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SPACE, TIME AND THE ETHER

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From the cradle to the grave every human experience or thought is wrapped, inextricably locked, in the enigmatic embrace of space and time. In fact, nothing has meaning to us unless so clothed. There is nothing with which man is more familiar, and about which, at the same time, he is more ignorant, baffled or lost in wonderment. Ever since he first turned his face from the clod, this wonderment and bewilderment have persisted. The Ancients were sufficiently intrigued by it to study and philosophize about it. In Plato's Idealism, a solipsistic fallacy in sense perception, space and time were cast in the leading roles. This strange duality—imponderable, intangible, elusive coordinator of our senses—is as close and familiar to us and equally as baffling as the miracle of life itself.

Greek and Roman thought failed to crack the shell of this mystery or throw any new light on the subject, but still it so plagued the intellectuals of Medieval Philosophy that libraries were filled with useless sophistry pertaining to it. It remained finally for Kant to break this miasmic mood of frustration regarding space and time, and with his solution of the problem modern relativity was born. Aside from its specific importance to this article and to relativity, failure to examine Kant's fundamental approach in any discussion of space and time would be an inexcusable oversight indeed. Accordingly, a brief analysis of his immortal contribution to knowledge as given in *Kritik der Reinen Ver-Nunst*, follows in abstract:

Space and time according to him are not objects of the senses; they are a mode of reasoning; they are *a priori* intuitiveness pres-

ent *in* and *before* the mechanism of perception operates; and the two operating factors are the *sensibility* and the *understanding*. In other words, the mind clothes objects with properties of space and time which are functions of reason. Energy, for instance, is the sole objective reality; and as it functions in time and space, or rather, as space and time become its manifest properties, its criteria, its *a priori* intuitiveness, space and time become the most fundamental elements of awareness. Further, as energy is the sole reality and objects in space are but its loci, it becomes obvious that the most fundamental element of awareness of space and time is but tantamount to a most fundamental awareness of reality itself. The usual labels fastened on energy are: *magnitude*, *distance* (space through which it operates), and *duration* (time of that operation), without any regard for the objects themselves, or as if the objects were not there and only their loci existed.

Taking for granted in a general way what Kant says,[1] that knowledge is the common product of sensibility and the understanding wherein sensibility furnishes the understanding with the materials of knowledge, what about the materials (objects) themselves of which the garment, knowledge, is to be made? Are these utterly raw materials, or has something already happened to them? Actually, they are no longer absolutely raw materials; the latter have already been subjected to the preliminary process of spinning and weaving, already have a certain shape. In other words, our sensibility is not purely passive; it does not turn over to the understanding the materials which the latter needs, without adding something of its own; it impresses its stamp, its own form, upon things; or as one might say, it marks the perceived objects just as the outline of our hands is traced upon a handful of snow. It is in particular what the faculty of knowledge is in general—both receptive and active; it receives a mysterious substance from without and *makes* an intuition out of it. Hence there are in every intuition two elements, form and matter—something that reason produces spontaneously, and something, "I know not what," derived elsewhere. (What this *something* is, he characterizes a little later.)

However, as to this *form;* what is it? What are the *a priori* elements which our sensibility does not receive, but draws from

[1] *Kritik*, p. 28

its own nature and adds to each of its intuitions, just as the digestive apparatus adds its juices to the swallowed food in order to transform it into chyle? These *a priori* intuitions, Kant proves, are *space*, the form of the outer sense, and *time*, the form of the inner sense. "Space and time are original intuitions of reason, prior to all experience!" [2] This is the immortal discovery of Kant.

Kant offers a number of proofs to support this view that space and time come from *reason* and not from experience. Only the simplest of these will be given:

Although the infant has no accurate notion of distance, it tends to withdraw from disagreeable objects and to approach such as give it pleasure. Hence, it knows *a priori* that such objects are in front of it, by the side of it, beyond it, etc. Prior to all other intuitions, it has the idea of *before*, *beside*, *beyond*; i.e., the idea of space, of which these are but particular applications. The same is true of time. Prior to all perception, the child has the feeling of *before* and *after*, without which its perceptions would be a confused, disordered, disconnected mass. That is, prior or *a priori* to every other intuition, it has the idea of time. The decisive proof of the a priority of the ideas of space and time is furnished by mathematics. Arithmetic is the science of duration, the successive moments of which constitute number. Geometry is the science of space. Experience does not teach us that two times four is eight, or that the three angles of a triangle equal two right angles; these are truths independent of experience. Experience, always restricted to a limited number of cases, cannot give a truth the absolute and unquestionable character possessed by the axioms of mathematics; these truths are always independent of experience and spring from reason; hence the sovereign authority which characterizes them, and the impossibility of doubting them for a single instant. But such truths, again, are concerned with and wrapped in time and space. Hence time and space, belonging to reason, must be intuitions *a priori*.

Experience, on the other hand, has to do with ideas formed by comparison and abstraction. But any general idea is bound to have fewer characteristics than a particular idea; the idea of man is less comprehensive and poorer than the particular ideas of Thales, Virgil, or Copernicus. On the contrary, how could uni-

[2] *Kritik*, pp. 31–54

versal space contain less than a particular space, or infinite time less than a fixed period of time. The ideas of space and time are, therefore, not the results of an intellectual operation, of the comparison of different spaces, from which the idea of general space is derived; or a comparison of moments of duration whence arises the general idea of time. They are not results but principles, conditions *a priori* and *sine quibus non* of perception. The common man imagines that he perceives space and time; that space and time are, just like their contents, *objects* of perception. But as a matter of fact, it is as impossible for them to be perceived as it is for the eye to see itself. We see all things *in space*, but we cannot see space itself, nor perceive duration independently of its content. All perception presupposes the ideas of space and time; and unless we had these ideas *a priori*, unless reason created them prior to all intuitions, unless they existed as original and inalienable forms, sense-perception could never take place.

Thus we have a simplified picture of the conditions under which sense-perception operates; that it depends on the *a priori* ideas of space and time which are, as it were, the prehensile organs of sensibility. These ideas are not images corresponding to external objects. There is no object called space, nor an object called time; time and space are not *objects* of perception, but *modes* of *perceiving objects*, instinctive habits, inhering in the thinking subject.

Finally, in clarification of what Kant says here, let the reader imagine a flower, red of color and possessing a bouquet. When white light falls on it, all wave-lengths except those corresponding to red are absorbed by the flower; the unabsorbed are reflected and enter the optical equipment, and the sensibility of the intuitive process modifies them, clothes them as it were, before turning them over to the understanding, which leaves the print or perception of red. Similarly, with the bouquet: the volatile molecules (usually an aldehyde, ketone, terpene or ester) diffuse through the air, reach the olfactory equipment, and react chemically with the lipoid nerve tissue; at which point the outer intuitive puts its stamp on the reaction and hands it over in modified, clothed, form to the understanding, which again analyzes, catalogues, prints and records it on the brain as a perception—odor. For the dog, whose equipment is of a different intuitive order, there is no color in the flower: he is destined to spend his life in a world of perpetual

gray, devoid of color. Is the color in the flower? Is the odor in the flower? Certainly not. Both are purely subjective: the wave energy in the light, the chemical energy in the bouquet, are both objective.

Thus, if neither space nor time exists independently of reason and its intuitive activity, then things considered in themselves, and independently of the reason which thinks them, have no existence in space or time; space and time exist for us but not for them.

Hence, if sensibility, in consequence of an instinctive and inevitable habit, shows us things in space and time, it does not show them as they are in themselves, but as they appear to it through its spectacles, one of whose glasses is called time, the other space. As they appear to it! which means that sensibility gives us appearances and that it is incapable of *giving* us the thing in itself (*das dinge ansicht*). And since the understanding obtains the materials which it needs exclusively from the senses, since there is no other channel through which the material can come; it is evident that it always and necessarily operates upon phenomena, and that the mystery concealed beneath the phenomenon forever baffles it, as it forever baffles the senses; true objectivity is forever unknowable!

In consequence of all this, Newtonian space and time as objective, physical realities, vanish; and Relativistic space and time, as subservient to and functions of energy, take over, with the invariant velocity of light as the sole physical constant in the universe, and the electromagnetic energy field, which extends itself at that velocity, as the sole physical reality. All other values and characteristics become relative.

Although the above-given abstracted version is only a meager part of Kant's profound doctrine of space and time, it should suffice to show the part it plays in both subsequent discussions; namely, relativity and the ether. Further, although not specifically germane to this article, as a further consequence of this altered concept of space and time, the longstanding controversy concerning the tenability of space and time as appointments of the spiritual world should be resolved. As long as the old concept prevailed, namely, that space and time existed as real physical objects of the natural world, then of course, they, with all other natural things would vanish with the termination of natural life; but if, as Kant's conclusion teaches, space and time have no existence as things or

objects but are merely modes of perception, existing only in us and because of us, then they would be just as tenable in the spiritual as the natural world—provided a form of objective energy existed, spiritual or other, to actuate them.

Modern Relativity

Relativity is not something new; from the Greeks to the present it has been diligently studied. But it should be clearly understood that modern relativity is something quite apart from all previous concepts. All prior forms were merely *descriptive* and *qualitative* and should be carefully differentiated from the modern form which is *analytic* and *quantitative;* i.e., amenable to measurement. Space and time, in the old sense, no longer exist; in their place a composite exists, made up of a) an energy field intrinsically a part of objects in apparent space, together with b) something that is really within us, subjective, but appears to be (that sense perception tells us is) outside us: objective, e.g., the color and odor of a flower; that is, in which the XYZ coordinates of energy loci give us the geometric space perception, and the integrated record of sequence of change of these coordinates gives us the perception of number, or time. Although this phenomenon was long known, Kant's discovery of the mechanism stands as an everlasting monument to human intellect.

Einstein, chief architect of the structure, although no more than the vicarious creator of the component parts, was a collector of physical concepts who artistically fitted, oriented, and wove into a system the creations of others. Minkowski's "Space Time Continuum," Gauss' "Coordinates," Riemann's "Geometry," Lorentz's "Contraction," Planck's "Quantum," and Heisenberg's "Indetermination Principle" were the six pillars of the structure, the sepulchre of the Ether Theory. Kant's space-time concept was the blueprint, and the Michelson experiment the interment address. It marks the final resting place of several antiquated theories. It is beyond the scope of this article to amplify or discuss the various aspects of the modern theory other than its bearing on the Ether Theory which follows.

The Three Ethers

Ideas of ethers, very tenuous substances, have existed since ancient times. The Greeks thought of light as a very tenuous,

discrete particle given off by the sun. They considered it to be a much finer substance than any of their four elements—earth, air, fire or water—and often used the term for it synonymously with light. During the Middle Ages, the alchemist often termed light, mobile, volatile liquids, alcohols, esters, aldehydes and petroleum distillates, incorrectly as ethers. Although that misnaming carried over until recent times, it is no longer an orthodox, accepted chemical nomenclature. A very definite homologous series of organic compounds comprises the ethers which are dialkyl or diaryl oxides. These are not to be confused with the atmospheric types of the Greeks, Swedenborg, or the Nineteenth Century physicist. Somewhat similar to the Greek type is that of Swedenborg. Utterly different from either of these two is that of the Nineteenth Century physicist. Aside from the fact that Swedenborg could not have known anything about the theory of the Nineteenth Century, it is difficult to see how the two could be confused. In fact, it would require a stretch of the imagination to find any similarity between them. The former is, strictly speaking, an atmosphere (Third Finite) made up of discrete particles capable of *generating* light, heat and electricity under different conditions of motion.

"The central motion of the particles of ether produces not only rigid expansion of every particle, but also heat; if this motion be urged from the centre to the circumferences, it causes light together with heat." [3]

Again: "If they are not spontaneously moved, but put in motion by means of vibration of the parts in any hard body where they are, then also light is produced, and also electricity, so long as the vibration continues." [4]

Never once does he mention his ether as a medium—a conductor of heat, light or electricity. On the other hand, the Nineteenth Century ether was not an atmosphere in any sense but strictly a conducting medium, a carrier *per se* invented for the express purpose of carrying electromagnetic waves and so designed as to accommodate the dispersion and diffraction properties of these waves, about which properties nothing was known in Swedenborg's time.

With all of its inherent fallacies, the Nineteenth Century theory, largely the brain child of Faraday and Maxwell, took quite a hold

[3, 4] *Principia*, p. 601.

on the scientific world and held sway for half a century, even though its promulgators realized it to be a frightening hodge-podge of illogic and were ever apologetic and embarrassed about its incongruity. In order to satisfy requirements of enormous elasticity it had to have a commensurately infinitesimal density; an elasticity quadrillions ($10^{20} \times$ elasticity), and one divided by that number (10^{-20}), of the density of any known substances. It is difficult to understand how a scholar of Maxwell's calibre, who produced the classic Electromagnetic Theory of Light, could have been so far misled into believing electromagnetic waves required a medium in which to be carried. In the light of Relativity and modern knowledge of atomic structure, it is known today that these waves are not only perfectly capable of carrying themselves, but of having properties accounting for their dispersion and diffraction.

In Maxwell's day elasticity was believed to be a property of matter, and atoms were believed to be ultimate, hard, solid, indivisible, impenetrable, isotropic substance of great rigidity. Young's modulus gave, in Hooke's law, a measure of the elasticity in terms of an actual distortion of this solid substance of which the atoms were supposed to be composed. Likewise in dielectric phenomena, this same distortion was thought to occur; the substances of greatest dielectric strength having the greatest rigidity and, therefore, offering the greatest resistance to distortion. Today, with the well-known open structure of atoms, the actual particles, protons, neutrons, electrons, etc., occupying an insignificant part of the space of atomic domain would not be expected to undergo distortion under dielectric or mechanical stress. Eliminating the particles, then there is no other matter within the confines of the atom; the sole other component being the field generated and maintained by the particles occupying this vacuous space. Consequently, under mechanical or dielectric stress, it is the field that is involved; elasticity is a field function independent of matter *per se*. As this knowledge of atomic structure was not available to Maxwell, he erroneously attributed the distortion to something material, just as did Hooke, Young and other contributors to this subject.

Thus, in his classical electromagnetic field transformations, Maxwell, in order to retain something of substantiality, used the

hypothetical ether to supply the necessary rigidity to account for the high elasticity values existing at light frequencies.

At this point, an authoritative statement by Steinmetz might be appropriate:

"The velocity of light has nothing to do with any elastic constants of matter, but is merely a function of the electromagnetic constants of space. Lack of familiarity with the conception of the energy field in space, and familiarity with the conception of matter as the (hypothetical) carrier of energy, may lead to the question: What is the carrier of the field energy in space? Would not the ether be needed as the hypothetical carrier of the field energy? All that we know of the world is derived from the perception of our senses. They are the only real facts; all things else are conclusions from them. All sense perceptions are exclusively energy effects. That is, energy is the only real existing entity, the primary conception, which exists for us because our senses respond to it. All other conceptions are secondary, conclusions from the energy perceptions of our senses. Thus space and time and motion and matter are secondary conceptions with which our mind clothes the events of Nature; that is, the hypothetical cause of our sense perceptions. Electrophysics has been developed successfully to the present high state, and has dealt with alternating currents, voltages and electromagnetic fields, without ever requiring or considering a medium such as the ether. Whatever may be the mechanism of the electromagnetic wave, it certainly is not a mere transverse wave motion of matter, and the light being shown to be a high-frequency electromagnetic wave, cannot be considered any more as a wave motion of the ether. The ether thus vanishes, following the phlogiston and other antiquated concepts."

Thus, even space possesses only dependent reality, and without energy it would not exist at all for us, and all of the properties referred to above belong not to space but to the electromagnetic field itself. Space, then, exists for us as a frame-work imposed on our senses and is characterized and oriented by energy. Matter, likewise, falls in the same bracket as restricted or condensed field, the energy imposing all the characteristic complications of geometry on our senses.

Returning now to Swedenborg, it seems absurd to attempt to defend his ether by identifying it with, or hitching it to, the obsolescent antique of the Nineteenth Century. Far more sensible

would be its union with the Greek, in which the ether *is* the element of light. Then his ether-atmosphere instead of being a *generator* of light and electricity, would be an actinic or electromagnetic atmosphere or field, in harmony with the modern concept; no stigma attaches to an ether deleted of incongruities.

All this to the contrary, there seem to be many still living in the last century who prefer a lingering to an abrupt death. A case in point is the mention (in this journal) of Dirac who wrote an article in 1952 directed ostensibly to keeping the old theory alive. Actually, for the purpose he has in mind, he needs no such properties as those tied to the old theory. Early in this century he originated a theory concerning positive electricity in which he conceived of positive charges as *holes* in an atmosphere resembling the ether. It is quite understandable that he should try to keep alive some semblance to the old ether, but he certainly has no misconceptions of the properties of electromagnetic waves and what they require for transfer. Man's past ignorance of the mechanism of that transfer in no wise lends any validity to a claim for something that never performed its imagined function. This entire attitude toward obsolete theories is rather deplorable because of the taint of wishful thinking; and nothing more nearly epitomizes mediocrity than an attempted wedlock of science and wishful thinking. Like warmed-over food, warmed-over theories are unpalatable. Much more fruitful—particularly for the young, showing aptitude and promise—would be the amplifying or at least the emulating of Swedenborg's endeavors to bring forth new concepts in the innumerable avenues of thought which he opened up and in which he pioneered.

The achievements of relativity, though many, have but scratched the surface of the unknown; we have but reached, as it were, the vestibule of a mighty mansion, and the door stands open! "In My Father's house are many mansions," and this surely is one of them. For herein lie untold treasures; indeed, a veritable paradise for the intellectual in which to roam; a fertile soil in which to plow; where thought, vital and unshackled, may be written on the wind and the mind soar free and untrammeled as a bird on the wing.