Thus the birth of planets must be an integral part of the plan of creation, not a cataclysmic accident resulting from some star or comet flying around at random and happening by chance to come near a sun.

It could be argued that God uses instrumental causes to achieve His ends, and that perhaps stray comets or stars might be used as instruments in the creation of planets. However, in view of the fact that scientists are not agreed even as to any general theory concerning the origin of planets (each theory does not satisfy mathematical or physical laws in some respects), we may as well incline toward those theories that seem to show order and purposefulness in the universe rather than toward those that depend on what appear to be freaks and accidents for the achievement of God's will.

"The philosopher naturally embraces the opinion which seems to him to be the most agreeable to reason, the most resembling visible nature, and which presents the least difficulties. . . . The mind naturally chooses the least difficult path, which it pursues like a traveller in the dark who gropes his way in the direction in which he meets with fewest obstacles" (*Principia,* Part III, Ch. iv).

SOME ASPECTS OF MODERN SCIENCE

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As some of you know, people able in other respects to do so are having difficulty in finding the time to make the studies required to produce articles for the NEW PHILOSOPHY. Yet it can hardly be maintained that either the potential writer or readers are not interested. Within the last two weeks several people have come to me with articles from newspapers and magazines indicating a considerable popular interest in activities going on behind the scenes in science. This is not only an interest in applications of science on every hand but in deeper things that affect the philosophical approach to science.

Specific questions have had to do with the nature of space and time, and what science really teaches about the existence of the ether. Articles referred to are "Science in Review—New Discovery in Physics Promises Light on the Great Paradox of the Cosmos," New York *Times*, January 20, 1957; "Scientists Bare New View of Atom by Disproving 30-Year-Old 'Law,'" The Philadelphia *Inquirer*, January 16, 1957; "Physics: The Magnificent Riddle," Bello, *Fortune*, January 1957; an editorial in *Life* for January 28, 1957 entitled, "A Crisis in Science—New Enigmas in Physics Revive Quests in Metaphysics," together with a short article "A Cherished Law of Physics Gets Repealed."

Plans are underway for the publication in these pages of some studies on space, if not on time; and a contribution on ether is being published in this issue of NEW PHILOSOPHY. It may well be that a knowledge about the preparation of these articles has encouraged some of the questions asked about space, time and ether. As for the newspaper and magazine articles, while other things enter each reference to make it somewhat distinctive, they have one thing in common, namely, they all refer in one way or another to the present questioning in nuclear physics of the so-called law on parity.

I thought that all this interest merits a few remarks on these problems, even if they cannot be solved. If the deeper problems behind the questions are to be solved, there are certain aspects of our approach to them that must be grasped by writers and readers if any progress is to be made; and it is to consider these aspects, rather than the problems themselves, that is the purpose of these remarks. There are four aspects that will be discussed as follows: I) History of science has shown that certain ideas are recurrent at different times. In between times these same ideas are held to be false. II) The present ideas in modern physics, while depending upon experimentation, have their philosophical basis largely in mathematics—especially in the solution of differential equations. III) Some ideas on the practical difficulties of understanding the philosophic problems that result from scientific progress. IV) Some judgments called "boasts" in the history of science that seem to indicate a belief from time to time that final truth—or at least the boundary of knowledge—has been arrived at.

I think that if our readers and our scholars realize how the above aspects are mixed in with all science—in fact, in all human thought—they will be better able to isolate what is significant to philosophical discussion.

I. There is an aspect of science that should be noticed by any one seeking fundamentals for philosophical thought. It is the recurring nature of certain ideas. In between times it is the custom to regard these same ideas with the utmost contempt. Once alchemy was the serious subject of the natural philosopher. Within the memory of any one now over forty, alchemy was beneath the consideration of any serious student. Now the original periodic table of about 90 elements has been expanded to over a thousand nuclides! The transmutation of one nuclide to another has become a common daily event today in research and industry.

The failure of the "law of parity" is another example. Although its history is a short one we cannot go into the details briefly any better than was done in the newspaper articles. An example that has had more numerous ups and downs, and covers a much longer period in history, is spontaneous generation. Ask any scientist today what he thinks of this! We are at present in-between-times on this. Yet even in the *Life* editorial it says:

"One recent experiment, subjecting methane, ammonia, water and hydrogen to artificial lighting, produced four amino acids essential to creating protein and therefore to life, reviving the ancient argument for the 'spontaneous generation' of life. And since everything in this cosmos, living or dead, appears to be composed of the same basic stuff of hydrogen ions, some scientists are arguing the logical likelihood of life of some sort on other planets."

How old is "ancient" meant to be? As recently as 1911 Sewall set forth argument for the possibility of life on planets throughout the universe as follows:

"Arrhenius . . . announces his theory, which he calls *Panspermia,* and which holds that the entire interstellar space is filled with germs of life thrown off from suns or planets in some great collision or combustion, and that these germs, planted by meteoric or other means, have served to introduce the animal and vegetable species into the many existing worlds." (NEW PHILOSOPHY, July 1911, p. 88.)

And, finally, let us consider a small portion of the history of the ether. In 1818 Fresnel held that the ether does not receive the least part of the motion of the earth. Later, in order to explain experimental results obtained by Fizeau and Wilson it was thought that there was a partial drag of the ether in the case of a liquid flowing in a tube. Still later this peculiar state of affairs was treated of by Lorentz as follows:

"Now, as I said, Fresnel supposed the ether not to follow the motion of the earth. The only way this can be understood, is to conceive the earth as impregnated throughout its bulk with ether and as perfectly permeable to it. When we have gone so far as to attribute this property to a body of the size of our planet, we must certainly likewise ascribe it to much smaller bodies, and we must expect that, if water flows through a tube, there is no current of ether. . . ." (*The Theory of Electrons,* H. A. Lorentz, p. 174.)

Lorentz then goes on to account for the experimental results in terms of his electron theory rather than in terms of an ether. However, the Lorentz theory suggested that so called "first order" experiments were inadequate, and that experiments of "second order" accuracy would give results due to motion of the earth through the ether. Such was the nature of the Michelson and Morley experiments. These, however, gave negative results. And so the universal ether theory and the related electron theory had numerous ups and downs during the last part of the 19th century after the Michelson and Morley experiments were begun. It was influenced by such things as the Fitzgerald contraction theory; experiments of Rayleigh and Brace, Trouton and Rankine, Trouton and Noble, Rowland, etc., until finally Einstein avoided the problems of the model theories with his special theory of relativity.

Yet it is idle to say that the concept of the ether is done away with. In an historical consideration of relativity d'Abro says: "However, in the general theory which we shall discuss in the second part of this book we shall find that the ether is reinstated in the guise of the metrical field of space-time." (*The Evolution of Scientific Thought from Newton to Einstein.* Dover, 1950, p. 153.)

And so as recently as in the issue of the *Physical Review* for December 15, 1956, there is an article entitled "Ether Drift and Gravitational Motion."

II) The attitude one must have in any study of the fundamentals of modern science must include a firm grounding in the place mathematics has to play. What is meant by such a statement, for example, as that quantum theory—which essentially involves the solutions of the Schrodinger differential equation—"explains" atomic structure? Again, what is meant by the statement that the field equations explain all the electro-magnetic phenomena (which include optics)?

It is essential to understand that no idea of cause and effect as usually understood is here involved, and that all model ideas, such as can be constructed or pictured by ordinary means, are sacrificed in these "explanations."

As an example consider the difficulty which is raised up so often by people in connection with the relation of relativity and the existence of the ether. It is said that Einstein denies the ether. He does nothing of the sort. It is merely that his theory makes no use of models as such, and all ether theories are model theories. For Einstein, physical laws arise through a consideration of space-time measurements. The mathematical results of these considerations have been subjected to many experimental verifications. This gives support to these mathematical considerations. The point could be made sharper if we could go into relativity somewhat further and consider its application to something other than the propagation of light as illustrated in the Michelson and Morley experiment.

In order to explain a number of experiments before Einstein, the Fitzgerald contraction theory was developed. Briefly, this theory was that a body in motion was foreshortened somewhat along its line of motion. Various known mechanical and electro-magnetic effects known were explained by assuming a *contractile* electron as opposed to a *rigid* one. That is, the foreshortening of a moving electron would cause it to be an ellipsoid rather than a sphere. While such an idea enabled physicists to explain a large number of phenomena otherwise difficult to explain, Einstein accounted for these same phenomena without recourse to any idea of the structure of the electron. Could we say then that he did not believe in the electron?

How this avoidance of a model is possible is given by d'Abro as follows:

"Consider again the FitzGerald contraction. Here Lorentz thought it permissible to apply the transformations; but owing to the slight difference in their significance in his theory, he concluded that a body in motion was really contracted owing to its real motion through the ether. Although the observer carried along with the body could not detect the contraction, yet it was physically real and would be observed by the observer at rest in the ether. A similar interpretation would have to be placed on the slowing down of phenomena. In Lorentz's theory the difficulty consisted in accounting for an identical contraction manifesting itself in exactly the same way for all bodies, soft or hard. Lorentz again appeals to the electronic and atomic constitution of matter and has to take into consideration elastic forces.

"With Einstein the explanation is simple. The contraction is due solely to a modification in our space and time measurements due to relative motion, and is completely irrelevant to the hardness or softness of the body, whose atomic or electronic structure need not be taken into consideration at all. In much the same way an object appears magnified under the microscope, and this magnification is independent of the body's nature.

"In short, the modifications are due to variations (as a result of relative motion) in our space and time measurements and perceptions, and in every case they are irrelevant to the microscopic constitution of matter. We see, then, that so far as all these curious modifications are concerned, Einstein's theory does not require any particular knowledge of the microscopic constitution and hidden mechanisms that are assumed to underlie matter. Herein resides one of the principal advantages of Einstein's theory over that of Lorentz; for we know very little about the mysterious nature of electricity and matter, and were all progress to be arrested until such knowledge was forthcoming, we might have to wait many a day without result." (*Ibid.*, pp. 149–150.)

At the end of his book on relativity, Rainich says:

"It is not asserted that there always exists a theory explaining all the facts, and it is not denied that there may exist at the same time two theories which explain (within the experimental errors) the known facts equally well. Thus neither uniqueness nor existence is claimed for a mathematical theory of physical phenomena. In this respect it differs from the concept of truth held by some people. The question whether there is such a thing as truth—questions of the type What does actually happen? questions about physical reality we do not consider in this book." (Rainich, *Mathematics of Relativity*. New York: Wiley, 1950.)

III) Next I want to treat of the magnitude of the studies necessary in order to grasp the problem of modern science. The case of the ether will be continued to illustrate this point. Already the reader will have some idea of the largeness of the problem from what was given above in the short history. While the emphasis there was on the ups and downs of the universal stagnant ether theory, the emphasis in this section is on the largeness of the problem.

The problem facing the beginner is partially stated as follows by d'Abro:

". . . This method of presentation, by appealing to the propagation of light, is likely to confuse the beginner, who is apt to assume that Einstein postulated the invariant velocity of light as the hypothesis *ad hoc* for the sole purpose of accounting for Michelson's negative experiment, and the critic assumes that could Michelson's experiment be explained in some other way, Einstein's theory would be obviated. This assumption appears all the more natural to the critic as Michelson's experiment is, nine times out of ten, the only negative experiment he is acquainted with. The result is that he assumes Einstein's theory to be nothing but a wild guess grafted on one of those highly delicate experiments where the chances of error are always great. As a matter of fact, by reasoning in this way, the critic loses sight of the entire *raison d'être* of the theory. It is safe to say that even had Michelson's experiment never been performed, Einstein's theory would have been forthcoming just the same (though, of course, had Michelson's experiment given a positive result, enabling us to measure our velocity through the ether, the theory of relativity would have been untenable)." (*Ibid.*, p. 147.)

To expand on the above ether theory as begun by Fresnel is only one half of the problem, as readers of Swedenborg will hasten to observe. What of the theory that the ether is carried with the earth? This theory was advanced to the scientific world by Stokes in 1845. Lorentz states it as follows:

"The theory of Stokes rests on the assumption that the ether surrounding the earth is set in motion by the translation of this body, and that, at every point of the surface of the globe, there is perfect equality of the velocities of the earth and the ether. According to this latter hypothesis, the instruments of an observatory are at rest relatively to the surrounding ether. It is clear that under these circumstances the direction in which a heavenly body is observed must depend on the direction of the waves, such as it is immediately before the light enters our instruments. Now, on account of the supposed motion of the ether, this direction may differ from the direction of the waves at some distance from the earth; this is the reason why the apparent position of the star will be different from the real one." (*Ibid.,* Lorentz, p. 170.)

With these assumptions Lorentz was able to compute aberration of stars as given in textbooks of astronomy. But he also discusses the difficulties with this theory (see *ibid.,* p. 173). One of these difficulties can be overcome, as Lorentz puts it, if we do not shrink from admitting an accumulation of ether around the earth of over 60,000 times as great as the density in celestial space. And d'Abro says:

". . . it would seem strange indeed that this considerable increase in the density of the ether should fail to manifest itself when we compared the results of optical experiments performed on the summit of a high mountain and at sea level." (*Ibid.*, d'Abro, p. 122.)

In a very recent book the authors discuss the possible physical models that have been presented to explain the Michelson and Morley experiment. The first one discussed is as follows:

"Perhaps the student will have wondered why we cannot simply assume that the earth drags the ether with it, much as a moving baseball carries along the air next to it. On this assumption there would never be any motion of the earth through the ether at all, and no difficulties could arise. One objection to this explanation is that the ether next to the earth would then be in motion relative to the ether farther away; and this relative motion between different parts of the ether would cause a deflection of the light rays coming from the stars, just as wind is observed to deflect sound waves. This deflection would alter the amount of the stellar aberration. It was found very difficult to devise a plausible type of motion for the ether which would give a value of the aberration agreeing with observation and yet at the same time preserve the negative result of the Michelson-Morley experiment. A second objection arises from the fact that, as has already been stated, experiments show that a transparent object of laboratory size does not drag the light waves with the full velocity of the moving matter, as it necessarily would do if it *completely* dragged the ether along with it; and the observed *partial* drag is fully accounted for by current electromagnetic theory." (Richtmyer, Kennard, Lauritsen, *Introduction to Modern Physics*. New York; McGraw-Hill, 1955, p. 55.)

The above treatment, while only a part of the story, will serve to indicate that the problem of the ether is not an easy one, and much in the way of a challenge lies before our scholars.

IV) Finally, there is in this so-called "Crisis in Science," and running through the newspaper and magazine articles referred to, an element of encouragement, in that possible results may well counterbalance the anxiety brought about by the potentially evil use of nuclear energy and other practical products of modern science. These results have to do with the possible philosophic outlook. Perhaps our sights may be raised and our horizons widened and deepened. The *Life* editorial puts it this way:

"From the present chaos of science's conceptual universal two facts about it strike the layman as significant. One is that old-fashioned materialism is now even more old-fashioned. Its basic assumption—that the only 'reality' is that which occupies space and has mass—is irrelevant to an age which has proved that matter is interchangeable with energy.

"Second conclusion is that old-fashioned metaphysics, so far from being irrelevant to an age of science, is science's indispensable complement for a full view of life. Physicists acknowledge as much; a current Martin advertisement says their rocket men's shop talk includes 'the physics (and meta physics)' of their work. Metaphysical speculation is becoming fashionable again. Set free of materialism, metaphysics could well become man's chief preoccupation of the next century and may even yield a world wide working consensus on the nature of life and the universe. This metaphysical quest must of course be compatible with the latest proven truths of science, and it is one in which scientists can be useful—but it is not confined to them. It is also a quest for philosophers and laymen and all who feel the challenge of eternal mystery."

The above might appear to the philosopher of the present day as naive because it seems to ignore the history of philosophy and revives from the past a study which Kant and his followers put to sleep, namely, metaphysics. But we are reminded of what happens to basic ideas which were put to sleep in science: alchemy, spontaneous generation, corpuscular theory of light, ether, etc. However, we need not go to these things. We can observe what has happened to Kant's concepts of space and time when viewed from the perspective that was added to geometry by Riemann and Lobachevskii during the nineteenth century.

The history of science shows that each age of new developments is brought to an end, and usually its death is symbolized by a dogmatic boast. The esoteric character of Egyptian science testifies by implication to a state of stagnation and smug complacence that all that could be known was known. A later example is the boast of Archimedes that given a lever and a fulcrum on which to rest it he could move the world. The latter 19th century attitude of certain mechanistic philosophers, that future work in physics would be limited to advancing the accuracy of measurements to another decimal place, is a fairly recent example. Since then science has advanced so rapidly that such boasts are so short lived that the public hardly hears them. During the recent 30's people were heard to say that with quantum theory atomic structure was completely explained. Today it would be more accurate to limit this by saying that quantum theory seems to be a way to systematize, mathematically, the evidence of atomic spectra. The psychological reaction to all this is that no one, although tempted, will wittingly express such a boast. But when the temptation is overpowering, its victim develops a noticeable twinkle in his eye and pushes his tongue visibly into his cheek, as was done recently in a talk I heard by a physicist who expressed the view that practically all fundamental problems of physics would be solved if only we knew the nature of nuclear forces—"in which case," he said, "I don't know what we physicists will do unless we take up biology!"

Swedenborg in his *Principia* uttered the following humorous suggestion while speculating on the diversity of worlds:

"The boastful Archimedes, who talked of moving by his mechanism the world out of its place, were he translated to another system and earth, might perhaps somewhat lower his tone, when he found in those worlds all his skill and ingenuity disappear, and himself at a loss how to apply the common powers of mechanism; for, if he there wished to make any experiments, he would have first to learn the very first principles and rudiments of mechanism; which could be deduced only from the phenomena peculiar to that earth." (II, p. 168.)

That suggestion comes from a suggested translation in space. We have seen that we need not await space rocketry but have only to refer to that translation in time that is ours in the history of thought.

Summary.—In presenting these aspects no solution is pretended. The big question is, do we have the talents, the patience and the interest to face the problems that lie at the basis of a New Church philosophy? We discussed in some detail only the ether. But a similar discussion is possible with regard to such questions as that of "parity" referred to in the current magazine articles, or with respect to cause and effect in modern science, or with respect to the doctrine of actives and passives in particle theories of modern physics, or the relation of relativity to space-time, etc. This is not to mention all that is no doubt possible with regard to biology, anthropology, social science, etc.

These remarks solve nothing. They represent a query. Do the readers of NEW PHILOSOPHY want expositions on these subjects? Do we have scholars who are able to and willing to study for such expositions? Someone recently recited to me all the bibliography that has been written on Swedenborg, the translations made, etc. "Now," he said "what is there for us to do in the next 50 years?" I think that if we can enter seriously into the study of what is basic in the tremendous developments in science in the last few years, even as Swedenborg did in the science of his day as evidenced in his works, our work will be cut out for us. In our readings of the history of science the ups and downs of certain ideas seemed to result often from the alternate acceptance and the subsequent acknowledgment as such such of an *ad hoc* hypotheses. We cannot be sure to avoid the same difficulty but we can be on our guard. Swedenborg, himself, would not wish to be supported by such hypotheses. He says:

"We may consider it as an established fact, that when anyone attains the truth, all experience, both general and particular, will be in his favor, and give him its suffrage; and that all the rules and decisions of rational philosophy will naturally and spontaneously do the same. . . ." (EAK II—217.)