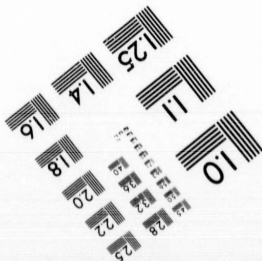
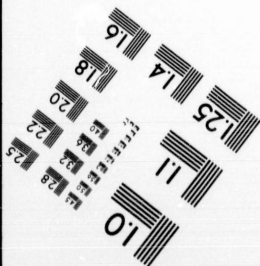
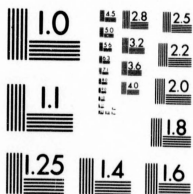


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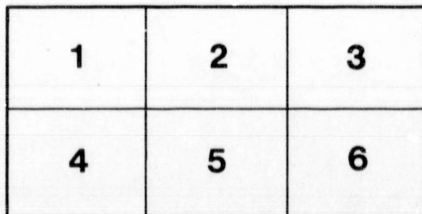
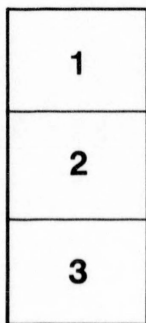
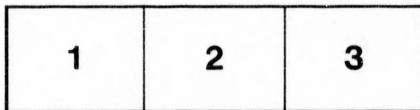
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**AN ANIMATED MOLECULE**  
**AND ITS NEAREST RELATIVES.**

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AN ESSAY READ BEFORE THE AMERICAN ASSOCIATION OF MEDICAL  
SUPERINTENDENTS OF ASYLUMS FOR THE INSANE, AT WASH-  
INGTON, D. C., ON THE 10TH OF MAY, 1878,

BY

**DANIEL CLARK, M. D.,**

MEDICAL SUPERINTENDENT OF THE ASYLUM FOR THE INSANE, TORONTO,  
CANADA; PRESIDENT OF THE MEDICAL COUNCIL, AND OF THE COL-  
LEGE OF PHYSICIANS AND SURGEONS OF ONTARIO; FORMERLY  
EXAMINER IN CHEMISTRY FOR THE COLLEGE.

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# AN ANIMATED MOLECULE

AND ITS NEAREST RELATIVES.

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# AN ANIMATED MOLECULE

AND ITS NEAREST RELATIVES.\*



Inquirers seeking in earnest investigation to find the basis of life, may be divided into three classes. The one class I shall call *subjectivists*, or those who study chiefly mental phenomena, and attempt to build up a system of philosophy from this source. The second class may be designated *objectivists*, or those who merely apply their attention to physical manifestations, and endeavor through them to solve all the difficulties which bar the way to a clear understanding of man in his multifarious relations. The third division may be styled the *eclectics*, who do not circumscribe their investigations to either body or mind, but on the one hand endeavor to know from all sources, whether a man be a unity, a duality, or a trinity, and what are the relations of this sphinx, which is continually propounding so many enigmas for our solution; or on the other hand, are seeking to find out if mind be a resultant or function of bodily forces and standing in the relation of effect to cause. The first class are pure metaphysicians, who adhere strictly to the study of mental modes. Many master minds have belonged to this class, but

*subjectivists*

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\*Read before the American Association of Medical Superintendents of Asylums for the Insane, at Washington, D. C., on the 10th of May, 1878.

because of the circumscribed field of investigation, have made "confusion worse confounded."

These were divided into two great schools, viz.: The idealistic and realistic. The former reasoned away the existence of the whole external world, including our bodies, except what is known by inferential evidence; and the latter logically proved that mind had no existence as far as known. Between these contending scholastics we were asked to believe that both the *ego* and the *non-ego* had a mythical existence. The second class are now called materialists by theologians on the one hand, and by a certain school of physical investigators on the other. I do not say the term is a misnomer, but seeing it is so often held up as a hideous ogre to frighten the timid, and as those who really are such deny "the soft impeachment" in the sense of holding any views inimical to ethical philosophy, I have used these phrases to indicate these classes of thinkers, and which cover the whole ground of mental and physical research. The egoist declares that there is an entity called mind, affected by, but not being matter, although in intimate relation to it, and capable of exciting it to action in will, emotion or desire. He appeals to our consciousness for proof of our power at will to produce physical effects by exercising volition, and stirring to intensity the affections, not as a secondary but primary cause. He holds that these efforts are initial, and are not primarily sensational. The basis upon which he builds is surely worthy of more consideration than a sneer. In such a simple physical act as that of raising my arm consequent on a volition, I ask the *objectivist* to tell me, if the primary impulse be a command of the nerve molecules to do so; and if so, what gave them the hint that this illustration was required

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Objectivist

Objectivist

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at this opportune moment? I wait for a reply, and am told that my will to do so, is only a function of these molecules, and can not be at any time an initiatory impulse. In some mysterious way they got to know that this movement was required at this particular time. In other words, it is necessary in every volition to suppose a goading primary sensation and consequent reflex action from the power developed. It is held the same is true of memory and the wildest flights of imagination. My will, imaginings, reminiscences and consciousness, are said to be the *results* of acts of the brain, which determines in an autocratic way their intensity, kind and variety, being amenable to no motive power higher than itself and the law by which it operates. Mental activity thus becomes a sequence of antecedent brain manifestation. The wild impossibilities of Milton—the creations of Shakespeare—the word pictures of Homer, Tasso, Dante, Scott and Longfellow—the wonderful combinations of Mendelssohn, Handel or Mozart, are only fortuitous presentments of a Molecular Grand Jury knowing no master *ab extra*—receiving no promptings but through sensation, and heeding no dictation independent of themselves.

The argument adduced by the objectivist seems to be, that there is no reason to assume an *ego* distinct from the varied functions of nerve molecules. The manifestations of the brain, of the spinal cord, and of the sympathetic system, can all be explained on physical grounds, he says; therefore, there is no need for laying down a spiritual hypothesis to account for that which natural laws explain. It will be my endeavor to prove the existence of a *psychical* power resident in nerve tissue—not in the relation of organ and function—but in that of organ and exciting agency, by parallel reasoning based on the phenomena of nat-

ural law. The physical system can be raised on a high pedestal of wonderful complicity and power, and at the same time mental modes need not necessarily be considered as a resultant of its activity, in order to unravel all its mysteries. There is a power or substance continually acting upon matter, from its lowest to its highest forms, which is the cunning workman that builds up the ultimate elements of organic matter, whose presence in the human body is evident by phenomena the most complicated and marvelous in the animal kingdom. This is called electricity in its simplest form. I will call it *vitalism* in the second series of its operations, and *psychism* in its highest manifestation in the more complicated groups of the animal creation, including man. These three substances are possibly developments of one active fluid—the latter including those in the lower forms, just as the brain of man is built up by this force in a more elaborate way than is done in the simple ganglia of the lower creations. The cunning of this workman is known by his handiwork. I will endeavor to show that the molecule, about whose creation so many scientific battles are being fought, does not create mental modes, but is only the medium of their manifestations, and that a common ground of agreement can be found in calling the psychic force—the ego—the highest development of that entity called magnetism. It is a substance more subtle than the ether which pervades all nature, and we have no reason to believe that grosser matter could possess sensible properties without its cohesive power.

With the permission of the Association I will condense a few general remarks on electricity, before considering its relation to the nervous system of man. The latter connection is very important to every student of insanity. It will be my endeavor to rigidly apply

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the same principles of reasoning adopted by the pure scientists, and draw no conclusions they would not readily admit as legitimate from the premises adduced. I wish to show briefly:

*First.* That it is not in accordance with physiological and pathological facts to call mental phenomena functions of the brain.

*Second.* That no evidence adduced has satisfactorily established the localization of mentality beyond the focal point of nerve tissue in the basal ganglia of the brain.

*Third.* That brain power is not dependent on the size of the organ only, but requires many other conditions to manifest its durability and intensity.

*Fourth.* That psychic force correlates to some extent with magnetism, and is probably a higher power of the same substance, and presumably is the most subtle form of material existence known to man.

*Fifth.* That this entity exists in the nervous system of all animals and beings possessing this structure, not depending on a molecule for its existence, but, on the contrary, the molecule could have no being without its constructive power. The maker of the molecule necessarily antedates the creation, and manifests the occupancy of the tenement in a series of functions numerous and complicated.

*Sixth.* That the intensity and complicity of mental modes, *cæteris paribus*, do depend on the condition and capacity of the organ, and that the intellectual and moral powers decrease in a certain proportion, as the instrument diminishes in efficacy (as a magnet decreases in power according to its size), until only automatic or reflex life remains. In other words, the descending series of *psychism, vitality, electricity*, leave in the in-

verse order to that in which they built up the system, until dust to dust manifests the ultimate elements in their primal form, with only a low grade of cohesive power remaining.

*Seventh.* That the different phenomena of mind in health and disease can be explained satisfactorily (to my mind) if the views stated be accepted without leading to illogical conclusions.

*Eighth.* That no appeal has been made to arguments and deductions beyond accepted phenomena, and only by legitimate conclusions drawn from evidence furnished by the senses.

We see the intimate relation existing between the ego and non-ego in the influence the one exerts on the other. Dyspepsia will give the patient that mental despondency which vulgarly goes by the name of the "blues." It is also true that strong emotion, or any mental shock, unexpectedly excited, at once affects the stomach, in disturbing its digestive powers, and in suddenly quenching all sense of hunger. Local causes will produce constipation, or flux of the bowels, or, it may be, retention of urine in the bladder, without the invasion of disease, but mental excitement or anxiety of any kind will produce the same results. Violent exercise will increase the heart's action; so also will sudden fright. Friction of the genital organs will excite them; the same results will be produced by prurient desires, either aroused when awake or asleep; on the other hand sexual excitation will be quenched by sudden fear. There is not an organ of the body but can be affected through mental influence. We shall see if this mentality can consistently be called a function of the organs it is assumed to have the power to rouse to action, or in other words whether an *effect* can perform the impossibility of being its own *cause*. These

dual phenomena have never received a satisfactory solution by looking at them only in one of their aspects and at the same time ignoring the other. Like the valiant knights of old, each school is prepared to fight for the truthfulness of the inspection of the face of the shield next to themselves, ignoring any other aspect. The wonderful force I am about to consider, explains this double influence. The myriad telegraphic offices in the body are in constant communication with the great central depositories of nerve force, called the cerebro spinal system. There is not a part of the physical system, however apparently automatic or organic, but is in some intimate relation to this cardinal motor power, and which necessarily responds to its influence. However multifarious the functions may be, each according to its kind, yet they are all within call of these centers. They are the primary conservatories of vital power and energy. Like armies in action, while fighting a stern battle against dissolution, they are within supporting distance of one another. The most remote organs from these centers are within reach of their influence. In the same way are those which belong to what Mr. Paget calls the "rhythmic nerve centers," *i. e.*, the organs of respiration, the heart, and the alimentary canal. A certain kind of electricity is essential to the existence of physical life. Its absence means death, and on the other hand it increases in intensity, or diminishes in force, according to the degree of mental or bodily health. Now, by a parity of reasoning, if this power be neither a primary nor secondary quality of matter, *i. e.*, not essential nor accidental, in any medium in which its energy may be manifested, it is not so monstrous to infer, by analogy, that mind is a unity of a subtle nature, like magnetism, but of a higher order of influence; it is directed and circumscribed in the



same way, by the body in which it resides, but at the same time equally capable of producing changes of a material and vital nature, in the different substances which it permeates with its influence, without being a secretion, quality, or condition of any of them. It is not my intention to inquire whether the higher power is an evolution from the lower, or whether each has a distinct creation, origin or existence. Suffice to show that this entity in the series of its manifestations does not depend on gross matter for its being, but on the contrary, the form and continuity of such matter are results of its operations.

There is a vast difference between the utmost boundary of the field of scientific investigation, and nature's laboratory, in building up structures of multiform complexity, out of the monads or molecules of matter. It is not in opposition to the severest rules of the inductive philosophy of a positivist to use imagination where observation can not go, and by analogy judge the unknowable from the knowable. We infer that a quantity of water has interstices between its particles, because we can compress it somewhat, and also dissolve a soluble body in it without increasing its bulk; but no human eyes ever saw these openings between the molecules of water. Cold is applied to water, and as a result it contracts, until it reaches the temperature of thirty-nine degrees Fahrenheit; when in violation of any well known law, by some unaccountable freak the liquid expands, and in its expansion becomes solid ice. This is a process in its elements most strange, but beyond our ken. This ice may be melted, and it may be minutely examined through the microscope, but no change can be seen in its physical appearance. Send a current of electricity through it and great changes take place in its condition; the particles of water are made

a better illustration  
gas -

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polar in a diamagnetic manner; the water is changed as a medium to transmit light, for a ray in its passage through it is twisted in a definite way, under this influence, not seen in water not under magnetic power. We can legitimately imagine that the molecules have been marshalled by this new force into other positions, but the *how* and *why* are matters for speculation, yet, in this phenomenon is a strong inferential proof of the change magnetism makes in the position of the ultimate elements of water. This movement or change is even more striking in solid bodies. Boyle, in his tract on "The Languid Motion of Bodies," shows that even compact bodies, such as turquoise and agate stones change in their molecules, and that spots in them shift their relative positions continually. The *platina* of antiquarians found on ancient coins is only the copper of the alloy having found its way to the surface during centuries of molecular action. The other metals of the combination were not as active as the copper in the magnetic race. The term *inertia* is a misnomer, for it is not a condition of matter any where in universal nature. This electrical state of motion and adhesion, can be observed in a simple way, by the tenacity of surfaces in contact, whether solid or liquid, and in the electricity evolved on their separation. This is best seen if glass be laid on the surface of mercury, or melted sulphur brought in contact with glass. The same is seen in capillary attraction, which experiments have shown to be from electrical results. These are evident in the minute arteries, which are filled with arterial blood, surcharged with oxygen, and that seeks with avidity the interstitial substances, satisfying the wants of the system, and through the veins carries the effete matter to the outlets of the body, but were it not for this subtle agent there would be stagnation and death. The same attraction

and repulsion is seen in the pulmonary and portal circulation. The molecular supply of blood to nerve-tissue, is doubtless a counterpart of this work, going forward elsewhere, on a larger scale. The objectivist says these processes are as mechanical or chemical as is the formation of a crystal or capillary attraction in a lump of sugar, a sponge, or a glass tube. It may be the same power but of a far higher order—shall I say a *Darwinian* development of it? The wonderful law of *selection* is not considered. This power uses a few primary elements to build up new substances, of the most complicated and diverse kind. We may sow in a box of uniform earth, the seeds of different plants; they are watered by the same fluid; heated by the same sun, to the same degree; grow in every way under the same external influence, but each will produce its kind. Selecting from these simple foods what each requires, and grouping with a master hand, the most harmless elements into rank poison, innocuous floral beauty, or luscious fruit, in keeping with the powers of each. The food we eat may be of the most heterogeneous kind, yet, nature's laboratory, by a more complicated, but similar law of selection, forms out of these the secretions, and the myriad variations of substances in our bodies. True, the law that operates to form the chemical models in nature, ~~is~~ is in force in these more complicated bodies, but above and beyond the simpler types of force, is an energy more intricate in its handiwork than can be produced in the world of chemistry, and whose patent right to manufacture, no power in the lower stratum of force can even approach in beauty and complexity. Alcohol can be made out of starch, but no cunning of chemistry can do what is undone and make starch out of spirits. We can reduce to their ultimate elements all organic bodies, and the varieties



are so few that we can count them on our fingers, but with the same elements at our command we can not reconstruct the simplest cell by chemical art. My dinner may be composed of roast beef, plum pudding and pumpkin pie. This meal builds up the millions of various substances in my body before I go to bed. I defy the ultra scientist to draw a successful parallel between this and any law of crystallization. We are asked to believe, in the face of facts such as these, that water, a crystal, a grain of corn, an egg, and animal bodies are all built up by exactly the same agency, in its lowest power, and that the vegetable and animal worlds are only multiples of the grosser forms of matter, thus making "vital force" a myth of the despised metaphysicians. A crystal can not produce its like as a cell does. It can not repair injury to it as life does the waste of tissue. Friction will reduce the size of the one, but the living form thickens by its application to the other. Vitality will rush to the rescue when a cut is made. It will join the ends of a broken bone and surround the breach with additional safeguards. Chemistry can show no equal to the law of diffusion. We can not imitate respiration in the laboratory by exchanging oxygen and carbonic acid through the same septa at the same time. We might enumerate in an endless catalogue, and put in antithesis the great difference that exists between chemical and vital processes.

The school of objectivists classify the beginnings, varieties and movements of all forms of organized life into a group of "affinities." According to the class of thinkers these may be called *chemical*, *elective*, *organic* or *inherent*, and if these terms are not satisfactory to the opposite class of inquirers, refuge is taken in the definition that "molecular life is a co-ordinating power."

I contend that all these terms refer to one and the same

substance—call it electricity, magnetism, odic force, or what you will, and is not a necessary quality of matter; but, on the contrary, all phenomena of matter go to show that on its cohesive power the existence of matter depends. It must necessarily antedate organized substances, unless a miracle takes place, and a molecule can originate itself. It is hard to say, however, what wonders of this kind may transpire when a great philosopher like Mill can say that it may be possible for two and two to become five, and that a part may be greater than the whole in some other condition of mind. That “condition” should only be found in the ward of an asylum. Herbert Spencer is forced reluctantly to admit (*Biology*, Am. Ed., page 167): “It may be argued that, on the hypothesis of evolution, life necessarily comes before organization. On this hypothesis, organic matter in a state of homogeneous aggregation must precede organic matter in a state of heterogeneous aggregation. But since the passing from a structureless state to a structured state is itself a vital process, it follows that vital activity must have existed while there was yet no structure; structure could not else arise.” Lionel Beale says, grudgingly, (*Bioplasm*, page 209, Ed. 1872): “The vital power of the highest bioplasm in nature is the living *I*.” Darwin calls this power “innate” in defining life. This may mean much or nothing. He vaguely applies it to that *something* in organized nature; that invisible builder known only in his works; that which the microscope has not brought to view; that which the scalpel has never laid bare; that of which the chemical tests have not found out its affinities, and the *spectrum analysis* has not displayed its color to the eye. Man may be said to consist of a collection of living cells, or organic monads. These have a dynamic union in which resides a power whose

crowning phenomenon we call consciousness. All the phases of mind knowing are in the latter, and one physical cell is the equivalent, prototype or representative integer of a multitude that constitute the body in its completeness. These distinct individual cells may have varied functions, but the vital energy controls them, prevents antagonisms, and procures concord of action to accomplish unity of purpose.

We see organisms of the lowest order multiply their kind by a division of themselves. This inherent power causes these separate parts to have a family resemblance. Each of these has a power to move, to feed, to grow, to multiply and to have a harmony of action in all their parts. No such complicity of power can be seen in chemical action and affinity. Then, look at the laws of heredity—the transmission of peculiarities of disposition, of idiosyncrasy, of resemblances, of tendencies to particular diseases, of constitutional and physical appearance to both parents in one case, in a second to only one, in a third to neither; of stupidity producing intelligence, and genius begetting mediocrity; of so much in common between parents and children, yet so much diversity in the nearest approach to likeness, even among the members of the same family. In the descending series of existences this diversity decreases until we come to the sameness of crystallization. The building power is more circumscribed in its capacity, although more general in its application, the lower it goes in the scale of existence. Look at the strange tendency toxic agents have to assail distinct portions of nerve tissue, as if each section had a different molecular arrangement. Strychnia, aconite, opium, alcohol, prussic acid, belladonna, select their locations with unerring aim whenever they come in contact with a nervous organization. There is no

reason to believe this law of selection lies in the poisons alone. The ultimate elements of nerve tissue may differ in each section. In lower nature we have the laws of cohesion and attraction, evidencing the one force called electricity. This power exists in the wide domain of matter animate and inanimate. The primary elements of all bodies are kept together by its cohesive power. It is indispensable to existence and compactness of outline. A remarkable form of this force is seen in animal magnetism. This pervades all our nerve centers, and their prolongations. It permeates the primitive fasciculi of muscle and binds them together. This animal magnetism will produce the same phenomena as frictional and atmospheric electricity. It affects the needle of the galvanometer, decomposes iodide of potassium, produces light and heat, and gives severe shocks such as are felt in the electric discharges of the torpedo or eel. The law of the correlation of forces is thus made manifest by this agent. Light is eliminated from the black hair of a nervous person, with a vulcanized rubber comb, or by friction from the fur of a cat, in a marked degree, and heat is generated at the same time. It is present in muscle and nerve only during life, and as long as the natural warmth remains, but is completely absent in *rigor mortis*; yet if warm blood be injected into the limbs of an animal after rigor has set in for a few hours, relaxation will return and with it animal magnetism; even contraction will be induced for a short time. If artificial or extraneous magnetism should be used to excite nerve or muscle while it occupies this medium, there is no evidence of the presence of natural inherent electricity; it seems the two can not co-exist in the same body at the same time. It is easy of demonstration that the fasciculi of nerve and muscle have in each, two antagonistic states of electricity. In the

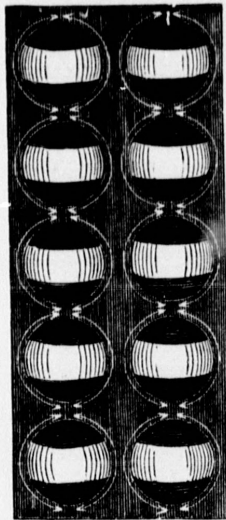
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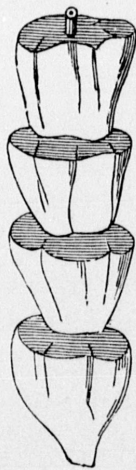




M. Dubois-Raymond puts the ultimate nerve and muscular fibres in the above bead-like shape. The poles would be, in the natural relation in a negative magnetic state, and the equator in a positive state. He holds that each molecule has in it these two potentialities, instead of dividing these opposing influences into distinct fibres. Each view is practically the same, and explains satisfactorily all the phenomena of animal magnetism.

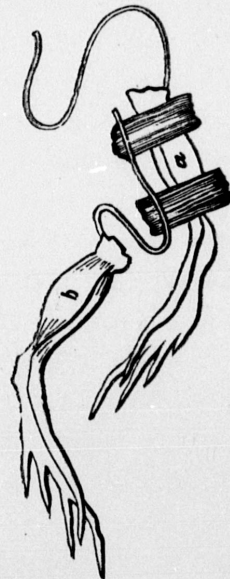


According to Radcliffe we may suppose the above a nerve or muscular fibre. The white is negative and the dark positive magnetism. In spasm, convulsions, &c., this natural condition may be reversed, in whole or in sections, and as in electricity attraction or repulsion would be the result, according to the law which operates when *plus* or *minus* conditions come in contact.



This is a magnetic pile made by the juxtaposition of four frogs' thighs. This battery will distinctly affect the galvanometer, decompose iodide of potassium, and display a high degree of tension when permeated by natural electricity.

(From the experiments of Matteucci of Pisa, and Dubois-Raymond.)



By pinching or irritating any way the nerve of the rheoscopic limb (*a*) "induced contractions" will take place in "*b*." The influence crosses the isthmus made of cotton-wick between the two limbs, in the same way as electricity would traverse it.

(Vide M. Beuquerel "Ann. de Chim.")

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natural condition the surface of each is in a positive state, and the core of each is in a negative relation; in other words, the longitudinal and transverse surfaces are, as a rule, relatively in the antagonistic conditions. Strange to say by irritation, heat, or the occurrence of death, a complete reversal of these magnetic relations takes place, not only so, but sections of nerve or muscle may change in this way, other sections remaining in the natural relation. Statical electricity in a state of rest is the primary condition of this power in these tissues, and in action magnetism usurps the place of this potent fluid, or rather it is a higher manifestation of the same energy. All physical action is accompanied by electrical discharge. In the experiments of Matteucci, Du-Bois-Raymond and others, this is clearly demonstrated directly and by analogy. The nerves of the electric system of a torpedo eel spring from the anterior track of the spinal cord, and at the periphery of each are the same complicated plexuses analogous to those in our bodies springing from a similar source. If the nerves of each are divided in any part of their course, both are equally affected by paralysis, and if shocked by electricity both show activity in an analogous manner. They are similarly affected by the application of toxic irritants, especially by strychnia, which induces in both convulsions and the elimination of electricity. Both become exhausted by action and return to their normal tonicity by rest. In a word, what can be predicated of the one, can be affirmed of the other, in all respects. If the nerves of the rheoscopic limbs of two frogs are only connected by water, or by candle-wick saturated with water, and the nerve of one is pinched, or any irritant applied, the magnetic fluid will traverse this foreign isthmus and cause contraction of the distal limb, showing conclusively that when electricity is

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given off, the muscle or nerve is in action, induced from any such exciting cause. It need scarcely be added that when muscular or nervous energy exists from the action of this agent, heat is generated. This correlation is universal. This transmission of nerve force explains much that is otherwise inexplicable, where there is diffidence or disorganization of nerve tissue, for even then its power of conveying this agent is not destroyed. It is even asserted by pathologists that the appropriate function is still preserved, through broken down tissue. This fluid is put in motion by friction and irritation on the one hand, or by volition, emotion, affection or desire, on the other. The nerves are excited by these currents, when the repulsion of the ultimate elements from their natural state of rest are temporarily reversed; in chronological order the same results follow in muscular fibre. This brings sections or molecules into apposition in their natural polarity; *plus* forces or *negative* states, in respective contact, will result in contraction of the parts affected. This condition explains the sudden invasion and departure of pathological causes, accompanied by spasms, fits, convulsions; also, the rhythmic movements of so-called automatic life. In this act of shortening, electrical action produces heat, and with it, ultimately, exhaustion, analogous to that seen in the torpedo. In chemical union or decomposition, the same effects are always seen, and living tissues are not an exception to this general law. These changes of conditions from positive to negative, and *vice versa*, are sudden in their effects, and may be transitory. Exciting causes may continue then for a short time, until feeble action compels at least intermittent secession of this condition, in order to give time to accumulate fresh force, as is the case in a battery. We can not grip continuously. We suffer when we keep our body in one position for a

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length of time. The periodical emphasis of the lungs, the heart, the bowels, the uterus, and it may be also of such busy laboratories as the liver, the kidneys and the stomach, show the necessity of these periods of rest, not to speak of intermittent sleep to the weary brain. We can not think without periods of rest of longer or shorter duration. All careful experiments go to show that any of these movements must be accompanied by a corresponding interchange between the external and internal magnetic relations of muscular and nervous fibres, giving out heat and throwing off decomposed matter during this activity.

This partial reversal of sections of nerves and muscles in their electrical relations is doubtless a normal condition. Huxley in his "Lay Sermons" seems to show this when explaining the circulation in a nettle sting. He says:

The whole hair consists of a very delicate outer case of wood, closely applied to the inner surface of which is a layer of semi-fluid matter, full of innumerable granules of extreme minuteness. This semi-fluid lining is protoplasm, which thus constitutes a kind of bag, full of limpid liquid. When viewed with a sufficiently high magnifying power, the protoplasmic layer of the nettle hair is seen to be in a condition of unceasing activity. Local contractions of the whole thickness of its substance pass slowly and gradually, from point to point, and give rise to the appearance of progressive waves. But in addition to these movements, and independently of them the granules are driven in relatively rapid streams through channels in the protoplasm which seem to have a considerable amount of persistence. Most commonly the currents in adjacent parts of the protoplasm take similar directions, and thus there is a general stream up one side of the hair and down the other. But this does not prevent the existence of partial currents which take different routes and sometimes trains of granules may be seen coursing swiftly in opposite directions within a twenty thousandth of an inch of one another; which, occasionally, opposite streams come into collision and, after a longer or shorter struggle, one predominates. The cause of these currents

seems to lie in *contractions* of the protoplasm which bounds the channels in which they flow, but which are so minute that the best microscopes show only their effects and not themselves.

In plant or animal, heat and electric shocks cause contractility in the same way and under similar conditions. This primal form is subject to laws of vitality and growth such as is seen in more complicated physical existences. It has in it these potentialities, and the experiments of eminent scientists go to show that electrical shock causes contraction of many of the first organized forms of life, and it is fair to infer it in all, were our knowledge extended. In a paper recently read before the Royal Society it was clearly shown that such plants as those of the *Dionœa* genus especially the Venus fly-trap not only secrete a juice as solvent as the gastric fluid and capable of performing the same work, but in the contraction of the lobes of this pitcher plant upon its food it gives out an appreciable current of electricity at every closure analogous to that obtained from the nerves and muscles of animals.

This also explains the flow of fluids against the laws of gravitation and which are vaguely stated to flow on account of the chemical reaction between the external moisture and the internal juices of the plants, excited in some way by atmospheric disturbance. This response to stimulation is analogous to that seen in the animal economy: even the change of direction of this fluid modifies and varies its action.

If a current of electricity be passed from the neighborhood of the nerve centres towards their ramifications, the result is violent contraction of muscle.

A current sent from the peripheral loops in a contrary direction will cause great pain, but only slight contraction. The power and medium are the same in both cases, but there is no doubt that the polar conditions

of the molecules of the nerves are changed by the difference in the direction of the force, if not, the effects would be the same in both directions, as on a telegraphic wire, when a message is sent from either termination. This difference of effect based upon change of direction is seen in the nervous excitations of sensation and volition.

To understand what follows, it is therefore necessary to remember that (*a*) what is called "voltaic alternatives," is a remarkable phenomenon, which is experienced when a *direct* and an *inverse* current is alternately sent through a section of nerve, it loses and gains its natural electricity, synchronous with the intermissions, and in the same degree as the loss and recovery of it, with irritability. (*b*) The influence sent through a nerve causes the muscle in which it ramifies, to contract when the galvanic circuit is closed, and not when it is opened. (*c*) A continuous action of magnetism will at last produce paralysis of the part affected—or in other words its irritability is lost, and in this deprivation it can no longer receive nor transmit impressions. Did time permit, it could be shown that in these changes we see phenomena that make it possible to arrive at rational conclusions in respect to the sudden invasion of such attacks as those of paralysis, epilepsy, St. Vitus' dance, hysteria, and allied nervous disorders. To illustrate the nerve influence by what we know in electricity, take two wires and place them parallel to one another, without touching; send a current through one, and a flash of electricity will instantaneously pass through the other, synchronous with that in connection with the battery. This wave passes away and is not repeated except the connection is broken, when the same results are obtained. These intermittent impulses, on connection and breach of continuity, can be repeated

indefinitely. In the connection the two currents go in the same direction, but break it and the secondary current returns in a contrary direction. In this way the two currents can be made to pass forward and backward, with regularity of a weaver's shuttle. It is worthy of note that the return current, induced by the break of connection, is much stronger in this parallel wire, on the "home stretch," than is that running in the same direction as the fluid in the connecting wire. If a number of insulated wires are coiled spirally round the primary wire, instead of running parallel to it, not only will these intermittent currents be produced, but also an extra or third current is produced in all the wires, no doubt induced by the magnetic influence of one upon the other. These facts will be of importance when we come to consider nerve influence, especially when we find that the larger the wire, the greater the number of spirals, the more powerful is the magnetic influence. The larger the healthy nerve is, the more capable it is to transmit magnetic power, in proportion to its size. Apparent exceptions do not violate this law. The point of a pin makes a limited impression on the end of my finger, yet, small though the injury may be, the nerve disturbance is considerable. There is no reason to believe that the irritation is confined to the fibre of nerve injured; nor that the influence travels to the nearest ramifications, and from them sends messages of alarm to the neighboring surface, as well as to the seat of sensation. According to the laws above mentioned, synchronous impulses can be sent through adjacent nerves, by induced electric currents, and at the cessation of excitation a powerful return current is set up, which produces the contraction of muscles, even before the will has power to act. I need scarcely add that a large number, if not all, of physical automatic

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action can be explained in the same way. It is the same in disease. A circumscribed injury will produce tetanus, or paralysis—effects out of all proportion to the local lesion. A few writhing worms in the bowels of a child, or a tooth keeping in constant tension a small portion of gum, will produce convulsions. A sudden emotion when we are awake, or the *phantasmata* of a horrid dream, will produce startling physical effects, although the cause be subjective. The centric excitant is equally strong to the objective when it dominates.

The inference, therefore, is strong that this substance gives impulses in and through itself, by filling the body it occupies, in all its interstices, and vibrating from the point of perturbation through *mesadic* contact. This is seen in the telephone. The voice—or in other words the undulating air—is not sent through the wire, but the vibration takes place in the medium, through its molecular structure, possibly in an infinitesimal degree, without any onward movement of the substance thrown into action. The reproduction of the nicest modulations of the human voice at the distal end of the telephone, is only a repetition of the motion continued, as is seen in the wave movements of a rope. The sound can be transmitted through a septum of boiler iron, or marble, as easily as through a thin membrane. This result can be produced without magnets, in the same way, with a thread as a means of communication. In fact, this power responds to the same tests, as if it were a subtle form of matter. It may be proper here to say that this manifestation of force is known in an exceptional manner to that of light and heat, showing that it does not, in every particular, correlate with these two forces, and must differ from them in some material way. Take a wire of unequal size, and place it between the two poles of a battery. Where this con-

ductor is smaller, there it heats more rapidly. In other words it condenses, and becomes more intense where the way is narrowed, as a stream becomes more impetuous where it is pent up by banks or rocks. Another illustration will show this: take a nodulated glass tube, in which the air is rarified, pass through it an electric current, which may be seen as a luminous spray. Where the tube is narrowed, the light condenses and becomes more bright; in other words becomes swifter in its flow the more it is confined. Here is a well known law of fluids in operation, and not mere force. The same experiments may be made with sound, light or heat, and it will be found that they do not condense and flow onward with increased intensity, but that they are refracted or reflected into or from the medium. Herein, even in this primary form, lies a radical difference in the phenomena of these forces, and leads me seriously to question their entire correlation. I have not the least doubt that in the wonderful phenomena of Edison's phonograph, in which a vibrating tympanum, a steel point, and a revolving cylinder covered with tin foil, can act as do the two complicated organs, the ear and the vocal parts, it will be found that the minute impressions depend on the molecular condition of the surface. Were it not so the ten thousandth part of a variety in the receiving of speech and giving it out, must change its character entirely. Thus far I have briefly indicated salient points in the phenomena of *magnetism*, and the analogous, but more varied force, which I have designated *vitalism*. The latter always includes the former, as a substantial energy. We can see that in *psychism* the two former are necessary to the latter, and that the trinity is indispensable to mental existence—shall I say—being mental life itself.

Thus far I have stated a few general principles. It is not too much for the egoist to ask that an analogy

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be drawn between the laws that govern matter, and those that he asserts control mind. In fact, he is dared to do this, and is promised, as a result of his research, utter discomfiture. He at once proceeds to do so by drawing parallels. For example, the pen-knife in his pocket has no magnetic power, but let him rub it along the pole of a magnet and the peculiar property of attraction in the magnet is communicated to the steel blade at once, without reducing this mysterious power of the magnet. Let the friction be reversed and this virtue is lost again. This inter-change can be carried on indefinitely. Here is a wonderful property induced and lost by gentle friction in a hard metal. How would it do to say that this manifestation of magnetic iron is a function? I take a piece of cold steel and a lamina of equally cold flint, and go out on a Canadian winter night, with the thermometer ranging from  $30^{\circ}$  to  $40^{\circ}$  below zero. I strike them together; heat and light are evolved from most unlikely substances under external conditions unfavorable to both. Would a philosopher call these evolved phenomena functions of matter? A savage on a lone island has lost his fire, and at once the friction of two pieces of wood eliminates heat and kindles into activity that power called fire. Why not call this element a secretion of any substance in which it resides, from which it can be abstracted, and which is the resultant of inherent forces as potent and active as in any organ of the body? Experiment shows that the active motion of all such bodies, whether by friction, by chemical union, or by vital processes, only make manifest these powers, but we would fly in the face of scientific investigation were we to say that all such forces which correlate were productions of these media. The molecules of the nervous tissues are put in similar activity by the irritation of contact, friction or

excitation; the result is heat, light, electricity. These are imponderable forces, of which we know nothing beyond their evidence of potential energy. A sudden emotion, a desire, a volition will produce evidence of these convertible forces in the animal system. As in the knowledge of material phenomena, or in the study of electrical force, it is not unscientific to assert that we have in self-imposed conceptions the evidence of "an invisible, supersensuous" *something*—a dynamical agent—a material force, it may be, which, at will, can, independent of sensation or automatic life, cause the excitation of nervous or muscular molecules, as efficiently and truly as is done by *ab extra* agency. The knowledge of force is as strong in the one example as in the other, and both are equally knowable by phenomena, and these only. Electricity excites molecular action, and through its action on matter we are cognizant of its existence. The so-called vital force is denied to these bodies, even in the lowest form, yet the same laws of chemical and electrical affinity are brought to play to build up a crystal, a grain of wheat, a muscle or a nerve fiber; but behind these, and producing each according to its kind, is a power that baffles the wisest objectivist, in spite of his acutest analytical investigation. This force is thus assumed by its phenomena. We may not see the worker, but on all sides is indubitable evidence of his craft. A mad man would not say that the means adapted to ends seen in universal nature were a jumble of fortuitous sequents and consequents.

Tyndall says ("Use and Limit of the Imagination in Science"):

The philosophy of the future will assuredly take more account than that of the past of the relation of thought and feeling to physical processes; and it may be that the qualities of the mind will be studied through the organism, as we now study the character

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of a force through the affections of ordinary matter. We believe that every thought and every feeling has its definite mechanical correlation—that it is accompanied by a certain separation and re-marshalling of the atoms of the brain. This latter process is purely physical; and were the faculties we now possess sufficiently strengthened, without the creation of any new faculty, it would, doubtless, be within the range of our augmented powers, to infer from the molecular state of the brain the character of the thought acting on it, and conversely to infer from the thought the exact molecular condition of the brain.

Herbert Spencer says that “with our present knowledge we are in this predicament. We can think of matter only in terms of mind. We can think of mind only in terms of matter. When we have pushed our explorations of the first to the uttermost limits, we are referred to the second for a final answer; and when we have got a final answer of the second, we are referred back to the first for an interpretation of it” (*Principles of Psychology*, p. 272).

Huxley says:

For, after all, what do we know of this terrible “matter,” except as a name for the unknown and hypothetical cause of states of our own consciousness? And what do we know of that “spirit,” over whose threatened extinction by matter a great lamentation is arising, like that which was heard at the death of Pan, except that it is also a name for an unknown and hypothetical cause or condition of states of consciousness? In other words, matter and spirit are but names for the imaginary substrata of groups of natural phenomena. (*Lay Sermons*).

This definition is doubtless correct, and “a state of consciousness” which exists, and which tells me that there is within me a power, at command now or in the future, and that through this residuary *something* my arm is raised, my head nods, my eye winks, or my imagination takes flights, at any time this something dictates, is entitled to ask for consideration as an entity as much as, for example, pain, which is only a state of

consciousness, and can not be weighed, measured, seen or heard. In fact, the operations of the laws of chemical affinity or of gravitation can not reach this height of complex power. A subtle influence pervades our bodies. It follows the nerve tracts from preference, but is everywhere present in the physical domain, exercising its power. It prevents the complete localization of each mental phenomena because of its ubiquity, yet may control the entire system from one central nerve capitol. It is not probable that the idea of the old philosopher in locating the soul in the pineal gland, or the doctrine of Bichat, in putting our feelings, affections, and desires in the sympathetic system of the bowels, is any more than the vagaries of visionary theorists, but it is evident that the organs at the base of the brain are the most wonderful of all brain locations, and that nerve influences emanate from the optic thalamus, the pons varoli, the medulla oblongata and the corpus striatum, that can be found nowhere else in the domain of nerve power. As you are aware, large portions of the cerebrum and the cerebellum may be taken away from the living body without immediate danger of death, but the organs in the base of the brain, from which spring the numerous nerves so essential to life, can not be touched in vivisection or by disease with impunity. From this central region nerve influence radiates to every part of the body, making its connections with the depositories of nerve power in the spinal cord, and with the ganglia of the sympathetic system.

The proofs upon which are founded the arguments in favor of different localizations are far from convincing, even were eminent pathologists unanimous in their conclusions. The results of disease in the physical manifestations of what Fritsch and Hitzig call the "psycho-motor centers" present so many exceptions to

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the generalizations of *localizers* that a verdict of "not proven" must at present be recorded against them. Take a few examples:

*First.* Hæmorrhage in the brain. Brown-Sequard justly observes (*vide Lancet*, July 29, 1876), that:

Convulsions may appear as well on the side of the lesion in the brain as on the other side, and that if they are more frequent on this last side when the cause is a tumor or an inflammation, they on the contrary, are more often witnessed on the side of a hæmorrhage in certain parts, and perhaps in more parts of the brain."

Out of two hundred and twenty-two cases of hæmorrhage collected by Gintrac (putting aside the cerebral ganglia, the ventricles, and the central parts) there were forty-seven cases of convulsions either on one side, or on the two sides of the body. Of these forty-seven cases, there were eleven in forty-five cases of hæmorrhage in the convolutions; two only in seventeen cases in which blood was effused in the anterior lobes; twenty-five in one hundred and twenty-seven, in which it was in the middle lobes, and nine in thirty-three cases in which it was in the posterior lobes. The same general distribution of efficient causes in the brain, producing similar effects, have been collated by thousands, all going to show that a local disease of the brain may (if at all manifest) produce certain effects, as is seen in the connection of aphasia with lesions of certain lobes, but when we find a large number of cases in which the same part is diseased, and no such results follow, and also that other parts of the brain becoming diseased do produce the same results, we are forced to the conclusion that some pervading influence must be at work upon nerve cells at a distance from the seat of the disease, and that it overleaps physical lesions and abnormal conditions in its operations. An insane person dies, and we find a large portion of his brain, or

it may be a section of the spinal cord, of the consistency of cream. The nerve substance has become homogeneous by gradual disintegration, yet, there may be no local or distal effect, commensurate with the breaking down of nerve tissue, and the evident destruction of nerve cells nor need there always be striking mental manifestations, consequent thereon. Brown-Séquard says: (*vide Lancet*, September 16, 1876) "that considerable alterations, and even complete destruction of parts, can exist without the appearance, or at least any marked degree of paralysis, whether the lesion exists in motor parts, or in the other parts, or in both simultaneously." On the other hand, a hæmorrhage, the size of a pea, in the pons Varolii, has been known to produce paralysis and death. The experiments of Hitzig, Ferrier, Carville, Durst and Nothnagel, lead us to believe that there is a center for perception, somewhere in the cortical substance of the brain. This is divided in true phrenological style into other circumscribed spaces, of distinct mental power. At the same time they tell us that the occipital lobe can be destroyed without producing any effect on the sensibility; that the convolutions of this lobe, as well as those of the frontal, the insula, those of the internal faces of the hemispheres, and those of the suborbital, do not respond to electrical excitation; and that for the most part lesions of these have little or no results. They think that ablations of the frontal lobes appear to lessen the activity of the intelligence, and that of the occipital extremity of each hemisphere seems to abolish the appetite. Orchansky, a celebrated pathologist of St. Petersburg, after numerous experiments on dogs and rabbits with the electric current, and by vivisection on the motor centers, candidly states that the separation of the cortex into motor and non-motor parts rests, probable upon an anatomical basis

only, but is little known. In other words, there is no special cerebral vaso-motor centers, except in intimate relation with the general motor system, this consisting of the cord, central ganglia, and the convolutions, but this tripartite is in mutual relation and subordination. The careful experiments of Brown-Séguard go to show that this mechanism of voluntary action does not depend on clusters of brain cells in one locality, but on the co-ordination of all the cells. The germ of the future therapeutics of brain disease may be indicated in the fact that paralysis is not always produced in the destruction or lesion of nerve matter, but often depends upon the influence exerted by disease upon parts at a distance. The supposed motor centers can be destroyed without any paralysis at all. On the other hand, paralysis may occur in arm or leg when it was the most anterior or posterior part of the brain—the part furthest removed from the supposed center of motion—that had degenerated. Paralysis may be quite independent of the destruction of the tissue. It might result from the puncture of the smallest needle.

It is, therefore, quite evident that if we can divide up our mental modes into sections, and give each a distinct domain within which only each can work; then the laws of co-ordination mean a perfect unanimity of a "committee of the whole" brought about in some fortuitous way, not from any *ab extra* influence, but by some intuition among the different organs. Without any autocratic authority to dictate to them they manage, in health and disease, to do tolerably well. These in the light of the *objectivist's* views of mental *localisms* should present good examples of modern miracles. The triumvirate of nerve systems have been divided so minutely that in each part is located all the intellect, volitions, emotion, desires and affections of humanity,



so that many pathologists profess to point out the capital seat of each of these manifestations, principally through the abnormal conditions of organs and localities, and in the perversion of functions co-existing with mental aberration. Ferrier (strong objectivist though he be) says: "We are still only on the threshold of the inquiry; and it may be questioned whether the time has yet arrived for an attempt to explain the mechanism of the brain and its functions." The applying distinct functions to the grey and white matter of the brain is not founded on a true basis of experiment, many have made the grey cortex uniform and without physiologically organic divisions, but Ferrier and his school, like surveyors, lay out this structure in definite order the more complex faculties of the ego, because in a number of cases certain abnormal states follow pathological conditions of localities in the brain. They ignore the large numbers of exceptions they find in opposition to their deductions. If we are able to see in even one instance without our eyes, it is evident that our optic organs have rivals. If we can hear in a solitary case, independently of our auditory apparatus, then must the ear look after its laurels. Memory is said to be located in the left, right, or both frontal convolutions, yet I find them diseased and memory intact. What am I to think of this division if I am told to believe that the motor centers of the upper extremities are in the optic thalami, and then find that in the experiments of Nothnagel this tract can be destroyed in rabbits without impairing their locomotion? Where am I to pin my faith? (*Vide Lancet*, January 23, 1875). Dr. Carpenter tells us that the *corpus callosum* is sometimes deficient or absent in man, and when so it is an evidence of low intellectuality. Professor Gerinano, of Turin, dissected the brain of an intelligent

soldier, who had served in the army eight years, but his *corpus callosum* was absent. When aphasia occurs deductions are drawn from disease being found in certain convolutions, that the nerve influence of speech must come from that locality. The witnesses do not agree as to place and boundary, so it will be necessary to rule them out of court until there is consistency and unanimity in their testimony. Ferrier tells us that he removed the whole of the occipital lobes of the brain of the monkey, Jacko, and this excision impaired his appetite. I have not the least doubt it would spoil the appetite of any one thus deprived. (See Review in *Journal of Psychological Medicine*, January, 1878). I need not cite historic cases like that of Gage; the case of Galli mentioned by Dr. Gray; the large list of soldiers with brain injury mentioned in Part I, and Vol. 1, of "Medical and Surgical Cases in the recent American War." Some had epileptic fits as a result; others were affected in one or more of the special senses, but quite a number had no permanent injury to intellect or function, with foreign bodies lodged in the brain. When I first had my attention seriously drawn to this matter it was about fifteen years ago. A lad of thirteen years of age had been kicked by a horse. A section of the skull was broken in the upper part of the frontal and occipital bones on the right side. One of the nine pieces fractured had been driven into the substance of the brain over an inch. The membranes were ruptured and broken up and brain substance protruded through the wound and was hanging in pieces on his cheek. At the time I first saw him he was comatose. I extracted the bones, cut away the ragged edges of the membranes and the lacerated brain substance. Consciousness returned immediately. He did not lose a night's sleep, nor a meal afterwards. No febrile symptoms intervened, but a

large cavity remained. He went to school to the same mistress as before, and she informed me that except a certain irritability of temper, he was as intelligent as ever and could learn his lessons with the usual aptitude. I need not enter into particulars, but merely say that some considerable cortical substance had been extirpated without serious results to mentality. Any number of such cases might be culled from medical literature to show that *all* brain substance is not necessary to physical nor mental life, and that the localization of psychical power is not borne out by experiment or pathology. It is dangerous to adopt a pet theory as a foregone conclusion, and endeavor to drag in every argument that we find at hand to support it, without stopping to find out if all the phenomena can be explained by our hypotheses.

If the views advanced by me are not accepted, I can not conceive any other solution except the old Hippocratic doctrine, a modified idea of which exists in "*bumpology*," viz: a duality of the ego, and that by mutual agreement this Siamese twin only becomes half diseased alternately. So by a law of compensation one can do the work of both if the necessity arises. If this suggestion of double function be not satisfactory, then vicarious work among the organs or segments of organs might approach a solution of the difficulty, although it would be a hypothesis fatal to the localizers' theory. The opinions given in this monograph meet many of the difficulties, and at the same time do not fly in the face of accepted facts exhibited in health and disease. All of the phenomena of mind, and of the functions of the physical system go to show, when brain tissue is injured by disease or by traumatic effects, that the artificial divisions of it by some physiologists are not consistent with experiment. It is worthy of note that no nerve

of the body can be traced into the substance of the brain beyond the basal ganglia. The olfactory and optic nerves were inferentially supposed to issue from the cerebrum, but no experiment nor development shows this to be the case. We have only to suppose the upper parts of the encephalon, the spinal cord, and the bodily ganglia to be depositories of psychic power to explain much in pathology. I have often been struck by Goethe's statement :

"Who of the living seeks to know and tell,  
Strives first the living spirit to expel,  
He has in hand the separate parts alone,  
But lacks the spirit bond that makes them one."

The fulcrum arguments in support of the idea that our mental and moral natures are "functions" of molecules of nerve substance, rest on three grounds principally. (a) The effect produced on mind by the healthy action of the nervous system. (b) The mental changes consequent upon pathological conditions. (c) The relation between mental power and the size of the organ in which it exists. In a word, the endeavor to find out what mind is, by a careful study of the phenomena of nerve tissue. This effort is praiseworthy, but is as one-sided as the *logomachy* of the mental philosophers.

We will consider the last argument adduced in respect to the relation of the massiveness of the brain to mental power. It is said there must be a necessary connection between the quantity of nerve substance—the proportion of grey and white tissue and *functional mentality*. The larger the brain is, the more complicated, varied and powerful are these functions. The nervous system is traced upwards in the scale of being from an *asidian* mollusk to the ganglia of the centi-

pede, and upward through the nervous systems of wasps, bees, fishes, reptiles, birds and quadrupeds to man. The simple ganglion in its upward growth becomes complicated by divisions into segments, convolutions and lobes. The more intricate in structure, and massive in substance the brain becomes, the higher are the psychical powers. It is stated that the relation is as marked as is the size of any other organ and its secretions, hence by parallel reasoning mental phenomena depend in force and complicity on the size of the organ, and must be necessarily the result of molecular action in the one case as in the other.

This assertion of an exact proportion existing between the size of the brain and mental power is as a rule; far from correct. A man with a large brain often shows less mental activity and power than a man with a much smaller brain. The tone of nerve fibre, the temperament, and the general recuperative forces have much to do with the condition of mental action. The temper of the medium has a great deal to do with the fluid which permeates and occupies it. The power of transmission, conduction and insulation of thought in brain matter depend on this as much as does the lowest form of electricity on the condition and size of the magnet. There are large animals such as the elephant and whale whose size of brain—if measured by cubic inches—should make them great philosophers, if well educated. This opinion is guarded, and this dilemma avoided by asserting that in some way we must take into consideration the relative size of the body to the brain. I have never been able to comprehend a rational reason for this explanation. Lubbock and Darwin being neighbors, watched together the habits of twenty kinds of ants, and they assert that for intelligence they rank next to man. Their wisdom,



their social economy, their aptitude to successfully provide for or against unforeseen contingencies in which instinct could hold only a minor part, their preparation for probable exigencies that could only be learned inferentially led these great scientists to rank these insects high in the intellectual scale. Yet, their ganglia are poor apologies for brain. The smallest human brain is said by Huxley to be fifty-five cubic inches in volume; the largest brain of the gorilla thirty-five, and that of the orang and chimpanzee to be twenty-six cubic inches in volume. These varied sizes give no reliable data for measuring the mental capacity of each. We may fill up the *hiatus* between the different brains of each with an hypothetical scale, and measure intelligence by it on some common basis, but the attempt would show the absurdity of the classification. Multifarious conditions, as well as quantity of brain matter, must be taken into account in measuring mind, and many of these being still involved in obscurity, no definite results can be obtained. A large brain in normal tone may exhibit greater mental power, than a smaller one in the same physical condition, just as a large magnet, or a cell battery in action increases magnetic strength in proportion to size, not because of the inherent potential energy of the instruments, but because of the attributes they possess in manifesting the activity of the fluid. The brain organ does not create and eliminate psychic force, *per se*, but its structure, and constitution are such that in tonicity it is the best medium to evolve the residuary phenomena of the *ego*. The activity of this agent shows that in emotion, will, passion or desire electricity and heat are the result of the energy of the tenant. Time would fail to show that this has been fully proven by experiments of the most conclusive kind. Apply

this solution to any of the so-called anomalies found in comparing the results of pathological research with mental phenomena, and we have here a key to unlock the door behind which so much mystery exists, and about which so many vague and unsatisfactory theories are propounded, founded on a physical basis alone. If these three forces be granted, and I am not aware of their being denied, the highest of which includes the two lowest, and the second of which is necessarily existent because of the first of the series; or if we hold that each is a development of the other, many of the riddles of pathology are solved, and existence is given to an entity not dependent on matter for its existence.

Take a few examples to show some of the difficulties the objectivist has to contend with in explaining his views, when brought to bear in the study of insanity. For the sake of argument we will assume his position to be correct. We will grant that the cerebro-spinal system is the causation of all mental phenomena. With Maudsley we will put memory in every molecule and consciousness as being only the recognition by a molecule of the influence of sensory impressions; like Carpenter we will put volition in nerve tissue wherever found, or to use his own terms call it "a function of the supreme centers" (*vide "Body and Mind;"* p. 30), or designate will to be merely "a result of organic changes in the supreme centers" (*vide Popular Science Monthly;* p. 320, vol. ii.); like Tyndall we will call the ego "a poetic rendering of a phenomenon which refuses the yoke of ordinary physical laws;" like Cabanis we may say "that as the liver secretes bile, so does the brain secrete thought." The same opinion is given by Voght. Moleschott says: "Thought is a motion of matter." Buchner asserts that "the soul is a product of a peculiar combination of matter—thought is emitted by the

brain as sounds are by the mouth, or as music is by the organ." These quotations are sufficient to show the standing ground of the objectivist school of thought. Let us see how they will apply to the observations of every day and asylum life. If these definitions of mind be correct, then it must follow as a corollary that a diseased brain and spinal cord must *always* produce abnormal functions, or morbid secretions. To state the contrary would be to give up the whole controversy, for as long as the disease continues it must produce its effects—if not uniformly—at least continuously.

Let us apply this doctrine to asylum experience. I go into the wards of an hospital and find cases of transitory mania. It may come on as suddenly as a blow, and in a short time may leave as abruptly, only to return in the same way at irregular intervals. Does our experience of disease enable us to consistently say that a permanent lesion could produce such erratic results? Let those who think so give a rational explanation from experience in other diseased parts of the body. The "lucid intervals" of insanity may not mean complete recovery, but the convalescence at stated periods is sufficient to make it an enigma, if a uniform pathological condition can produce results so diverse in intermittency to similar states in other parts of the body. It means that at times the brain can perform its work as thoroughly as ever in spite of disease. Can its *mental* functions then depend on its condition? The parietic will recover his intellect for months. The most acute observer can discover no mental obliquity in the interval of relief. We know too well the victim is doomed and that the disease has not relaxed its grip. Sooner or later it will become evident with increased intensity. Must we believe that the organ, diseased as it is, can do its work healthily at one time and at

another morbidly, yet under the same conditions in both cases? If not let the objectivist explain the enigma, for I know of no parallel to such a uniform cause having such diversity of sequence in the whole range of psychological physiology. The intermittent character of a disease caused by morbid germs, the invasion of which nature is struggling against principally by excretion, becoming alternately victim and victor, is not a parallel example to permanent disease of an organ. How often do we see in asylums the partial or complete return to reason in a dying hour? We have clearer answers to questions, and more intelligent conversations than at any time during the insane period. This lucidity may continue until the final capitulation is about to take place. If mentality be a resultant of molecular action, then is seen the strange anomaly of the secreting cause becoming gradually feebler, yet at the same time the effect increasing in strength. The fountain has risen above its source. The psychical energy increases in the inverse ratio to the power of the brain to perform its *egoistic* functions. Nor can it be compared to the spasmodic efforts of expiring nature, because we have to do with a permanently diseased brain which can not give normal results from an abnormal source.

Consciousness remains with us during all the mutations of our physical system. In that time millions of brain molecules have grown to maturity—produced their like—and having become an excretion are cast out as useless drones from the busy hive. Each parent monad has left to its child, as a legacy, a biography of the past. Each succeeding generation has garnered permanent and fleeting impressions to be harvested and appropriated by the living tenant as emergencies arise. The older the facts of memory in childhood the more

ividly are they portrayed in the vast picture gallery of the brain. The molecules change in substance and possibly in contour, as do the other parts of our physical system. Every impression, mental or physical, makes a fixed change in the ultimate elements. From this storehouse, at will or by association, the past is brought up to mental view with all its varied experiences. The instrument is ever changing in essence and capability during revolving years, but consciousness remains true to its impressions in spite of these disturbing transitions, and even of much organic lesion. What hypothesis can consistently explain this, if our consciousness were only a function or a secretion? No wonder that Maudsley takes every opportunity to have a tilt at it, and calls it only an "indicator" to tell what the molecular agent is doing, for if it be a faculty taking cognizance of the conditions and acts of the ego, or rather the ego itself, acting such a living fact, would strike a fatal blow at the substratum on which is built the doctrines of the school of Comte.

These puzzling problems might be extended indefinitely, based upon the experiences of asylum life, and no satisfactory solution can be given, unless we take for granted that a large part of the cortical and medullary substance is only a depository of *psychic* energy, and that when disease attacks these non-vital parts, or traumatic injury impairs their receptive powers, the mental force is often not weakened to an appreciable extent, because the conducting capacity of the abnormal parts may not be impaired to any extent. A shock or the sudden crushing of a small portion of nerve tissue, or pressure from slight effusion may be productive of danger, or even destroy life, from the sudden invasion of a powerful eccentric influence into the life center, but the gradual slicing away of the surface of the



brain, or the slower breaking down of its peripheral substance through disease, often produces no mental disturbance proportionate to the injury done. If an equation is to be made between mental power and organic lesion, the collation of cases and the experiences of life problems have not given us a solution to it, except in some way not yet unfolded by the objectivists. This paper is written in the hopes that it may be a small plank of a common platform upon which all can stand with consistent adherence to the facts of physical and medical science.

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