in the features of disease, both in the *animal* and *vegetable* kingdom, long before the appearance of Cholera. *It seems impossible to doubt the existence of a cause infinitely more general than mere contagion.*" I have endeavoured to delineate such a cause, and if I am correct, would not different physical, vegetable and animal substances, taken into the alimentary canal, produce Cholera in the individual, just in proportion to their *negatively electric quality:* for it must be presumed, that where such a deficiency of electricity prevails in a locality, those substances which are naturally negative, under ordinary circumstances, must be rendered still more so by the general cause. Andral found that of all the fluids of the economy, the serum of the blood is the most decidedly alkaline ; and whatever the nature of the disease, or its duration in which he had examined this fluid, he never found the intensity of the re-action sensibly vary. The alkalies are generally positive, and the blood is in this state to a high degree. In Garrod's Lectures on the Chemistry of Pathology, published in the *Lancet*—while treating of Cholera the lecturer says : —" In this disease the evacuations very much resemble whey in appearance; have usually a very *strongly marked alkaline* reaction, and effervesce on the addition of an acid." Now in order to account for all the phenomena of Cholera by the cause which I have identified, we have only to suppose, that substances of a strongly negative character are brought in contact with the mucous membrane of the alimentary canal ; but if

authentic records of the disease fully exonerate us from the necessity of depending upon mere supposition in this matter.

Although my data are not so numerous as I could wish, on account of the indifference of medical men about recording what their cholera patients had been eating previous to their having been attacked, still the evidence as far as it goes, fully sustains my theory.

In the *London Lancet* for August, 1832, the Editor says that in three-fourths of the cases of Cholera, that he had witnessed, *fruit was clearly ascertained to have been the exciting cause.*

In connection with the peculiar affinity that the disease seems to have for water, several extraordinary cases are recorded of fish having died in great shoals while the disease was raging in some regions: for example, in Prussia, in the year 1831, while the Cholera prevailed there, all the fish died in the ponds, and forty tons of them were taken from the single pond of Dinperburgh, and buried. And it is a remarkable fact, that in a great number of cases where any notice was taken of what the patients had eaten before the attack, fish of one kind or other was said to have been the exciting cause. Other articles are mentioned, such as fruit, *butter-milk*, potatoes, and in a few cases, pork and veal. Now, every one of these articles might have been pointed out as dangerous, merely from an *apriori* consideration of the theory for which I contend. It is well known how easily pork and veal are injured by thundery weather; and there is reason to believe that the diet in the cases referred to was actually tainted,—indeed it is expressly stated in some instances that such was the fact.

I have made out a list of 92 cases, taken from English papers, these being the only ones in which I found food chargeable with being the exciting cause. The following is a copy:—

Fish:—Herrings, 11 times; sprats, 1; Salmon, 1, ... 13 times.
Fruit:—Gooseberries, 9; Currants, 2; Cher.

ries, 1; Lemon, 1; Whinberry Pudding, 1, ... 14 times.
Vegetables:—Potatoes, 18; Cabbage, 1, . 19 do.
Milk, 2; *Buttermilk*, 18; Curds and Whey, 1, 21 do.
Animal Food:—Pork, 2; Do., tainted, 3; Veal, 3; Sour do., 2; Lamb, 2; Tainted Fowl, 2, ... 14 do.
Beer, 4; Sour do., 7, ... 11 do.

The reader will remark in this list a strong corroboration of the idea which I have advanced. Why does thunder-weather hinder butter-making? I presume that it is because there is too much electricity in the atmosphere, which keeps the oleaginous particles in such a state of combination with the other elements of the milk, that they cannot be separated. Why, under ordinary circumstances, are the milky contents of a churn transformed into butter and buttermilk? Is it not because the commotion among the particles causes part of the electricity to escape, allowing the oleaginous atoms to coalesce by their superior capacity for the remaining electric fluid, while the other ingredients, by abstracting oxygen from the atmosphere, became sour, *acid*,—NEGATIVE buttermilk.

Every Physiologist is aware of the analogy subsisting between milk and blood. Indeed, their constituents are almost identical. Milk is the only secreted fluid which contains the three classes of nutritive principles, of which the blood is composed—the albuminous, oleaginous, and saccharine; and thus the coagulation of both may be accounted for on the very same principles.

Why does a thunderstorm make animal and vegetable substances sour, and hasten their dissolution, I ask? Is it not because, when the overcharged atmosphere is relieved by the explosion which ensues, the superabundant electricity is not only carried off, but also a part of that which naturally belongs to those substances, which are most ready to give it up. Thus, I conceive that substances may be deprived of electricity in two degrees: 1stly, that which is superadded to them in their natural state; and 2ndly, that which holds their particles in combination, the deprivation of which causes a change in their sensible properties, producing disintegration,

Dr. Gaulter of Manchester, in his work upon Cholera, uses language to the following effect :—"The most ordinary exciting causes of common cholera, are rightly considered to be errors of diet; the same is true of malignant cholera. It can be shown, that in almost eight cases out of ten, something had been taken as food or beverage calculated to derange the digestive organs, and it would appear from the preternatural sensibility of these organs, as the heat of summer becomes more intense, *even the diet habitually taken*, and which generally agreed with the alimentary passages, *was liable then to act as an irritant.* In the majority of instances the offending matter was either the low-priced ale of the beer-shops, *semi-putrescent buttermilk, fœtid pork, and fish*, or *rotten potatoes.* In one instance, a quantity of the latter, which were vomited during the incipient stage of the disease, continued *to emit for many days a phosphorescent light* —a circumstance that appeared most mysterious and alarming to the neighbourhood where it happened."

A due supply of electricity is as essential to the healthy functions of the body, as water is to the operations of a steam-engine; and of course, when this *vital* element is withheld, a derangement proportionate to the demand must be the consequence. Dr. Bell has satisfactorily proved the relationship subsisting between ague, congestive fever, and cholera; and I do not doubt, when the science of medicine comes to be based more upon philosophical principle than it is at present, that all epidemic diseases will be found to depend upon different degrees of this all-pervading agent, prevailing at the time; and of course a knowledge of the laws of which, will constitute the most essential qualification of the physician. This may be called hobbyism; well, be it so. Let those who call it such tell me of any molecular change that can occur in the physical, the vegetable, or the animal world, in which electricity is not *essentially concerned*, and I will resign my hobby, to launch again upon the chaotic ocean of empyrical speculation.

"According to the analysis of the Chemist, the atmosphere is composed of seventy-two parts of nitrogen, twenty-seven of oxygen, and one of carbon. From the experiments of Philosophers we find that the fluids, produced by the putrefaction of animal substances, possess the same ingredients as those composing the common atmosphere—but in different proportions—viz., sixty-three of nitrogen and thirty-seven of oxygen."

The above extract is from an old author, and although it might be corrected in one or two particulars, yet it indicates a general truth which is of great practical importance, by showing the tendency of decaying animal substances to render the atmosphere *negative*, and thereby indirectly vitiating the blood.

The alimentary canal in a physiological point of view, can hardly be considered the internal of the body. The mucous membrane, by which it is lined, is only a modified continuation of the skin which covers the external parts. The serous membrane which lines the heart and arteries is the true internal, hence the blood has no direct communication with the external world; hence its condition will not be directly affected by external influences; but it will be affected by such influences, *through the capillary system*. The function of the lungs in oxygenating the blood, according to Dr. Christison, is a purely physical operation. The production of heat in the human body can be considered nothing else. If a stream of electricity is passed through a certain quantity of water, the water will be converted into a certain bulk of the mixed gases which, in this state, represents the elements of the water, together with the electricity required for their formation. If the gases are again combined so as to form water, not a trace of electricity is given off, but their union is accompanied by an intense heat. We have only to enquire where the electricity went to in the first part of the experiment, and where the heat came from in the latter, in order to be convinced that the one is nothing but a modification of the other.

I presume the attentive reader will now be in a position to comprehend the *modus operandi* of Cholera. The earth and the lower strata of the atmosphere being charged with electricity *below par*, the blood must be indirectly affected; so that there will be a more than ordinary tendency to dissolution amongst its elements. Food is taken into the stomach *powerfully negative*. I mean by this, that it contains so little electricity that it will have a powerful attraction for

liquids, which naturally contain more; hence it abstracts the electricity contained in the cells of the mucus membrane; capillary action is thus excited, and the arteries of the gastro-intestinal system pour out their serum, in order if possible to neutralize the demand. A communication is thus established between the blood and the external world, *and, according to an universal law, the life of man must do its part, in order to restore the general equilibrium.*

The eccentric character of cholera has hitherto baffled all attempts to investigate its cause. Persons belonging to the same family, though residing in different houses, have been simultaneously attacked.—Prisoners confined in a solitary and condemned cell, have been *executed* by cholera, without having had any communication whatever with persons having the disease. A case of this kind occurred in Prussia, in which the only communication which the prisoner had with the living world was through the medium of his keeper, who gave him his *food* through an iron grating. If my theory is correct, these and many other eccentricities connected with the progress of the disease are satisfactorily accounted for.

Dr. Bell says:—"We must, in endeavouring to ascertain the source of this disease, look to the sympathetic system of nerves—and it is particularly worthy of notice, that wherever the branches of the sympathetic are largely distributed, there the symptoms of the disease are most prominent." Proceeding further, he shows that Cholera cannot be referred to a *topical and exclusive affection of any of the great organs.* He also briefly asserts, that the cause of Cholera is not a *morbid state of the circulating blood, how deeply soever that alteration may be occasioned, as a consequence of the true morbid impression.*

The essential manifestations of Cholera, according to the *London Lancet*, are "*collapsed countenance*, blue lips and nails, shrunken fingers, *the total failure of the usual secretions, deficient animal heat, suspen-*

sion of the pulse, and remora, or stagnation in the venous circulation.

According to Dr. Kennedy: in the first stage "the patient complains of feeling of *anxiety*, or of *uneasiness at the pit of the stomach;* after some time *nausea supervenes*, and the uneasiness changes into a feeling of *heat or pain*. To these symptoms succeed *vomiting* and *purging*, and prostration of strength. The evacuations at first consist of the common contents of the alimentary canal, afterwards of a fluid like rice water; occasional cramps are felt in the limbs; the pulse is small and rather quick. The skin feels a little cold, and the temperature is gradually decreasing. The countenance is rather shrunk, and the features appear sharper than natural." In another place the same author tells us, that "the evacuations go on, and the bowels are filled after the heart has ceased to act, when the arteries are empty and the capillaries of the circulation are no longer supplied with blood by the usual course."

Dr. O'Shaughnessy proved by a series of rigid experiments, that the blood in the worst cases of Cholera retains its globular or anatomical structure; that the lungs are capable of performing their functions, in so far as the act of respiration is concerned, in the decomposition of atmospheric air; and that the dejections of the cholera patient are strongly alkaline, and contain just those elements of which his blood has been deprived; or, in other words, the addition of the dejections to the blood, in due proportion, would have restored the latter to its normal constitution. The same results were obtained by other chemists in different parts of Europe.

Now, if it be admitted that the physical laws of nature are universal in their operation, then it must follow, that the excretion of the fluid portion of the blood into the alimentary canal in Cholera, has been fully accounted for. That the cause is a physical one, there can be no doubt whatever. The action of some kinds of purgatives upon the bowels belongs to the same

class of phenomena, but differing in degree. *If blood be placed on the one side of a capillary membrane, and certain purgative solutions on the other, the serum of the blood will pass through the membrane, to unite with the medicine. This is just what occurs in the body;* and I think the evidence already afforded, that such phenomena are dependent upon electrical attractions, should satisfy all reasonable minds.

Pathology likewise, according to the best authority, is altogether in our favour. A vermilion injection of the gastro-intestinal mucus membrane of the alimentary canal, indicative of inflammation proportionate to the prolongation of the disease. Sometimes patches of gangrene, indicating the violent electric action that had been in operation; while in every other part of the body all such action, (even normal) had entirely ceased. The same membrane also covered with a pultaceous substance, of a white-grey colour. The stomach contracted in its substance; hard, and frequently thickened.

The liver shows marks of congestion or inflammation, and is of a darker colour than usual. The gall bladder distended with bile, while the ducts remain quite pervious. The bile is generally considered by physiologists, the natural purgative of the bowels. It must be electro-negative, having been secreted from the blood, after that fluid has been deprived of its electricity in the systemic capillaries, through which it has passed before arriving at the *vena porta*. Why, in a cholera patient, does the bile not flow into the intestines through the open ducts? Answer—*Because two negatives do not attract each other.*

Here I might close my case, and claim a verdict, on the ground that this theory accounts for all the phenomena of the disease, as far as I have ascertained, which, in the abstract, would be deemed a legitimate conclusion, unless other facts could be brought forward, contravening the hypothesis; but I have some evidence of a more positive character yet to offer, which, if it can be relied on, in my estimation, sets the mat-

ter beyond a reasonable doubt; of that, however, the reader must judge for himself.

From the *London Lancet* of November last, I extract the following. A letter from St. Petersburgh states, "that whilst Cholera was at its highest, the action of the magnet was nearly neutralized, which now, the disease is gradually subsiding, assumes by degrees its former power. A magnet block, which used to carry eighty pounds, would not carry more than thirteen pounds during the worst time of Cholera. *The Electro-Magnetic Telegraph at one time would not work at all.*"

Here was a report from the arcana of nature by the Telegraph itself, informing us of the cause of this disease. *Murder will out.*

Several authors on Cholera have, as it were, groped around the truth, but the want of a proper knowledge of Chemistry has occasioned some of them to commit strange blunders. When treating on this subject, Dr. Tunstall of Bath, in a paper in the *Lancet*, of the same month, uses the following language:—"If we adopt the theory, that in Cholera the impurity of the blood arises from its containing too much positive electricity, we must bear in mind that the secretions from the bowels and stomach show an excess of acid, or, in other words, of oxygen, a positively electric condition." Now there can be no doubt that in Cholera the evacuations are positively electrical, but if he is correct in saying that these excretions are acid, and that acid or oxygen is positively electrical, then I have been greatly misinformed by the best Chemists the world has ever produced, as well as by my own senses. However, as far as the evidence accords with chemical science, it is corroborative of the position I maintain.

Again we have in the *Lancet* of the 8th November, the following from J. C. Atkinson, Esq.:—"I am desirous, at the present moment, of directing the attention of scientific readers to a very interesting phenomenon, more or less present, in the collapsed stage of Cholera, which seems to have hitherto escaped the

observation of medical men, namely, animal electricity or phosphorescence of the human body. My attention was first attracted to the subject during the former visitation of that fearful disease in the metropolis. It was indeed singular to notice the quantity of electric fluid that continually discharged itself on the approach of any conducting body to the skin of a patient labouring under the collapsed stage. Streams of electricity, many of them an inch and a half in length, could be readily educted by the knuckle when directed to any part of the body, as if it were a charged Leyden jar. I may remark the coincidence that, simultaneously with the heat of the body passing off, the electricity was evolved. I am therefore led to ask the question—Are not heat, electric and galvanic fluids one and the same thing? Does not the passing off of both imponderable substances, at one and the same time, strengthen this conclusion? Again, are not the whole of what we call vital phenomena, produced by the electro-galvanic magnetic matter and motions? And do we not find that these vital phenomena are continually affected by the relative state of the surrounding electric medium? To what can we attribute the present fluctuating condition of the Barometer if not to this?"

If the reader will remember the variable results obtained by Gay Lussac, in experimenting on the chemical affinity of the same substances, with the electrometer, under what he conceived to be the same conditions, at different times, the occult nature of the cause of Cholera, or the eccentricity of its character, will not excite much wonder.

In the same periodical Dr. Smellie remarks, "that on those days on which the disease was most prevalent, *the electric condition of the atmosphere was in a highly disturbed state;* and the various instruments used to exhibit the phenomena of electricity failed to be depended on, by reason of the paucity and the irregularity of the electric distribution in surrounding nature. The magnet also exhibited a diminution of seventy per cent. of its usual power.

During the prevalence of cholera in St. Petersburgh last year, we had authentic reports testifying to the same general fact. One report says, *that a magnet which would, under ordinary circumstances, sustain forty pounds weight, was not capable of sustaining more than four or five pounds when the disease was at its height.*

The *London Lancet* for March last, contains a report from the Registrar General, in which the electrical state of the atmosphere and the number of Cholera cases weekly, are stated in tabular form; by which it appears, that the decrease of electricity in the atmosphere maintained a proportion to the increase of the disease, and when the cases amounted to a certain number, no indications of electricity could be obtained. What stronger evidence could any person require?

In drawing this subject to a conclusion, I will briefly direct the attention of the reader to the points which I have endeavoured to elucidate:

I commenced with the simplest form of capillary attraction, and proved by good authority that the passage of liquids through porous substances, whether they be physical, vegetable, or animal, is due to the same cause; and inasmuch as the rapidity of the current is concerned, it depends upon two conditions: First, upon the attraction of the flowing liquid for the capillary substance; and secondly, its affinity for the matter on the other side of the capillary series.

Secondly,—It has been shown that all such phenomena are caused by the tendency of all substances, differently charged with electricity, to unite together, so as to bring the electric fluid with which they are charged to an equilibrium; or, in other words, that capillary attraction, cohesive attraction, and affinity, are but modifications of electric attraction.

Thirdly,—I have maintained the theory of a single electric fluid, and endeavoured to shew that it is adequate to account for all the facts of the science, without involving the obvious difficulties of the double theory. I have directed attention to the universal

influence which electricity exercises over vegetable and animal phenomena. I have proved by Professor Faraday and others, that the electrical, the galvanic, and the magnetic forces are identical; and that heat is a modification of the same agent. It has been proved that there are constant currents of electricity passing round the earth, *from east to west*—that these currents are liable, from astronomical or other causes, to periodical and irregular variations in their quantity and intensity, by which animal and vegetable substances are both sensibly and insensibly affected.

Fourthly,—Independent of astronomical or geological causes, I have adduced one good reason that *may account* for the origin of Cholera in India, in the year 1817, on the foregoing principles. I have proved that, in the great majority of cases, eight out of every ten, the producing cause of Cholera has been food, in an electro-negative state, which almost puts it beyond doubt, considering the occult nature of the essential element, *that such food produced Cholera in all cases.* I have demonstrated that the cause implicated is fully competent, according to *natural law*, to produce the effect; and in conclusion, I have proved by the most indubitable evidence, that the cause identified actually did exist, in proportion to the effect observed. *That cause was a great diminution of the ordinary electricity of the food and air;—that effect was* ASIATIC CHOLERA.

That Cholera has often been ascribed to the cause which I have identified, is a fact of which I have given several illustrations; but the statement has been as often and as flatly contradicted; because the chain of natural relations subsisting between the disease and the cause presumptive was not made manifest. This *desideratum* I have endeavoured to supply: with what success, let each determine for himself.

In conclusion, it is pleasing to observe that those remedies which are now the most generally recognised as being the most beneficial in the treatment of Cholera, are just the medicines indicated by the electric theory, viz., those of a positively electric character—hydro-car-

bons and the alkaloids. Amongst these may be mentioned, camphor, petroleum, or Barbadoes tar, turpentine, veratria, quinine, alum, &c. I would also recommend strychnine, naphtha, and creasote. Substances that have a powerful affinity for oxygen, or those that are very combustible, seem to be the best. In the first stage, I would recommend an emetic of ipicac. A gentle cathartic may also be necessary. If the attack is not very severe, the cure may be completed with a few doses of the compound tincture of camphor. Where the symptoms are more urgent, the selection of the appropriate remedies will depend upon the judgment of the enlightened physician, who ought to be in attendance as soon as possible after the first symptoms make their appearance.

"Prevention is better than cure." And the means of prevention that I would recommend, are cleanliness, temperance—both in eating and drinking; friction to the skin daily; light flannels next the body; exercise, when the air is dry and pure. When the weather is damp, even though sultry, it would be advisable to keep up a coal fire in sitting rooms, in connection with bed-rooms, &c. Avoid the use of acids, unripe fruit, or uncooked vegetables; avoid everything like tainted meat, or buttermilk; avoid physical and mental exhaustion. Use, principally, a farinaceous diet, with the soup of good animal food, rather than the meat itself, unless you have a good deal of bodily exercise. Use good bread and butter. If you drink much water, it ought to be filtered through charcoal. A little clean powdered charcoal in the water that you drink will be a very good substitute, or, if it is preferred, a few drops of the compound tincture of lavender will have a good effect. By attending to these requirements—by doing what we can to alleviate the miseries of those who have not the means of providing for themselves—by maintaining a clear conscience, and a contented mind, we will be best prepared to meet Cholera, or any other evil with which Divine Providence may be pleased to visit us.

Montreal, April, 1849.