

III.—BEING AND BECOMING.

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I.

“GENERAL ideas,” says Emerson, “are essences. They are our gods: they round and ennoble the most partial and sordid way of living.” It is, then, not to be wondered at that man’s most general idea should be handed down from age to age, that the riddle of the meaning of the cosmos should offer itself for solution to each new generation. The search for a solution is doubtless largely a threshing of old straw, but none the less does each generation garner a few grains of corn into the store-house of truth as food for the inner life; and though it may well be that there is no answer to the questions, “What is man, that Thou art mindful of him?” and, “What art Thou which art mindful of man?” yet many partial answers have been offered, in general from two markedly contrasting, indeed often bitterly opposing points of view. The terms of this opposition change, but after all necessity and free-will, materialism and idealism, the mechanistic principle and the teleological, monism and dualism do in a way but illustrate the metempsychosis of the spirit of the idea through the body of the word. It is not our purpose to examine, or re-examine, in detail these systems under any of their names, but merely to point out, as we sketch the outline of the system which we accept, a few important particulars in which the opposing view seems fallacious. In conclusion we shall indicate briefly some evidence furnished by the theory of relativity in general support of our own views.

It is now universally conceded that to the physical world the mechanistic principle applies. The principles which prevail in the world of inanimate nature obey the laws of mechanics; and these laws, capable of exact mathematical statement, are simply the formal and generalised expression of what these principles are found to be by observation of physical phenomena and by experiment thereupon. When,

however, we enter the realm of the animate the idea of purpose is thrust upon our notice, and it is the phenomena of consciousness, more specifically of the will, which lead to the opposing views of teleology and mechanism, of dualism and monism.

We find it impossible to accept the dualism which marks off the animate and the inanimate as lying in two separate realms, or that which completely differentiates mental and physical life. Matter and mind-stuff, to use the terms of W. K. Clifford, are not for us distinct entities of such a nature that consciousness, "a stream of feelings," cannot "interfere with [or] influence" the body, which is itself an automatic, physical machine. The fact of consciousness, or more specifically the will, in man and other animals will not be denied, and its presence in plants also is accepted by many;¹ but the nature of consciousness or the will is a subject of dispute. In our view, as will be explained more fully, the will is a store of energy and an act of will is a liberation of stored up energy. That this is so, or that the will is a force, is denied by Clifford and others on the ground that the assumption would imply the creation of energy, somewhere in the process, when a stimulus passes through a sensory nerve to the brain and out through a motor nerve; a contradiction of the law of the conservation of energy. Clifford's statements² were made before the discovery of radium, the compounds of which are known to remain continuously at a higher temperature than the surrounding atmosphere, and the energy of which, stored in the atom, though not inexhaustible, is very great in quantity. It is conceivable at least, even if not demonstrable, that in organic matter, complex as it is, there may be a store of atomic energy which in the brain would constitute the will, or more generally the mind.

Clifford remarks that it is not right to say the mind is a force, "because if the mind were a force we should be able to perceive it". It is difficult to understand what he means by perceiving a force. We can perceive the effects of a force, the phenomena which follow a liberation of energy, and the teleologist maintains that he sees precisely such effects due to the action of the will. Clifford, on the other hand, while he accepts the existence of "mental facts" which accompany "physical facts," denies that either can in any way interfere

¹ See J. C. Bose, *Plant Response, Researches on Irritability of Plants*.

² His address, *Body and Mind*, from which we quote, was delivered in 1874.

with the other. It "is not untrue," he says, "but it is nonsense [to say] that the will influences matter". If, however, the will be a store of pseudo-radioactive or other kind of energy, the statement is by no means nonsense. Clifford uses the word influence to mean the action of matter upon matter. It hardly seems a valid argument to say that "the only thing which influences matter is the position of surrounding matter or the motion of surrounding matter," and that, therefore, mind cannot influence matter. The contention of the teleologist is that there is in the will just this immaterial thing, which we believe is a store of energy, which does influence matter. Indeed, in the study of radioactivity we seem to be brought face to face with an instance of matter, using the term in Clifford's sense, being influenced by the immaterial. The γ rays, which are looked upon as immaterial particles, have the power to ionise gases; that is, to break up molecules of the gas into parts charged respectively with positive and negative electricity. If this be true there seems no reason why volition may not be considered a similar phenomenon; and the discontinuity in the action of matter upon matter, the point at which energy is liberated, cannot be called a place "where physical causes do not apply".

To admit the possibility of discontinuity may, as Clifford says, "leave the way open for the doctrine of a destiny or a Providence outside of us," though not necessarily "overruling human efforts and guiding history to a foregone conclusion". Even if it do so the scientist should not fear to leave the way open for the entrance of possible truth in any form, and we may suspect here scientific prejudice as illiberal as the prejudices of teleological polemics. Perhaps if Clifford, instead of saying Providence or destiny, had been content to say merely that which is outside of us, he would have been more willing to leave the way of entrance open. Science, as well as religion, has its superstitions.

We are not, however, arguing for the existence of discontinuity in such phenomena; indeed, we believe the process to be strictly and physically continuous—but we cannot accept the theory of non-interfering mental and physical phenomena moving on "parallel planes". No more can we accept a discontinuity permitting the entrance into the sequence of events of a super-consciousness, whether this be purposive or unpurposive. We do not deny the super-consciousness; we simply deny the necessity thereof to the sequence of events in question.

II.

Whether "hard and heavy matter" be one day shown to be ether in motion; whether the atom be a whirl or vortex-ring producing a strain or tension in the ether; whether it be a sphere of positive electricity in which negative electrons revolve, or an infinitely minute, one-dimensional particle (*Hohlraum*) moving with the velocity of light—in any case the atom would seem to imply energy, and a material body to imply a store of energy. We believe the atom is energy, and that mass is energy or a store of energy due to motion. The idea of motion, of a store of energy, would seem to be essential to any theory of matter and the atom. To the theory and its essential idea add the facts of chemical affinity, of radio-activity and of electro-magnetism, and we venture to say that what is known as life, man's will, the will of organic matter—to say that life is stored up energy differing in degree, but not in kind, from other stored up energy, and that an act of the will is a setting free of a portion of this energy. The will would act according to mechanical laws, would be mechanistic, precisely as gravity, chemical action, and radio-activity are mechanistic; while these, on the other hand, would imply life, consciousness, just as the will implies life and consciousness.

Man performing an act of will is said to be conscious, while a stone performing an act of falling is said to be unconscious, but we believe the acts are the same in kind. The will acting in the brain of man, a liberation of energy, causes movement in the brain or possibly of the whole organism. Gravity acting in the atoms of the stone, a liberation of energy, causes movement of the stone. When one uses the term "conscious" one would seem to have in mind too exclusively the consciousness of man. If, step by step, beginning with man, we follow back the idea of consciousness through the higher animals to the lowest forms of organic existence, animal or plant, consciousness at every step being accompanied by stored up energy and liberation thereof—if we follow back this idea through complex chemical compounds, through radio-active substances, to the primitive ether whirl which possesses a store of energy, electro-magnetic or due to stress and strain—if, step by step, from the highest to the lowest we follow back the sequence, it may be doubted if at any point we should be able to say, on this side lies consciousness on that side unconsciousness; on this side the animate, on that side the inanimate. The vegetable world is organic. Is a plant conscious or unconscious?

There are organisms such that we are uncertain whether to classify them as animal or plant. Are they conscious or unconscious?

We are fully aware that it is a logical fallacy to say that because consciousness implies a liberation of energy, therefore a liberation of energy implies consciousness. That is not our argument. We contend that the descending scale of liberation of energy from man to lower animals, to plants, to radio-active substances, to chemically active substances, to inert substances, the last possessing at least the energy of gravitation, is nowhere delimited. If this liberation of energy be called consciousness in man, it should be so called throughout all the steps of its descent. We offer a categorical statement of the case as follows :—

1. All the scientifically tenable theories of the nature of the atom describe it as energy or motion. Mass, an assemblage of atoms, is a store of energy.

2. An act of will, from its observed effects or consequences, connotes an addition to the energy involved in a physico-mental-act. This does not, however, contradict the principle of the conservation of energy. A portion of the consciousness-energy has been transformed or transferred; the energy of the system remains the same.

3. This increment of energy is derived from the store of energy which constitutes the organism; is a liberation of stored up energy.

4. Consciousness is a term of wide connotation, embracing the knowledge of the Me as shown in divers forms from man to the lowest grades of animal and plant. It is impossible to fix its exact delimitation.

5. Consciousness has as concomitant the liberation of stored up energy.

6. There are instances in which stored up energy is liberated from inanimate or unconscious matter, so called; that is, liberated without external stimulus.

7. Of different radio-active substances some possess greater power than others to liberate energy, and in chemical reaction there is every gradation of energy liberating power from the most active to the most inert. At the bottom of the scale lies gravity-energy which can be liberated and which is possessed by every substance.

8. There is no delimitation to the degree of external stimulus which may accompany the act of liberation of energy from the consciousness of man to gravitation.

9. It would not seem erroneous, by reason of item 4, to call all cases of liberation of energy, with or without external

stimulus, voluntary acts or acts of will, and to call the synchronous state of the liberating body a state of consciousness.

10. Any body, any aggregate of atoms, which possesses the power voluntarily to liberate stored up energy is animate or conscious. Any aggregate of atoms which does not possess this power is dead.

11. Life is of varying intensity, and the individual is of greater or less complexity. There may be variations or fluctuations of consciousness or life (sleep and waking) in the individual; variations or changes of degree, and more or less permanent in character (chemical change).

12. By virtue of the possession of gravity all matter is living. Gravitation is the lowest and universal form of life, and no matter is absolutely dead. There is no absolute death in nature as we know it.

13. Inquiries into the origin of absolute life have no meaning, except in so far as they may be inquiries into the origin of the entire universe. Inquiries into the origin and characteristics of any particular form of relative life, as well as into the relations between the various forms, are the legitimate field of science.

III.

While the phenomena of consciousness, in our theory, are not separated from those of the physical world, still a distinction is made between subjective and objective phenomena. It has been pointed out that an act of will may be regarded as a liberation of energy; all subjective phenomena may be so regarded; every feeling is a liberation of stored up energy. On the other hand, every objective phenomenon of the physical world is a result of subjective phenomena, a result of liberations of energy. We cannot perceive feelings, or thoughts, or sentiments; we can perceive only their sequelæ which we call objective phenomena. We do not perceive the liberation of energy in a man's act of will or a stone's act of gravitation; we perceive the sequelæ.

On the table is a ball of which we shall disregard all the properties except colour. There is a subjective act, a voluntary liberation of energy, resulting in light falling upon the ball. The light is reflected to the eye and carried to the brain. There have intervened other liberations of energy, for of course it is not meant that the actual light is carried to the brain, but for simplicity we omit consideration of these others. Then in my brain there is a liberation of energy, and the colour of the ball is seen. The objective phenomenon, colour,

is the resultant, the sequela, of two subjective phenomena, two liberations of energy, one in the source of light, the other in my brain. Nor are we assuming two objective phenomena in the usual sense, brain and light-source, to explain one colour ; for they also are the resultants of antecedent or synchronous subjective acts.

The objective phenomenon colour may not be the same for you as for me. For you the colour is the resultant of the subjective acts of the source of light and *your* brain. The liberation of energy in our two brains may be different in degree, so that you see the colour green while I see it red. The same ray of light may fall upon the same ball, and pass to the eye and optic nerve of a third person whose optic ganglion has been atrophied or destroyed. In his brain there will be no liberation of energy, no subjective act, and for him there will be no objective phenomenon, no colour. But even if all three persons were absent the ball would reflect only rays of a definite wave length. The selective process at the surface of the ball, by which some wave lengths are absorbed, others reflected, may be a voluntary liberation of energy in the surface atoms, so that, possibly the ball may be said to have absolute colour ; but even in this case the objective phenomenon is the sequela of at least two subjective acts. If on the other hand the liberation of energy in the light source were such that only those wave lengths absorbed by the ball were sent out, there would be no objective phenomenon, no colour either relative or absolute.

We may next imagine a being, an aggregate of atoms, of any degree of sentience, performing a subjective act for the first time, for the first time liberating stored up energy. The subjective act is followed, let us say, by an objective phenomenon. A second subjective act is performed, a third, and so on indefinitely. The second and following acts may or may not be performed with greater ease than those preceding, but there would seem to be, in general, an increase in facility, or at least no decrease. Greater ease of performance might be called habit or incipient habit, leading with still greater ease of performance to confirmed habit or memory. Thus habit and memory are the results of subjective acts, and may be called subjective states. In the aggregate of atoms objective phenomena, movements, would often accompany the subjective acts, and thus more or less definite habits of body might be formed. There may be a distinction also between ancestral habit and memory, and those of the individual, the former resulting in instinct ; though there would be no sharp line of division between the two types.

The beating of the heart, for example, may be a habit resulting from ancestral liberations of energy extending from *gastraea* to man.

Repetitions of a definite subjective act give rise to a definite memory. Repetitions of many and varied subjective acts, accompanied in general by corresponding objective phenomena, constitute the subjective state, general or absolute memory. Absolute memory is consciousness, and is not, it must be borne in mind, an attribute of so-called living beings only, but is an attribute in greater or less complexity and degree of all things. Absolute memory is the resultant of all individual, ancestral, and ur-ancestral voluntary liberations of stored up energy, and in it are involved three fundamental concepts, space, time, and causation.

Time and space are subjective, not objective. My space and time may be very unlike your space and time; man's space and time are not the space and time of the *amoeba*. The subjective acts which have given rise to absolute memory and the objective phenomena which, in general, accompanied the subjective acts were a succession of events. This is time. Moreover, the subjective acts which have given rise to absolute memory and the corresponding objective phenomena were in many cases simultaneous, not successive, events. This is space. Time and space are subjective states arising from sequence and simultaneity of subjective phenomena. We do not say that space is infinite, that time is eternal. Synchronism and sequence of subjective phenomena do not, it is true, connote a beginning or an end, and, therefore, absolute memory cannot say that space is limited or that time is finite. On the other hand, to the question whether space is absolutely infinite, time absolutely eternal, it can only reply *ignoramus*.

The third component of absolute memory is causation. The subjective acts which give rise to absolute memory possess a third attribute, order. Subjective act A precedes subjective act B, subjective act B follows subjective act A, in the ancestral as well as in the individual act. This constitutes order, the causation of absolute memory. We give causation no teleological significance, it is not *a priori* truth. My causation, my cause and effect, may not be identical with yours. Man's causation is not that of the *amoeba*. Causation is not the same for man to-day as it was a century ago, and need not be the same to-morrow as it is to-day, for other subjective acts may come to be recognised as forming an integral part of any given order.

With this conception of time, space, and causation as the

basic content of absolute memory ; with the conception of absolute memory as the resultant of ceaseless and innumerable individual and ancestral liberations of energy ; with the conception that these characteristics belong, not to man alone, but to all things—with these conceptions we cannot believe that human life, or amoeban life, or even atomic life in its lowest form can be called empty and vain ; nor that a time and space which are the resultant of acts of living, of liberations of energy, can be thought of as “ that in which all things pass away ”. No more can we believe, with Mr. Bertrand Russell, that “ brief and powerless is man's life ; on him and all his race the slow, sure doom falls pitiless and dark [while] omnipotent matter rolls on its relentless way ”. For man is, as are all things else, a part of this omnipotent matter, this energy, in which “ we live and move and have our being ”. For man, as for all things else, there is change, there is evolution or Becoming ; but for man and for all things there is also Being, the Continuity of Becoming.

IV.

We have based our system upon one fundamental idea, the liberation of stored up energy. We have not, however, made any attempt to define energy, nor shall we do so. In this respect, we contend, our system is no weaker than any other. The teleologist bases his system upon a more or less anthropomorphic deity ; the materialist bases his upon matter, or upon matter and motion. The *a priori*, it would seem, must underlie any system, and our *a priori* assumption—or fact, if you will—is energy, the common attribute of all things. It may be true, with modifications it probably is true, that the laws of motion, the principles of mechanics are the generalised and formalised statement of the nature of energy, of the nature of life. In this respect our universe is mechanistic. But we have said with modifications, for our generalised and formalised statement is, beyond a doubt, partial and incomplete. Whether it shall be found when our statement has become full and complete—if it ever so become—that energy is one and unchangeable we do not know. We are led to believe, however, that energy is one and unchangeable. This is not a teleological hope—or fear—it is not an act of faith, for we believe it is based upon evidence.

Science recognises transformations or transferences of energy, and it is true that ours is a universe of becoming, of liberations of stored up energy ; but back of, deeper than all becoming lies being. All things are, as well as all things

become. Being is the continuity of becoming, and it is this that we consider evidential of the unity and unchangeableness of energy.

Being, continuity of becoming, in an aggregate of atoms is individuality, is the ego. In this sense the solar system is an individual composed of other individuals. Man is an individual composed of other individuals, the body cells, each having the attribute continuity of becoming. Discontinuity of becoming means partial death or individual death, but this, as we have pointed out, is not absolute death. Man does not die because a constituent cell has died; the earth does not die because a constituent aggregate of atoms has died; the solar system does not die because a constituent world has died.

When two pieces of iron are welded together, or when copper and zinc are fused, there arises a new individual. When ovum and spermatozoon unite there arises a new individual. Upon cell cleavage, or the division of an amœba, a new individual arises. The new individual may differ in its characteristics in varying degree from the individuals which produce it. In the case of the welded iron, in the case of the fused copper and zinc, in the case of the ovum-spermatozoon union, an external agent, an external store of energy, brought about the production, the birth, of the new individual. When a cell, when an amœba divides, when a radium salt disintegrates, when aphid produces aphid asexually, new individuals arise, are born, without the agency of external stores of energy; ¹ new individuals in varying degree like or unlike those from which they arose. The birth of new individuals is not a uniform process in either the animate or inanimate worlds so called, but in both these realms similar diverse processes prevail. There is no inanimate, as we have said, but a rising sequence of life from the mere possession of gravity to the complexity of man, while through the whole sequence there runs the continuity of becoming.

Continuity of becoming would seem to be implied by the phenomena of becoming, by evolution which deals with becoming, or better which is a generalised and systematised statement of the observed facts of becoming. Evolution makes no statement as to the continuity of becoming except in so far as the particular implies the general. Continuity is the common characteristic of all the observed phenomena

¹This whole matter is relative. Man brings about the union of ovum and spermatozoon, but also spermatozoon actively seeks out ovum. Parthenogenesis in the aphid appears to be contingent upon external heat and light.

of becoming. To argue from becoming in our universe to continuity of becoming does not necessitate arguing from continuity of becoming to the becoming of our universe. All A is B does not imply that all B is A. It follows, therefore, that continuity of becoming still remains even if the interpretation of becoming in our universe, our theory of evolution, be wholly or partly false.

Upon this basis alone rests any mathematical conception of space. The concept of space, arisen from simultaneity of subjective acts ancestral and individual, and practically the same for all men, is three-dimensional and Euclidean. Continuity of becoming may, however, include n-dimensional and Riemannian space. But to argue from this possibility to the possibility that ours is an n-dimensional or a Riemannian space and to believe that it actually is so is an attitude of mind which has been well named mystical.¹ We do not wish to be misunderstood. Our space, the resultant of subjective acts, is three-dimensional and Euclidean. A thousand years from now, fifty years from now, it may be four-dimensional or non-Euclidean. Indeed, if the mathematician assert that his space is now four-dimensional we cannot deny it, though we may be permitted to doubt and to suspect that there has been transferred to science a characteristic of religious belief—mysticism.

Whether we shall call continuity of becoming God or the divine we shall not offer to suggest, for as Bacon says, "It were better to have no opinion of God at all, than such an opinion as is unworthy of Him; for the one is unbelief, the other is contumely". If there be an omnipotent, supreme divinity, identical with or superior to continuity of becoming, it is as independent of mechanistic or scientific argument as it is of teleological and anthropomorphic misrepresentation. The religious instinct is a fact of man's life, is a component of absolute memory, precisely as are the æsthetic instinct, the philosophic and the scientific. Indeed, these instincts—the word seems appropriate enough—are not wholly independent of each other, could not be so if absolute memory be what we consider it to be. It follows, of course, from our conceptions that religion is a growth, an evolution; that it is so is now generally conceded on other grounds and without reference to its origins. As has been said, religions are "the infinitely curious products of man's imagination and of man's reason in its infancy";² and we would add in its maturity. Moreover, if the pietist declare that his religion

¹ *Mysticism in Modern Mathematics*, by Hastings Berkeley.

² *Orpheus: A General History of Religions*, by Salomon Reinach.

is revealed we cannot, with our conception of absolute memory, deny that it is so, any more than we can deny the four-dimensionality of the mathematician's space. But in this case also we may be permitted to doubt without, it is hoped, engendering denunciation and invective.

We describe our system as one of idealistic dualism, but the dualism is not teleological in either the broader or the narrower sense. We have assumed an unknown energy and an unknown ether. If energy or mass (the terms are synonymous) be regarded as "non-matter in motion," we believe there is still dualism in the two conceptions motion and non-matter. The conception non-matter either implies its opposite, matter, or is itself a direct conception which might be called as well matter as non-matter. If, however, we make but the one assumption of energy, or motion, non-matter being absolute emptiness, vacuity, we venture to assert that vacuity is a conception impossible to man's absolute memory. If energy be electro-magnetic, a system based upon positive and negative electricity would be dualistic. If positive electricity be simply a mobile arrangement of negative electrons, we still have the negative electron and its motion; unless we assume motion together with vacuity. Granting the possibility of the conception vacuity in motion, we still have the conceptual dualism of Becoming and Continuity of Becoming.

V.

In general the principles of the theory of relativity are consonant with our system, but some of the conclusions of that theory appear to us to be false. If space and time be, as we have stated, conceptions of simultaneity and sequence of subjective acts, of liberations of energy, it would appear to follow logically that space and time are not independent, and that the laws of their dependence can be mathematically expressed; but the sequence of subjective acts (time) need not, does not, add a fourth dimension to simultaneity of subjective acts, man's space. Nor does it militate against our system that in order to express this dependence a system of non-Euclidean, four-dimensional geometry may be used. This is merely a convenient, though not necessary, mathematical device to express the relations between space and time, and only "mystically" can it be said that space has more than three dimensions. On the other hand, man's present interpretation of phenomena is doubtless incomplete, and the progress of becoming, evolution, may in the future

give rise to a space-time-causation conception in absolute memory very different from that of the present.

The conclusion reached by the relativity theory that the mass of a body is equal to the energy is in agreement with our assumptions concerning energy, and the assumption that absolute mass, that is, mass determined by a person at rest relatively to the body, is known, would seem to be but another way of leaving energy undefined. Possibly absolute mass may be regarded as the energy of a body at rest in free space, free space being absolute simultaneity, simultaneity without sequence of subjective acts in the universe. We fear the idea is inconceivable; space without time. Absolute mass, as we shall presently point out, need not be constant. Its value might perhaps be a maximum under the conditions just adverted to, of rest in free space, and a minimum if the entire cosmos were in motion with the velocity of light. The analogy of the two assumptions of absolute rest and absolute motion, as we may call them, is obvious.

On the other hand, the conclusion that "there is no such thing as the absolute simultaneity of events happening at different places,"¹ seems to be falsely drawn. The statement is based upon the proof that if an observer on a system S has two clocks which mark simultaneity for him, the clocks will not appear simultaneous to an observer on another system S' moving with a velocity v relative to S . But the clocks, it may be remarked, are simultaneous to S and could be made simultaneous to S' , so that both observers have an identical conception of absolute, that is, exact simultaneity. Moreover, all observers would have the same conception of exact simultaneity, a conception which is not vitiated by the impossibility of identical measurement. The sequence and simultaneity of subjective acts and their concomitant objective phenomena are independent of the possibility of absolute measurement of the interval between two events, and independent also of the length and uniformity of the interval.

Man's first clock ticked at sunrise and at sunset, and the unit of time was variable. If we hear a clock chime the hours and quarters the unit is shorter and less variable; still shorter if we listen to the ticking of a clock or watch. We see a man walking in discontinuous steps; we know that there is an interval between two events in cinematograph pictures, although the discontinuity is not perceptible.

¹ *The Theory of Relativity*, by Robert D. Carmichael. See also H. Poincaré, *La Valeur de la Science*. The word absolute has not the same meaning here as in the phrase absolute simultaneity of the preceding paragraph.

Whether the discontinuity lie primarily in the subjective acts, liberations of energy, or in the objective phenomena, in either case from discontinuity of subjective acts, at intervals as small as we please, we arrive by induction at the conception of the continuity of time, let us say of psychological time. Sequence of the objective phenomena which accompany subjective acts may be called physiological time, and is capable of measurement. Even if physiological time be discontinuous and incapable of absolute measurement by an exact and invariable unit, the conception of the continuity of psychological time, and the conception of simultaneity of events are not affected.

To one other conclusion which is sometimes drawn by relativists we are disposed to take some exception. Relativity derives the following formula for l , the longitudinal mass, that is, mass in the direction of motion, of a body moving with a velocity v with respect to a system S,

$$l = \frac{m}{\left(1 - \frac{v^2}{c^2}\right)^{3/2}};$$

where c is the velocity of light, and m the absolute mass of the body. From this formula, or law, the conclusion is drawn that as v approaches the limit c the longitudinal mass approaches infinity, and that, therefore, an infinite force would be required to give a material body the velocity of light. This statement assumes that m , the absolute mass, even if not constant, has always a finite value and continues finite as v approaches c as a limit. But there are cases in which the absolute mass of a body does not remain constant,¹ and it may possibly be true that, as the velocity of a body approaches the velocity of light, the absolute mass of the body approaches zero.

The case in question is when there is impact between two particles which are not perfectly elastic and which, therefore, remain together. The sum of the absolute masses (energy) in these circumstances "would be increased by the heat (or mass) produced by the impact and obtained from the 'kinetic energy' of the relative motion".² It is conceivable that a body acquiring a velocity equal to that of light would have its absolute mass decreased by the heat required to separate its particles; heat given back to the "kinetic energy of the rela-

¹ E. B. Wilson and G. N. Lewis, *The Space-Time Manifold of Relativity*.

² Wilson and Lewis, *loc. cit.*

tive motion". That is to say, there would be a sort of reversal of impact, a tearing apart of the particles of the body, with a corresponding decrease of absolute mass; and in the case of the extreme velocity of light the disruption would be so great as to make the absolute mass infinitely small. Light is, so to speak, the apotheosis of mass or energy. A body moving with the velocity of light would become light, and its absolute mass would be zero. The longitudinal mass (energy) would in that case take the indeterminate form $l = \frac{0}{0}$, which might have, mathematically, any value whatever, and physically, a value to be otherwise determined.

If, however, the absolute mass of a body moving with the velocity of light be not zero but a finite number, it seems worth while to point out that very great velocities may be reached without increasing the longitudinal mass by an enormous amount. If the velocity of the body be nine-tenths the velocity of light, the longitudinal mass becomes about twelve times the absolute mass; if v be ninety-nine one hundredths the velocity of light, the longitudinal mass becomes about 360 times the absolute mass. Thus v must increase from 0 to about 170,000 in order that l should increase from m to $12m$.

We may imagine a nebula in space as being nearly pure light-energy, moving with a velocity very nearly that of light. Its absolute mass might be infinitesimal or finite, and its longitudinal mass, perhaps, infinitesimal also; perhaps infinite. As the velocity of the nebula decreased its absolute mass (energy) would increase, and its longitudinal mass would decrease; until, the velocity having reached the ordinary range of our observations, the nebula would become ordinary mass (energy), a star, that is, a sun, a "dark body," to be again transformed into pure light by some cataclysm. Thus the universe goes on in involution and evolution of energy, while beneath all runs the steady current of continuity of becoming.

To summarise our system we may say, the atom is energy and mass is a store of energy. Energy is life, and to live is to liberate stored up energy, the liberation of energy being a subjective act. Two or more subjective acts give rise to an objective phenomenon. All things are living, the lowest form of life being gravitation. Repeated liberations of energy, ancestral and individual, form or constitute habit, memory and absolute memory, or consciousness, of which the fundamental concepts are space, simultaneity of subjective acts; time, sequence of subjective acts; and causation, order of

subjective acts. Liberation of energy in time, space, and causation is becoming, or evolution; the common characteristic of all phenomena of becoming is continuity. Continuity of becoming in an aggregate of atoms constitutes the individual. The individual may die, but absolute death is not. We do not define energy, we do not explain life; but also we do not personify these ideas. To us they are neither occult nor mystical, but natural, for they are "nature". ~~Mysterious~~ they may be, mysterious and wonderful as all is mysterious and wonderful. Perhaps, however, it is not too much to say that the fullness of life gives us hope that the fullness of time may give knowledge.