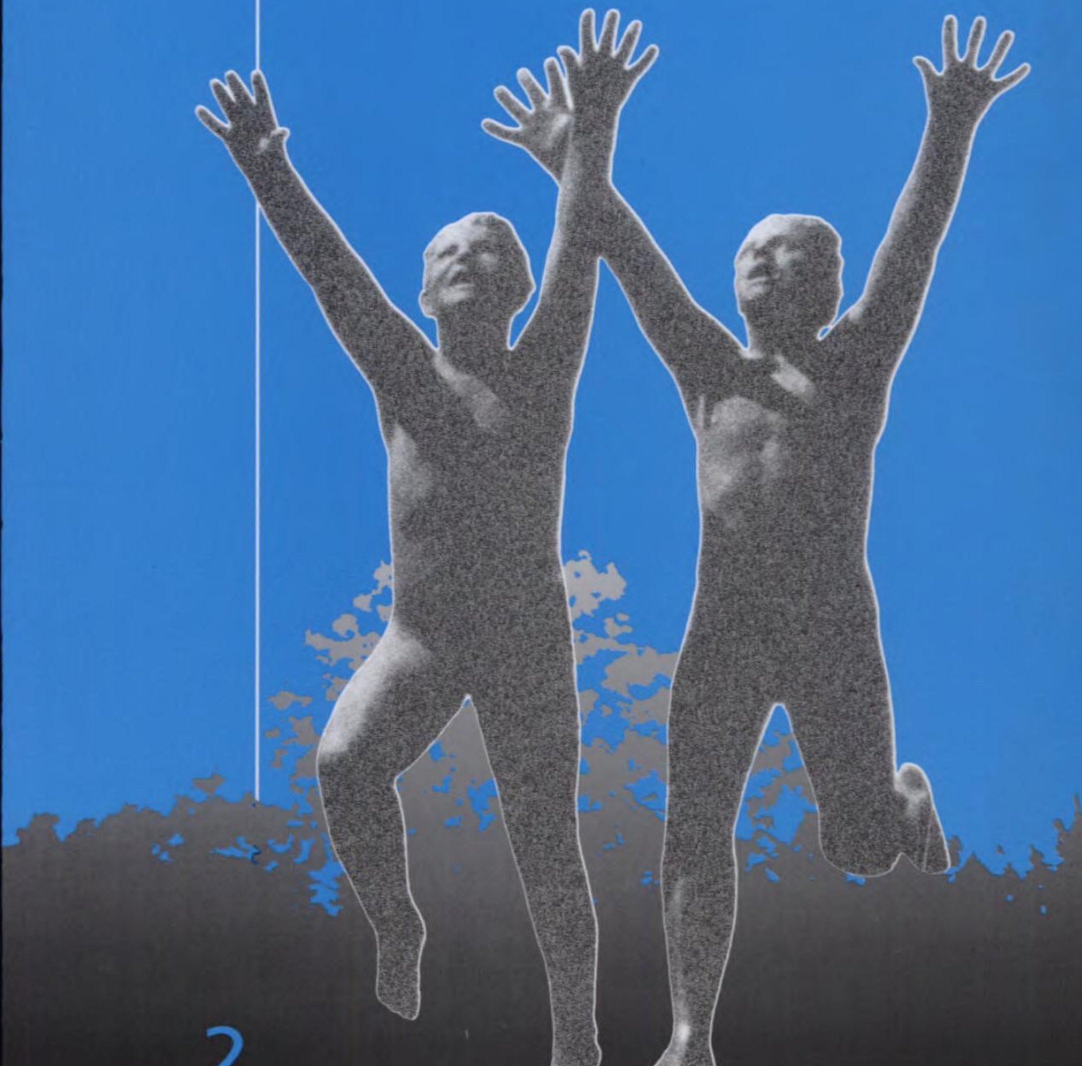
Archie J. Bahm

Axiology: The Science of Values



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VALUE INQUIRY BOOK SERIES

Axiology: The Science of Values

Archie J. Bahm

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Foreword

Archie J. Bahm has written a frank and mature defense of the science of values as a major field of knowledge that stands on its own power while also serving other valuable fields of knowledge ranging from economics to aesthetics. He makes room for the big shoulders of axiology among the crowd of respectable sciences in this scientific age. Bahm's case for the scientific status of axiology is presented from a comprehensive view of all knowledge, yet he gets into the detailed substance of the distinctions that flow from the field. Thus, he clarifies central subjects of Good and Bad, Ends and Means, Actuality and Potentiality, and Objectivity and Subjectivity as applied to values, while he explores our coming to know values and our terminology for them. This work is foundational yet relational, for it focuses on the social context of knowledge. People are at the heart of knowledge and value.

Bahm's vision is informed by cosmopolitan experience in several areas of human value, including religion, the arts, and moral activity, and he has a keen sense of the standards for scientific method. This succinct and pungent text will give second thoughts to those who regard science as above or beyond values as well as to those who regard values as merely emotive, exclusively personal, or otherwise unscientific. As he has done throughout his distinguished career, Bahm throws bridges across the notorious gap between the two cultures of the sciences and the humanities. He does so here with the vigor and freshness of informed inquiry. More than just an able introduction to value science, this book is a spirited defense of our humanity as knowers, judges, and beings of value.

Robert Ginsberg
Executive Editor

Preface

Values, good and bad, are omnipresent in human experience. Everyone understands values as enjoyed and suffered, yet the theories formulated about them have created doubts. How should you decide what values are?

Science is reputed to have the acceptable methods for achieving reliable knowledge these days. Yet science has adopted a partly false philosophy, Positivism, claiming that science is or ought to be, completely value-free. This philosophy relieves scientists from responsibility for investigating values and prevents them from doing so as scientists. When you desire to understand values, you must seek information elsewhere.

I was trained to believe that scientific methods ought to be used in solving philosophical problems. My philosophy of science is Pragmatic rather than Positivistic. My theory of values can be tested personally by scientists and by you and all other persons.

Archie J. Bahm

One

WHY AXIOLOGY?

The value of values is self-evident. This work is not so much about values as about axiology, the science of values. Values have existed as long as human beings, and longer, since animals also experience values. All of the pre-historical developments bringing human beings into existence functioned as instrumental values.

Trying to understand the nature and kinds of values has been a perpetual problem. Despite multitudes of theories, some of them persisting for millennia as guides for civilizations, the best word for characterizing the current situation is "confusing." I do not mean that no clear and definite solutions exist. In fact, some theories are proclaimed as dogmatic ideologies. But growing doubts about traditional doctrines and proliferation of new conjectures characterize current uncertainties. Personal speculations about the nature of values, nurtured not only by long-prevailing ideals of freedom of thought and speech but now also by spreading ideals of permissiveness (freedom without responsibility), contribute to present chaos.

Axiology is valuable in many ways. These will be summarized in two groups. The first is more general, the second more specific. The first pertains to the nature of axiology and its role in normal times, the second to the urgent need for it at present. The first evaluates it as a science among sciences, the second evaluates it as a vital tool for understanding critical personal, megalopolitan, national, and global problems. The two groups will be named (1) axiology as a science and (2) relevance to crisis solutions.

1. Axiology as a Science

A. Axiology is One of the Three Most General Philosophical Sciences.

The three inquire into existence ("metaphysics"), knowledge ("epistemology"), and values ("axiology"). All other sciences may be located in one of these three areas, although some specific sciences involve inquiries of all three areas.

The distinction between existence, knowledge, and value does not imply that what is distinguished is thereby separated. Knowledge and values exist, and as such are properly investigated by metaphysicians. Existence and values are known, and as such are properly investigated as objects of knowledge by epistemologists. Existence and knowledge have value, and as such are properly investigated by axiologists. But the distinctions between existence, knowledge, and values provide bases for distinguishable kinds of questions and of inquiries into these questions.

Axiology, as the science inquiring into values, is thus one of the three most general kinds of inquiry, and thereby is one of the three most important kinds of science.

Each kind of inquiry - each science - has its own primary contribution to make to human understanding. Each is superior to all others with respect to its contribution. Axiology inquires into goodness which is a condition of inquiries into existence and knowledge (and the inquiries constituting all other sciences). That is, we inquire because inquiry is good. Axiology, in inquiring into the goodness involved in inquiry, has the goodness of all other inquiries, that is, of all other sciences, as its particular contribution to all other sciences, including the general sciences of metaphysics and epistemology.

B. Axiology Is the Most Basic Value Science.

There are many value sciences. These include aesthetics: the science of beauty, ugliness and fine art; ethics: the science of oughtness, duty, rightness and wrongness; religiology; the science inquiring into the ultimate values of life as a whole; and economics: the science of wealth and illth relative to the production, distribution, and consumption of goods. Some sciences are more obviously value sciences because they deal directly with some values. The foregoing involve subsciences dealing with values: the psychological, sociological, and political sciences, as well as historical and anthropological studies, all involve values in their inquiries.

Since beauty and ugliness, rightness and wrongness, wisdom and folly, income and expenditures all involve goodness and badness, then understanding the general, specific, and particular problems in aesthetics, ethics, religiology, and economics, etc., involve understanding goodness and badness. Thus, axiology is significant because successful achievement in its inquiries is required for fully successful achievements in all other value sciences. they depend on it. In performing its function as the most basic value science, axiology is the most important value science.

C. Axiology is Needed by Non-Value Sciences.

Many sciences do not intend to make values objects of their inquiries. Axiology makes no direct contribution to understanding things that do not involve value. But sciences as inquiries involve problems, attitudes, methods, and successes and failures. Each science involves concern with such questions as to whether a problem is a genuine problem, is clearly conceived, and is likely to be solvable with appropriate efforts. Since scientists believe that inquiry will be better when their problems are genuine, clearly conceived, and likely to be solvable, their beliefs involve goodness.

Each scientist has the scientific attitude, which involves curiosity, open-mindedness, willingness to be guided by experience and reason, willingness to suspend judgment until sufficient data are available, and willingness to hold conclusions tentatively. Each of these is a good characteristic of the scientific attitude, and having the scientific attitude is better than not having it; in fact, having it, and its goodness, is essential to science. Each scientist uses some method, usually involving gathering data, formulating an hypothesis, and testing the hypotheses. Each wants good data, a good hypotheses, and good tests. Idealizing the goodness of data, hypotheses, and tests, that is, of methods, is inherent in science. Although scientific inquiries often involve many trials and errors, scientists naturally believe that it is better to make as few errors as possible, and that final success in solving a problem is a good to be sought and, when achieved, a good realized. In all of these ways, every science, including those that do not make values objects of their inquiries, inherently involves values.

If the value aspects of non-value sciences are to be understood scientifically (and what other way would a scientist want them to be understood?), then scientists in these sciences depend on axiology as a science for inquiring into the nature and kinds and ways of functioning inherent in all sciences In this way, axiology has an useful contribution to make to all sciences, including the non-value sciences.

The magnitude of these three values of axiology as a science is a measure of the deficiency of the scientific community in neglecting to include it as a recognized science.

2. Relevance to Crisis Solutions

Awareness of accelerating national and global crises urgently calling for solution spurs my efforts to pressure the scientific community to recognize and support axiology as a basic science. Its usefulness will be observed relative to causes of our crises, to understanding our crises, and to overcoming our crises.

A. Negligence of Axiology as a Cause of Our Crises.

Our crises, national and global, are of many kinds and result from many causes. Having surveyed some of these elsewhere,[1] I limit consideration here to causes involving values and, specifically, (a) to misunderstanding values and (b) neglect of axiology.

i. *Misunderstanding of Values*. That our crises problems are essentially value problems should be clear to everyone. But that values are misunderstood is not so clear. There are many reasons for these misunderstandings. Values are complex in their natures, and yet they often appear simply as feelings. Such feelings are difficult to describe. Explanations that have developed, in folklore, ancient scriptures, early philosophies, sectarian schools, and in popular mores, have contributed to culturally inherited misunderstandings and confusions that few can escape. Theories developed by scientific specialists, such as psychologists, physiologists, anthropologists, sociologists, economists, and aestheticians, reflect influences of both specialized viewpoints and sectarian schools of thought.

When persons responsible for policy decisions face actual decisions, the value theories called on, implicitly or explicitly, reflect prevailing confusion and biased explanations. When disagreements occur and appeal is made to the excuse, "There is no disputing about taste," efforts to seek truth about values are abandoned. When each person's opinion counts as equal to that of others, and decisions are based on votes, the result is determined by which biased opinion happens to be most prevalent among those voting. When no demonstrable basis for value decisions is available, decisions reflect quantitative bias. When this is the case, those who would succeed will seek converts to their biases. Special interest groups then rightly increase pressures in support of their views. Increase in group membership, often involving population increase, becomes the way to promote decisions favoring its bias. This kind of thinking is used to justify racism, nationalism, and loyalty to political, religious and any other kind of ideology. But conflicts arising from such movements are among the primary causes of current crises. So long as genuine understanding of the nature of values is missing, continuing acceleration of conflicts caused by such lack of understanding can be expected to increase.

ii. *Neglect of axiology*. The scientific community, which could challenge sectarian theories by recognizing axiology as a science, by developing its demonstrable principles, and by including these in its science education programs, could then demonstrate the falsity of mistaken views. But it has failed to do so. Many scientists too have been captured by sectarian philosophies of science, and some of these that exclude value from scientific consideration happen to have achieved predominance. There are historical reasons why such philosophies were adopted by scientists. Need for freedom from biasing influences when performing experiments aiming to be objective readied scientists for accepting a philosophy of science claiming to free them from such biases. But they mistakenly adopted another bias, a bias against value judgments which is itself a basic value judgment that has been questioned more often recently. By causing neglect of axiology, the scientific community has contributed to a condition in which policy deciders have not had reliable information that may have prevented some of our crises problems.

B. Importance of Axiology for Understanding Our Crises.

If we cannot overcome our crises until we understand them, and if we cannot understand them as value crises until we understand the nature of values, then recognizing and developing axiology, the science devoted to understanding the nature of values, is necessary for overcoming our crises.

Axiology alone, i.e., as a most general science, cannot provide sufficient understanding to overcome our crises because they are extremely complex, and understanding them will require information drawn from many of the sciences. Major problem solutions now require multiscientific contributions and more and more interscientific, or interdisciplinary, research. Understanding our crises will require understanding also the nature of oughtness, a major task of the science of ethics. But ethics, as a science of right choices (wise policy decisions) such as choosing the better of two or more alternatives, presupposes understanding the nature of good and bad, better and worse, or of values. Part of the significance of axiology is its providing a necessary foundation for ethics as a science. Intrinsic values are the ultimate bases for moral appeals. They are also the ultimate bases for economic, political, educational, and religious appeals. So axiology is needed for understanding our crises, partly because it is important for understanding the nature of ethics and other sciences that depend on ethics.

Contributions from still other sciences, such as psychology, sociology, economics and political science, are needed for understanding our crises. But these sciences too, as value sciences, depend on axiology. Scientists in these fields cannot understand the value aspects of their problems fully until they too achieve the kind of understanding sought through axiology. Thus, part of the importance of axiology is to be found in its services to other value sciences that provide information essential to understanding our crises.

C. Values of Axiology in Overcoming Our Crises.

As long as value conflicts constitute our crises and no method, short of war, can be agreed upon for resolving them, doomsday warnings seem warranted. If persons responsible for policy decisions can be persuaded that a science of values exists and that its demonstrated principles can be relied upon, then they should feel warranted in considering any demonstrations needed because they have found scientific demonstrations reliable in dealing with other problems. These demonstrations will have to be rigorous. If the demonstrations are convincing, deductions concerning decisions and behavior commitments should follow. When this occurs, the usefulness of axiology for overcoming our crises will be demonstrated.

Axiology as a necessary means for overcoming our value crises is of interest not merely to the scientific community, which should want the science established, developed, and used, but also to the whole community, to the nation, which has a stake in human survival, and to humanity. The urgency of our needs for crisis solutions implies urgency for the development of axiology. It should be given top priority by those concerned with national interest and human survival. A crash program is needed, both to make up for lost time and to bring results to bear quickly on our problems.

Two

WHAT IS SCIENCE?

Fully conceived, science involves six major kinds of components. These pertain to problems, attitude, method, activity, conclusions, and effects. Some minimal understanding of each component is essential for full understanding of the nature of science.

1. Problems

No problems, no science. Scientific knowledge results from solving scientific problems. No problems, no solutions, no scientific knowledge.

What makes a problem "scientific"? Are all problems scientific? No. If not, what then characterizes a problem as scientific?

Differing answers to this question by scientists and philosophers of science are so various that general agreement soon seems impossible. I propose, as an hypothesis, that a problem can be regarded as scientific only if it has at least the three following characteristics, pertaining to communicability, to the scientific attitude, and to the scientific method.

A. No Problem Is Properly Called "Scientific" Unless It Is Communicable.

I am sure that some will insist that, to be scientific, a problem must already have been communicated. But when competent scientists have discovered a problem and have worked on it privately for a long time before communicating their conclusion to others, it seems unreasonable to judge that their private work was not scientific in any sense. Communicability seems sufficient. But problems that are incommunicable do not achieve the status of "being scientific."

B. No Problem Is Properly Called "Scientific" Unless It Can Be Dealt With by Means of the Scientific Attitude.

See "attitude" below.

C. No Problem Is Properly Called "Scientific" Unless It Can Be Dealt With by Means of the Scientific Method.

"Wherever the scientific method cannot be applied, there cannot be science...." See "Method" below (Weisz, 1961, 4).

Being scientific is a matter of degree. Science exists in its fullest sense when all of the six components outlined here exist to their fullest capacity. But science exists, as problems, already in problems. Problems that are being dealt with by the scientific attitude and method are more scientific, or more fully scientific, than those problems that are dealt with without them. Problems that are well along toward solution are, in a sense, more scientific than those on which work has just begun. Problems that have been solved, so that their problematic character has diminished considerably, are, in a sense, still more fully scientific. Problems that interrelate other scientific problems and solutions systematically (and more adequately in providing greater understanding) are in a sense more fully scientific than problems that are treated in isolation from other problems and solutions. But, I propose, problems that are communicable and capable of being treated by means of the scientific attitude and method are already, in an initial sense, properly called "scientific."

2. Attitude

The scientific attitude includes at least six major characteristics: curiosity, speculativeness, willingness to be objective, open-mindedness, willingness to suspend judgment, and tentativity.

A. Curiosity.

But not idle curiosity. Scientific curiosity is concerned curiosity. It is concern about how things exist, what is their nature, how they function, and how they are related to other things. Scientific curiosity aims at understanding. It develops into and continues as concern for inquiry, investigation, examination, exploration, adventure, and experimentation.

Some scientists have scientific curiosity about some things but not about others. Some are trained to hold the scientific attitude toward problems within their specialized fields, without developing feelings of concerned about furthering inquiry needed for understanding as much as prudently possible.

ii. *Willingness to be guided by experience and reason.* Extreme empiricists and rationalists often try to separate reason and experience. Extreme empiricists assert that sensory experience is the only source of knowledge. Extreme rationalists assert that only beliefs that conform to rational laws can be true. Such extremists often disagree about the nature and reality of universals and particulars. Extreme empiricists hold that we can have certain knowledge only of particulars, that is, of particular sensory experiences in which data are intuited. Extreme rationalists hold that we can have certain knowledge only of universals, and of valid deductions from them; somehow the universal forms must be intuited as well as the deducible implications. But actually universals and particulars interdepend and interact in experience (Bahm, 1974b, 78-94), and processes of scientific investigation depend on success in interrelating them. Although tentativity is also required for the scientific attitude, enough trust in generalizations based on past experience and in deductions based on demonstrations of logical validity is needed to enable a scientist to proceed with investigations on the basis of them. Demonstration that an hypothesis involves a contradiction is sufficient reason for rejecting it.

Before leaving reason, we should observe two meanings of reason that are sometimes distinguished and even separated. On the one hand, reason is conceived as conformity to rational law.[2] On the other hand, reason is conceived as ability to choose the better, or best, between two or more alternatives. That is, when choosing between two alternatives one of which appears to be better than the other, what is the reasonable thing to do? Choose the better. Actually these two meanings interdepend, for those who advocate being reasonable as conformity to rational law do so because they believe such conformity to be better. In choosing the better of two alternatives, one is already conforming to a rational law. The willingness to be guided by experience and reason includes the willingness to be reasonable in both of these ways.

iii. *Willingness to be receptive.* Data, something given in experience when objects are observed, are received as evidence relevant to a problem being solved. The scientific attitude includes a willingness to receive data as they are, uninterpreted by biasing preferences of the observer. Receptivity involves a willingness to take what is given for what it is, or appears to be, without willful, or even willing, distortion. Granted that each observing mind brings with it some preconceptions and a somewhat fertile imagination and that these often participate unintentionally in scientific observations. The willingness to be objective involves a willingness to achieve understanding by maximizing reception of what is received from objects and by minimizing subjective factors (that is, preconceptions, imagination, preferences).

Granted that data uninterpreted by biasing preferences are useless until related to an interpretive hypothesis, and that many scientific data are sought deliberately to confirm (or refute) an hypothesis and that such deliberate seeking often embodies biasing preferences. Nevertheless faith that the hypothesis itself, if it succeeds in solving the problem, will reflect the real structure of the problem so that it serves as an instrument for achieving truth about the object itself, can embody willingness to be objective.

Although each formulation of an explanatory hypothesis involves both some discovery (observation of facts about the object or problem) and some invention (ideas intending imaginatively to construct a conception of the object or problem), the willingness to be objective involves a preference for discovery and a willingness to forego invention as much as possible. Objectivity means that the object, not the subject, is the authority, the source of the knowledge sought by the scientist. So long as the authority refuses to reveal its nature, the scientist must speculatively invent. But willingness to be objective involves readiness to receive more data regarding the object or problem being investigated, because understanding, which is the aim of scientific investigation, is achieved to the extent that something about the nature of the object is revealed from the object. Although the Aristotelian interpretation of knowledge as "in-form-ation," somehow getting the form of the thing to be also the same form in the mind, is much too simple for contemporary scientists, it embodies an ideal of objectivity, namely, that the primary source of understanding of objects is in the objects.

iv. *Willingness to be changed by the object*. Whenever a scientist discovers something that he did not know before, the scientist becomes changed by the addition of this new knowledge. Such changes may seem insignificant to a scientist who has desired to acquire some knowledge and then has the previously-existing desire satisfied. But some scientific discoveries result in scientific revolutions, that is, in radically changed conceptions of the nature of things, including selves, societies, atoms, and galaxies. These require the scientist, as willing to be objective, to revise and reconstruct his conceptions of himself as well as of other things. If one is unwilling to become changed in any way required by the results of successful scientific investigation, then he lacks something of the willingness to be objective.[3]

Current clamor about global crises resulting from rapid technological changes has popularized evidence of how much people's lives have been changed as a result of scientific developments. Scientists need not go so far as to join a Federation of Atomic Scientists and feel compelled to regret publicly the consequences of their discoveries. Nevertheless a willingness to be aware of the possibilities and prospects of changes resulting from their investigations and a willingness to be influenced by such changes and to become changed all seem to be implied in the willingness to be objective.

v. *Willingness to err.* Trial and error methods are so characteristic of science, and the quantity of the errors occurring before each success is so great, that a scientist must expect to spend much more time in efforts resulting in errors than in achieving the truth. To the extent that each error, each erroneous hypothesis eliminated, is instrumental in bringing investigations to final success, each must be regarded as having instrumental value and thus as worthwhile in its own way. A person who demands success on a first trial lacks something essential to the scientific attitude.

Although "objectivity" pertains primarily to the objects being investigated, it also pertains to the methods used in trying to understand the objects. For objects are such that they yield information when some methods are used but not when other methods are used. Thus, the willingness to be objective uses the methods required by the objects. The willingness to be objective involves willingness to err whenever an inadequate method is used and willingness to overcome the error by another, better method. The willingness to be objective may involve a willingness to be frustrated as often as is needed during the processes of investigation.

This willingness to err should not detract from the unwillingness to err, also characterizing the scientific attitude. But this characteristic, that is, the intention to be truthful, both to accept the truth and to tell the truth, is such a fundamental and obvious presupposition of the

G. Tentativity.

Not only should unproved hypotheses, including working hypotheses, be held with an attitude of tentativity, but the whole scientific enterprise, including each specialty, remains somewhat dubious. Although personal and group experiences warrant firmer convictions regarding conclusions as they continue to work longer and better and more fully (through harmonious inter-relation with conclusions held in other fields), proof of certainty always remains less than one hundred percent (the percentage available from deductive proof).

Studies in the history of science provide evidence that scientific systems that become established and almost universally accepted in one era have always remained inadequate and have given way eventually to revolutionary conceptions that led to the establishment of new systems based on radically different pre-suppositions (Khun, 1962). Historical evidence, at least, indicates that the firmest convictions now held and the most intricate and most adequate interpretive systems prevalent may yet give way to something more adequate. As long as this possibility remains in prospect, dogmatism regarding currently accepted conclusions is unwarranted. The scientific attitude remains tentative regarding all scientific conclusions. This implies a need for remaining undogmatic about methods, since different conclusions may depend for their establishment on differing methods needed to establish them.

The foregoing interpretation of the scientific attitude portrays the scientist as forever experiencing a tension between tenacity and tentativity. On the one hand, persistence is needed for holding on to an hypotheses as long as it is the best available. On the other hand, since the best conclusions are never fully warranted, the scientist must remain unsure. Even though the suffering may not be great, a scientist must be willing to suffer whatever tensions are required by embodying the double willingness to be tenacious and to remain tentative.

3. Method

My proposals regarding the scientific method must be regarded as hypotheses for further testing. The subject is extremely controversial.

On the one hand: "What makes a study scientific is not the nature of the things with which it is concerned, but the *method* by which it deals with these things" (Thompson, 1911, 38). "The essence of science is its method" (McGrath, 1950, 118). "Science [as theories] is something that is always changing. The theories of today are not those of a hundred years ago.... Is there something...about science which does not change...? I think there is, and it is the method" (Ritchie, 1923, 14). On the other hand: "With regard to the nature of scientific method scientists themselves are not always possessed of clear and sound ideas" (Cohen, 1949, 48). "In any case, there is no unanimity about methodology among scientists themselves" (Jevons, 1893, 51). "The scientific method, like the Abominable Snowman, has been the object of an enthusiastic but on the whole unsuccessful search. ...The search has yielded up a number of somewhat bewildered scientists;...leaving the searchers no more enlightened than before" (Caws, 1965, 276).

A. Method Versus Methods.

The controversy and confusion results, I suggest, partly from neglect to relate the problem to distinctions between science and the sciences. Even here, controversy persists. On the one hand: A reason for interpreting "...the scientific method as though there were one and only one method is that the similarities between different applications of it in different sciences are greater than the differences. ...Full abstraction discloses that there is only one scientific method" (Fiebleman, 1971, 7). On the other hand: "Not science but sciences. ...There is no single science, but only a series of families of sciences" (Kantor, 1953, 5).

My response to this controversy about whether scientific method is one or many is that there is some truth to both views. Scientific method is both one and many.

i. *It is one*. "There is no subject matter to which scientific method cannot be applied" (Ross, 1971, 95). The nature of this method will be examined more fully below.

ii. *It is many*. In fact, it is many in many ways:

(1) Each science has its methods best suited to its problems. Obviously biologists must use microscopes, while astronomers must use telescopes; and biologists use control groups while astronomers cannot control their objects. "Each particular science will vary considerably in its methods..." (Ross, 1971, 95). The methods of different sciences

problems, such as how to grow food, build and contain fire, or domesticate animals, likewise require ideas. Those that help solve these problems survive and are used again. Those that fail are discarded and perish.

The two philosophies differ thus somewhat regarding the originating step in the scientific method. Empiricists: "All science begins with *observation*, the first step of the scientific method. ...After an observation has been made, the second step of the scientific method is to define a *problem*. In other words, one asks a question about the observation" (Weisz, 1961, 4,5). Pragmatists: "The task of the first stage of inquiry is the analysis of the problem." The task of the second stage "is to inspect the relevant facts designated by the analysis in the first stage. ...the method of observation, the method of description, and the method of classification" (Northrop, 1947, 34,35).

Although some may regard differing about whether the scientific method begins with an observation or a problem as quibbling, since a person does not become aware of a problem without observing, and an observation does not become scientific until it arouses interest (becomes problematic), nevertheless these differings beget differences in conceptions of how to proceed. Those who begin by observing data proceed naturally to analysis of data, such as sense data. Those who begin by being disturbed by a problem proceed naturally to an analysis of the problem. The problem itself determines what data are relevant and functions as a guide to observations as well as to the kind of hypothesis needed for its solution. I favor the view that science is a problem-solving enterprise and thus see the scientific method as having the characteristics essential to problem-solving methods.

In proposing five steps as essential to the scientific method, I am stating a theory not only about them but also an ideal about how these steps should be taken. I am aware that, in practice, scientists do not follow this pattern step by step but commonly jump back and forth from one to another many times. Often a scientist has to formulate an hypothesis and begin testing it before it is possible to decide reliably which data are genuinely relevant to the initial problem. Furthermore, as accepted scientific conclusions become more complicated, many problems originate as technical difficulties such as systemic inconsistencies or experimental limitations, so that it now seems possible that a person employed as a scientist may never have an opportunity to experience the challenge of an original problem of the problem, how it is related to, or interrelated with, other factors in experience, and whether and how it is like similar problems dealt with previously. These questions involve inferences about such causes, other factors, and other problems. Problem solvers often remark that "Well begun is half done." The more fully a problem is understood, the more likely a workable solution will be achieved. Thus, thoroughness and carefulness in examining a problem are prescribed as beneficial in scientific method. The more highly socialized a scientific inquiry, the more attention needs to be paid to expressing clarifications in language easily and clearly communicable to other scientists. Accuracy as well as adequacy in observing, analyzing, and communicating a problem are excellent ideals for a good beginning.

iii. *Proposing solutions*. Solutions, to be adequate, must be clearly relevant to the problem. Initial suggestions often spring spontaneously from initial observations of the problem. But progressive clarification of the problem usually refutes initial suggestions yet leads to others seemingly more adequate. Trial and error thinking is to be expected. Some problems, when clearly understood, generate solutions almost immediately. Other problems resist clarification and obvious solution. When a problem defies efforts to propose relevant solutions, scientists often try out "working hypotheses," hypotheses relevant to only some of the main features of the problem. Then by exploring implications of such hypotheses, they may discover additional data relevant to further clarification of the problem or refutation of the working hypothesis.

iv. *Testing proposals*. Two kinds of testing ("verification of hypotheses") can be distinguished: mental and operational.

(1) Any hypothesis suggested, early or late in an investigation, should be examined mentally before other efforts are expended on it. Criteria for a good hypothesis have been suggested: (a) Consistency, within itself, with known facts, and with the prevailing body of scientific theory. (b) Relevancy of the hypothesis to the problem and evidence available. (c) Adequacy in comprehending all relevant factors, in revealing theoretical understanding, and in providing for testability and final solution. (d) Clarity and simplicity are desirable, but clarity should include what is clearly unclear, while simplicity that reduces adequacy falsifies. (e) Communicability, especially easy communicability, when possible.

Although reasoning occurs at every step in the scientific process, it receives special emphasis during mental testing because mental tests are primarily rational in nature. Consulting with colleagues during mental testing is especially beneficial, because deficiencies in the hypothesis, including any failure to embody the criteria of a good hypothesis, can be detected and corrected more easily before efforts are invested in costly operations. As science becomes more complicated, criteria for numbers and kinds of colleagues to be consulted are established; at the same time, the more highly specialized a scientific investigation becomes, fewer colleagues are available for consultation. Growing awareness of the increasing importance of interdisciplinology should have the effect of encouraging, if not requiring, inquiry into and evaluation of implications of the hypothesis for other fields.

(2) Operational testing, often involving designing one or more experiments, aims to demonstrate the workability of the hypothesis. It involves observation of new evidence tending to verify or refute the hypothesis. Each science, often each problem, will require its own kind of experiments and its own instruments for measuring. Each kind of experiment will have its own criteria for excellence. In addition, operational testing is better (other things being equal) when it is more efficient (yields more evidence, verifying or refuting the hypothesis for less costs in time, money, equipment, and effort), when it provides more conclusive evidence, and when it is more easily repeatable, as well as when it better continues to embody the criteria cited for mental testing.

The ideal experiment is called "crucial" because it is designed to determine definitely and finally whether an hypothesis is true or false. Crucial experiments are difficult to design, especially as problems become more complex and include more factors. Increasingly evidence is stated in terms of probabilities, including, where possible, estimations of probable error. So hypotheses are "verified" only approximately, or in some degree, and, in many cases, only under limiting conditions.

v. *Solving the problem*. Problems may remain scientific even when they are not solved. Problems may remain scientific even when they appear to be unsolvable by presently known methods. But the aim and purpose of scientific method is to solve problems. Problems originating in doubt are not fully solved until that doubt has subsided and investigators feel satisfied that understanding has been achieved.

This book expounds the basic principles of Axiology as a major field of philosophical inquiry. Those principles can be discovered and demonstrated by scientific method. In treating scientific inquiry the book throws light on what values are and how they are known. It explores questions of Good and Bad, Ends and Means, and Appearance and Reality as applied to values. Axiology, argues the author, provides the basis for ethics as the science of *oughtness*: the power that a greater good has over a lesser good in compelling our choices. The book concludes with a survey of efforts to establish Axiology as a science.

Archie J. Bahm

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