

Experimental Science

❧ THE Great Conversation began before the beginnings of experimental science. But the birth of the Conversation and the birth of science were simultaneous. The earliest of the pre-Socratics were investigating and seeking to understand natural phenomena; among them were men who used mathematical notions for this purpose. Even experimentation is not new; it has been going on for hundreds of years. But faith in the experiment as an exclusive method is a modern manifestation. The experimental method has won such clear and convincing victories that it is now regarded in some quarters not only as the sole method of building up scientific knowledge, but also as the sole method of obtaining knowledge of any kind.

Thus we are often told that any question that is not answerable by the empirical methods of science is not really answerable at all, or at least not by significant and verifiable

statements. Exceptions may be made with regard to the kinds of questions mathematicians or logicians answer by their methods. But all other questions must be submitted to the methods of experimental research or empirical inquiry.

If they are not answerable by these methods, they are the sort of questions that should never have been asked in the first place. At best they are questions we can answer only by guesswork or conjecture; at worst they are meaningless or, as the saying goes, nonsensical questions. Genuinely significant problems, in contrast, get their meaning in large part from the scientific operations of observation, experiment, and measurement by which they can be solved; and the solutions, when discovered by these methods, are better than guesswork or opinion. They are supported by fact. They have been tested and are subject to further verification.

We are told furthermore that the best answers we can obtain by the scientific method are never more than probable. We must free ourselves, therefore, from the illusion that, outside of mathematics and logic, we can attain necessary and certain truth. Statements that are not mathematical or logical formulae may look as if they were necessarily or certainly true, but they only look like that. They cannot really be either necessary or certain. In addition, if they have not been subjected to empirical verification, they are, far from being necessarily true, not even established as probable. Such statements can be accepted provisionally, as working assumptions or hypotheses, if they are acceptable at all. Perhaps it is better, unless circumstances compel us to take another course, not to accept such statements at all.

Consider, for example, statements about God's existence or the immortality of the soul. These are answers to questions that cannot be answered—one way or the other—by the experimental method. If that is the only method by which probable and verifiable knowledge is attainable, we are de-

barred from having knowledge about God's existence or the immortality of the soul. If modern man, accepting the view that he can claim to know only what can be demonstrated by experiment or verified by empirical research, still wishes to believe in these things, he must acknowledge that he does so by religious faith or by the exercise of his will to believe; and he must be prepared to be regarded in certain quarters as hopelessly superstitious.

It is sometimes admitted that many propositions that are affirmed by intelligent people, such as that democracy is the best form of government or that world peace depends upon world government, cannot be tested by the method of experimental science. But it is suggested that this is simply because the method is still not fully developed. When our use of the method matures, we shall find out how to employ it in answering every genuine question.

Since many propositions in the Great Conversation have not been arrived at by experiment or have not been submitted to empirical verification, we often hear that the Conversation, though perhaps interesting to the antiquarian as setting forth the bizarre superstitions entertained by "thinkers" before the dawn of experimental science, can have no relevance for us now, when experimental science and its methods have at last revealed these superstitions for what they are. We are urged to abandon the reactionary notion that the earlier voices in the Conversation are even now saying something worth listening to, and supplicated to place our trust in the experimental method as the only source of valid or verifiable answers to questions of every sort.

One voice in the Great Conversation itself announces this modern point of view. In the closing paragraph of his *Enquiry Concerning Human Understanding*, David Hume writes: "When we run over libraries, persuaded of these principles, what havoc must we make? If we take in our hand any volume

. . . let us ask, *Does it contain any abstract reasoning concerning quantity or number?* No. *Does it contain any experimental reasoning concerning matter of fact and existence?* No. Commit it then to the flames: for it can contain nothing but sophistry and illusion."

The books that Hume and his followers, the positivists of our own day, would commit to burning or, what is the same, to dismissal from serious consideration, do not reflect ignorance or neglect of Hume's principles. Those books, written after as well as before Hume, argue the case against the kind of positivism that asserts that everything except mathematics and experimental science is sophistry and illusion. They state and defend propositions quite opposite to those of Hume.

The Great Conversation, in short, contains both sides of the issue that in modern times is thought to have a most critical bearing on the significance of the Great Conversation itself. Only an unashamed dogmatist would dare to assert that the issue has been finally resolved now in favor of the view that, outside of logic or mathematics, the method of modern science is the *only* method to employ in seeking knowledge. The dogmatist who made this assertion would have to be more than unashamed. He would have to blind himself to the fact that his own assertion was not established by the experimental method, nor made as an indisputable conclusion of mathematical reasoning or of purely logical analysis.

With regard to this issue about the scientific method, which has become central in our own day, the contrary claim is not made for the Great Conversation. It would be equally dogmatic to assert that the issue has been resolved in favor of the opposite point of view. What can be justly claimed, however, is that the great books ably present both sides of the issue and throw light on aspects of it that are darkly as well as dogmatically treated in contemporary discussion.

They raise the question for us of what is meant by science

and the scientific method. If all that is meant is that a scientist is honest and careful and precise, and that he weighs all the evidence with discrimination before he pronounces judgment, then we can agree that the scientific method is the only method of reaching and testing the truth in any field. But this conception of the scientific method is so broad as to include the methods used by competent historians, philosophers, and theologians since the beginning of time; and it is not helpful, indeed it is seriously misleading, to name a method used in all fields after one of them.

Sometimes the scientific method seems to mean that we must pay attention to the facts, which carries with it the suggestion that those who do not believe that the method of experimental science is appropriate to every other field of inquiry do not pay attention to the facts and are therefore remote from reality. The great books show, on the contrary, that even those thinkers of the past who are now often looked upon as the most reactionary, the medieval theologians, insisted, as Aristotle had before them, that the truth of any statement is its conformity to reality or fact, and that sense-experience is required to discover the particular matters of fact that test the truth of general statements about the nature of things.

"In the knowledge of nature," Aristotle writes, the test of principles "is the unimpeachable evidence of the senses as to each fact." He holds that "lack of experience diminishes our power of taking a comprehensive view of the admitted facts. Hence those who dwell in intimate association with nature and its phenomena grow more and more able to formulate, as the foundation of their theories, principles such as to admit of a wide and coherent development; while those whom devotion to abstract discussions has rendered unobservant of the facts are too ready to dogmatize on the basis of a few observations." Theories should be credited, Aristotle insists,

"only if what they affirm agrees with the observed facts." Centuries later, an experimental physiologist such as William Harvey says neither more nor less when he declares that "to test whether anything has been well or ill advanced, to ascertain whether some falsehood does not lurk under a proposition, it is imperative on us to bring it to the proof of sense, and to admit or reject it on the decision of sense."

To proclaim the necessity of observing the facts, and all the facts, is not to say, however, that merely collecting facts will solve a problem of any kind. The facts are indispensable; they are not sufficient. To solve a problem it is necessary to think. It is necessary to think even to decide what facts to collect. Even the experimental scientist cannot avoid being a liberal artist, and the best of them, as the great books show, are men of imagination and of theory as well as patient observers of particular facts. Those who have condemned thinkers who have insisted on the importance of ideas have often overlooked the equal insistence of these writers on obtaining the facts. These critics have themselves frequently misunderstood the scientific method and have confused it with the aimless accumulation of data.

When the various meanings of science and the scientific method are distinguished and clarified, the issue remains whether the method associated with experimental science, as that has developed in modern times, is the only method of seeking the truth about what really exists or about what men and societies should do. As already pointed out, both sides of this issue are taken and argued in the Great Conversation. But the great books do more than that. They afford us the best examples of man's efforts to seek the truth, both about the nature of things and about human conduct, by methods other than those of experimental science; and because these examples are presented in the context of equally striking examples of man's efforts to learn by experiment or the

uniformities of behavior under identical conditions, we are justified in concluding that if we know the conditions are identical, which is possible only in the laboratory, and if we know that the number of units under examination is large enough, then probably such uniformities of behavior as we detect will recur under identical conditions.

The griefs and losses sustained by those social scientists who predict the outcome of horse races and presidential elections are sufficient to indicate the difficulties of their subject. No one would propose that the social scientists should not keep on trying. The more refined and complete our knowledge of society, the better off we shall be. But it would be helpful to the social scientists if they recognized that in understanding human beings, who often cannot be subjected to experiment in the laboratory like guinea pigs and atoms, the method of experimental science cannot, in the nature of things, produce results that can compare with those which science achieves in dealing with matters more susceptible to experimentation.

One eminent social scientist, Professor Robert Redfield, has suggested that his colleagues consider their relation to the humanities as well as to the natural sciences. "The imitation of the physical and biological sciences," he says, "has proceeded to a point where the fullest development of social science is hampered." Identification with the natural sciences shelters the social scientist "from a stimulation from philosophy and the arts and literature which social science needs . . . The stimulation which the social scientists can gain from the humanities can come from the arts and literature themselves, and through an understanding of some of the problems which interest philosophers and the more imaginative students of the creative productions of mankind."

According to Professor Redfield, the bond that links the social scientist and the humanist is their common subject

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matter. "Humanity," he says, "is the common subject-matter of those who look at men as they are represented in books or works of art, and of those who look at men as they appear in institutions and in directly visible action. It is the central and essential matter of interest to social scientist and humanist alike." Though they differ in their methods, they "share a common effort, a common interest"; and Redfield adds, "it may be doubted if the results so far achieved by the social scientists are more communicative of the truth about human nature than are the results achieved by the more personal and imaginative methods of the artist."

We should remember such sound advice when we are urged to abandon methods that have yielded important insights in favor of one that will doubtless be helpful, but may not be able to tell us everything we need to know. It may be unwise to reject the sources of wisdom that have been traditionally found in history, philosophy, and the arts. These disciplines do not give us mathematical knowledge or knowledge acquired in the laboratory, but to say that for these reasons what they give us is not knowledge in any sense is to disregard the facts and to put the world of knowable things in a dogmatic strait jacket.

The rise of experimental science has not made the Great Conversation irrelevant. Experimental science is a part of the Conversation. As Étienne Gilson has remarked, "our science is a part of our humanism" as "the science of Pericles' time was a part of Greek humanism." Science is itself part of the Great Conversation. In the Conversation we find science raising issues about knowledge and reality. In the light of the Conversation we can reach a judgment about the question in dispute: How many valid methods of inquiry are there?

Because of experimental science we now know a very large number of things about the natural world of which our predecessors were ignorant. In this set of books we can observe

the birth of science, applaud the development of the experimental technique, and celebrate the triumphs it has won. But we can also note the limitations of the method and mourn the errors that its misapplication has caused. We can distinguish the outlines of those great persistent problems that the method of experimental natural science may never solve and find the clues to their solutions offered by other disciplines and other methods.