PHILOSOPHICAL NOTES

Materialism and Science. Newton was not a materialist, and yet philosophers have made use of the successes of Newtonian mechanics in physics to strengthen the arguments for materialism in philosophy. This form of monism favors the belief that the ultimate particles of nature governed by deterministic laws such as those associated with Newtonian mechanics are sufficient to explain all that goes on in the universe.

At the time when classical physics was at its zenith, that is at the end of the nineteenth century, this materialism was receiving its greatest support from deterministic mechanics.

What were the ingredients of the classical Newtonian mechanics? And hence also what were the ingredients of materialism? First of all, it was thought that there must be some kind of primordial substance represented by mass particles. Second, it was thought that there must be some activity of these particles. Third, this activity was governed by the laws of mechanics.

This oversimplifies the matter very considerably in at least two respects: First, as to the identity of the primordial elementary particle; that is, whether it could be given a generic name such as atom—of which there were many examples. Or whether the electron and a positive sphere of the J. J. Thomson variety were more fundamental, or whether the electron and the positive nucleus of the Rutherford variety (*circa* 1911), or of the electron-positron-neutron combination (*circa* 1932), etc., as other particles of physics were discovered. Second, as to the sufficiency of Newtonian laws themselves. For example, in the years between the publication of Newton's *Philosophiae Naturalis Principia Mathematica* in 1687 and the year 1900 physics had not stood still. Not only was the enormous amount of empirical knowledge concerning electricity, heat, light, sound—and especially of the electromagnetic spectrum—gained, but also the development of the mathematical theory of fields (Maxwell) as well as other theoretical developments took place during those years.

An important example of other theoretical developments was the formulation of conservation laws. Two of the most important of these laws were: a) the Law of Conservation of Mass, and b) the Law of Conservation of Energy.

Nevertheless, the materialist rested his case on the belief that deterministic laws, whether Newtonian or extended to include Maxwell's field equations—plus the ultimate material mass particles, by whatever name we wish to call them—were sufficient to explain the present state of the universe, its creation, and what goes on in that universe—even life.

In presenting the materialist's position we bypass—as of course he often did as well—the problems of the physicist. The physicist by definition is one who has problems. When the problems of the physical universe are solved the physicist will be out of a job. But in 1900 he was far from being out of a job. It can be parenthetically remarked that today (1964) he realizes that he is still further from that possibility than he was able to realize in 1900. But then as now two main problems were: (1) to bring about a unity—or better a reduction—between Newtonian particle physics and Maxwellian field physics, and (2) to bring about and to understand the relation between the experimental regions in nature where Newtonian mechanics governed and those regions, as in thermodynamics, where statistical mechanics governed.

At any rate in the next few notes let us consider briefly some matters related to this dependence of materialism upon physics. The first of these notes will consider something about the status of the conservation laws at the turn of the century. Then will follow a note or two on "models." If mechanics applies, then the physicist must give numerical measures to mass, distance, and time —all of which implies a picture or model. Balls rolling down inclined planes, or the moon "falling into the earth" represent models to a Galileo or a Newton. By Maxwell's time the problem of fabricating a model to go with such mathematics as his becomes excruciatingly difficult. (Refer to his papers on the ether!) Nevertheless most physicists at the turn of the century were still optimistic about the possibility of success in constructing models. Witness, for example, Rutherford's models of alpha-scattering (1911) and its relatively simple mathematics, and Bohr's atomic model (*i.e.*, of hydrogen, 1913) with its not much more difficult mathematics. But the question that requires explicit answer is this: does the scientist's success in his effort to produce a model for his concepts determine whether or not he can maintain a belief in the reality of these concepts?

Other notes will be added briefly relating two important new theories of twentieth century physics to materialism, namely, quantum mechanics and relativity. This series will conclude with notes of a more general nature, trying to bring biology in particular, and some more general scientific attitudes, into the picture relating science and materialism.

It is not pretended that these notes answer the problems of philosophy associated with monistic materialism. But at least they should indicate that the world in which we live is not as simple as would seem to be the case if such a philosophy represented a true picture of creation, existence, and persistence of the world—not to mention life together with psychological phenomena.

Materialism and Conservation Laws. The Law of Conservation of Matter and the Law of Conservation of Energy were the very substance of nineteenth century physics itself. The success of Newtonian laws relating matter and energy as distinct entities served as the basis of materialism. True, for it happened a number of times, if some physical phenomenon did not seem to be explained by the conservation laws as they were stated, then the laws could be restated so as to include that phenomenon. If for example Rumford and others came to doubt the belief that heat is a substance, called phlogiston, then heat could be regarded as the energy of subtle particles of nature called molecules. Thus heat moved from the province of the law of conservation of matter to that of energy.

In 1900, the discoveries of natural radioactivity, of the electron, and of x-rays were yet to challenge these two laws. They were still supreme. It was at this very time that these laws and the deterministic ideas associated with Newtonian laws outside physics were coming to be regarded as sufficient to explain creation—even that part dealt with in the life sciences!

Thinking based upon this materialism represented an extravagant philosophical conclusion of that period whose consequences have not yet been set aside by people today. Not only did the extrapolation of materialism beyond physics and the objects of study proper to that subject represent an extravagance of thought itself but it also represented an extravagance of another sort. For the philosophical judgment that seemed to say that all is explained by materialism carried with it the absorption into physics of the art of explanation itself. This then was the final judgment of philosophy upon itself—on its death bed it transferred its very soul to science. After this transmigration what remained of philosophy was but a memory of antiquated and outmoded concerns of minds that preceded the wonderful times of modern science. All of the branches of traditional philosophy that might be generally classified as metaphysics, as it was called by a scholar who followed Aristotle, were now for the birds. This would include all of what Swedenborg called rational psychology as well as his cosmology and his physiology that depend upon a First Cause. It is true that during the first five years of this century Einstein was to lay the foundations in relativity and Planck in quantum theory that might lead man's mind away from the materialism of the nineteenth century in physics. But the seeds of that religion of materialism were already sprouting in other fields. In the meantime the experimental findings that have resulted to such an accelerating degree during this century have been so enormous in number that the mind of man has been as yet unable to cope with the problem of trying to understand.

When the conservation laws were readapted—as they had been adapted in the past to accommodate them to new circumstances—they became not two but one law, involving both energy and mass together. One could again say that the universe was an orderly one. And yet what could be said concerning the nature of man's understanding at this stage in the history of thought?

Millikan said:

> Thus we saved, after a fashion, our nineteenth century faces, though the seeking for any kind of mechanical model to carry the enormous subatomic energies released in the radioactive process seems so hopeless that it has ceased to be an interesting diversion in the kindergarten of the physicist. (*Evolution in Science and Religion,* p. 15)

Models. Swedenborg was well aware while writing his *Principia* that to represent his ideas concerning the interiors of nature was at least a difficult if not an impossible task. His words indicate this. The indecisive nature of his drawings indicate this. Can these be blamed merely on poor draftmanship? As his *Principia* progresses he looks for some kind of manifestation to our senses of the activities within the interiors of nature. He finds this in magnetic phenomena. And so a large portion of his work is devoted to magnetism.

And yet it must be clear from the *Principia* itself that in tracing cosmology backwards from gross matter toward the earlier finites one must leave that gross matter somewhere. What then happens to models? Models—even if they are not identical with the thing they represent—must be made of some *thing,* that is, of wood or iron or clay—or perhaps merely marks on paper. This representation must have some *thing* that agrees with the idea represented if indeed it has any claim to being a model. How then can we represent by a model any idea of an immaterial part of creation?

Until early in this century it was unscientific to speak of the immaterial. But two important physical theories of the twentieth century went far to change the ideas people have of what is scientific and what is not. These two theories were the theory of relativity and quantum theory.

Models and God. Before indicating how modern physics has been destructive of the use of models as used in earlier scientific periods and yet at the same time perseveres in a belief in the reality of its "objects" which it cannot picture, let me direct our attention to a related problem: man's idea of God.

In a book which I hope can receive full treatment in a future issue of NEW PHILOSOPHY, Lecomte Du Noüy states:

> Many men who are intelligent and of good faith imagine they cannot believe in God because they are unable to conceive Him. An honest man, endowed with scientific curiosity, should not need to visualize God, any more than a physicist needs to visualize the electron. Any attempt at representation is necessarily crude and false, in both cases. The electron is materially inconceivable and yet, it is more perfectly known through its effects than a simple piece of wood. If we could really conceive God we could no longer believe in Him because our representation, being human, would inspire us with doubts. (*Human Destiny.* New York, 1947. pp. 134–135)

Quantum Mechanics vs. Materialism. Already in these notes in the past we have emphasized the difficulty of representing atomic structure. In the so-called "old quantum theory," following that of the Bohr theory from 1912 to 1926, the atom was pictured in the well-known orbital manner. That is, it was pictured as composed of a nucleus about which the electrons revolved in orbits.

While this theory was originally invented by Bohr in an effort to "explain" the origin of the hydrogen spectrum, it could not be adapted to explain atomic spectra in general. When the "new" quantum theory of Heisenberg and Schroedinger was developed from 1926 on, this orbital model was discarded. What was substituted? In one of Edward Teller's books he has a diagram showing the nucleus with orbital electrons—a figure so well-known now that it is even used in advertising. Under this picture Teller has added the caption "This is how an atom does *not* look."

Since 1926 neither Teller nor anyone else has published a picture of how the atom does look. Evidently if the material or substance that composes the atom is fixed at all in space or time, this phenomenon in no way has made itself known in experiments. There are good theoretical reasons, bordering on the verge of certainty, that such a phenomenon will never become observable.

And yet what would modern physics be without the electron or the atom? Here are two "objects" that cannot be observed although their effects are legion in number, not only in the physical laboratory constructed for the very purpose of observing these effects, but also in the multitude of practical applications to which these two objects are put.

If these two objects present as to their superficial aspects such mystery as to defy a model representation of them, what can be said of those "things" which constitute the nucleus of the atom or of the structure of the electron itself?

The positivist who identifies knowledge with empirical knowledge has had his day. No scientist today would be limited in his studies to "observable" entities—even extending "observable" to include that which can be sensed by instrumentation.

But throughout this change in the way in which man has come to think about nature, what has happened to his feeling for a desire to represent what he is talking about by means of physical stuff: wood, iron, clay—or even just some pencil carbon traced out on a piece of paper? What has happened to the scientific tenet associated with what is "observable"?

What happens to the condemnation of efforts of the past to describe the how and the why and the connectedness of things in the present scientific period when its workers are crying out for more "imagination," "inventiveness," "intuition"?

What are these things that defy the effort to represent by models that which cannot be so represented? Are they real? Are they material or are they immaterial?

Relativity vs. Materialism. Just as this century was getting under way Einstein derived the formula

$$E = mc^2$$

as a consequence of relativity. In this formula E stands for energy, m for mass and c for the velocity of light. Although this formula was about a quarter of a century old by 1927, it was not yet known to the general public—being buried still in the then esoteric volumes of physics. It required the terrible incident of Hiroshima some seventeen years later to make this formula almost commonplace in everyday conversation.

Although the nuclear bomb was not developed until years later, physicists understood the possibilities that were implied by the formula when Millikan wrote in 1927. He said,

> This equation seems now to have the best of experimental credentials. If it is a correct one, it means that matter itself in the Newtonian sense, the quantitative measure of which is mass or inertia, has entirely disappeared as a distinct and separate entity, as an invariant property of any system. In other words, matter may be annihilated, radiant energy appearing in its place; and in view of the enormous value of the factor 9×10^{20}, a very small number of grams of matter may transform themselves into a stupendous number of ergs of energy. (*Evolution in Science and Religion.* p. 16)

To contrast this new idea with the thinking of the nineteenth century Millikan says,

> But what a shock it would be to Lord Kelvin if he should hear the modern astronomers talking about the stars radiating away their masses through the mere act of giving off light and heat! And yet this is now orthodox astronomy. (*ibid.* p. 17)

What sort of a picture can one make to illustrate this exchange between mass and energy? Energy is manifest when a mass has an apparent motion. A mass is evident either when in relative motion or apparently at rest. What sort of a picture can one make that relates energy and mass to equate these two things? Evidently science has concerned itself already in mechanics with objects that cannot be represented by means of models.

Religion and Rational Scientific Thought. The review of Millikan's book has led me to bring in a rather long series of notes relating religion, philosophy, and science. It appears that if one tries to see how things are connected, as Millikan appeared to try, one is necessarily led into each of these fields.

I cannot help at this point quoting again from Lecomte Du Noüy's *Human Destiny*. In this he says,

Two different paths may eventually lead to the comprehension of man. The first, revelation, is a direct road, but it is closed to a great many people and independent of rational thought. Those who can make use of it are fortunate. The second, on the contrary, is strictly rational and scientific. . . . This method requires a description of the universe as it is perceived and conceived by the human brain. . . . Unfortunately, we must take into account the fact that this picture is constructed *by the mind,* and that as a consequence it is dependent on the structure of the brain, on the sense system which puts us in contact with the outside world, and on the logical mechanisms which are at the base of the interpretations of direct sensorial observations. (p. 1)

Swedenborg writing just two hundred years earlier than Du Noüy said,

I grant this: nor would I persuade anyone who comprehends these high truths by faith, to attempt to comprehend them by his intellect; let him abstain from my books. Whoso believes revelation implicitly, without consulting the intellect, is the happiest of mortals, the nearest to heaven, and at once a native of both worlds. But these pages of mine are written with a view to those only, who never believe anything but what they can receive with the intellect. . . . (*Animal Kingdom,* no. 22)

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