power to abstain will both continue and strengthen with time. It is a mistake to do too much for weak, sinful men, even by way of charity, for charity with all her tenderness, "rejoiceth not in iniquity," and the truest charity is that which teaches men to win their own independence, by convincing them that they are never morally enslaved except by themselves.

ON THE GERM-THEORY OF DISEASE.

BY THEODORE DEECKE,
Special Pathologist of the New York State Lunatic Asylum.

I.—THE LIFE QUESTION.

No recent theory has given a greater impetus to scientific investigation than that of evolution. We can not avoid its influence, upon the elucidation of histological processes, of the morphological changes in diseased structures, formation and decomposition, and upon the theories of disease, since cellular-pathology, and the germ-theory, have directed attention more and more to the minute forms and phenomena of life. Everything living is subjected to a continual change of its constituents produced by constantly operating causes. The single cell itself represents life, and where heterogeneous cells are bound in a state of interaction, they may support each other, or the process of life of the one may destroy the life of the other. Assimilation and excretion are the two active preservers of life, and as one or the other predominates the phenomena of growth or of decay will occur. Growth or decay! "Where are the beginnings?" "What are the ultimate laws of life?" And again arises the question:

transformation or origination, *ex ovo aut ex archē?* No question at the present time has been the subject of more experimental research; none has been more earnestly debated, and with more discordant results.

Even the evolutionists are divided in their opinions, some (Bastian, Häckel, *et. al.*,) considering the law of natural selection as not being confined to living matter alone, and regarding life as "one of the natural results of the growing complexity of our primal nebula." Darwin himself concludes his great work "On the Origin of Species," with the following words:

> It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us. These laws taken in the largest sense, being growth with reproduction; inheritance which is almost implied by reproduction; variability from the indirect and direct action of conditions of life, and from use and disuse; a ratio of increase so high as to lead to a struggle for life, and as a consequence to natural selection, entailing divergence of character and the extinction of less improved forms. Thus, from the war of Nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator in a few forms or into one; and that while this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.

These are words which need no interpretation. Huxley, although, supposing it were given to him "to look beyond the abyss of geologically-recorded time," he would expect to be "a witness to the evolution of living protoplasm from non-living matter," adopts it "as an article of scientific faith, true through all

space and through all time, that life proceeds from life, and from nothing but life." While Sir William Thompson in his most interesting hypothesis of the origin of the germs of life on our globe, resorts to "the moss-grown fragments from the ruins of another world."

It will not be my endeavor in the following pages, to sum up all that has been done to elucidate the question of the law of life; but to give a somewhat critical review of the value of the experiments, of the observations and of the philosophical considerations brought forward to establish a theory which harmonizes with our conception of natural processes, and our faculty of recognizing the invariable laws of nature.

The following statements will define the leading principles which should guide us.

1. In observing nature we are accustomed to accept all that our senses perceive, as physical facts. Facts are exclusive, although no one can exist without some relation to others; but all our sensual perceptions are limited.

2. Experiments are employed in studying natural processes for the purpose of confirming facts, but in relation to every fact observed, the one established by experiment may at all times appear altered by the conditions under which the experiment is made.

3. A theory can never be regarded as a true conception of nature, which is not the expression of facts observed and confirmed, or which commits us to suppositions not realizable in thought.

The question of the law of life has been entertained by naturalists in every age. The *archigenesis*, *generatio æquivoca veterum*, according to the former crude observations of nature, has been generally adopted by the older naturalists, even in regard to the production of

higher organized animals, as insects, fishes, reptiles, etc., and still occupies a somewhat important rank among the popular errors of the present time. After the more scientific investigations of Spallanzani and others, after the improvements made in the optical parts of the microscope and its application to science, after the study of the development and the life of the entophytes and entozoa, and of the processes of fermentation and putrefaction, after the discovery of germs of life throughout the atmosphere of our globe, of growing life even in clouds,—as has been established by numerous examinations of hailstones,—which, impregnated with organic substances, wander from the tropic regions to the pole and back, the biogenesis or the "*omne vivum ex ovo*" theory became more and more triumphant. In the last twenty years, however, the diversity of opinions has remarkably increased. The defining power of our microscopes has been more than doubled during that time; the air, the earth, the ocean, even to the enormous depth of 24,000 feet, have been thoroughly examined, and new orders of organic beings of the lowest kinds have been detected. Experiments, brought to the highest point of accuracy, manifest the most careful considerations of all circumstances which might possibly complicate the result; and yet all the results are discordant. It is true the specialists incline more than ever before, to assume the archigenetic theory. "Evolution," it is asserted, "implies continuity and uniformity. It teaches us to look upon events of all kinds as the products of continuously operating causes, it recognizes no sudden breaks or causeless stoppages in the sequence of natural phenomena." (*Bastian.*) Though the existence of a new order of beings, intermediate between animals and plants, of organisms, paradoxical as it sounds, without organs, the Protista of Häckel,

the first representatives of terrestrial life, from which all other forms are developed, and which are claimed to represent the leading scale from unorganized matter to organic life, has been established, still this evidence has not dispersed scientific skepticism, and natural philosophy clings even now to another conception of organized matter and of what is called "life."

All experiments which have been employed to decide the question, whether living matter is produced without the influence of organic life, turn upon the observation of the changes that a liquid, which contains nothing but dissolved chemical compounds adapted to the nourishment of some of the so-called lower forms of life, may undergo. This is heated and boiled in a flask for the purpose of extinguishing all germinal matter, and the flask is closed hermetically while in ebullition. If gaseous mixtures are allowed to enter the liquid, they are likewise heated, or pass through porous media as a freshly burned porcelain plate, or through a filter of cotton impregnated with resinous substances, or through tubes filled with powdered glass moistened with sulphuric acid, etc. And yet in the one case an actively moving bacterium-termo, or a monad, makes its appearance; while in the other no changes, no alteration of the liquid is observable. Referring to my own experiments, first executed some ten years ago, and repeated at intervals several times since, I have never found any other reason for such discordant results, than that in the one case all imminent germs were destroyed and new ones excluded, while in the other case this was not accomplished. The apparatus employed by me in these experiments, consisted of three wide-mouth flasks holding about four ounces of water. Flask 1 and 2, and 2 and 3, were connected by india rubber tubes, three inches in length attached to stoppers of the same

material, (especially made for this purpose.) In flask 2 a thermometer was inserted, and from the stopper of flask 1, another small tube branched off. All tubes could be closed by very strong clamp wires. After the flasks were charged with the liquid, in every case all clamps were opened, and flask 3, containing air was heated until the thermometer in 2 showed about a temperature of 150° Fahr. This was done to deprive the apparatus of some of the air, and thus prevent so high a pressure during the following operations.

EXPERIMENT 1. Flask 1 was charged with three ounces of turnip infusion, flask 2 with one and one-half ounces of Pasteur's ammonio-tartrate solution. Clamp 1, at the branch-tube, and clamp 3, between flask 2 and 3, were closed, and flask 1 exposed to heat until one and one-half ounces of its water were distilled over into flask 2, raising the temperature in 2 to about 190° Fahr. After this, clamp 2 was closed, clamp 3 opened, and one and one-half ounces of the contents of 2 distilled into 3, raising the temperature as high as 212°, and immediately afterwards the liquid was redistilled into 2, clamp 3 closed, clamp 2 opened and the same quantity distilled back into 1. All clamps were closed. After two days bacteria were found in flask 1, after four days flask 2 was infected. The experiment was repeated with the same result.

EXPERIMENT 2. Clamp 1 and 2 closed. One ounce of the liquid in flask 2 was distilled over into 3 and back. The clamps were closed. After four days living bacteria were found in flask 2. The distillation was then twice repeated: After fourteen days no signs of bacteria could be discovered.

EXPERIMENT 3. Flask 1 charged with three ounces of Pasteur's solution, flask 2 with one and one-half ounces of distilled water, one and one-half ounces dis

tilled over from 1 into 2, from 2 into 3 and back. No bacteria existed either in 1 or in 2 after fourteen days.

EXPERIMENT 4. Flask 1 charged with three ounces of the infusion, flask 2 with one and one-half ounces of distilled water. Distillation as above from 1 into 2 into 3 and back to 1, all clamps were then closed; after eight days bacteria were found in flask 1, but after fourteen days none were observed in flask 2.

EXPERIMENT 5. To two ounces of the infusion in flask 1, two ounces of water were added, flask 2 charged with Pasteur's solution. Clamp 1 and 2 closed. One ounce of 2 distilled into 3 and back, and the operation twice repeated. After eight days there were no bacteria in flask 2. Then clamp 1 was opened, the infusion boiled down to two ounces, and again the clamp closed in ebullition. Clamps 2 and 3 were kept open to allow the air to pass freely into 1. All clamps were closed. This experiment was repeated six times. In two cases bacteria were found after eight days as well in flask 1 as in flask 2. In the other four cases, after twenty-one days, no traces of living beings could be detected.

These experiments show very plainly,

1. The germinal matter of the bacterium is extinguished by the continual action of heat.

2. It is not extinguished under all circumstances at 212° Fahr.

3. The germinal matter exhibits a greater resistance to the action of heat in Pasteur's solution than in water, and a greater in the infusion than in Pasteur's liquid.

Whatever the cause of this protection may be it is at present impossible to say. It is true no one has yet seen the germs or germinal matter of the bacterium, but what we know of the minuteness of the germs of some monads, which are barely visible with the 1-50 object-

ive of Powell and Leland, and the size of which must be less than the 1-300,000 of an inch, justifies the supposition of their existence. Is it their minuteness which protects them for a time against the action of heat? This is not quite impossible, as will be explained in another place. But we may refer, also, to some other phenomena concerning the relation of heat to the molecular state of bodies in general.

Considering heat as a mode of motion, of molecular motion, it is well known that an increase of this motion, transferred to any unorganized or organized matter, will, at a certain point, alter its entire molecular constitution, producing a physical or chemical displacement of its molecules. But the quantity or the intensity of motion required for such an effect depends entirely upon the bodies or substances engaged, and upon certain circumstances which may influence the action.

Albumen coagulates at 145°; dry albumen may be heated as high as 212° without losing its solubility. Caseine is not coagulable, and globuline, (hämato-crystalline,) a compound perhaps of the highest order (C_{600} H_{960} N_{154} F_{e_1} S_3 O_{179},) resists a displacement of its molecules by heat, up to 176°. Some of the offsprings of albumen exhibit very different qualities. Kollagen is transformed into glutine by boiling water, while elastine shows a remarkable resistance against its action. Steam and water at 212° are commonly said to destroy all organic beings and germs, yet undoubtedly not by the action of heat alone, but by the action of heat and water or steam. Many seeds may be heated dry, others in oil up to the same degree for a certain time without losing their germinative power, and even mammalia will exist, without injury, in rooms filled with dry air, of a temperature as high as 300° Fahr. Suppose now the germinal matter of an animalcule of the

lowest order, of a bacterium, a monad, to consist of an elastine-like and other proteinous compounds, the molecules of which are not displaced at once by the action of water or steam at 212°, there is no reason to conclude that all its germinative power would be destroyed after five, ten or fifteen minutes' ebullition. Now we must always keep in mind that we know still very little of the chemical constitution of living matter represented in the so-called lower forms of life, and the series of the proteinous compounds recognized by our chemists has not yet been closed.

In regard to the means adopted for the purpose of excluding all new germinal matter from the liquids, we meet with more difficulties, the less we alter the natural conditions of the experiment. Where the tubes or flasks were hermetically closed while in ebullition, by the aid of a soldering pipe, I have never observed any traces of bacterium, and seldom when sealing wax was used; but wax, sealing wax, etc., may contain germs. The porous porcelain plate employed by Huizinga will in no event answer the purpose. In his experiments where bacteria were not found, may not the vapor of mercury, by which the tubes were closed, have had some influence? The filtering of air or forcing the same to pass through sulphuric acid, gives at all times very discordant results, as the smallest bubble of air may contain germs which enter the liquid, and if only a few are safely introduced, we know they will be sufficient for the production of millions and millions of offspring. In the experiments of Davaine, the living particles which produce septicæmia, though introduced into the blood of an animal in a quantity only corresponding to the trillionth of a drop, by an infinite multiplication of their numbers, caused death.

It is therefore my conclusion that a single experiment, which establishes the possibility of preventing the occurrence of the forms of life, in liquids adapted to sustain them, by the employment of such simple means as those above mentioned, is convincing, or, in the words of Huxley: "There must be some error about these experiments, because they are performed on an enormous scale every day with quite contrary results. Meats, fruits, vegetables, the very materials of the most fermentable and putrescible infusions are preserved to the extent, I suppose I may say, of thousands of tons every year, by a method which is a mere application of Spallanzani's experiment." There is another reason why I can not give any credit to the objections made by Häckel and others, that we have to deal in our experiments with quite unnatural conditions. It is a fact well known to all experimenters, that substances exposed to heat for a time sufficient to destroy all imminent germs of life, are nevertheless, quite fit for a pabulum for organic life, and that the minutest quantity of living matter will in it carry on its life to indefinite reproduction.

I proceed to review the observations and the conclusions drawn therefrom by the naturalists, in regard to the laws of life.

In France, (Pouchet, Pelletier,) and in Germany, (Schaafhausen, Büchner,) authors have expressed the results of their observations in words which would settle the whole question at once, if their comprehension of observed facts was not open to the gravest objections. They pretend to have seen with their own eyes, by the aid of high magnifying powers, organic beings separated from liquids, containing dissolved organic compounds, just in the same manner as a crystal is separated from a solution. The distinguished Häckel, himself, seems

inclined to subscribe to such a belief when he speaks of a moner "as a structureless, uniform little mass of proteinous matter which represents, chemically, only one single albuminous compound." Nevertheless this moner is shown to be composed of a slimy matrix, in which numerous small particles are imbedded, and it may be called, at the same time, a protamœba. It nourishes itself by assimilation, reproduces itself by fission into a group of young; and slowly diffusive movements make manifest its contractility. It is developed by spontaneity. Nuclei and nucleoli appear in the uniform structureless little mass of albuminous matter, and soon it enters into the little more respectable society of the amœboids, which very likely already exhibit sexual differentiations, like some of the smallest monads, since I have observed them at times in a state of greater compactness and density, and in rapid motion, one revolving around the other, in a state of activity which undoubtedly stands in some connection with procreation, although I have not yet been able to observe another kind of multiplication as that by fission. Among the English naturalists, Bastian declares himself very decidedly in favor of "the ultimate similarity between crystalline and living matter," that is between the process of crystallization and the supposed spontaneous production of organic forms. May we be allowed first to explain the process of crystallization of the simplest kind, when a liquid throws out crystals of a compound which was dissolved in it.

A solution represents a mixture of heterogeneous molecules. The homogeneous molecules of the liquid, easily displaceable according to their state of aggregation or latent heat, are placed in such a manner between the homogeneous molecules of another compound of different latent heat, or molecular motion, that these

become as displaceable as the molecules of the liquid itself. In consequence of an increase or a decrease of molecular motion, the liquid, it is apparent, will exhibit altered capabilities in regard to its power of transferring molecular motion to the other heterogeneous molecules. Besides this, some certain peculiarities of the latter, may at all times influence the interaction, and establish so great a variety of relations between such heterogeneous substances, as may confound the simplicity of the fact. Nevertheless, all phenomena of dissolution are liable simply to molecular motion, and stand in direct proportion to that kind of molecular motion, which we call heat, and upon which the state of aggregation of all bodies is based. During solution, therefore, as well as during fusion, a certain quantity of heat always becomes latent, and hence it is that the solution of a substance usually produces a diminution of temperature, that is, heat is absorbed from all bodies which are in contact with the substances engaged. In certain cases, however, instead of the temperature being lowered, it actually rises, but this depends upon the fact that two simultaneous and contrary phenomena are produced. The first is the passage from the solid to the liquid condition, which always lowers the temperature. The second is the chemical combination of the body dissolved with the liquid, and which, as in the case of all chemical combinations, produces an increase of temperature. Consequently, as the one or the other of these effects predominates, or as they are equal, molecular motion in the form of heat will be expelled, or absorbed, or remain constant. Concerning the interaction between liquids and solids, the following laws regulate the phenomenon. 1. At a fixed temperature only a certain quantity of the solid is dissolved. 2. The solubility increases and diminishes

between certain limits, as the temperature or the molecular motion of the liquid rises or sinks.

Now it will be easily understood that in cases where the quantity of a dissolving liquid diminishes or its temperature sinks, a corresponding portion of the dissolved substance will be thrown out, according to a physical affinity, perhaps, in combination with a certain quantity of the dissolving agent or without it.

Concerning the form or the figure under which the solid appears, we know, regarding the law of isomorphism and dimorphism, that it depends for the most part upon the number, and therefore upon the arrangement of the atoms of which the compound molecule consists. Molecules of different atomical constitution must therefore themselves differ in form and figure, and although not visible to the eye, exhibit *de facto*, the principal form under which larger aggregations are perceived.

Now, as to the microscopical observations, in regard to the process of separation of a solid from a liquid, it is apparent, that the first moment in which the eye will find itself engaged by rays of light reflected from a solid aggregation within the uniform solution, will depend upon, first, the angle under which we observe; second, upon the quantity of light (the number of undulations) reflected; third, upon the sensibility of the retina of the observer himself.

Supposing, now, in reference to first and third, the most sensitive retina, and that we operate with the highest powers obtainable, would there not be in virtue of the second statement, at all times, a boundary beyond which no perception is possible? This may be disputed, but without reason. There is a certain law in nature which seems altogether unknown or too much neglected, that is, as far as we are able to conceive, that

all interaction in nature is related to quantity. This law is of universal validity, and no interaction and no conversion of motion can take place, except as regulated by quantity of matter. As little as one single longitudinal oscillation of an air molecule represents a sonorous wave and will be perceived by the ear, so little will one transverse undulation of an atom irritate the nervous elements of the retina of our eye. The motion of one or two single molecules can not be transformed into mechanical energy, and yet, molecular motion (heat,) and mechanical energy are mutually convertible in numerical proportions expressed by the quantity of matter in motion.

It is for this reason that all sensual irritability is in proportion to the quantity of matter in motion, which is to be transformed into nervous energy. When, therefore, in a mixture of two heterogeneous molecules, the refracting power of both, separately comes into action, and they are separately perceived by our eye, it is absolutely necessary for both substances to be present in an aggregation of such dimensions, that the number or the quantity of reflected or refracted undulations required for a substantial phenomenon, and for the transformation into nervous energy, are furnished. From this time only, the body will be distinguished by the eye, nevertheless we must suppose that an aggregation of some dimension may have existed long before, for we are not able to observe anything aside from an alteration of form produced by the process of growth. In the theory of the constitution of matter, we distinguish between atom, aggregate of atoms or molecule, and aggregate of molecules or body; in regard to the activity of matter, between motion of bodies, motion of molecules, and motion of atoms. Sound, heat, electricity, are phenomena of molecular motion; light and

chemical energy of atomic motion. Modes of motion are mutually convertible; the motion however of a single molecule can not be converted into mass motion, the motion of a single atom can not be converted in molecular motion, and inversely a motion of a molecule can not be converted into that of one atom; motion includes a multitude of actions. The analysis of a chemical process leads to similar conceptions. Chemistry teaches us, that for instance in water (88,9, O, 11,1 H, by weight,) one atom hydrogen is combined with one atom oxygen, to one molecule H O. Does this molecule represent water, steam, or ice, or the form under which H O seems to be bound in a crystal, or an organic being? Certainly not, because only a multitude of such molecules can enter into a substantial existence and into actual relations to other bodies. No body is divisible by itself or by another body, but by its molecules, and no molecule is divisible by another, but by an atom and no atom is divisible by another atom. So the indivisibility of the atom is only a quality of relative validity. But as all the properties of the chemical elements are changeable, when they pass into combinations, there remains one unaltered under all circumstances, that is their weight, and only in definite unchangeable proportions of weight do they combine. Heterogeneous atoms must, therefore, represent either equal spaces filled with unequal quantities of matter, or unequal spaces filled with equal. In both cases, however, all interaction which may take place between them is an interaction of quantities, so that the general law of quantity has even here its foundation.

It may be permitted us at this point, to take again into consideration those remarkable facts above mentioned, concerning the action of heat upon the germinal matter of the lower forms of life. The supposition that their

minuteness might protect them, at least for a time, seems no longer quite so unreasonable and vague, when we consider that the quantity of matter in action will doubtless have some influence upon the effect produced. The active quantity of heat transmitted to a body, must diminish with the size of the body itself, as the points of aggression diminish. The diffusion of heat is at any event a slow process and organic bodies belong to the list of bad conductors. According to Prof. Tait, "In a single drop of water there are a thousand quadrillions of ultimate particles. Each particle in a drop of water, is to the entire drop as the size of a walnut is to the earth," and it will hardly be granted that we recognize in an organic germ, nothing more than a compound molecule, but this does not in the least affect the law which regulates all interaction in nature.

Since there is no possibility of witnessing an act of origination in nature, we must allude to the theoretical views laid down, to assist our comprehension.

Analogy has, at all times, played an important role in the interpretation of natural processes, but with very dissimilar results. Häckel, in regard to crystallization and the formation of a Protista, has carried these analogies to their utmost limit. He acknowledges two formative principles in nature: the inner plastic energy, depending upon the number and the arrangement of the atoms, corresponding to inheritance in living forms, and the action of external forces, as temperature, atmospheric pressure, etc., by which a continual modification of the forms is produced, (the law of accommodation;) but there is one distinction, he continues, as the crystal grows by aggregation, so the organic being grows by intussusception. This is owing to their different densities, or the different state of aggregation, by which they are characterized. According to this theory, an organic

being would be assumed to consist, like a crystal, of molecules, of course in a peculiar, or *fourth* state of aggregation. This peculiarity threatens to overthrow the laws upon which the other three states of aggregation depend, if we do not acknowledge another energy as acting in nature, which, although it paralyzes the physical forces, appears not to be convertible into the same.

We have not yet the slightest evidence to justify the assumption, that an organic being consists of molecules; and that even the simplest moner, by the action of any of the physical forces should be divisible into its molecules, no one has asserted. Why, however, if it really consists of only one chemical compound, should this not be done, since other albuminous or proteinous compounds may undergo these changes without an alteration of their chemical nature? And, how can the transformation of a dissolved albuminous compound into a moner, by the action of the same physical forces, be assumed? There must be something wrong about those analogies, and a moner must represent more than Häckel seems inclined to admit.

Since every living thing is subjected to a continual change of its constituents, such transformations occur under the direct influence of life everywhere. Compounds in a molecular state are decomposed, and others in the same state excreted; but what changes they have undergone during these processes and what constitution of matter they have represented, of these we have attained no knowledge, by means of our chemical and physical examinations. No doubt chemical forces are active, and the formation of a chemical compound can not be considered as the only effect of chemical affinity. We have gained some familiarity with these processes, since the discovery and the separation of

those peculiar compounds, which are recognized as the direct causes of fermentation, putrefaction and digestion, which, under certain circumstances in the minutest quantity may continue chemical interaction almost *ad infinitum.* It is true they are created by the action of life, and our chemists have not yet been successful in producing one of them without the aid of life. The number of these substances must be almost as infinite as the organic forms themselves. In some instances they support life by transforming compounds into a state for assimilation, while in other cases they act as the most poisonous and life destroying agents, and the so-called vegetable alkaloids and the animal poisons, stand in a close relationship to them.

But although this illlustrates how life preserves itself, and by what means it may be developed, it throws very little light upon its ultimate causes and sources. The form remains unexplained.

Analyzing a crystal we find a geometrical body, in which the sides, the enclosed angles, the axis, stand in certain definite relation to each other. The body is mathematically constructed, without referring to its material composition, and the most heterogeneous compounds appear in the same figure. An equal quantity of one element may be replaced by another one, according to the law of isomorphism, without changing the crystal's figure, and numerous other combinations are recognized, as dimorph and trimorph. Upon the arrangement of the atoms, and upon the motion of the molecules against each other depends the invariability of the constructed form, and no geologically-recorded time has changed, no law of evolution developed the form. In a similar manner motion may be conceived. A mathematical curve is constructed in thought; it may be represented by a point or a celestial body in

motion, and the laws which regulate the undulations of a liquid, a solid, a gas, may be conceived of by substituting for each of these forms of matter, some imaginary substance. A chemical compound is virtually the same whether it appears under the form of a liquid, a solid, or a gas. This is not so in the perception of an organic being, which represents a perfect oneness, an insoluble unity of action, composition and form. Therefore one form is not equal to another; and the one is not equal to itself, from one moment to the other, although both are similar. We are not able, in thought, to separate the action from the substance which acts, or the substance from the figure. There is no geometrical body before us which matter constructs by its motion; if it were so, we must construct in thought, an organic form, by substituting an imaginary medium in motion.

In a moner, a cell with or without a membrane, the form is not separable from its essential nature, and no definition can be given which includes all or excludes one. It is therefore not comprehensible in thought how an organic form has been originated. It has not come into existence by an agglomeration of molecules, because no molecule is actually formed during the continual change of its constituents. This fact of change excludes the possibility of formation, and should we draw the parallel, so would the whole being, as each cell itself represents one molecule.

These considerations are the same, very probably, by which Häckel was governed, when he conceded that an organic being grows by intussusception. Intussusception demands an interaction of the *ultimate* particles of matter, of the atoms themselves. The distinction between a crystal and an organic being is therefore an essential one, and since no intussusception is thinkable

without a being that intussuscepts, so nothing can have been originated by such an act.

There is one thing in any event undisputed: that life proceeds from life. I can see no reason why this law, even if it is of universal validity, should interfere with the general law of evolution. "Evolution implies uniformity and continuity," *heterogeneity* without any doubt. Herbert Spencer gives us the following definition: "It is a change from an indefinite, incoherent homogeneity to a definite, coherent heterogeneity, through continuous differentiations and integrations." How can this be comprehended? The continually operating causes which produce the heterogeneity, must either be conceived as inherent in nature, or as external supernatural forces. In the latter case Spencer's definition would just about cover a definition of Creation, while in the former, instead of homogeneity, the *pre-existence* of *heterogeneity* is supposed. Continually operating causes exclude entirely the supposition of a beginning, of an act of origination, and interaction itself demands heterogeneity, through all time and space. All natural processes are therefore only comprehensible as facts of transformation, and the law of evolution expresses the nature of these transformations, as acts of relation in the midst of an infinite heterogeneity, as infinite as the universe itself. So the universal validity of the law of life, that life proceeds from life and from nothing but life, stands by no means in opposition to evolution, and if life is regarded as eternal, as replanted upon our earth "by the moss-grown fragments, from the ruins of another world," so will a hypothesis like this seem not more unscientific than any other. Why may we ask are only a few of the elements, which compose our globe, supporters and formers of life, while all the others are ex-

posed to the same acting forces? There is something aboriginal and immediate in life, which no history, no philosophy explains. And when it is said that "we are like colonists, like cultivators, upon this world," these words are the expression of a natural sense, perhaps of a truth, which seems approved in science by the conception of that first, that greatest of all the laws of life, which elucidates the others and points toward the disproportion, so evidently pronounced between life and inanimate matter—*the struggle for existence.*

PSYCHOLOGICAL RETROSPECT.

English Psychological Literature.

Journal of Mental Science, Vol. XVIII.—January, 1873.

Part I.—*Original Articles:*—The Madmen of the Greek Theatre, (No. 3,) J. R. Gasquet, M. B. The Religious Sentiment in Epileptics: James C. Howden, M. D. Lunacy Legislation in New Zealand: W. Lauder Lindsay, M. D. Tumors of the Brain in the Sane and the Insane: R. Boyd, M. D. On Larceny, as committed by Patients in the earlier stages of General Paralysis: J. Wilkie Burman, M. D. The Shower Bath in Insanity: John A. Campbell, M. D.

Dr. Howden has called attention to a peculiarity of the epileptic state, in the development of the religious sentiment, which has been little noticed by writers. Many instances are at hand, in the lives of leaders and founders of sects, and in those religious fanatics, who figured in the epidemics of the middle ages, notably that of the dancing mania. He reports several well marked cases occurring under his own observation, and introduces those of Anna Lee, the founder of the Shakers, of Emanuel Swedenborg, and of Mahomet, in all of whose lives there are evidences of abnormal nervous manifestations, of a cataleptic or epileptic character.