Theological Resources from the Physical Sciences

CAN PHYSICS CONTRIBUTE TO THEOLOGY?

by Sanborn C. Brown

Perhaps the most spectacular development in recent history has been the truly amazing rise of the importance of science, and the effect it is having on every facet of human life. No less amazing, particularly to the scientist, is the equally spectacular lack of understanding of the scientific endeavor which the non-scientist not only exhibits but seems to revel in.

A present-day educated man would be disdainfully scornful of anyone who knew nothing of the writings of Dante or Homer, the paintings of El Greco or Renoir, or the music of Telemann or Verdi. Yet, this same man is heard to brag that he never could pass elementary physics and that high-school biology made him sick at his stomach.

The intellectual of the future not only will know something of science but will be so attuned to its intellectual discipline that he can use its relevant teachings to make progress in his own field of learning. We are gathered together here not to look backward or even at the present but forward to the future to try to plot a course for theology in the modern idiom—to search for the relevancy of all aspects of the modern world to the highest aspirations and goals toward which men strive.

Specifically what I want to address my remarks to is the thesis that theologians have much to learn from the methodology and intellectual

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discipline of the scientist. In my opinion a knowledge of the intellectual procedures in common use by a research physicist in his search for the organization of the universe is far from irrelevant in developing a modern epistemology for theology.

Since I am a physicist, I am going to draw my examples from this science I know best. But so that there is no misunderstanding, from the very beginning let me state in unequivocal terms that I do not intend to discuss how knowledge of the subject matter of physics in general can be carried over to the great problems of either theology or religion. There are, of course, some great physical principles which do have deep philosophic implications, but these I am not going to talk about since the scholarly literature is full of their descriptions: relativity, the uncertainty principle, the laws of thermodynamics, quantum mechanics, and so on.

Rather, I want to focus our attention on the methodology of science, how it is employed in building up an intellectual structure we term scientific knowledge, and how relevant it should be to other learned disciplines which at present seem to reject it.

The intellectual discipline of science is not unique in its operation; and to emphasize this point, let me point out its similarity to the acquisition of knowledge in other fields. The development of knowledge can be differentiated in three phases: phase 1, the acquiring of facts and basic concepts; phase 2, the application of these facts and basic concepts to skills for extending the boundaries of the discipline; and phase 3, the deep penetration into the fundamentals which produce a basic understanding of the interrelationships of the knowledge and facts which lead to further implications of this knowledge.

Surely these three phases are typical of many branches of human endeavor, and let me draw a couple of illustrations from the humanities. Take, for example, the study of language. Phase 1 consists of learning the words and grammar, phase 2 of applying this learning to reading and writing. Here we have the tools for communication and for acquiring further knowledge. But the real essence of the value of language does not come until phase 3, where prose and poetry are brought to bear on man's character, his hopes, his aspirations, his loves, his hates, and the whole gamut of his emotions.

To take another case, this time let me chose from the field of art. In phase 1 a man must learn the use of materials and media, the paint, the brush, the chisel, the canvas, the metal, or the stone. In phase 2 one learns to form the drawings, to put the paints together, to express one's art form in a unified whole. However, we do not recognize

phase 2 as real art. It is not until the human aspect or emotions are transferred to the canvas or the bronze that we reach phase 3, and something of real value has been contributed.

Science has the same three phases. Phase 1 contains the collection of facts, the laws and postulates, the mathematical models and formulations, the array of basic building blocks, the strange language and tools which so frighten the non-scientist. Phase 2 involves the application of this knowledge to the extension of knowledge and to the technologically useful devices which the layman often confuses with science itself. But not until phase 3 does the scientist reach the appreciation of the understanding of nature, its unity and its beauty, as well as its impact on lives and emotions of modern man.

Am I implying by this that the discipline in science cannot be basically differentiated from that of art or language? And the answer is, of course, "No." But I am suggesting that the difference does not lie in the mechanisms of acquiring knowledge but, rather, that the characteristic which sets the scientific discipline apart from other fields of intellectual endeavor is its particular set of criteria of relevancy and credibility.

A scientist does not know what truth is. But he has developed a remarkably successful attitude of mind which allows him to reach a consensus of agreement with his peers, to test what is acceptable and applicable as an explanation for the nature of the phenomena of human experience and what is unacceptable. One of the difficulties of following the course of scientific development in a historical sense is that the agreed criteria of credibility change as a science develops. For example, one of the historical results of using the concept of order and predictability as a basic argument of credibility led the ancients to the concept that self-consistency could serve as a basis for truth in the scientific sense. But anyone who has studied the emergence and decline of the formalism of Greek logic, which was based on the self-consistency of hypothesis and conclusion, knows that this whole formalism has not proved sufficient as an over-all methodology in science. Recognition of the necessity for change in the criteria of credibility is an inherent feature of scientific methodology, and an understanding of its operation is fundamental to the appreciation of science. In the historical perspective, theologies also change their criteria of credibility, so this in itself is not a fundamental epistemological difference between science and theology. It is in the area of validation that a real difference appears.

To be specific, let me outline briefly the basic operation of the

scientific approach to gaining knowledge. The scientist collects the basic facts in the field he wishes to study and then creates an intellectual model to explain all the facts and predict further facts to be looked for as well. This is often called the process of forming a hypothesis. However, the term "hypothesis" has come to be used in too narrow a sense, and the word "model" seems now more adequate. The model is the whole picture, the hypothesis is the guess in a particular area.

After a model has been put together, the scientist must test its credibility in every way that his imagination can suggest to him. First, a model must agree with the experimental facts to a sufficient accuracy to differentiate an acceptable model from an unacceptable one. No agreement is perfect since no model or experiment is perfect. Disagreement may mean an imperfect model or an imperfect experiment, and the research scientist in general does not know which is the case. In very refined models (theories of long standing, tested at many points), the necessary accuracy for credibility may require a precision of one part in many millions, whereas for new models (new concepts in the first exciting stages of emergence), agreement within a factor of ten may winnow the wheat from the chaff, opening new vistas of understanding the operation of nature. Thus, when we say a model must be tested and found to agree with the operations of nature as we find them, we have no absolute criteria in mind. For credibility, observations need only agree with a particular model insofar as they differentiate the acceptable model from the unacceptable one. This leads to the obvious result that sometimes there are two different models, and at the same time they can explain with similar adequacy most of the known facts. The caloric and energy theory of heat and the duality of the nature of light are two classic examples in physics of two acceptable models of the nature of heat and light, both of which were simultaneously useful for generations.

Model-making as I have described it for science is by no means unique to these disciplines. The searching for truth in theology can be cast in the same mold. In theology also we can set up a model and validate the credibility of what we believe to be true in terms of agreement or disagreement with the model.

Let me illustrate by taking the case within the Christian tradition of the authority of the Bible. We do not have to believe that the Bible is an accurate history, by today's standards, to appreciate that it records the searching, the striving, the failing, the sinning, the hoping, the struggling, and the thinking over a thousand years by a people in our particular cultural background, represented and symbolized for our

consideration. Here is a testimony to a people who survived about as much travail and anguish as any people could be asked to submit to in any given thousand years. But it is more than survival, it is survival with a development of thought and quality of being, a chronicle of an ethical development, and an enlarging sensitivity to the essential interrelatedness of life. The Bible is a document which, in symbolic form, testifies to the survival and qualitative growth of a people despite the worst that could be done to them. Here, then, is a range of criteria for judgment, the testimony of a culture that weathered the "hell and high water" of history. It is a model by which to test the criteria of credibility in theology as surely as the similar procedure in science.

I hope none of you believes for a minute that by this discussion I am trying to persuade you that the specifics in the methodologies of science and theology can be made the same. Not at all. What I have tried to suggest, rather, is that there are enough similarities in the intellectual approach in the two disciplines so that it is not inconceivable that the scientists might be able to offer some interesting methodological avenues of approach for the theologian to consider in his work within his own discipline.

Let me now point out a few of the most productive tools which a physicist uses in defining his theories of nature so that they apply to the physical world and generate viable solutions which may be applied to real and not just to hypothetical cases.

One of the most important criteria for a valid theory is that not only must it agree with data within the limits of observation but it must predict sensible results everywhere. This is known technically as the requirement of boundary conditions, and in most physical problems the boundaries are really at the limits of zero and infinity.

Let me take an illustration of this from cosmology. The processes going on in the stars, the sources of their heat, what makes them expand and contract, and how they are constituted in detail can be explained in many ways, and since stars and galaxies are not subject to man's experimentation and manipulation, for many years cosmology was a highly speculative and, in the strict sense of the word, unscientific science. In the steady state, in the here and now, there appeared to be no acceptable criterion for the credibility of any particular model. As boundary-value problems came to be recognized more and more in the scientific world as a powerful tool in suggesting ways to validate a theory, cosmologists turned to testing conflicting models by extrapolating time to zero and infinity. The requirement, in testing the details

of stellar evolutionary theory, to include both the birth and the death of a star or a nebula has proved to be a most powerful guide in sorting out the true from the false, the possible from the impossible. More progress has been made in this area since it was reduced to a boundary-value problem than was ever made considering it in the steady state.

So, why not apply this method to theology? Now, of course, I could have chosen many examples, but I picked the cosmological development because in a way it is so parallel to the case of the theology of man. Here and now, man as he is and has been since the dawn of recorded history is essentially in a steady state, and theologies explaining his goals and purposes are many but lack anything like universal credibility in terms of today's criteria.

Let me try to persuade the theologians among you to apply the boundary conditions. The biological evolution of man is common knowledge. Are your theological theories valid for man as he first emerged? The thermodynamicists and the biologists can predict for you with considerable accuracy when our solar system will have cooled off to a point in time when man will no longer be able to exist on earth. You must define man's goals and the purpose of his existence to cover that inevitable tragedy as well.

Usually, when we think of the heat death of the universe, we say to ourselves, "But that is so many millions of years away that it is unprofitable to spend our time worrying about that when we have so many more pressing problems of the present to be solved first." If you are saying that now, you have missed my main point. What the methodology of science tells us is not only that a solution is assured by requiring consistency and validity at the boundaries but that some of the most difficult problems have been solved only by worrying more about the extremes in time than about the present. Look to the boundary-value solutions and you may well make more progress toward an ultimate theology for the present. As a matter of fact, you theologians have already used this principle in the context of more primitive cosmologies when you developed your pictures of "in the beginning" and "the end of the world." Your task now is credibility in the twentieth-century imagery.

Let me now change my direction radically to point out another example of an area of methodology in physics which might have useful suggestions to the theologian of the future. Physics of the nineteenth century concentrated on measuring every physical parameter and quantity with ever increasing precision. Physicists so concentrated on this aspect of the subject that the reputation of the profession was synony-

mous with the highest accuracy in every detail of every particle measured. A twentieth-century physicist, however, finds more and more that the interesting problems of nature that are to be studied are statistically random phenomena where not only would the older method of attention to every element no longer be profitable but where to deal with the details of each particle would actually prevent arrival at a solution.

A good illustration of this approach is found in studies of the plasma state of matter where atoms are stripped of their electrons and the ions and electrons dance around in random motion as in the case of a gas in a neon sign, or in the sun, or throughout interstellar space. For years physicists tried to make sense out of the behavior of this fluid by accounting for the motion of each electron and ion, calculating the result of every collision and the individual forces affecting each particle. Always the answer was the same—it was valid only in special cases and in narrow regions of the values of the controlling parameters.

And then there emerged a new method for dealing with this whole area of nature. Instead of considering the detailed behavior of any particle, the whole fluid was treated as a statistical ensemble of particles adding up the effects of all the particles at once over all the possible variations and functional behaviors. And suddenly the new statistical model became credible, theory and observation agreed, and new progress in understanding was achieved. And most important, by closing one's eyes to the behavior of the individual and treating the vast collection of particles as a statistically fluctuating continuum, the behavior of the individual entities became explained with much greater precision and understanding.

I hope that it is obvious that I have tried to couch this discussion of a fairly difficult problem on the forefront of research physics in a way that will be suggestive to the theologian. Certainly it is ridiculous to suggest that the mathematical operations which led to success in the physical problem would have any relevance to a similar theological problem. That is not at all what I am suggesting but, rather, that the theologian might find it profitable to study the philosophic shift in the epistemology underlying this demonstrated success in going from an attempt to understand the result of all the forces acting on an individual to treating the problem as a whole characterized by a statistically fluctuating ensemble.

Now some of you may be saying, "It is all very well for you to talk of atoms and electrons as statistical fluctuations. But we are dealing with human individuals. The goals and purposes of each man are as impor-

tant as those of the next. You cannot reduce the dignity of man to statistical fluctuations."

If you are thinking such thoughts, I again have failed to make myself clear, because the real lesson to be learned from this example of physical methodology is that by dealing with the problem as a whole we understand better the nature of the individual, better even than we did by concentrating on the individual alone.

Let me now start to draw this talk to a close by reviewing the concepts I have been trying to explain.

I have not sought to relate the specific subject matter of physics to specific problems of theology. A science of inanimate nature does not tell us about the goals and purpose of life in the way the life and behavioral sciences do. On the other hand, the operation of the enterprise of physics, the intellectual structure and methodology by which physicists create their models and try to validate their conclusions, should be looked into carefully by the theologians. I have picked only two examples of many obvious cases where a sophisticated understanding of the methods of physics might well be helpful in forming epistemological guidelines for theological progress. I have tried to emphasize the fact that it is not the subject matter—the facts or the mathematics—of science that I am urging the theologian to take time really to understand but that the intellectual point of view, the methodological manner of proceeding in the validation of theories and hypotheses, should be an integral part of the training of every future theologian.

We are gathered here today to mark the initiation of what we all hope and confidently expect will be an exciting direction for a theological school to travel. The development of modern theologians and religious beliefs or concepts adequate for guiding human behavior in the coming scientific age is an absolute necessity, and all of us from every intellectual discipline must bring to bear our applicable methodologies to this deepest of all problems, the "logos of theos."