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# THE CONCEPT OF GOD AND THE METHOD OF SCIENCE: AN EXPLORATION OF THE POSSIBILITY OF SCIENTIFIC THEOLOGY

Karl Edward Peters

1971

Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, in the Faculty of Philosophy, Columbia University

"In the age of science the ruling commitment of religion and the knowledge and power of science must work together if human life is to continue."

Henry Nelson Wieman

ABSTRACT

THE CONCEPT OF GOD AND THE METHOD OF SCIENCE:

AN EXPLORATION OF THE POSSIBILITY OF SCIENTIFIC THEOLOGY

Karl Edward Peters

This dissertation explores the possibility of using the method of science to develop and test ideas about God and also what kind of understanding of God might be so developed.

In Chapter I "science" is defined as a type of inquiry that seeks to explain, predict and control phenomena by developing with the aid of certain procedures and attitudes hypotheses, which, if they fulfill certain criteria--including the occurrence of expected facts perceived in controlled observation--become laws and theories. "Religion" is defined as "valuing most intensively and comprehensively," and "theology" is defined as inquiry into the nature of the proper object of this valuing--God. The grounds for exploring the possibility of using the method of science in theological inquiry are then presented.

In a more detailed discussion of science, Chapter II examines the reciprocal interaction between experience and concepts, and the nature of data, facts, laws and theories, while Chapter III outlines procedures, attitudes and criteria employed in forming hypotheses and in evaluating the significance of data-facts and hypothesized laws and theories, concluding with a discussion of the decisions made in designing a controlled experiment.

In Chapter IV, following Henry Nelson Wieman's understanding of

God as whatever saves men from evil and brings about the greatest good possible provided that men commit themselves to it, and recognizing that, if the method of science is to be used, God and the good God brings must exist in space-time and must be regularly occurring, isolatable types of events, it is argued that the greatest good possible is the continual establishment of greater relations of mutual support between what men value or the continual expansion of men's minds and the world relative to men's minds in the cognitive, aesthetic, social and personal dimensions of life, and it is hypothesized that what brings about this expansion is the process of creative interchange between men and between men and the rest of the world.

To indicate how this general hypothesis might be tested scientifically in the cognitive dimension, in Chapter V, with information gathered from Wieman, social scientists and the method of science itself, a possible interchange theory consisting of several stages and subprocesses is proposed, and the kind of commitment necessary to test experimentally hypotheses derived from the proposed theory is discussed. In Chapter VI, the facts against which hypotheses about creative interchange might be tested are developed by operationally defining "expansions of men's minds" as "integrative" solutions to conflicts between two ways of accomplishing the same thing. An experiment is designed, and the generalizability of the experiment and its results from the cognitive to the other three dimensions is discussed. It is concluded that it is possible to test scientifically ideas about creative interchange in the cognitive and perhaps also in the social dimensions, and that more study is needed to establish this possibility in the personal and aesthetic dimensions.

The concluding chapter attempts to show that it is theologically appropriate to call creative interchange "God," because it can be valued as most important and as related to all of human living. Since other understandings of God can make this same claim, the issues between competing theological "paradigms" are discussed; it is indicated how the paradigm of God as creative interchange is preferable to that of traditional supernatural Christianity, because it resolves rational problems in supernaturalism, is able to answer crucial problems raised in return, can translate key ideas about God from supernaturalism into the paradigm of creative interchange, and offers more promise for the future of theology by providing a way to constructively relate science and religion.

## PREFACE

One of the major themes of this dissertation is that God may be conceptualized as the process of creative interchange between men, and between men and the rest of the world. In exploring the nature of this process and how ideas about it might be developed and tested with the method of science, I have gradually become aware that I have not only been studying something from outside but that I myself have been caught up in creative interchange, more or less, depending on my own openness to the challenging ideas of others.

The other parties involved in the interchange have included writers on religion and science, natural scientists, philosophers and historians of science, and social scientists who themselves have been studying creativity. Also involved are a small group of men who have contributed to the underlying philosophical perspective of the dissertation: the American pragmatists Charles S. Peirce, William James and John Dewey, and the founder of process philosophy, Alfred North Whitehead. It is perhaps because three of these men were scientists as well as philosophers and because the fourth, Dewey, devoted much of his time to studying the nature of inquiry, including scientific inquiry, that their thought provides such a natural framework for our exploration in religion and science. The most important party in the interchange is Henry Nelson Wieman, for without his years of effort in developing an empirical theology my own ideas probably would not have been conceived. With his profound theological reflection in relation to many areas of life I am in basic agreement. My own efforts are an attempt to carry only one of his major themes a little further, namely to explore what must be done if his empirical theology is to become truly scientific.

For permission to quote from the following writings of some of those with whom I have been engaged in dialogue, grateful acknowledgement is given to Basic Books, Inc.--Norwood Russell Hanson, "Observation and Interpretation," Philosophy of Science Today, edited by Sidney Morgenbesser, 1967; T. S. Denison & Co., Inc.--Paul Holmer, Theology and the Scientific Study of Religion, 1961; Harcourt Brace Jovanovich, Inc.--Ernest Nagel, The Structure of Science, 1961; Harper & Row, Publishers, Inc.,--Donald D. Evans, "Differences Between Scientific and Religious Assertions," Science and Religion: New Perspectives on the Dialogue, edited by Ian G. Barbour, 1968; Holt, Rinehart and Winston, Inc.--John Dewey, Logic: The Theory of Inquiry, 1938; The Macmillan Company--Antony Flew, "Theology and Falsification," New Essays in Philosophical Theology, edited by Antony Flew and Alasdair MacIntyre, 1966; The Macmillan Company--William J. J. Gordon, Synectics: The Development of Creative Capacity, 1969; The University of Chicago Press--Henry Nelson Wieman, "Knowledge, Religious and Otherwise," The Journal of Religion, XXXVIII (January, 1958); and Yale University Press--Henry Margenau, Open Vistas: Philosophical Perspectives of Modern Science, 1964.

In my study of religion and science over the past five years and in the course of writing this dissertation I have been fortunate to have been able to engage in interchange with three men who are interested and extremely knowledgeable concerning the problems I have been considering, Professors Joseph L. Blau, James A. Martin, Jr., and Daniel D. Williams.

Their encouragement has helped me to continue on a rather difficult course, and their critical insights have continually sparked intellectual reflection that has always been rewarding.

I have also been fortunate to have had the friendship of Coleman Clarke, Jr., one of the few people I know who often expresses my own ideas better than I can. The countless hours spent in conversation have not only been intellectually rewarding but also a pleasure. Another friend, Donald Livingston, who is a research physicist, was kind enough to read the first draft of the two chapters on the method of science; his helpful comments are appreciated. I also wish to thank Mrs. Kathy Priebe for her careful proofreading and typing of Chapter I, and my mother and father for assisting in proofreading the final copy.

Finally, how can one express thanks to a wife who for numerous years has supported a student husband in every possible way, who has spent many evenings and weekends at the typewriter, who has been helpful in weeding out incoherent and repetitious sentences to make the product a little more readable, and who has shown infinite patience in waiting for its completion? Perhaps the fact that the dissertation is now completed is the best expression of appreciation I can give her.

All these people have been my partners in interchange. Of course they are not to be held responsible for any aberrations in the outcome, which are my responsibility. They are, however, largely responsible for contributing to the growth of my own mind, which signifies that for me the interchange has been creative. The result now comes to you, the reader, with the hope that through it you too will be caught up in the process of creative interchange.

Karl E. Peters

TABLE OF CONTENTS

TABLE OF CONTENTS

# CHAPTER I

## SCIENCE, RELIGION AND THEOLOGY

> When we consider what religion is for mankind, and what science is, it is no exaggeration to say that the future course of history depends upon the decision of this generation as to the relationship between them.
>
> Alfred North Whitehead

If we take seriously the above statement of one of the great scientists and philosophers of our century, we cannot avoid raising the question, in our time what should the relationship between science and religion be? Between three logically possible relationships, that of conflict between science and religion, that of a coexistence of separate spheres or that of a constructive relationship in which both science and religion benefit, it is my belief that the last possibility provides the greatest hope for the future course of history. Accordingly it will be the basic purpose of this dissertation to suggest and explore one possible way of constructively relating science and religion so that they can work together to the benefit of both.

Because we are interested in the possibility of a constructive relationship between science and religion, our writing will have a certain bias. We shall try to avoid regarding religion and science in such a way that they must inevitably conflict or be relegated to two separate spheres; instead we shall attempt to regard them in such a way that a constructive relationship is at least a strong possibility. Our bias will underlie--and perhaps even function as a selective principle for--the way we define science and religion, the way we view the method of science, and the type of theology we select.

What is the possible constructive relationship between religion and science that we are interested in exploring? It involves a number of steps, which shall be the concern of this chapter. First, we shall define "science" and "religion," the first as a way of knowing and the second as a way of valuing. Second, we shall make a distinction between "religion" and "theology," regarding theology as inquiry concerning the beliefs of theistic religions. This raises the possibility of conflict between science and theology, since both are ways of inquiry. However, because scientific inquiry can be defined according to its method, which involves certain procedures, criteria and attitudes, while theological inquiry can be defined according to its subject matter or the questions it tries to answer, a third step can be taken: it becomes possible to ask whether or not the procedures, criteria and attitudes of science can be used in seeking an answer to one of the basic questions of theistic religion, namely what is the nature of that to which man should totally commit himself? As one way of constructively relating science and religion, I wish to explore this possibility of using the method of science to develop and test ideas about God as well as the kind of concept of God that might be so developed.

## Defining Terms

Precisely defining general terms such as "science" and "religion" is extremely difficult, largely because of the wide range of meaning associated with such terms in common usage. Hence it must be acknowledged at the outset that the definitions we shall propose are not the only possible definitions of these terms. We do hope, however, that they will meet some of the basic criteria of a good definition.[1]

We shall define "science" as a type of inquiry that seeks to explain, predict and control phenomena by developing with the aid of certain procedures and attitudes hypotheses, which, if they fulfill certain criteria including the occurrence of expected facts perceived in controlled observation, become laws and theories.[2]

This definition will be fully explicated in the following two chapters; however, it is important now to emphasize and describe more

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[1]Our definitions are of the kind that names the more general class of which the thing indicated by the word is a member and then the characteristic or set of characteristics that distinguishes what is being defined from other members of the more general class. The criteria as to what constitutes a distinguishing characteristic are: 1) it must always be present in the object or activity in question; 2) it must not be present in other activities or objects that are not generally signified by the word being defined; and 3) it must be so important that it is impossible to imagine its not being present in whatever is denoted by the word being defined. For discussions on defining terms, cf. Susan Stebbing, A Modern Introduction to Logic (New York: Harper & Row, Publishers, Harper Torchbooks, 1961), pp. 421-442; John Hospers, An Introduction to Philosophical Analysis (2nd ed.; Englewood Cliffs, N. J.: Prentice Hall, Inc., 1967), pp. 22-32; and Frederick Ferré, Basic Modern Philosophy of Religion (New York: Charles Scribner's Sons, 1967), pp. 37-44.

[2]This definition is an expansion and modification of the one proposed by James Bryant Conant, who defines science as "a series of concepts or conceptual schemes arising out of experiment and observation and leading to new experiments and new observations." Harvard Case Histories in Experimental Science, I (Cambridge, Mass.: Harvard University Press, 1957), x. The primary difference is that while Conant regards science as a product of inquiry, our definition views it as a process of inquiry and thus more according to the method of science.

The various parts of our definition also reflect indirectly Harold K. Schilling's discussion of "some of the various aspects and modes of science" in his essay, "Natural Science and Religion," Teacher Education and Religion, ed. A. L. Sebaly (Oneonta, New York: The American Association of Colleges for Teacher Education, 1959), pp. 175-211; also Harold K. Schilling, Science and Religion: An Interpretation of Two Communities (New York: Charles Scribner's Sons, 1962), pp. 14-15.

clearly the most important aspect of the definition, namely controlled observation. This is because, while other types of inquiry may exhibit certain features of science (such as seeking to explain, predict and control aspects of the world, to hypothesize laws and theories about the nature of the world or parts of it and even to evaluate these according to the criteria of logical coherence with other ideas and the predicting of phenomena observable with the senses), no other type of inquiry attempts to control the situation in which its observations are made.

What is meant by "control," when we speak of controlled observation? First, it means a refining of ordinary sense experience by isolating key variables from other possible interacting factors. Often special instruments need to be devised before variables can be isolated and observed.[1] While the sciences use different techniques and instruments to achieve such isolation, varying from Galileo's inclined plane to the sophisticated instruments of quantum physics to the still being developed techniques used in psychological testing, the aim of such instruments and techniques is the same, namely to refine sense experience by isolating key variables to be correlated or explained by laws and theories. Second, "controlled observation" often means a refining of sense experience by quantification, the applying of numbers to the phenomena observed. Although phenomena can be isolated and correlated without quantification, in order to develop laws stating the functional

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[1]The importance of the invention of specific instruments and techniques to the discovery of new data and refinement of older observations and hence to the advance of science is amply illustrated by H. T. Pledge, Science Since 1500 (New York: Harper & Brothers Publishers, Harper Torchbooks, 1959), passim.

relationship between phenomena, quantification is necessary.[1] Third, "control" sometimes means the actual physical manipulating of the isolated and sometimes quantified variables, and the physical eliminating of unwanted variables, which is the crux of the laboratory experiment. But where quantification is possible such laboratory control may be supplemented or even replaced by statistical techniques, such as those used in quantum physics or in the social sciences. Finally, "controlled observation" means that the scientist has enough mastery of the phenomena in question so that when certain conditions are present or supplied he and other scientists can repeatedly observe the same type of phenomena.[2]

Having defined science as a type of inquiry that develops as possible solutions to problems hypotheses that can be evaluated through repeated controlled observations or experiments, we can now proceed to define the term "religion." At this point we shall follow Frederick Ferré, who regards religion as a way of valuing, distinguished from other forms of valuing by its maximum comprehensiveness and supreme intensiveness. "Religion, then, we define as the conscious desiring of

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[1]Cf. infra, pp. 57-59.

[2]Controlled observation is what occurs in a scientific experiment. However, it would not be quite correct to say that the distinguishing feature of science is that it conducts experiments, especially if by "experiment" is meant the laboratory manipulation of phenomena. The photographing of the May 29, 1919 eclipse of the sun to test Einstein's prediction, based on the general theory of relativity, that the light from stars closest to the sun would shift about 1.75 seconds of an arc is certainly not a laboratory experiment but is a controlled observation made with the aid of instruments. Cf. Lincoln Barnett, The Universe and Dr. Einstein (New York: The New American Library, A Signet Science Library Book, 1964), pp. 89-92. While experiments do play an extremely important role in science, it is the notion of control of the data underlying experiments that constitutes the distinguishing characteristic of science. Such control applies to both laboratory experiments and non-laboratory observations.

whatever (if anything) is considered to be both inclusive in its bearing on one's life and primary in its importance." Or in other words: "Religion is one's way of valuing most comprehensively and intensively."[1]

In light of Ferré's definition of religion, we can define "theology," which is often confused with the term "religion" but should not be, for theology is not a type of valuing but a type of inquiry. It may be defined as inquiry into what is meant by "valuing most intensively and comprehensively," into whatever is considered to be the object of such valuing and into the implications of such valuing for our lives. Another way of expressing this definition of "theology" is to use concepts proposed by Henry Nelson Wieman, who understands religion as "ultimate commitment,"[2] an understanding of religion that seems to be equivalent to Ferre's idea of valuing most intensively and comprehensively. If religion is "ultimate commitment," "theology" would then mean inquiry into the nature of ultimate commitment, into whatever is thought to be the legitimate object of that commitment and into the implications for living of ultimate commitment to any particular object.

In its broadest sense this definition of "theology" includes inquiry that takes place in any religion whether or not that to which ultimate commitment is made bears the name "God." There is a narrower definition of "theology" that takes into account the derivation of this word from the Greek language, in which it means "the study of God."

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[1]Ferré, Basic Modern Philosophy of Religion, p. 69; for a fuller discussion of the characteristics of comprehensiveness and intensiveness, cf. pp. 64-69.

[2]Henry Nelson Wieman, Man's Ultimate Commitment (Carbondale, Illinois: Southern Illinois University Press, Arcturus Books, 1958), pp. 9-11.

Theology is thus the inquiry that is pursued in theistic forms of religion and may be defined as inquiry into the meaning of the term "God" or into the nature of God, as well as inquiry into the nature of ultimate commitment to or faith in God and the implications of faith in God for the lives of men. We shall be using the term "theology" in this narrower sense, since the type of religion that is the major concern of our dissertation is theistic religion.

Even in its narrower sense our definition still leaves open the question of what is the appropriate method of theological inquiry. In contrast to our definition of science, we have not defined theology according to any method but according to the basic questions it seeks to answer. This in intentional, for we wish to suggest and explore the possibility of using the method of science to investigate the nature of that which is the object of man's most intensive and comprehensive valuing, which in theistic religion is called "God."

Having defined "science," "religion," and "theology" we are now in a position to state the nature of our own enterprise in this dissertation. Strictly speaking, our inquiry is neither that of the scientist nor that of the theologian. For the inquiry of the scientist involves the use of certain procedures and criteria, and the holding of certain attitudes, which we are calling the method of science, in order to understand what happens in the world; it does not involve, however, inquiry into the nature of the method of science itself as that method is related to its subject matter, although a scientist may from time to time self-consciously reflect on his procedures, criteria and attitudes. Such inquiry into the method of science itself is the primary task of the philosopher of science. Similarly, the theologian, while he often self-consciously reflects on the method he employs, is more concerned with using that method to answer basic religious questions; inquiry into the appropriateness of various theological methods themselves and of their relation to different answers concerning the nature of faith, the nature of God and the implications of faith in God for people's lives is a primary task of the philosopher of religion. Therefore, since we will be exploring the possibility of using the method of science to investigate the nature of God and also analyzing the kind of understanding of God one might arrive at when the method of science is employed, our task will be that of a philosopher, concerned with both scientific and theological inquiry and with a possible positive relationship between them.

## Relating Science, Religion and Theology: The Problem

A solution to the problem concerning the relationship between science and religion is indicated by the manner in which we have defined them. First, because science and religion are two quite different activities, one a way of knowing and the other a way of valuing, there should be no need for conflict between them. Second, on the basis of our definitions it is possible to suggest a way of constructively relating science and religion. Since religion is concerned with what one ultimately values, around which other values may be oriented, it should be in a position to guide science so that the latter can be used to the benefit of mankind. In return, if science as a way of knowing can be used in the study of values, it might help theology to determine how man's values are engendered as possibilities and the conditions under which they are actualized. In other words it might help men to discover the nature of the object of their ultimate commitment and the proper relation of men to this object. But wait! Have we not said that the study of the object of man's comprehensive and intensive valuing is the task of theology? Are we then suggesting that science do the job of theology? In a sense we are, but perhaps a better way of expressing it is to say that we are suggesting the possibility of theology becoming scientific.

Conflict between science and theology.--In order to see why we make this rather unusual suggestion, we must take a look at the possible relations that can exist between science and theology. Although, as we have just indicated, with our definitions of "science" and "religion" there is no conflict between them, there is a real possibility of conflict between science and theology, because both claim to be ways of knowing. In fact, many of the so-called conflicts between science and religion in the past are more appropriately regarded as conflicts between science and theology. For what seems to have been at stake in such conflicts was not religion in general but theological ideas about the nature of the world and the methods through which those ideas were established as true.[1]

Logically speaking there are three possible relationships between science and theology: they can conflict with one another, they can affirm and support one another, they can be distinct from but neither conflicting with nor supporting one another.

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[1]Although we have defined theology as inquiry into the nature of man's ultimate commitment and into the object of that commitment, namely God, still it is not possible to develop ideas about these in isolation from ideas about the world, man and society, simply because, according to our definition, God is something related to everything else; this is what "valuing most comprehensively" means. Cf. Ferré, Basic Modern Philosophy of Religion, pp. 64-65. This perhaps helps to account for the need to relate theology to some more comprehensive philosophy, such as Platonism or Aristotelianism, in the past or to the ideas of science about the nature of the world, man and society in the present.

It is not correct to say that whenever science and theology have come in contact with one another they have been in conflict, as some of the older histories of the relationship between science and theology imply.[1] There have always been great Christian theologians who have tried to reconcile the science of their day with theology; in fact it is because such men as Thomas Aquinas attempted and achieved with some success such a reconciliation that they are regarded as among the greatest of the theologians. There have also been scientists who have not viewed science and theology as in conflict but have tried to hold science and theology together. Galileo's assertion that the truth discovered from nature and that revealed in scripture cannot possibly contradict one another and the frequently asserted idea that science, in uncovering the laws of nature, is only coming to a fuller understanding of how God works are only two examples of attempts to allow science and theology to affirm and support one another. However--and this is important--whenever the theories and facts of science have been held in conflict with the doctrines of theology, that conflict has contributed to the demise of those theological doctrines held to contradict science, to the questioning of the method of appealing to sacred writings used by traditional theology in establishing the truth of such doctrines, and in the final analysis to the discrediting of the religion involved as a guide for science.

Interestingly, when one first examines actual conflicts between science and theology regarding, for example, questions about the nature of the solar system, the age of the universe, the manner of creation or

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[1]E.g., Andrew D. White, A History of the Warfare of Science with Theology (New York: D. Appleton and Company, 1896), and John W. Draper, History of the Conflict between Religion and Science (New York: D. Appleton and Company, 1875).

the nature of disease, the conflict sometimes appears not to be between science and theology but between new and old scientific theories. The sixteenth and seventeenth century controversy over whether the earth or sun was the center of the universe was essentially a controversy between Ptolemaic science and the new science of Copernicus, Galileo and Kepler. The controversy concerning evolution can be viewed primarily as a struggle between a biology that goes all the way back to Aristotle and that stresses the fixity of the species and a biology based on Darwin's theory that through random variations species are modified and occasionally emerge into new species and that, according to the principle of natural selection, the variations that are biologically fittest survive.[1]

If the controversies over the location of the earth in the solar system and evolution can be viewed primarily as scientific disputes, how then did theology become involved? It became involved because it had incorporated the older scientific views into its own framework. The geocentric position that regarded the earth as the immovable center of the universe was taken up into the theological distinction between heaven and earth: the heavens contained the planets, themselves perfect spheres, and the stars, which travelled in a perfect and eternal circular motion and were thus symbolic of the perfection of God; but the earth, which itself lacked motion, was the location of everything that was changing and corrupt and provided the center of the stage for the drama of salvation.[2]

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[1]Of course the scientific controversy was more complicated than this, for it involved a number of scientific theories of evolution that were in some way or other alternatives to that of Darwin, e.g., Lamarck's earlier theory of the inheritance of acquired characteristics and, later, de Vries' theory of mutations.

[2]Cf. Arthur O. Lovejoy, The Great Chain of Being (New York: Harper & Row, Publishers, Harper Torchbooks, 1965), pp. 101-102.

Concerning the question of evolution, the older scientific idea of the fixity of the species had been incorporated into a doctrine of creation in which God himself had created each species from the beginning of time.

More important, however, than the incorporation of specific scientific theories into theology was that in this process the astronomical theories of Ptolemy and the biological notions based on Aristotle were interpreted in such a way as to be in accord with Christian scriptures. From this it was but a short step to maintain that such ideas were true because they were in accord with the revealed word of God. And there was no higher theological authority to which one could appeal in order to question the truth of an idea once it was asserted to have a scriptural basis. Any idea that opposed such ideas as the geocentric theory must be erroneous, or even worse, heretical, as exemplified in the charges on which Galileo was tried and condemned by the Cardinals of the Inquisition for suggesting the Copernican theory of the universe: "The proposition that the Sun is the center of the world and does not move from its place is absurd and false philosophically and formally heretical, because it is expressly contrary to the Holy Scripture."[1]

The theological linking of the truth of the geocentric theory with the truth of scripture placed Christian theology itself in a very awkward position. For if the geocentric view so supported should ever lose favor and be replaced by the heliocentric theory, scripture itself and those who proclaimed scripture as the criterion of truth and falsity would both be called into question.

This seems to be what actually happened. Science established

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[1]Quoted in Georgio de Santillana, The Crime of Galileo (Chicago: The University of Chicago Press, 1955), p. 307.

the Copernican theory to the point where even the Catholic church, which had condemned Galileo and prohibited the publication of his Dialogue, had to reverse itself. Furthermore, the same story has been repeated in other conflicts between theology and science. Regarding the question of the age of the universe (six thousand years as was worked out by Archbishop Ussher from the genealogies of Genesis versus the billions of years assumed by some scientific theories), regarding the question of the manner of creation (special creation of each species by God at the beginning of time versus evolution), regarding the question of the nature of disease (brought about by evil spirits and cured by prayer versus brought on by micro-organisms and cured with the help of chemical compounds and other means of modern medicine)--regarding all these issues the more recent theories of science have won the day over older scientific or philosophical ideas affirmed by theology. And most important, in as much as the older theological views were held on the grounds that they were the truth revealed by God and recorded in scripture, the authority of scripture itself is called into question as the means of deciding whether ideas are true or false.

The calling into question of the method of appealing to scripture, used by many traditional theologians to establish the truth of their ideas, has been one factor that has contributed to the decline of organized religion and to the corresponding bewilderment of men, including scientists, who seek to commit themselves to something of ultimate worth but do not know what that something is. Thus religion itself, although it is more than theology, has been hurt by the conflicts between science and theology. For how can one commit himself to something of ultimate worth if he does not have at least some partial knowledge of what that something is? It is theology's task to try to provide that knowledge. However, if in the conflicts with science over what may be more properly called scientific questions, the method of theology is called into question--in spite of the claims of many theologians and religious leaders as to its validity--how is the scientist to accept that same claim concerning the validity of a theological method that uses scripture interpreted by the theologians to establish knowledge of what in life is worthy of man's ultimate commitment? The past failure of this method when used by theologians in conflicts with science offers no positive reason for the continued belief that theologians can still provide knowledge about that which should be the object of man's most intensive and comprehensive valuing.

This loss of confidence in the claims of theologians and the corresponding befuddlement in religious commitment becomes a serious problem when one recognizes that at the same time science has helped call theology into question, it has also enabled men not only to gain a greater understanding of the physical world than ever before but also a continually increasing ability to control and even alter that world. Nothing illustrates this more clearly than the discovery and development of atomic energy and the ability given to the world's leaders by scientists to use such energy for destructive purposes or for the making of a better life. Furthermore, the success of the method of science in helping man to gain an understanding of and control over inanimate nature is currently being extended to man himself with the development of such sciences as eugenics and genetic engineering. Finally, although it is still developing as a science, the study of men's relation to their environment and to one another promises to result in the ability further to control the life of men.

With this increasing power given by science to men to alter and control the world, including man himself, one is forced to ask, to what end should such power be used? How can one avoid using it, as it often has been used in recent history, to destroy? Is there something that can demand universally the total commitment of men, something which can so order every man's life so that the power given to man by science can be used for the good of mankind rather than for evil? Science, itself, because of the power it has unleashed drives us to ask the fundamental religious question.[1]

Who is to answer this question? It is the theologian's task to seek an answer. However, the method of appealing to scriptures, used by many theologians to arrive at answers to questions, has itself become problematic. Thus a serious dilemma is the end result of the conflicts between theology and science. On the one hand science increases our understanding of the world, man and society and releases into our hands the power to control and alter the world, thus raising the question as to how that power is to be employed. On the other hand, theology, which is the intellectual discipline supposedly equipped to answer this question, has been repeatedly called into question as to the adequacy of its method of appealing to scripture and the validity of the ideas resulting from the employment of this method. In the end, when science

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[1]Cf. the call of a well-known scientist for religion to provide the proper guidance for science: "The day is come when man has gained the power actually to destroy himself if he will. Whether his moral stature can rise to the demands made on it by the modern world is the gravest problem he is facing now. This stems directly from the progress of the sciences and demands for its solution an equal progress in morality and in religion." Edmund W. Sinnott, Science and Religion: A Necessary Partnership (New Haven: The Edward W. Hazen Foundation, 1951), p. 21.

and theology are held in conflict, both the theologian and the scientist suffer--the former because confidence in his discipline is eroded and the latter because, with a loss of confidence in those who are supposed to provide some knowledge of that which works for the good of man when man totally commits himself to it, to whom can the scientist and the one who uses the power given by science turn for guidance concerning the best way to use science for the benefit of mankind?

Two sphere approaches to science and theology.--Aware of the detrimental effect that a direct conflict between science and theology has for both enterprises, many today have turned toward a second way of relating science and theology; they have tried to relegate scientific thinking and theological thinking to two separate spheres in such a way that they cannot possibly conflict. This is done by maintaining that not only is the subject matter of theology totally different from that of science but that the method by which ideas are developed and evaluated by the theologians is different than that employed by the scientists. With distinct subject matters and methods of inquiry the two enterprises cannot come into conflict.

Perhaps the most prominent example of the two sphere approach to relating theology and science has been that of the neo-orthodox theologians, among whom Karl Barth is the dominant figure.[1] To characterize it very briefly, for neo-orthodoxy both the subject matter and the method

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[1]Karl Barth, Church Dogmatics, II, 1, ed. G. W. Bromiley and T. F. Torrance (New York: Charles Scribner's Sons, 1957), pp. 3-254; Karl Barth, Church Dogmatics: A Selection, trans. and ed. G. W. Bromiley (New York: Harper & Brothers, Harper Torchbooks, 1962), pp. 29-86; Heinrich Emil Brunner, "Nature and Grace," and Karl Barth, "No!", Natural Theology, trans. Peter Fraenkel (London: G. Bles, The Centenary Press, 1946).

of theology are distinct from that of any other discipline. The subject matter is a transcendent God "beyond" the structures of space-time but, nevertheless, at certain points breaking into history with judgment and grace. Because God is not within space-time, man cannot gain any knowledge about God by ordinary human means: neither everyday experience, nor reason, nor even the combined refinement of these in science can yield knowledge about the transcendent God according to neo-orthodoxy. Such knowledge can only come from God himself through his own self-disclosure within certain historical events. Such events are recorded in the Christian scriptures; it is, therefore, to these that one must turn to gain knowledge of God.

However, scriptures are also the human recording of God's self-disclosing. Because of this, the report of divine revelations is cradled within the various understandings of man, society and the physical world held by the many biblical writers. This realization helps one to understand how scripture might be in error concerning certain "scientific" questions, while at the same time the claim can be made that it presents a true understanding of God. From the neo-orthodox point of view one can distinguish between human experience and reason in scripture, which are quite fallible, and the message of a God who has created man and who judges and redeems man, which cannot be called into question from any human point of view, because it is the content of God's own revelation.

In order to distinguish between what is human and what is divine in scripture, one must have some criterion, some normative revelation in which God discloses himself more completely than at any other time. The neo-orthodox point to the life, death and resurrection of Jesus Christ as the primary revelation of God that provides the final norm for evaluating all other ideas about God and his relation to man, even other ideas recorded in scriptures.

It can be argued that neo-orthodoxy's two sphere approach to science and theology does a service for theology and ultimately preserves the Christian religion. In this respect it is a powerful solution to the problem of theology and science, especially if one stands within this theology itself. However, if one backs off and looks at it from a distance, from the point of view of a philosopher of religion, this two sphere approach to science and theology appears to actually widen the gulf between them. On the one hand science can in no way be used to help the theologian understand the nature of that to which one must ultimately commit oneself. On the other hand, theology cannot guide the scientist concerning the object of religious commitment. Of course, the neo-orthodox theologian can tell the scientist about that to which he ought to totally commit himself, admitting that Christian theology has made a grave mistake in attempting to provide answers to "scientific" questions. But the scientist then recalls that the answers to those questions provided by the theologian concerning the world and creation were derived by the same method that the theologian is now using to give him knowledge about God; they were, according to the claim of the theologians, a part of God's revelation. That claim is now acknowledged by the neo-orthodox theologian to have been mistaken. However, what reason has the scientist to accept the same claim concerning the knowledge of God? In the final analysis, especially for one who stands outside of the framework of neo-orthodoxy, the claim that a supernatural God has disclosed himself in certain historical events is a human claim. The two sphere approach thus may not be so much a solution to the conflicts between science and theology as a symptom of the gulf that the specific conflicts concerning certain theories about the world have created.

One way of countering the questioning of the claim to have a special revelation that gives knowledge about that to which man is to ultimately commit himself is to say that the claim itself becomes validated for each individual, whether he be scientist or not, when he has an experience of God. This is a position held by some who offer a second two sphere approach to science and theology, that based on religious experience.

From Schleiermacher's feeling of absolute dependence to Rudolf Otto's experience of the numinous and Buber's I-Thou encounter, a variety of types of religious experience have in some way or other served as a ground for theological ideas.[1] In some ways this approach to theology may be regarded as an attempt to take into account the scientific appeal to contemporary experience as a criterion for knowledge while at the same time affirming that both the content and method of theology are completely distinct from scientific inquiry, because religious experience is itself a special kind of experience.

One of the most responsible current representatives of this approach is Donald D. Evans, who presents five types of religious experiences, which he calls "depth experiences," as the ground for faith in God: the encounter with another person in which each becomes more truly human, the "overwhelming feeling of awe" when beholding the beauty of

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[1]Friedrich Schleiermacher, The Christian Faith, I, ed. H. R. Mackintosh and J. S. Stewart (New York: Harper & Row, Publishers, Harper Torchbooks, 1963), 12-18; Rudolf Otto, The Idea of the Holy, trans. John W. Harvey (New York: Oxford University Press, A Galaxy Book, 1958), pp. 5-40; Martin Buber, "I and Thou," The Writings of Martin Buber, ed. Will Herberg (New York: Meridian Books, Inc., 1960), pp. 43-62.

nature, "a strong sense of moral responsibility," the state of radical despair with its complementary passionate protest against the meaninglessness of life, and, finally, the compassionate sharing of the suffering of another human being.[1] He then asserts that these experiences serve as the ground for the belief in "a hidden personal being" called "God," who reveals himself through these experiences "as the Eternal Thou, the awesome numinous, the Moral Sovereign, the source of meaning, and the grieving friend."[2]

The basic question that must be put to Evans concerning these experiences of God is how does one validate the relating of a hidden personal being to the depth experiences of life? To answer this question one must note that Evans' depth experiences are not pure but are really interpreted experiences, and that there are at least three levels of interpretation.[3] These levels can be seen if one examines his presentation of each of the five kinds of experience. We shall limit ourselves to the experience of personal encounter. Evans writes:

> I encounter John Brown. He has an I-Thou attitude toward me, as Martin Buber would say. That is, he is outgoing, open, available, and responsive. He focuses his whole self exclusively on me in

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[1]Donald D. Evans, "Differences Between Scientific and Religious Assertions," Science and Religion: New Perspectives on the Dialogue, ed. Ian G. Barbour (New York: Harper & Row, Publishers, Harper Forum Books, 1968), pp. 102-107.

[2]*Ibid.*, p. 108.

[3]Of course there are no "pure" experiences as Evans rightly acknowledges when speaking of scientific experience: "there are no 'pure' observations, 'given' perceptions, or 'raw' experiences. Human minds impose various conceptual frameworks on all observations, perceptions, or experiences." *Ibid.*, p. 118. However, one can still, through analysis, distinguish conceptual and perceptual aspects of experience, and it is this that Evans does not sufficiently do in regard to religious experience. The result is what looks like a unique type of experience but is not.

> my uniqueness, involving himself in my world and committing himself to me. If I respond in kind, even though less profoundly, something mysterious flashes between us, changing both of us so that we become more truly human, more real as persons.[1]

What is in this encounter or experience of John Brown? At the first level there are sense experiences of certain words, expressions, which are interpreted by Evans as Brown being "outgoing, open, available, and responsive," or as having "an I-Thou attitude toward me." There is nothing specifically religious about this kind of experience; it is simply sense experience coupled with a rather common interpretaion.

Evans also speaks of "something mysterious flashing between us" in the encounter. Here a second level of interpretation seems to emerge. There are not only two people becoming involved with each other on the one hand, but also the awareness of a "new meaning in life" for each on the other hand. In between something happens which Evans cannot specify; he refers to it as something mysterious. What does this mean? Does it simply mean, as a scientist would tend to look at it, that what happens is largely unknown, although perhaps not entirely beyond the realm of scientific inquiry? If this is so, the indication of something mysterious is an indication of something to be explored as to its true nature. The something mysterious then is not something unique to religion. Evans does not seem to understand mysterious in this way. That something mysterious happens indicates that there is something religious about the total experience: "the superstructure of religious and theological assertions, however, is based on reports of elusive and mysterious depth-experiences rather than on common-sense observations."[2] And yet, not only are these

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[1]<u>Ibid</u>., p. 102.

[2]<u>Ibid</u>., pp. 128-129.

depth experiences tied to definite sense observations, as we have indicated, but as Evans himself admits, even an atheist can have depth experiences that are mysterious. Only, for the atheist the mysterious aspect of the experience indicates something about men and not about God. It does not mean that the experience is uniquely religious.

The question still remains, how do the sense experiences, interpreted at the two levels we have indicated, qualify as religious experience, that is, as experience to which theological assertions are related? This brings us to a third level of interpretation, one which Evans explicitly acknowledges. Although each of the five types of depth experiences could be had by an atheist and could be interpreted as non-religious, simply as revelations concerning man, he argues that they can also be interpreted as revelations concerning both man and God, and this latter interpretation is that of "faith." "Faith is an ongoing practical commitment to an interpretation of some depth-experiences as revelations not only of man but also of God. . . . [The faith of the believer] presupposes a belief that there is a hidden personal being called 'God' who sometimes reveals Himself in depth-experiences."[1]

We must now push our basic question of why call depth experiences religious one step further and ask, what is the grounds for faith? The answer is not that one can directly experience or observe God, for Evans says that this personal being is hidden. It is not that the interpretation of faith can be tested as an explanation that accounts for how depth experiences come about, for Evans denies the validity of any such testing. He says that even if people stop having depth experiences, as a believer one

[1]*Ibid.*, p. 103.

should go on believing. "Depth-experiences depend on elusive personal conditions, and those which are divine revelations also depend on the free action of God. Men ought not to try to test God; it is God who 'tests' men by sometimes withdrawing His presence."[1] Why then accept Evans' interpretation of faith that depth experiences are revelations of God? In the end it seems to come down to also acknowledging one's membership in an historic religious community: "the believer's convictions concerning what counts as revelation are derived mainly from the religious community."[2] And the community itself must derive its interpretation from some special source of knowledge, a source which not only reveals God but which tells us that God is revealed in the depth experiences Evans describes. Thus, when we start with religious experience, such as that described by Donald Evans, if we ask why call that experience "religious," we seem to be driven back to the same point made by neo-orthodoxy, that ultimately knowledge of God comes from a special divine disclosure, a communication from God not only about the nature of God but also about how God, who is hidden, is to be experienced in our own lives.

If this is so, the same question can be raised in regard to religious experiences as was raised in regard to neo-orthodoxy. How can one rely on the claim of theologians to have a special revelation that gives knowledge of God's presence in certain life experiences when in conflicts with science concerning questions about the nature of the world and creation that same claim has been called into question?

It is perhaps becoming clear to the reader that one of the major

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[1] _Ibid._, p. 129.

[2] _Ibid._

results of conflicts between science and theology is that science itself has come to provide the understanding as to what constitutes knowledge. For knowledge results when one uses the criterion that is the distinguishing characteristic of science, namely the prediction of what can be observed in controlled observations. This understanding of knowledge has reinforced a philosophical understanding of knowledge known as empiricism; only what can be tested by the fulfillment of predicted observations can be said to be known.[1] In its extreme form, the empiricist concept of knowledge takes the form of logical positivism, in which only statements that can be verified or falsified by sense experience are meaningful statements. When this is applied to theological statements, since even according to the claims of many theologians, theological statements are not testable in relation to ordinary sense experience, theological statements are meaningless. They cannot give any kind of knowledge.

In light of the predominance of the empiricist view of knowledge, of which the scientific method is a refinement, some theologians, on the basis of a recent development in philosophy known as linguistic analysis, have developed a third way of separating science and theology into two completely separate spheres.[2] They argue that although theological

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[1]Technically, empirical knowledge and scientific knowledge are different: empirical knowledge is based on predictions of what can be experienced with the senses, while scientific knowledge is based on predictions of what can be experienced in controlled observation, as we have described <u>supra</u>, pp. 4-5. Hence scientific knowledge is a special case of empirical knowledge, and as such reinforces philosophical empiricism.

[2]For excellent discussions of linguistic analysis and its relation to theological language, cf. James A. Martin, Jr., <u>The New Dialogue Between Philosophy and Theology</u> (New York: The Seabury Press, 1966), esp. pp. 130-166; and Frederick Ferré, <u>Language, Logic and God</u> (New York: Harper & Row, Publishers, Harper Torchbooks, 1969), esp. pp. 121-145. More brief but also helpful is Ian G. Barbour, <u>Issues in</u>

assertions such as "God exists" or "God loves" are not empirically verifiable and hence cannot claim to provide knowledge, such assertions are not meaningless as the earlier positivists had argued. This is because the meaning of a statement is not dependent on whether or not it is a cognitive statement but is to be determined according to how the statement is used, and there are many uses of statements other than to provide knowledge. Theological statements may be meaningful in that they give recommendations about how to live by advocating allegiance to certain moral principles. Or it may be that the proper use of theological language is in relation to worship: its function is to praise God and not to describe him. Or theological language may be viewed as meaningful in that it evokes a total life commitment to that which is of ultimate worth, usually called "God."[1]

The studies made of the various uses of language, including theological language, have been quite helpful in pointing out the complexity of the statements we make and that statements have other important functions besides offering knowledge. However, they do not help us in the search for a way to gain knowledge about God, and, unless we are able to gain at least some knowledge about God, some of the other functions of theological language become problematic. For how can one worship God if he does not know what he is worshipping? Or, more important, if theological language is to evoke one to some kind of ultimate commitment, to what is

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Science and Religion (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1966), pp. 121-125, 243-248.

[1]According to Barbour, representatives of the view that religious language has functions other than providing verifiable statements and hence knowledge include R. B. Braithwait, D. M. MacKinnon, Ian Ramsey, Paul Holmer and William Zuurdeeg. Ibid., pp. 244-247.

one supposed to be ultimately committed? A typical answer is that one is to be committed to God. But who or what is God? Unless one has some knowledge of that to which he is to be committed, the call to commitment is really quite empty. One cannot commit himself simply to a theological term.

Many of us, including the scientist, are seeking something worthy of our total commitment, something which can help guide us in the proper use of the power unleashed by science so that man will benefit rather that be destroyed. However, the separation of science and theology with the claim that in the final analysis theological assertions about God give us no knowledge about God seems to be the most complete way of assuring that theology can never offer any guidance in directing the power of science. This is in fact the problem with each of the three approaches we have examined, which relegate science and theology to two separate spheres. Ian Barbour well summarizes this criticism of the two sphere approach: "The defense of religion from attack by science is accomplished by totally separating them; no conflicts are possible because any issue is assigned to one field or the other, but never both, on jurisdictional grounds. But by the same token neither can contribute positively to the other."[1]

Toward a constructive approach.--We have mentioned that many have accepted the view of science as to what constitutes knowledge. It has been recognized as such by many theologians who, operating in the philosophical framework of linguistic analysis, view religious statements as non-cognitive, although meaningful, statements. Of course, the

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[1] Ibid., p. 116.

scientific understanding of knowledge is not accepted by the neo-orthodox and religious experience theologians. They have another understanding, and it is the difference in understandings of how knowledge is to be achieved that is one of the two aspects that is at the heart of the problem of relating science and theology. The other aspect at the heart of this problem is two different views of the reality about which knowledge is sought, views which correspond to the respective epistemologies of science and of neo-orthodox or religious experience theology.

Since we shall develop the scientific understanding of knowledge and reality more fully in Chapters II, III and IV, we shall focus on the view underlying the theological positions we have just been considering. In these positions the view of the reality about which knowledge is sought is of God as a personal being. This means that God is considered to be some kind of entity acting upon other entities in the world and that this entity called God can be conceptualized in personal terms. God can be referred to as "He" or as "Father" or as "Lord," and this "He" creates, sustains, directs, judges and redeems the world. This ontology of God as a personal being has its corresponding methodology. As a personal being God is known as other personal beings are known, through their communication to one another in word and deed. In this manner the personal view of God presents both an understanding of the reality of God and of how that reality is to be known.

The correspondence between ontology and methodology concerning God is most clearly seen in neo-orthodoxy, where knowledge of God is to be had only through communications from God himself, spoken of as the "word of God," and where the God so communicated is conceptualized in personal terms such as the ones mentioned above. This correspondence is less explicit when one views the religious experience theologians, but if our analysis is correct, in the end the relating of God conceptualized as a hidden personal being to certain depth experiences depends on some prior revelation that God is present in such depth experiences.

When we examine those theologians who regard theological assertions as non-cognitive assertions we find a curious absence of correspondence between ontology and methodology concerning God. In fact it is more than a lack of correspondence; it is a confusion. On the one hand, the ontological view seems to be that of a personal being; on the other hand, the method accepted for gaining knowledge is an empirical one akin to that of science.[1] It may be that this confusion is what is primarily responsible for the problems that have arisen in our century concerning the knowledge of God or, better, the inability to gain knowledge of God.

The confusion of views of the reality of God and of how knowledge

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[1]This confusion seems not only to be present in the critics of theology, such as Antony Flew, as we shall see below, but also in a theologian like Paul Holmer, Theology and the Scientific Study of Religion (Minneapolis: T. S. Denison & Company, Inc., 1961), p. 26: "As knowledge becomes more precisely ordered, the learned have to admit not only their ignorance but also that there is plenty of room left for faith and theology. . . . We are beginning to see that contemporary learning has little to contribute directly to a theological view; for theological convictions are not hypotheses, and they are not probable or improbable on the basis of evidence. The passing of time and the accumulation of learning has little to augment them or to alter then fundamentally." With this dichotomy between knowledge and faith, Holmer combines the notion of God as a personal being, who cannot be decerned except through faith: "It must be apparent already that God contrives to maintain His invisibility. Not even the most refined tools of learning have enabled us to discern the presence of God. Nature is His handiwork and history His arena, but only the handiwork and the arena are directly present. But all of this is to say again that within everyman is another potentiality, not of sight and hearing and learning, but of moral sensitivity and ethical inwardness. When this inner life is awakened and becomes strong, then the relationship to God is established. Then it also becomes possible to see God everywhere. This is the work and province of faith." Ibid., p. 233. Cf. Barbour, Issues in Science and Religion, p. 124.

of that reality is achieved seems to go back to the predecessors of the linguistic analysts, the logical positivists. We find it in what has become a basic parable concerning the question of knowledge about God for this school of philosophy, John Wisdom's story of two men in search of an invisible gardener, and in Antony Flew's retelling of the parable to make the point that what at first appears to be an assertion that might be empirically tested and can in principle be falsified actually becomes an assertion that is in no way falsifiable and hence not a cognitive assertion.

> Once upon a time two explorers came upon a clearing in the jungle. In the clearing were growing many flowers and many weeds. One explorer says, "Some gardener must tend this plot." The other disagrees, "There is no gardener." So they pitch their tents and set a watch. No gardener is ever seen. "But perhaps he is an invisible gardener." So they set up a barbed-wire fence. They electrify it. They patrol with bloodhounds. . . . But no shrieks ever suggest that some intruder has received a shock. No movements of the wire ever betray an invisible climber. The bloodhounds never give a cry. Yet still the Believer is not convinced. "But there is a gardener who has no scent and makes no sound, a gardener who comes secretly to look after the garden which he loves." At last the Sceptic despairs, "But what remains of your original assertion? Just how does what you call an invisible, intangible, eternally elusive gardener differ from an imaginary gardener or even from no gardener at all?"[1]

Flew then goes on to point out that such theological assertions as "God has a plan," "God created the world," and "God loves us as a father loves his children," like that of the believer in the parable, although they look like assertions that should be experimentally testable, in the end die the death by a thousand qualifications in that nothing is allowed to count against them.

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[1]Antony Flew, "Theology and Falsification," New Essays in Philosophical Theology, ed. Antony Flew and Alasdair MacIntyre (New York: The Macmillan Company, 1966), p. 96; cf. John Wisdom, "Gods," Philosophy and Psycho-analysis (Oxford: Basil Blackwell, 1957), pp. 154-155.

This parable and what it illustrates has been taken by many to indicate why theological statements cannot claim to give any knowledge about God; this conclusion has been accepted by many theologians, who have turned to examine other uses of such statements. However, it seems to me that the fault of all this does not rest with theology itself but with a mistaken notion of theology contained in the parable. The mistake is to assert that theology can only understand God as a personal being who plans, creates and loves, while at the same time claiming that one should evaluate statements about God coming out of such an understanding by using a method that is not compatible with this view of God, namely the empirical method based on sense experience. It is this confusion that prevents the gaining of knowledge about God. If it were remedied such knowledge might once again be a possibility.

One way of remedying this confusion is to bring the method by which one gains knowledge about God into line with the understanding of God as a personal being. This indeed is what neo-orthodoxy has explicitly done, and it is to be commended in so far as it has recognized the need to have an epistemology that is consistent with its ontology concerning God. However, as we have already pointed out, this approach has serious drawbacks as a way of relating science and theology. This leads us to ask, is there another way to remedy the above confusion? There may be, namely to attempt to develop an understanding of God that is consistent with the method of science, which is a refinement of the empirical method. If this could be done, not only could one gain knowledge about God by using the method of science but one could also constructively resolve the problem of the relation of science and theology and thus remove a major block to a positive relation between science and religion.

This second alternative is the one we wish to explore in the remainder of this dissertation. In pursuing it we are admitting that the understanding of God as a personal being is of such a nature as to preclude the use of the method of science to investigate the nature of God.[1] However, we can also ask, might it not be possible to have a view of what is to be the object of our most intensive and comprehensive valuation that is such that the nature of this object is open to investigation by the method of science? If this is acknowledged as at least a possibility, and we ask nothing more right now, then the basic question we are interested in exploring is twofold: can the method of science be used to develop and evaluate ideas about God; what kind of God can the method of science investigate?

In suggesting and exploring an answer to these questions we shall not attempt to eliminate all distinctions between theology and science. However, instead of arguing that the major distinction is one of method we shall maintain that it is one based on the kinds of questions asked. As we shall point out in the following chapters, there are similar differences in conceptual schemes between the various sciences, and these differences account for the differences between the sciences as to the subject matter and the specific techniques by which the subject matter is analyzed. But we shall also attempt to show that even with different conceptual schemes all the sciences use a general method that employs certain procedures, criteria and attitudes in developing and evaluating

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[1]This does not mean, however, that one cannot use personal language in speaking both about our relation to God and in some cases about God himself. To use personal terms such as "love" and "wisdom" in referring to God is not the same as having a view of God as a personal being. Cf. <u>infra</u>, pp. 259-262.

scientific hypotheses.

What distinguishes a theological conceptual scheme from those of forms of inquiry that are commonly called scientific is the kind of questions asked. Theology asks what is good and what is evil, and most important, what saves men from evil and brings about the greatest good that is possible, and is hence worthy of being the object of man's most comprehensive and intensive valuation. Whatever does this, we shall argue, may appropriately be called God.[1] Now, when this conceptual scheme is employed, and if one meets the basic scientific requirement of investigating only that which exists in space-time by postulating, as an understanding of what brings about the greatest possible human good, an existing process called creative interchange, then it becomes possible in principle to use the method of science to develop and evaluate ideas about God.

This is the suggestion as to how theology might become scientific that we wish to explore. We shall proceed as follows: in Chapter II we

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[1]The words, "good," "evil," and "greatest good" have a wide range of meaning in common usage. We shall develop our own understanding of them in Chapter IV, <u>infra</u>, pp. 121-136. Briefly, "good" refers to relationships of mutual support between what men value, while "evil" refers to relationships that are destructive of what men value. To "value" something means to desire it consciously. Not all that is valued is good, i.e., supportive of other values.

The word "greatest good" as it is used here refers to the greatest good that is possible under existing conditions. This will always be our understanding of "greatest good" when we use it in connection with what is good for man. Because "greatest good possible" means possible under existing conditions and not the greatest good possibly conceived, we often shall substitute for it the word "greater good," which means an increase in relations of mutual support between what men value; cf. <u>infra</u>, pp. 127-128.

However, we shall use the word "greatest good" also in connection with God, as often has been done in western theistic religion, <u>infra</u>, pp. 136-137. Here the word has a slightly different meaning; it refers to what brings about greater good or the greatest good possible for man under existing conditions. This is our understanding of salvation. Hence, God is the greatest good because of what God does for men.

shall attempt to come to a fuller understanding of science by examining the relation between experience and concepts, the distinction between data and facts, ways of classifying scientific laws, the nature of an "ideal" scientific theory and the question of the existence of theoretical entities. In Chapter III we shall expand our basic definition of science as the process of inquiry by which hypotheses are developed and evaluated against controlled observations and experiments by outlining some of the procedures, criteria and attitudes employed in developing and evaluating scientific hypotheses. It is out of this process that scientific laws and theories arise as explanations of facts.

In Chapter IV, following the thought of Henry Nelson Wieman, we shall begin to explore how one might develop a conceptual scheme for a scientific theology. First we shall outline what is good, evil and the greatest possible good for men in life's cognitive, aesthetic, social and personal dimensions. We shall do this in such a way that at least in its cognitive dimension the greatest possible good can be linked to certain regularly occurring phenomena subject to controlled observation. Again following Wieman we shall also introduce a concept of what brings about the greatest possible human good, a process in space-time called "creative interchange," and shall indicate how one must go beyond Wieman if one is to develop and evaluate ideas about creative interchange with the method of science. In Chapter V we shall continue to use the thought of Wieman but shall also use aspects of the method of science itself and research carried out by social scientists as sources of ideas about the nature of creative interchange. We shall note in particular the similarity between Wieman's fourfold "creative event" and our understanding of the general method of science outlined in Chapter III, and shall examine why

Wieman does not see this similarity himself. Then, using our three sources of information we shall develop hypotheses about the stages and subprocesses of creative interchange, hypotheses which also operationally define creative interchange in terms of activities in which human beings can engage. Finally, we shall examine the types of conditions considered to be necessary for the effective operation of creative interchange, indicating how these can also be regarded as variables to be controlled in scientific experiments. In Chapter VI we shall conclude our exploration of how one might develop a possible scientific theology by first discussing the need for clearly stating the facts of such a theology, phenomena of a type that occurs regularly and is publicly discernable in controlled observation. Next we shall attempt to construct such facts by operationally defining the greatest possible human good in its cognitive dimension. Then we shall design a possible experiment that tests hypotheses about the subprocesses of creative interchange against our theological facts, and finally we shall discuss the grounds for generalizing the results of this kind of experiment.

Although at this point we will have explored how the method of science might be used to develop and evaluate ideas about creative interchange, a final link must be forged in our argument before the possibility of scientific theology becomes fully clear. We must answer the question, why call the process of creative interchange "God"? In response to this question we shall outline how one might justify calling creative interchange "God" by using two criteria based on our original definition of religion and by comparing our notion of God with that of other theological conceptual schemes, using traditional supernatural Christianity as our primary example.

As this brief outline of our procedure indicates, the problem of whether the method of science can be used to develop and evaluate ideas about God is extremely complex. It is so complex that it would be foolhardy not to admit at the outset of our exploration that instant success in developing a scientific theology is not at all assured; indeed it must seem to many to be highly improbable. However, it is my belief that whether one is immediately successful or not in developing a way in which the method of science might be used to develop and evaluate ideas about God is relatively unimportant; even a cursory study of the history of human inquiry shows that as much can be learned from failure as from success. What is important is that an attempt is being made to constructively relate science and religion. If this dissertation does nothing more that stimulate some thought among its readers and provoke further such attempts, I will personally be satisfied.

# CHAPTER II

## EXPERIENCE AND CONCEPTS OF SCIENCE

> If, on the one hand, every positive theory must necessarily be based on observations, it is equally sensible, on the other hand, that in order to carry out observations our minds need some theory.
>
> Auguste Comte

In our first chapter we defined "science" as a form of inquiry that seeks to explain, predict and control phenomena by developing, with the aid of certain procedures and attitudes, hypotheses, which, if they fulfill certain criteria including the occurrence of expected facts perceived in controlled observation, become laws and theories. We then suggested that it might be possible to use the method of science to develop and evaluate ideas about God, and also raised the question of what kind of God might be so investigated. We must now spell out more completely what it means to use the method of science. This will be done in two steps. In this chapter we shall seek to come to some understanding of the nature of certain scientific concepts, namely laws and theories, and their relation to that which the scientist perceives with his senses. After speaking of the interaction between concepts and experience we shall make a distinction within experience between data and facts. Then we shall examine the various types of scientific laws and the nature of an "ideal" scientific theory, concluding with a discussion of the problem of the existence of theoretical entities. In the next chapter we shall outline more completely what we will call the general method of science, conceived of as a set of procedures, criteria and attitudes that aid in the development and evaluation of possible scientific laws and theories.

To illustrate the points made in these two chapters we shall draw on both the physical and social sciences. One reason for this is a concern to show some of the similarity between these two types of scientific inquiry, especially in regard to the general method of science. A second reason is that some of the specific techniques of inquiry employed in the social sciences will be relevant to our later discussion as to how the method of science might be used to evaluate ideas about God. This is because the model of God we shall be proposing is a model of a social process rather than a physical process.

## Experience and Concepts

Scientific knowledge grows out of the complex interaction between experience and the various kinds of concepts that formulate experience. The interaction between experience and concepts is reciprocal. On the one hand, experience is the source and the ultimate test of various scientific concepts; on the other hand, already formed concepts help to determine what kind of experiences one has.

One of the oversimplifications found in some writings about science is the view that the person seeking knowledge comes to the world as a completely neutral and objective observer. Based on the correct notion that all experience is received through receptors that are the same in all normal human beings, this view erroneously concludes that every person has the same kind of experience. What it ignores is that in addition to physical receptors, without which there can be no experience, human beings from the time of birth build up a conceptual system that organizes past experience and helps to determine the kinds of succeeding experiences each individual has.

The conceptual system that organizes experience is learned. Learning takes place in many ways. It may come through experience itself, when the conjunction of two or more phenomena is repeated over and over until one of the phenomena comes to be regarded either as a sign of or as a condition of the others. This kind of learning enables a rural farm boy, a man of the jungle or an experienced seaman to see things that a city dweller would be totally unaware of when he is with them. As Leonard K. Nash writes, "we learn not only how to see but also what to see; often we simply don't see any thing for which our learning has not, in some sense, prepared us."[1]

Although learning takes place through everyday experience of the world, in our modern society it also involves the learning of a well developed language, through which a culture's basic ideas about the way things are, and its customs, conventions and values are conveyed. These ideas also become part of the conceptual scheme that helps determine how a person experiences the world. A rather trivial but enlightening experiment that illustrates this was carried out by J. S. Brunner and Leo Postman. They asked subjects to identify a series of playing cards on short and controlled exposures. Many of the cards were normal but some were not--for instance, a red six of spades and a black four of hearts. Even on short exposure the subjects had no difficulty identifying the normal cards correctly, but the abnormal cards were also identified as

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[1]Leonard K. Nash, The Nature of the Natural Sciences (Boston: Little, Brown and Company, 1963), p. 9.

normal, being fitted into a learned conceptual category of the nature of playing cards. If the experiment had stopped there, most subjects would never have known that there was anything amiss with the playing cards. But with increased exposure many of the subjects became aware that something was wrong, even though they still could not identify what the problem was. Exposed to a red six of spades, for example, some would say, "that's a six of spades but there's something wrong with it--the black has a red border." Further exposure increased the confusion until, sometimes suddenly, the abnormal card was correctly identified. Then after identifying two or three of the abnormal cards correctly, subjects had little further difficulty identifying others. They had enlarged their conceptual system of what was to be expected in experience, making it possible to recognize the abnormal cards. Some subjects, however, were never able to make the required adjustment of categories.[1]

While the playing card experiment illustrates that a person's mental set composed of learned concepts can help determine what he experiences, it also illustrates that experience itself, if persistent enough, can alter a person's conceptual categories. A key factor seems to be that the experience must be persistent. At first the subjects in the

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[1]J. S. Brunner and Leo Postman, "On the Perception of Incongruity: A Paradigm," Journal of Personality, XVIII (December, 1949), 206-223; referred to by Thomas S. Kuhn, The Structure of Scientific Revolutions (Chicago: The University of Chicago Press, Phoenix Books, 1962), pp. 62-64. The subjects of the Brunner and Postman study were twenty-eight students at Harvard and Radcliff, who were not analyzed for factors that might make for individual differences as to their tolerance for incongruity. Hence no conclusions can be drawn as to why some individuals adjusted their concepts more rapidly than others and why some were never able to make the required adjustment. Nevertheless, the experiment still supports the general hypothesis "that perceptual recognition is powerfully determined by expectations built upon past commerce with the environment." Brunner and Postman, p. 222.

playing card experiment did not even notice the abnormal cards. But increased exposure led first to the awareness of something wrong and then to the recognition of what the problem was. Thus experience, at first determined by the conceptual scheme of the subjects in the experiment, in the end brought about a change in the conceptual scheme itself. The relationship between experience and concepts in this case was one of reciprocal interaction between the two.

So far we have discussed elements of a person's mental set that are learned by natural experience and from one's culture. Still other elements are acquired through formal education, in which one learns some of the specialized conceptual schemes currently prevalent in various disciplines. By learning these schemes through textbooks and in courses on various subjects one can have experiences that are impossible for those not trained in that particular subject, as is illustrated by Pierre Duhem's example of what a layman and the physicist each observe in the physicist's laboratory.

> Enter a laboratory; approach the table crowded with an assortment of apparatus, an electric cell, silk-covered copper wire, small cups of mercury, spools, a mirror mounted on an iron bar; the experimenter is inserting into small openings the metal ends of ebony-headed pins; the iron oscillates and the mirror attached to it throws a luminous band upon a celluloid scale; the forward-backward motion of this spot enables the physicist to observe the minute oscillations of the iron bar. <u>But ask him what he is doing</u>. Will he answer, "I am studying the oscillations of an iron bar which carries a mirror?" No, he will say that he is measuring the electrical resistance of the spools. If you are astonished, if you ask him what his words mean, what relation thay have with the phenomenon he has been observing and which you have noted at the same time as he, he will answer that your question requires a long explanation and that you should take a course in electricity.[1]

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[1]Quoted without reference by Norwood Russell Hanson, "Observation and Interpretation," <u>Philosophy of Science Today</u>, ed. Sidney Morgenbesser (New York: Basic Books, Inc., 1967), p. 96. Another illustration of

Different sciences are directed by different conceptual schemes. Because of this it is possible to perceive the same entity or event in several different ways, depending on the particular science. This is especially true if the entity is complex, like man. As Henry Nelson Wieman points out, a man may be described in terms of physics, chemistry, biology, psychology, sociology or in terms of a personal friend. All descriptions are valid; they complement one another.[1] Moving one step further, it is possible to argue that theology offers further conceptual schemes through which the world can be perceived. Just as various scientists experience the world in terms of conceptual schemes learned in graduate schools, so the professional theologian perceives things in terms of a mental set acquired in seminary. With their respective conceptual schemes both the theologian and the scientist may confront the same events but experience them in different ways. In a sense each perceives things that the other does not; however, each one's description

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our point is given by Michael Polanyi's example of how one has to learn to read an X-ray photograph, Personal Knowledge (New York: Harper & Row, Publishers, Harper Torchbooks, 1964), p. 101.

[1]Henry Nelson Wieman, Religious Experience and Scientific Method (New York: Macmillan Company, 1927), pp. 167-168. This notion of being able to view the same entity or event in terms of various conceptual schemes is close to the viewpoint that various sciences offer complementary languages in terms of which the world can be represented. However, to speak of complementary languages is not quite adequate, because a conceptual scheme through which a person views the world includes not only theories about the nature of reality and laws describing the regular conjunction of particular phenomena, which might be called the language of science, but also the techniques and instruments used to investigate the phenomena. Only by using the term "language" in the broadest sense can one speak of complementary languages. Our notion of conceptual scheme, while more than the notion of language, is very close to, if not identical with, Thomas Kuhn's idea of "paradigm," which is a scientific achievement that guides research and includes "law, theory, application and instrumentation together." The Structure of Scientific Revolutions, p. 10.

may be valid and complement that of the other.

The assertion that the theologian sees things that the various types of scientists do not see and vice versa raises the question of whether or not there is a special kind of religious experience. To answer this question we must examine in further detail what is meant by the notion of experience.

Experience can be described as either "sense experience" or "felt experience." The first is a fairly definite perception that is circumscribable in space and time. It may be the perception of a specific object such as a tree, or an event such as a Columbus day parade in New York, or of a bodily state such as a toothache. The second type of experience, felt experience, is more vague; although one can point to and identify felt experiences, because of their complexity they are more difficult to analyze into something specific and discrete. Felt experience may be associated with a specific object (one may feel the presence of something behind one's back), but it more commonly refers to events such as love between persons or to bodily states such as suffering, joy and peace.[1]

When the distinction between sense and felt experience is translated into forms of language it manifests itself as the distinction between denotative and connotative meanings of words. Denotative meaning indicates something that is definite, discrete and easily recognizable by

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[1]The distinction made here between sense and felt experience is based on but not meant to be an explication of the distinction between sense and felt quality made by Henry Nelson Wieman, The Source of Human Good (Carbondale, Illinois: Southern Illinois University Press, Arcturus Books, 1964), pp. 160-161, and Man's Ultimate Commitment (Carbondale, Illinois: Southern Illinois University Press, Arcturus Books, 1958), pp. 82-83, 146-147; and the distinction between the perceptual modes of "presentational immediacy" and "causal efficacy" made by Alfred North Whitehead, Symbolism, Its Meaning and Effect (New York: Capricorn Books, 1959), pp. 13-18, 39-49.

any number of people sharing a common language; it expresses sense experience. Connotative meaning is much richer, pointing to a complex and often broad range of interconnected events and emotions and is hence not so easily communicable from one person to another but tends to be more subjective or individualistic; it expresses felt experience. In fact, when it comes to expressing the richness of what is felt, words, even used connotatively, are sometimes not enough. Other symbolic structures are required, some involving patterns of words such as poetry, some involving a combination of words and actions such as drama, some involving no words at all such as music, painting or sculpture.

In noting the distinction between sense and felt experience, and between denotative and connotative meaning, we have already begun to analyze what many recognize to be a major distinguishing characteristic between the sciences and the arts. The scientist is primarily interested in sense experience, taking it and organizing it in terms of laws and theories in order to explain the phenomena experienced and their conjunction with other phenomena, and in order to predict and where possible to control the occurrence of such phenomena. The artist on the other hand is primarily concerned with felt experience, taking it and organizing it with artistic structures in a painting, novel, symphony or the like in order that his own felt experience may be awakened in others via the structures.

This distinction between the scientist and the artist is an important one, but if it is to adequately represent both, two qualifications must be made. The first is that scientist and artist may be concerned with the same basic thing that is experienced, whether it be an external object like a tree or some animal, an internal bodily state like a feeling of anxiety, a social organic unit such as a family or ethnic group, or a social process such as erotic love or an armed conflict. Both are concerned with the same thing although they approach it in different manners.

The second qualification is that while the scientist seeks sense experience and the artist is concerned with what is felt neither eliminates the kind of experience emphasized by the other from his activities. For example, when a scientist tests a given hypothesis he may have a feeling that something is wrong with his experiment, a vague awareness of something in the total situation that is present but which he cannot identify. This felt experience is a clue that he has not yet fully understood the phenomenon with which he is concerned, and it stimulates him to further research. In that research, however, because he is a scientist, he seeks to identify and isolate what he feels, thus converting felt experience into sense experience. To isolate and specifically define phenomena is still one of his primary concerns. The artist, on the other hand, is primarily concerned with capturing the fullness of what is felt, but he does not eliminate sense experience from this activity. In fact he often uses definite sense images in order to capture and convey felt experiences, using such images, however, for their connotations rather than denotations. Furthermore, the development of these images may at times involve the artist in a scientific study of the object of his concern, concentrating on discrete sense experiences rather than on the overall felt quality. For example, Michelangelo, in the course of his studies as an artist, studied human anatomy, in particular dissecting cadavers in order to determine the exact structure of the muscles. Whoever has seen the great sculptor's "David" cannot help but be vividly aware of the influence of this careful study of anatomy and also of Michelangelo's use of it to awaken in the observer a vast amount of felt experience that includes the power, beauty and magnificence of a human being.

That the scientist does not limit himself to sense experience but also takes into account that which is felt, striving to precisely delineate what he feels, and that the artist makes use of discrete sense experiences to evoke a wide range of felt experience indicate that these two types of experience are best viewed not as contrary to one another but as two stages on a continuum of a person's awareness in response to external stimuli.[1] The stage that is closest to the external stimuli in that it encompasses a greater amount of the world is felt experience. However, correlative to its capturing a greater amount of the world, to its being deeper, richer and broader, is a necessary vagueness of this kind of experience. Hence it is expressed in connotative language and other symbolic forms that point to but do not precisely describe the reality that is experienced. In order to eliminate the vagueness of felt experience and gain some degree of precision one must focus on specific, selected external stimuli. This allows for more discrete and circumscribed observations that we have called sense experience, uses denotative and hence more precise language that not only points to but claims to be descriptive of the world. However, its descriptiveness is only of selected aspects of reality; it sacrifices much of the fullness

[1]By external stimuli is meant stimuli external to a man's perceptual apparatus but not necessarily external to his body; hence body states may be regarded as external inasmuch as they physically manifest themselves through a person's nerve network, which is the apparatus associated with the tactile sense.

of the world, the complexity of all the external stimuli that bombard us at any given moment, and is therefore more abstract.[1]

We are now in a position to give an answer to our above question as to whether there is a special kind of religious experience, distinct from that of the scientist. In one sense the answer is yes. Religious experience is basically the same felt experience that is the primary consideration of the artist, but may be even richer, deeper and broader in the amount of reality it encompasses at any one moment. In the extreme it is the mystical union of the self with the totality of existence. Although this experience can be captured to some extent by symbols, which do not describe but only point to what is experienced, much of it is beyond positive expression. Hence, negative symbols may be used that point to the mysteriousness and transcendence of what is experienced.[2]

Yet, even though it is possible to regard religious experience in this sense as something distinct from the experience of the scientist, it is in my opinion not correct to maintain that, although it is akin

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[1]This view of the relation of felt and sense experience seems to correspond to a psychological analysis of the human mind that considers the mind as operating at levels of awareness, usually indicated by the terms "conscious" and "subconscious." It is not that there are two different parts of the mind involved or two different areas of reality experienced, but rather that there is a continuum of awareness from subconscious awareness, which is revealed more by emotions, to the highly conscious awareness of communicable sense perceptions.

[2]From our point of view, however, the use of terms like "mysterious" and "transcendence" does not indicate that what is being experienced is beyond space-time. What terms such as these properly indicate, in our estimation, is the profound vagueness of a felt experience that encompasses so much of the world that it is extremely difficult to express it with any degree of precision. Hence, we are critical of the interpretation of religious felt experience presented by men like Donald D. Evans, _supra_, pp. 19-23.

to that of the artist, religious experience is <u>exclusive</u> of the experience of the scientist. On the continuum described above felt and sense experience shade into one another. Furthermore, it may be possible to abstract out of felt experience definite sense images and sounds that not only can be used by the artist and religious leader to evoke the richer, although more vague, feelings, but that can be used also as the basic data which can be connected to other discrete observations and hence explained via scientific laws and theories. This last point is particularly important for our own problem of whether the method of science can be used to develop and evaluate ideas about God. For, as we shall see later, if the method of science is to be used, it must be possible to move from religious experience as felt experience to definite and discrete sense perceptions that can qualify as facts against which ideas about God can be tested. This does not deny the importance of religious experience as felt and of symbols that evoke the richness of what is felt. It only seeks to add another dimension to the work of the theologian, a dimension that attempts to come to an understanding of God with the help of the method of science.

If it is possible to abstract from the felt experience of religion to definite phenomena that can be designated by denotative statements and hence that are publicly observable, then in this sense the answer to our question as to whether there is religious experience that is different from the experience of the scientist is no. Yet, even if this answer is given, meaning that both scientist and theologian make use of sense experience, there is still a way in which the experience of the theologian is different from that of the scientist. It is the same difference as occurs between the various sciences: each science in examining man, for example, may see the object of its inquiry differently than the other sciences although the experience of each science is still sense experience. What accounts for the difference in experience is the differences in conceptual schemes in terms of which each science selects out certain kinds of sense experiences while excluding other kinds. We shall maintain that the distinction between the sciences also holds between theology and the sciences when a theology that attempts to use the method of science selects out certain experiences on which to base its ideas of God and against which such ideas are tested. The experiences are indeed sense experiences but they are different sense experiences than those had in the other sciences, since the theologian sees the world in terms of a conceptual scheme that is different from the schemes of physics, biology, psychology and so on. Hence, even when religious experience is defined not solely in terms of what is felt but also in terms of what is sensed, one can make the claim that there is a definite kind of religious experience.[1]

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[1]The position we have developed is both different from and similar to that of John Dewey, A Common Faith (New Haven: Yale University Press, 1934), pp. 10-14. We disagree with Dewey inasmuch as he denies a religious experience "that is marked off from experience as aesthetic, scientific, moral, political; from experience as companionship and friendship." Ibid., p. 10. We agree with him, however, in that he is fighting against a notion of religious experience that is a special kind of experience of a supernatural and personal God. In commenting on the claim to such an experience Dewey does not deny the religious experience as such but says, "in reality, the only thing that can be said to be 'proved' is the existence of some complex of conditions that have operated to effect an adjustment in life, an orientation, that brings with it a sense of security and peace." Ibid., p. 13. In my opinion Dewey did not see the possibility of viewing religious experience in a strictly naturalistic manner but different from other kinds of experience, a difference based on a special conceptual scheme and not on a special kind of experience of something beyond space-time. Because of this he denies that religious experience is marked off from aesthetic, scientific and other kinds of experience, arguing that it is a quality of experience belonging to all of these. Ibid., p. 10.

## Facts and Data

We have been discussing the relationship between experience and concepts: how the concepts we hold often help determine the experiences we have, and how experiences in turn, if persistent, can lead to an alteration of concepts. To further this discussion it is now necessary to delineate what is meant when we speak of experience and concepts in scientific inquiry. Our present section on facts and data will be concerned with the experiential aspect of science, while the following sections will be concerned with two basic kinds of scientific concepts, namely laws and theories.

Although it is possible to distinguish the experiential and conceptual aspects of science, in actuality not only do these aspects interact with one another but in some cases they seem to overlap. The overlapping is evident when one considers the definition of the word "fact" offered by Brown and Ghiselli, which states that the term "fact" refers to "an experience, event, change, or occurrence for which there is substantial evidence."[1] In other words, a fact is something whose existence is widely recognized.

One type of thing for which there is substantial evidence are phenomena that are perceived by the senses. Although, as we indicated above, the scientist does not eliminate felt experience from his work, his main concern is with sense experience; when he does have a felt

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[1]Clarence W. Brown and Edwin E. Ghiselli, Scientific Method in Psychology (New York: McGraw-Hill Book Company, Inc., 1955), p. 7. In what follows I am making the same basic point made by Brown and Ghiselli, that a fact can be conceived of as "a continuum of experience, from experience that is immediate to experience that is highly conceptual." Ibid.

experience he tries to refine that experience into discrete perceptions of phenomena that also can be had by other qualified observers under specifiable conditions. In doing this the scientist is able to establish the existence of something that is widely recognized; hence, regularly observable phenomena are accepted as facts in science.

Two additional points must be made about regularly observable phenomena. The first is that they need not be simple but can be quite complex. A line drawn on a piece of paper or a patch of color is a simple phenomenon. The physical, mental and emotional growth of a child or the solving of a complex scientific problem is relatively complex, but these also can be observed. The second point is that regularly observable phenomena can be experienced either directly through the senses or indirectly with the aid of instruments. A heartbeat indicated by a line on an electrocardiogram or the temperature of the air measured by a thermometer are examples of phenomena that are observed indirectly with the aid of instruments. Whether phenomena are relatively simple or complex, directly or indirectly observed, if there is substantial evidence for them they can be called facts.

The word "fact" as Brown and Ghiselli define it, can refer to more than phenomena; it can also refer to a relationship between phenomena for which there is substantial evidence. However, if such a relationship occurs regularly, it can also be called a law. Boyle's law of gases, for example, states a regularly occurring relationship between the temperature, pressure and volume of gases.

It seems that the same thing can be called both a fact and a law. Yet, there is a difference between these two words that expresses a difference in how the relationship itself is used in science. On the one hand, the relationship can be offered as an explanation for the occurrence of individual phenomena. When, for example, it is asked how one phenomenon happens, the answer may be that it regularly follows the occurrence of another phenomenon. When the relationship between phenomena is offered as an explanation it can be called a law. On the other hand, one can also ask for an explanation of the relationship itself. When this happens the relationship is considered as a fact, for which an explanation is sought in terms of more comprehensive laws or in terms of a more general theory. In this way, Boyle's law, in addition to being a law that explains the conditions under which the pressure of a gas in an enclosed container may increase or decrease, can also be considered as a fact that is explained by the kinetic theory of gases. Thus the word "fact," as indicating something for which there is substantial evidence, can refer not only to observable phenomena but to established relations, which when offered as explanations are called laws but when requiring an explanation can be called facts.

This, however, does not exhaust the meaning of the word "fact." It can also refer to one aspect of a scientific theory that is quite abstract from observable reality. In the development of theories, often unobserved entities are postulated, for example, particles or molecules in the kinetic theory of gases. If the theory is substantially confirmed as true, that is, if it explains a variety of gas laws such as Boyle's law, then it can be said that the entities postulated by the theory exist. To acknowledge the truth of a theory, in a sense, becomes a way of acknowledging that there is substantial evidence for the existence of entities postulated by the theory, and, hence, such entities may be called facts.[1]

Even though the term "fact" has a wide range of meaning, in the rest of the dissertation we shall be using the term in reference to simple or complex phenomena that are regularly observable directly through the senses or indirectly with the aid of instruments. When facts are considered primarily as observable phenomena, however, a further distinction must be made; to refer to all regularly observable phenomena as facts is not sufficient, because phenomena may be perceived either in isolation or in relation to other phenomena. One can, for example, observe such things as the growth of a tree, the sun or a table as standing alone, as individual phenomena. However, one can also observe them in significant relationships to each other, that is, in a relationship where the occurrence of one makes a difference in the occurrence of another. For a furniture manufacturer there is a significant relationship betweeen trees and tables; for a man who grows trees there is a significant relationship between the rate of growth and the amount of sunlight. In order consistently to recognize this difference in perceived phenomena, when they are observed individually, in relative isolation, we shall call them "data," and when they are observed in a significant relationship with other phenomena we shall call them "facts." Hence, both "datum" and "fact" refer to regularly observed phenomena, but a fact is a datum that is significantly related to other data.[2]

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[1]For further discussion of the problem of the existence of entities postulated in the development of a theory, cf. infra, pp. 70-73.

[2]To avoid possible confusion, above we said that a relationship itself, often called a law, could be called a fact if there was sufficient evidence for it. Here, in speaking of phenomena significantly related to one another as facts, the word "fact" refers to the phenomena themselves and not to the relationship.

In the various sciences, individually observed phenomena called data are converted into facts when they are brought into a significant relationship with one another via scientific laws, for instance, the relation of pressure, temperature and volume of gases specified by Boyle's law. Also in science, data are converted into facts when they are significantly related to laws and theories. In this case the significance is a result of the phenomena in question being able to either help support or deny a proposed law or theory.[1] For example, a psychologist interested in perception may observe a phenomenon called hypernesia under hypnosis, that when hypnotized a person seems to remember more than under normal conditions. Such an observation by itself is a datum. However, if this datum is taken as something that might support a proposed theory that the mind perceives and processes information subconsciously as well as consciously, then the phenomenon of hypernesia under hypnosis acquires a significance that converts it from a datum into a fact.

When data are converted into facts in science, quite often it is through a process that refines a general observation into a more specific observation which regularly occurs under certain conditions. Taking, for example, the datum of hypernesia under hypnosis, if it were thought that this phenomenon might help to either support or deny an hypothesis about subconscious perception, one might refine the original datum into a concise fact by setting up an experiment. A person could be taken into a strange room and requested to observe as many things as he could over a two minute period. Next, after leaving the room he could be asked to

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[1]Here, too, there is a kind of law via which the relationship is established called a rule of correspondence or an operational definition. Cf. <u>infra</u>, pp. 69-70, 96-98.

recall all that he saw. To determine if he perceived things subconsciously he then could be hypnotized and again asked to relate all that he saw. If the difference between the number of objects recalled consciously and the number recalled under hypnosis were statistically significant,[1] then this fact might serve to support a theory of subconscious perception. In this process the original datum, a general observation that people seem to remember things better under hypnosis than consciously, is refined into the fact of the difference between the number of objects from a certain room that can be recalled consciously and under hypnosis, a fact which may help confirm or disconfirm a proposed theory about how the mind perceives things.

The refinement of observations in the process of converting data into facts is integral to the method of science; it is an important aspect of what we discussed in Chapter I as controlled observation. Without such a refinement of experience, one might be able to test ideas empirically by relating them to that which is perceived directly with the senses, but one would not be testing them scientifically. The scientific evaluation of ideas involves the refinement of what is observed to the point where the fact that is expected, if a proposed theory or law is true, is found under conditions set up in controlled observation.[2]

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[1]To say that a numerical difference is "statistically significant" is to say that it could not be due to chance. Cf. <u>infra</u>, pp. 113-114. This is not the same as saying a datum is significant and hence a fact, i.e., that it either supports or denies a proposed law or theory. In our example, if the numerical difference is statistically significant, it supports the proposed theory; if it is not statistically significant, it is still a fact that denies the proposed theory of subconscious perception.

[2]For further discussion of how data become significant and hence are converted into facts by which proposed laws and theories are evaluated, cf. <u>infra</u>, pp. 96-98.

## Laws

As we have indicated, the scientist not only observes individual phenomena; he also at times observes the occurrence of one phenomenon with others. This leads him to seek to determine whether or not this occurrence can be formulated as a regular logical relationship between the phenomena involved, that is as a law of nature.

In science there are a great variety of relational statements that bear the title of "law."[1] Most of these, however, can be classified in four different ways. First, laws can express either a regular conjunction of two or more kinds of phenomena, or the mathematical form of such a relationship. Second, the relationship presented may be either universal or probable. Third, it may be either more empirical or more abstract. Finally, laws can be classified as to whether the expressed relationship between phenomena is experimentally independent-dependent, interdependent or dependent-dependent.

Laws express either the regular conjunction of two or more kinds of phenomena, or the mathematical form of such a relationship. The first is illustrated by the simple prediction of one phenomenon from the observation of another phenomenon or set of phenomena. It can be expressed in the logical form, if A then B. Some philosophers of science prefer not to call a statement of the regular conjunction of phenomena a law, reserving the term "law" for statements that express the form of

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[1]Although most scientific laws are expressions of relationships, there are some important exceptions, where the word "law" is applied to something that is not a relationship, e.g., the law of the constant velocity of light in a vacuum in relativity theory. In such instances the word "law" indicates that the scientist has a high degree of confidence in his assertion.

a relationship.[1] Indeed, if one looks only to the physical sciences as a model of scientific inquiry, this position is supported by the fact that the laws of physics are generally stated in mathematical terms and reveal the form of a relationship between phenomena. For example, Boyle's law states that the volume of a given gas varies inversely with the pressure if the temperature is constant. Newton's law of gravitation also states the form of a relationship: the attraction between two bodies varies directly with their masses and inversely with the square of the distance between them. However, if one looks also to the social sciences, one discovers a similarity between our two kinds of laws and two approaches to related phenomena, the factorial approach and the functional approach. The first attempts to discover a regularity between phenomena: it "involves an attempt on the part of the experimenter to discover what condition or factor will cooperate with what other condition or factor to produce some desired result."[2] Quite often the social sciences, because of the complexity of the situations with which they are concerned, can go no further than the stating of what can be called conjunctive laws. However, where possible they do try to move from factorial analysis of a situation to a functional analysis that "indicates how changes in one phenomenon, called the independent variable, are related to changes in another phenomenon, called the dependent variable."[3] This results in functional laws like Fechner's law that the form of relationship between

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[1]Stephen Toulmin, The Philosophy of Science (New York: Harper & Row, Publishers, Harper Torchbooks, 1960), p. 64.

[2]John C. Townsend, Introduction to Experimental Method (New York: McGraw-Hill Book Company, Inc., 1953), p. 83.

[3]Ibid., p. 84.

a person's sensations and the intensity of stimuli is $S = k \log I$, where $S$ is the strength of a person's sensation, $k$ is a constant dependent on the sense modality and $I$ is the intensity of the stimulus.[1]

Inasmuch as every science tries not only to state laws of conjunction but also laws of functional relation, every science finds it necessary to quantify its concepts and make use of various techniques of measurement. This is because functional laws relate two classes of phenomena, each of which can exist in varying magnitude. When one can judge that in one instance a phenomenon is present in a greater or lesser degree than in another instance, a qualitative kind of measurement has already taken place, although the standard of measurement remains unspecified. Examples of this implicit kind of measurement are found in judgments of longer or shorter, heavier or lighter, harder or softer, brighter or darker. A judgment between better or worse may also in some instances indicate that qualitative measurement has taken place, for example, A is a better student than B.

Science does not rest satisfied with qualitative measurement but instead quantifies the variation in magnitude of a kind of phenomenon by the application of numbers. Measurement may be defined "as the assignment of numbers to objects and events according to certain rules."[2] The

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[1]For a brief discussion of Fechner's law and some other laws of experimental psychology, cf. Robert Plutchik, Foundations of Experimental Research (New York: Harper & Row, Publishers, 1968), pp. 123-125, 138-142.

[2]Ibid., p. 226. Cf. S. S. Stevens, "On the Theory of Scales of Measurement," Philosophy of Science, ed. Arthur Danto and Sidney Morgenbesser (New York: The World Publishing Company, Meridian Books, 1966), p. 142, and Ernest Nagel, "Measurement," Philosophy of Science, ed. Arthur Danto and Sidney Morgenbesser (New York: The World Publishing Company, Meridian Books, 1966), p. 120.

simplest form of measurement is the rank ordering of members of a class, that member with the greatest amount of the attribute or quality measured at the top and that with the least at the bottom.[1] What is thus established is an "ordinal scale." Rank ordering is accomplished by direct comparison of two instances of a class, judging one to be greater than the other, then further comparing each of these with other instances, so that in the end A is greater than B, B greater than C, C greater than D, and so on in respect to the attribute being measured. Although an "ordinal scale" is a relatively simple form of measurement, it is possible roughly to determine increases or decreases in the amount of a quality in a given individual or subgroup of a large class of phenomena over a period of time. This can be done by rescaling the individuals or subgroups at different times. For example, if on the first scaling subgroup D is number 3 on an ordinal scale of 20 and if on the second scaling it is number 12, it can be concluded that this instance of the class of phenomena increased in a sizable amount of the quality measured. If two classes of phenomena are so scaled and are thought to correlate with each other so that as instances of one increase instances of the other also increase, the magnitude of increase can roughly be determined on ordinal scales. Hence, ordinal scales can be a means of establishing a functional law of rather inexact form.

To have a functional law that is more exact, however, a second

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[1]Since measurement in science is related to functional laws and hence to variations in magnitude, we agree with Plutchik, Foundations of Experimental Research, p. 228, in questioning Stevens' "nominal scale" of measurement, which is simply the assignment of numbers to entities judged to be equal, e.g., numbers of football players or identification numbers of students. Cf. Stevens, "On the Theory of Scales of Measurement," Philosophy of Science, pp. 144-145.

kind of scale, the "interval scale," must be developed. Here the differences in amount between individuals or subgroups of a class are equal. There are two basic ways of establishing equal intervals. One is by taking a specific amount of the quality to be measured as a standard unit, for example, a yardstick graded into inches to measure length. The second is to relate measurable units of one quality to another quality that is not easily divided into units of itself directly, for example, the relating of the ability to work arithmetic problems and knowledge of vocabulary to the ability of students to do college work, or the level of a mercury column to increases and decreases in temperature. Although there are many instances of interval scales in the sciences, in most of these, that the equal intervals expressed by the numbers actually exist in the real world is more an assumption than an empirically demonstrated fact. However, this does not prevent the use of such scales in seeking functional laws. For as Plutchik points out, the physicist in particular and the scientist in general are not as much concerned with whether the scale is of equal units as "about the consistency and reliability of the data resulting from his method. . . . [and] their relations to other kinds of data. . . ."[1] If the increases and decreases of different compared instances of two kinds of phenomena are consistent, it is possible to formulate that relationship in terms of a functional law.[2]

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[1]Plutchik, Foundations of Experimental Research, p. 235.

[2]Another kind of scale, the "ratio scale," which requires not only equal intervals but also an absolute zero point, is desirable but not necessary in developing functional laws. In fact, the whole idea of various types of scales is questioned by Plutchik on the grounds that many scientists claim it is possible to change a scale from a lower to higher type by the proper mathematical transformation. For discussions of kinds of scales, cf. Stevens, "On the Theory of Scales of Measurement," Philosophy of Science, pp. 141-149, and the

A second way of classifying scientific laws is by whether they are universal or probable. As Carl Hempel says, "a law of universal form asserts that in all cases without exception when conditions of a specified kind C are realized, a phenomenon of a certain kind E occurs; whereas a probabilistic law states that under conditions C there is a statistical probability r for the occurrence of E, so that, in the long run, the proportion of cases of C that result in E will be r."[1]

In classifying laws as both universal and probabilistic, we are acknowledging the place of both in science. Probabilistic or statistical laws seem to be quite frequent in two areas of science, for two different reasons. The first is in the microcosmic world of quantum physics, where it is not only unfeasible but also not useful to investigate single microcosmic phenomena and individual instances of relationship between such phenomena. It is possible, however, to link up statistical laws of the microcosmic world with universal laws of the macrocosmic order. For example, Boyle's law, which is a universal law involving the non-statistical terms of temperature and pressure can be

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criticism by Plutchik, Foundations of Experimental Research, pp. 230-231. For an analysis of measurement in general and especially of measuring a thing by a unit of itself (fundamental measurement) and measuring a thing by a unit of something else (surrogate measurement) cf. Nagel, "Measurement," Philosophy of Science, pp. 121-140. For some techniques of measurement and the statistical notion of "standard deviation" as a unit of measurement in a variety of psychological scales cf. Brown and Ghiselli, Scientific Method in Psychology, pp. 105-130, and L. L. Thurstone, The Measurement of Values (Chicago: The University of Chicago Press, 1959).

[1]Carl G. Hempel, "Scientific Explanation," Philosophy of Science Today, ed. Sidney Morgenbesser (New York: Basic Books, Inc., 1967), pp. 83-84. While we are using the term "universal" to mean "without exception," the term can also mean "for all time." Universality in this second sense applies to both our universal laws and to probabilistic laws. It depends on establishing both the truth of a law and its scope. Cf. infra, pp. 98-103.

deduced from the kinetic theory of gases, which employs the statistical terms of mean kinetic energy and average rate at which particles strike the sides of a container. Thus statistical laws of the microcosmic world can be compatible with universal laws of the macrocosmic world.[1]

The second area that employs statistical laws is the social sciences. Because the subject matter, namely human beings, is so complex it is in practice virtually impossible to establish universal laws. In trying, for example, to establish a correlation between a type of behavior B and a certain environmental situation A, because of the possibility of other factors influencing individual instances, a statistical law that B accompanies A with a frequency of r is perhaps the best that can be established. However, in spite of this, universal laws might play a role in the social sciences. If nothing else, they can function as ideals, in the light of which on some occasions one might be dissatisfied with statistical laws and seek through further inquiry to establish a more exact law, possibly even a universal one. For example, suppose one had established a law stating that a phenomenon of class A is accompanied by a phenomenon of class B 85% of the time or with a probability of .85. The question can then be asked, why only 85% of the time? To answer this question one might hypothesize an unknown factor, a phenomenon of class X, which when present with a phenomenon of class A

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[1]Cf. Ernest Nagle, The Structure of Science (New York: Harcourt, Brace and World, Inc., 1961), pp. 312-316. Nagle is arguing against the indeterministic view of the world based on quantum physics, according to which all laws are ultimately statistical and all natural processes "acausal." While at the microcosmic level the world may be indeterministic and all laws statistical, when one is concerned with macrocosmic phenomena a deterministic view is possible: "the statistical content of quantum mechanics does not annul the deterministic and nonstatistical structure of other physical laws." Ibid., p. 216.

was always followed by a phenomenon of class B. If this hypothesis tested out positively, it would become a universal law stating that A plus X unexceptionally was accompanied by B. This example indicates that sometimes when one has formulated a probabilistic law, there is the further question requiring scientific explanation, namely why the degree of probability is what it is. Answering this question may lead to a refinement of the original statistical law and, in principle at least, possibly to a universal law.[1]

The third way of classifying laws of science is according to their degree of abstraction from the observed world. There is a continuum of laws, at one end of which are empirical or phenomenological laws while at the other end are laws that are often called theories. An example of an empirical law is Boyle's law, which states that the pressure and volume of gas vary inversely at a given temperature. The terms of this law, pressure, volume and temperature, refer directly to observed facts.[2] A more abstract law is Snell's law of refraction, which makes use of the theoretical term "light ray." Examples of the most abstract laws are Newton's laws of motion, Maxwell's laws of electromagnetism and the laws of thermodynamics. These laws do not so much account for the

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[1]Another way of expressing this point is that when predictions fail there is always a reason. To attribute such failure to chance is simply to say that there are factors one does not know about. Cf. Brown and Ghiselli, Scientific Method in Psychology, p. 74.

Although our example regarded the unknown factors as positive, there may also be negative factors preventing the universal occurrence of B with A. Their discovery and removal could also bring about a revision from a probabilistic to a universal law.

[2]That the terms of a law like Boyle's law refer directly to observed facts does not necessarily mean that the facts referred to are observed directly with the unaided senses; in the case of Boyle's law, pressure, temperature and volume are observed indirectly, i.e., with the aid of instruments.

relationships between observed phenomena as provide a framework from which more empirical laws can be derived. Because laws like those of Newton and Maxwell make use of terms that designate entities that are not in themselves observable but are theoretical, they are often called principles or theories.[1]

The final way of classifying scientific laws is according to whether the experimental relationship between variables is independent-dependent, interdependent, or dependent-dependent. A law expressing an independent-dependent relationship between variables states that one variable follows another but not vice versa. It can be diagrammed A --→ B. An example of this kind of law is Snell's law of refraction, which states that whenever any ray of light is incident at the surface which separates two media, it is bent in such a way that the ratio of the sine of the angle of incidence to the sine of the angle of refraction is always a constant quantity for those two media. If this law is applied in an experimental situation, one is able to vary the angle of refraction by varying the angle of incidence, but not vice versa. Although one may predict the angle of incidence if the angle of refraction is known, it is not possible to vary experimentally the angle of refraction and change the angle of incidence, because in the experienced world, as opposed to the logical world, the angle of incidence must always come first.

When a law expresses a relationship between two variables as interdependent, what is meant is that both variables can be varied not

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[1]This discussion of empirical and abstract laws is based on that of Toulmin, The Philosophy of Science, p. 86. Cf. also Nagel, The Structure of Science, pp. 79-90.

only logically but also experimentally in such a manner that one changes with the other according to the law. Formally this may be expressed as $A \longleftrightarrow B$. A good example of this kind of law is Boyle's law; the volume of a gas is inversely proportional to the pressure when the temperature is constant. It is experimentally possible to vary either the volume or the pressure of the gas and to correspondingly alter the other factor.

The final kind of law in this classification scheme is the law that expresses a relationship between two dependent variables. Here it is possible to predict one variable from the other, but it is experimentally impossible to change either variable in terms of the law alone, because each variable is dependent on a further variable that is either unspecified or unknown. Formally the relationship expressed by this kind of law can be stated as $X \begin{array}{l} \dashrightarrow A \\ \qquad \updownarrow \\ \dashrightarrow B \end{array}$ where X is the unspecified or unknown variable. An example of this kind of law is a probabilistic law stating: there is a probability "r" that an increase in college grades is directly proportional to an increase in scores on an intelligence test. Although it is logically possible to predict the value of either variable from the measured value of the other, it is experimentally impossible to change either variable in a particular person, because both are dependent on a number of factors, some unformulated and some unknown.

The basis for distinguishing laws in this final classification scheme is whether or not the variables can be manipulated or controlled. When it is possible to consistently produce a change in one phenomenon by manipulating another, then a causal relationship between the phenomena is indicated. When such manipulation is not possible, the best that can be established is a correlation between two phenomena, because neither is a cause or condition of the other but both may be the result of unspecified or unknown conditions. If this is the case, then it is possible to reformulate this final classification scheme in terms of causal and correlational laws. An independent-dependent experimental relationship between variables would be evidence of a causal law. An interdependent relationship would point to a law of mutual causation. A dependent-dependent relationship would be expressable as a correlational law.

## Theories

As was the case with the words "fact" and "law," the word "theory" is used by scientists in a variety of ways.[1] However, while it was possible to describe most scientific laws in terms of four classification schemes, no such approach presents itself for theories. Instead, we shall try to state what constitutes an ideal scientific theory, recognizing that not every actual theory will completely exemplify our ideal, although it is hoped that every actual theory will illustrate some aspects of it.

Briefly stated, an ideal scientific theory is a statement about the nature of some aspect of the world; it is based on an analogical model; it includes logical statements developed into an abstract calculus and nonlogical terms designating entities that are not in themselves observable; and it is connected to the observed world by means of rules of correspondence.[2] In explicating this notion of scientific theory we

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[1]Laws are sometimes called theories, e.g., the law or theory of gravitation. Principles are called theories, e.g., the special principle or special theory of relativity. Models are called theories, e.g., the Bohr model or Bohr theory of the atom.

[2]We will generally follow Ernest Nagel's description and discussion of scientific theory, <u>The Structure of Science</u>, pp. 90-105.

shall use as our primary example the kinetic theory of gases.

A theory is first of all a statement about the nature of some aspect of the world. There are theories about physical entities such as the theory that light travels in a straight line. There are theories about the nature of the mind such as Freud's theory that the mind consists of the id, the ego and the superego, or Lawrence S. Kubie's theory that the mind consists of conscious, preconscious and subconscious processes.[1] There are theories about scientific ideas such as Einstein's general theory of relativity which states that the laws of nature are invariant when transformed from one frame of reference to another.[2] These examples indicate that, when we say a theory is a statement about some aspect of the world, we do not simply mean physical entities. The world includes not only physical objects but also highly complex processes and even ideas about the world.

Before a theory can be developed about anything, the existence of what the theory seeks to explain must first be accepted at least tentatively. This may seem to pose no difficulty until one remembers, for example, that there was a time when the existence of a wide variety of gases was not recognized. The term "gas" and the idea that there are many kinds of gases was invented by Van Helmont in the first half of the seventeenth century.[3] Thus, what today is regarded as a common entity

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[1]Lawrence S. Kubie, Neurotic Distortion of the Creative Process (Lawrence, Kansas: University of Kansas Press, 1958).

[2]"All Gaussian co-ordinate systems are essentially equivalent for the formation of the general laws of nature." Albert Einstein, Relativity: The Special and General Theory (New York: Henry Holt, 1920), p. 115.

[3]Herbert Butterfield, The Origins of Modern Science (New York: The Macmillan Company, 1957), pp. 94, 194ff.

was not even an idea four hundred years ago.

Once the existence of something is accepted then questions about its nature can be raised and answered. This may take some time. In the case of gases, while the term was invented by Van Helmont in the seventeenth century, it was not until the nineteenth century that the kinetic theory of gases was fully developed. In between, different kinds of gases were recognized and labeled, and various gas laws, such as those of Boyle and Charles, were formulated. The kinetic theory had to take into account the various facts and laws about gases that had been established.

What is the nature of gases according to the kinetic theory? In contrast to an older theory that regarded a gas as a fluid,[1] the kinetic theory regards gases as consisting of very minute particles or molecules in random motion, constantly colliding with one another and with the walls of a container. The molecules may be viewed as analogous to elastic billiard balls. Both the notions of elastic fluids in the older theory and of moving particles behaving like elastic billiard balls are examples of what are called models in scientific theory. A model is basically an analogy transferred from one area of inquiry to another. It generally presents a more or less familiar image in terms of which the theory can be more easily understood. Furthermore, it suggests theoretical ideas that contribute to the elaboration of the theory. The Bohr model of the atom, the Watson-Crick model of DNA and the cybernetic information processing model of the operation of the brain are examples that are not only illustrative of a theory but also suggestive, leading to further

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[1]Kuhn, The Structure of Scientific Revolutions, p. 28.

insights.[1]

One reason why a model is helpful in understanding a theory is that the nonlogical terms of the theory, as well as the logical terms, do not usually refer to anything that is observable. In the kinetic theory of gases, the randomly moving particles cannot be seen; they are theoretical entities, whose existence is postulated by the theory and pictured by the model. But the question of their actual existence is an open question that is dependent, as we shall see later, on the validity of the theory itself.[2]

Besides the nonlogical terms that postulate theoretical entities, a theory contains statements about the behavior of these entities that can be developed into a logical calculus. In the kinetic theory of gases the molecules are postulated to be in random motion, colliding with one another. Because these particles are so minute and because any given volume of a gas contains so many of them, it is impossible to determine the motion and location of each particle. Therefore, statements about the activity of the particles are made statistically for a given volume of gas. The statistical statement of the amount of activity of a given group of particles expresses the mean kinetic energy. As the molecules move faster the mean kinetic energy increases. As the mean kinetic energy increases it follows that, if the particles are in a container, the number striking the sides of the container will also increase. It can also be said that if the size of the container is made smaller, even

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[1]Models may also be mathematical, in which case it is the relationship that is transferred by analogy from one area of inquiry to another.

[2]Cf. *infra*, pp. 71-73.

though the activity level of the particles remains the same, the number of molecules striking a given unit area of the container will increase. Such statements as these can be put into purely logical form by the techniques of statistical mechanics.

So far the kinetic theory of gases remains quite far removed from the world we can observe. However, it is possible to relate the abstract statements of a theory to the observed world by rules of correspondence. In the kinetic theory of gases the term "average kinetic energy" can be so linked to the empirical term "temperature," and the term "rate at which the particles strike a given area of the container" can be linked to the empirical term "pressure." "Temperature" and "pressure" are terms that apply to the observed world and both can be easily measured with reasonable accuracy.

By relating the terms of the kinetic theory of gases to "temperature" and "pressure," it becomes possible to derive previously established gas laws from the theory. For example, when one concludes on the basis of the theory that making the container smaller (while the kinetic activity of the particles and the number of particles remain the same) results in an increase in the rate of particles striking a given area of the container and then translates "size of container" into "volume," "kinetic activity" into "temperature" and "rate of particles striking a given area" into "pressure," one arrives at Boyle's law, that when the temperature and amount of gas remain constant, the pressure of a gas varies inversely with the volume.

Boyle's law is a member of the class of empirical laws in which the nonlogical terms refer to facts that can be measured by scientific instruments. Experiments can be conducted that either confirm or disconfirm the truth of Boyle's and other similar gas laws. Insofar as these laws are confirmed, the theory from which the laws are derived is also indirectly supported. And when a theory is continually supported in this manner, the theoretical entities that have been postulated come to have a status at least similar to, if not identical with, entities that are directly observed.

There are two basic alternatives regarding the status of entities postulated by a theory. One can regard them as useful fictions and say, for example, that gases behave as if they were composed of molecules in random motion. Or one may regard them potentially as real entities in which case one would say that gases are composed of molecules in random motion. With the first alternative the usefulness of the postulated entities is dependent on whether the theory as a whole is evaluated as useful or not, while with the second alternative their reality is dependent on the truth of the theory. However, since a theory is judged to be true or false by the same means that it is judged to be useful or not, namely by deriving via rules of correspondence propositions that can be observationally or experimentally confirmed or disconfirmed, the issue of whether postulated theoretical entities are useful fictions or real entities may be, as Nagel concludes, primarily semantic.[1] Nevertheless, a decision about this issue has philosophical implications concerning the general nature of the world. If theoretical entities are useful fictions, then the world consists only of what is observed directly with the senses or with the aid of instruments. If the entities postulated by a theory can be considered as real, then the world also contains entities

[1]Nagel, The Structure of Science, p. 152. For Nagel's full discussion cf. pp. 117-152.

that cannot themselves be observed or measured but whose existence is asserted on the basis of measurements and observations of phenomena to which they lead through a series of inferences. Though semantically grounded, the issue seems to be quite important.

It seems to me that the issue of the status of theoretical entities might be resolved in a manner that takes both of the above alternatives into account. Following a line of thought similar to that of C. F. Presley,[1] we suggest that when a theory is first proposed it is appropriate to use "as if it were" statements in the theory. Thus one says that gases behave as if they were made up of minute particles. Furthermore, as long as there are facts and laws that cannot be accounted for by the theory but can be accounted for by some alternative theory, then the truth of either theory and the reality of entities postulated can be questioned. Perhaps the best example of this kind of situation is the question of whether light is best considered as particles or waves of energy. There are some circumstances that can be accounted for only by the particle theory and other circumstances that can be accounted for only by the wave theory. Quantum physics, therefore, acknowledges the usefulness of both models in understanding light. This acknowledgement, however, seems to be an admission that at the quantum level we do not yet fully understand the nature of light. Our theoretical apparatus is not sufficiently developed to encompass all the phenomena of light within one comprehensive model. This being the case, it is appropriate to speak of the nature of light in "as if it were" terms, and to speak

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[1]C. F. Presley, "Laws and Theories in the Physical Sciences," Philosophy of Science, ed. Arthur Danto and Sidney Morgenbesser (New York: The World Publishing Company, Meridian Books, 1966), pp. 224-225.

of the usefulness of both models.

However, if after much evaluation, no circumstances are found that cannot be accounted for by the theory, and if the evidence indicates that it is very unlikely that any such circumstances should be found, then the scientist can shift from the first to the second alternative and accept the truth of the theory and the reality of the entities it postulates. That this process does take place in the sciences is illustrated by Henry Margenau in his discussion of empirical verification of theories, which he calls constructs:

> the scientist starts with an observation; this observation is then interpreted in terms of the constructs that are associated with it. These constructs allow him to reason, and he finally emerges with a prediction which says that if the original observation was true, then something else must also be true. This something else can usually be investigated empirically. If it is found to be true, the circuit is declared successful. Now the requirement of empirical verification demands that a set of constructs be traversable in many ways by circuits of the type I have described. If all these circuits have been found successful, that is to say if the theory has been tested in many ways, the scientist regards the constructs forming the theory as valid. What was originally an hypothesis has now become a satisfactory theory, the former constructs have transformed themselves into verifacts, and insofar as the constructs had the character of tentative entities these entities have now become realities, and they are said to exist.[1]

After all this has been said, one important qualification is necessary. What we have described is actually an ideal process, because no one theory covers all the phenomena it is intended to explain; there are always circumstances left unaccounted for by the theory.[2] How then can a theory ever be judged true and postulated entities, real? The answer is that after a theory has been successful in accounting for the

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[1]Henry Margenau, Open Vistas: Philosophical Perspectives of Modern Science (New Haven: Yale University Press, 1964), p. 15.

[2]Kuhn, The Structure of Scientific Revolutions, pp. 79-81.

great majority of facts and laws, it is thought that the few outstanding circumstances will eventually be explained by the further elaboration or modification of the theory. Of course, if after some time the outstanding circumstances are not explained, a new theory may be proposed and eventually replace the older one. In this process entities once thought to be real with a high degree of assuredness may pass out of the scientific picture of the world and be replaced by new entitites.[1]

To conclude this chapter, the purpose of this extended discussion of the concepts of science and their relation to the experienced world has been to indicate a structure of science that can be applied to the process of theological inquiry. To anticipate briefly, we shall propose that in theological inquiry we attempt to examine the same world that science examines, but we view it through a partially developed theological conceptual scheme that views the world in terms of what contributes to and what hinders the realization of the greatest good for man that is possible. Within this framework we hope to construct facts, establish relations between facts in the form of laws, and finally develop a theory of what it is that saves man from destruction and brings about his greatest good. Thus, through the procedures of scientific inquiry we hope to arrive at a concept of God that can be evaluated according to the same criteria of verification that are used to test the theories of science. We shall now proceed to a closer examination of the procedures, attitudes and criteria employed in the formation and evaluation of scientific

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[1]E.g., the demise of phlogiston, which in terms of the phlogiston theory of combustion was thought to be an actual physical substance, and the rise of a new entity, oxygen. Cf. Herbert Butterfield, The Origins of Modern Science 1300 - 1800 (rev. ed.; New York: The Free Press, 1968), pp. 206-221.

concepts. The purpose will be the same as that of this chapter, to develop the structures of scientific inquiry in order to see if theological inquiry can be modeled after it and thus become scientific.

# CHAPTER III

## THE METHOD OF SCIENCE

> Let us learn to dream, gentlemen, then perhaps we shall find the truth. . . . But let us beware of publishing our dreams till they have been tested by the waking understanding.
>
> Friedrich August Kekulé

Having considered the relation between some scientific concepts, namely laws and theories, and experience, articulated as facts and data, we can now proceed to a more detailed examination of the method by which concepts and experience are related. In this examination we shall be making two basic affirmations, first, that there is a general method of science more or less common to all the sciences and, second, that this method includes both the formation and the evaluation of scientific concepts in relation to experience.

Some, like Stephen Toulmin, assert that it is "fruitless to look for a single, all-purpose 'scientific method': the growth and evolution of scientific ideas depends on no one method, and will always call for a broad range of different inquiries."[1] However, Toulmin's claim seems to be based on a use of the word "method" that refers to the variety of ways in which different sciences make observations, measure phenomena, design experiments and interpret results. Such things might better be

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[1]Stephen Toulmin, Foresight and Understanding ([Bloomington]: Indiana University Press, 1961), p. 17.

called the techniques of the various sciences.[1] The word "method" can also be used in another way, which emerges when one compares the sciences with non-scientific disciplines. One then discovers, first, that there is a procedure that is common to the various sciences but that is not found in other types of inquiry, controlled observation. Furthermore, one also discovers other procedures, attitudes and criteria which are employed by scientists, not as hard and fast rules but as guides, in the development and evaluation of hypotheses. Although these procedures, criteria and attitudes may also be found at times in other types of inquiry, when they are used in conjunction with the procedure of controlled observation, they constitute a pattern of inquiry that is scientific. In order to recognize the validity of Toulmin's point and also of our own understanding of the word "science," it seems helpful to follow the suggestion of Brown and Ghiselli and maintain that the method of science "is a very general method, modified in various ways into many less general methods that are utilized in the study of specific problems."[2] The less general methods may be regarded as techniques employed within the framework of the general method by the various sciences. We ourselves shall outline some special techniques employed by the social sciences, because these will be useful in our later attempt to show the possibility of using the method of science in theology. But our main purpose in this chapter will be to outline a general method of science that might serve as a method in theological inquiry.

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[1] Ray Hyman, The Nature of Psychological Inquiry (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1964), p. 6, is another example of the use of the word "method" as meaning "techniques."

[2] Clarence W. Brown and Edwin E. Ghiselli, Scientific Method in Psychology (New York: McGraw-Hill Book Company, Inc., 1955), p. 5.

It is possible to consider the method of science only as a set of procedures and criteria for the evaluation of the truth of or the verification of ideas.[1] This is because historically the method of science has developed in contrast to other methods as a way of judging the correctness of ideas. Other alternatives, such as listening to authorities, to intuition or to the "voice of reason" break down, because they do not provide any way of determining which of two or more disagreeing authorities, intuitions or "voices of reason" are correct. The method of science solves this problem by asking what consequences, perceivable in controlled observations, must follow if an idea is true. If the predicted results do occur, the truth of the idea is supported; if not, the idea is judged to be incorrect. Because it solves this important problem better than any other method of concept evaluation to date, it is quite natural to stress, as many have done, that the method of science primarily consists of procedures and criteria by which we can verify or falsify our ideas.

In spite of the emphasis on verification, it will be our position that the method of science includes not only procedures and criteria for determining the correctness of ideas but also procedures and attitudes for generating new ideas. As John Dewey writes, any account of science must deal both with "the methods by which generalizations are arrived at . . . 'induction' [and] the method by which already existing generalizations are employed . . . 'deduction'."[2] This notion of the method of

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[1]We prefer the term "evaluation" to "verification" because, as will be shown later, scientific concepts make other claims besides a claim to truth. Cf. infra, pp. 101-102, 103-104, 107-108.

[2]John Dewey, Logic: The Theory of Inquiry (New York: Holt, Rinehart and Winston, 1938), p. 419.

science is closely related to Dewey's idea of inquiry in general, which can be characterized as problem solving, "the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole."[1] Problem solving, which includes scientific problem solving, begins with an indeterminate situation that must first be recognized and accepted as problematic. Next the problem is defined by examining its constituent elements, and possible solutions are suggested. Finally, through a reasoning process, a solution is developed to the point that it indicates operations to be performed to test its applicability. The whole process, then, includes the recognition and formation of a problem, the formulation of a possible solution, and the testing of that solution.[2]

Justification of this broader view of the method of science can be based, surprisingly, on the narrower view of scientific method, when the latter is compared with other methods for establishing the validity of ideas. Following Charles S. Peirce, there are four basic ways to establish a solution to a problem. The first is tenacity, holding on to an idea as true and ignoring all counter evidence. The second is the appeal to an institution of authority that teaches only one correct doctrine and suppresses any contrary ideas. The third is the *a priori* method in which men conversing together follow their natural preferences and

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[1]*Ibid.*, pp. 104-105.

[2]*Ibid.*, pp. 105-114; another instance of this approach to science is Brown and Ghiselli, *Scientific Method in Psychology*, pp. 133-264, where included in the "Steps of the Scientific Method" are the definition and delimitation of the problem, the formation and use of hypotheses in formulating a problem, collecting the facts and organizing, analyzing and interpreting the facts, and finally generalizing from scientific data.

accept that which their reason leads them to believe. In contrast to these, Peirce proposes that the best method of establishing a valid idea is the method of science, because it is the only one

> which presents any distinction of a right and a wrong way. If I adopt the method of tenacity, and shut myself out from all influences, whatever I think necessary to doing this, is necessary according to that method. So with the method of authority: the state may try to put down heresy by means which, from a scientific point of view, seem very ill-calculated to accomplish its purposes; but the only test _on that method_ is what the state thinks; so that it cannot pursue the method wrongly. So with the _a priori_ method. The very essence of it is to think as one is inclined to think.[1]

Just why can the method of science determine between a right and a wrong way, between what is true and what is false, while the other methods cannot? It is because, while the other three methods are oriented toward the past, the method of science points toward the future. With an orientation toward the past, the criterion of truth is already given; it is what either individuals or institutions proclaim. With an orientation toward the future, however, the criterion of truth is the ability of an idea to predict what will happen in the world if the idea is true.[2] An idea when it is first stated is always tentative, waiting for confirmation or denial by experience. If the experience turns out other than predicted the idea can be rejected, something which cannot occur with the other three methods if they are rigorously followed.

If this contrast between the scientific method and other methods

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[1]Charles S. Peirce, _Collected Papers_, ed. Charles Hartshorne and Paul Weiss (Cambridge, Mass.: The Belknap Press of Harvard University Press, 1965), Vol. V, §385.

[2]Peirce says that according to the method of science, truth "is distinguished from falsehood simply by this, that if acted on it should, on full consideration, carry us to the point we aim at and not astray. . . ." _Collected Papers_, Vol. V, §387.

of establishing true ideas is correct, then it follows that the method of science has something important to say about the procedures of concept formation as well as procedures of concept evaluation. For, by establishing the criterion of truth in the past, the methods of tenacity, authority and a priori reasoning tend to suppress the formation of new concepts, while, by relating the criterion of truth to future acts and perceptions, the method of science allows for the free emergence of new concepts that, when they emerge, have just as much claim to being true as older ideas.[1] Indeed, it can be argued that when it leads to the challenging of existing laws and theories, the scientific evaluation of the truth of ideas is not only the end stage of an inquiry but the beginning stage of a new instance of inquiry.[2]

## Scientific Concept Formation

The process of scientific inquiry is very complex; therefore, any attempt to describe it will necessarily be an oversimplification. Although it is possible to select out certain procedures and attitudes and to present them as successive stages of inquiry as we shall do, it is important to remember that in the actual research of the scientist the stages are not simply successive but continually interact with one another. With this qualification in mind, we shall first consider some of the procedures and attitudes involved in the formation of concepts and then some of the procedures, criteria and attitudes involved in the

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[1]For how the other three methods of inquiry sometimes oppose the scientific method of concept formation and evaluation, cf. infra, pp. 83-85, 88, 92-93, 95, 116.

[2]Cf. infra, pp. 82-83.

evaluation of concepts in science.

The problem.--The first procedure in the formation of scientific laws or theories is the acknowledgment and statement of a problem to be solved. Without a problem there is no scientific inquiry. This is illustrated by the fact that, even though there may be potential solutions already in existence, unless there is a need for them as the answer to a recognized problem those solutions are never utilized. As C. F. von Weizsäcker has said: "even if someone came today who knew the answer to all unsolved problems, we should not understand him if our own need had not already driven us to put the questions which he answered. No help comes where a need has not even been felt."[1] An example of a solution that went unused because there was no need for it was the heliocentric theory of the universe advanced by Aristarchus in the third century B.C. Although his basic position finally replaced the geocentric theory, at the time of Aristarchus the geocentric system reasonably answered all questions. There was no problem to be resolved and thus no need for Aristarchus' theory.[2]

The problem dealt with by the scientist may be one of four general types. The first involves the attempt to explain one kind of fact by relating it to other facts that can be observed. For example, to help prevent automobile accidents, the social scientist seeks possible conditions that might contribute to accidents by examining reports for

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[1]C. F. von Weizsäcker, The World View of Physics, trans. M. Greene (4th ed.; Chicago: University of Chicago Press, 1952), p. 12; quoted by Leonard K. Nash, The Nature of the Natural Sciences (Boston: Little, Brown and Company, 1963), p. 248.

[2]Cf. Thomas S. Kuhn, The Structure of Scientific Revolutions (Chicago: The University of Chicago Press, Phoenix Books, 1962), p. 75.

such things as times and locations of accidents, and the condition of the drivers. His goal is to discover which combination of facts has the highest correlation with automobile accidents and to formulate this combination as a scientific law. The second type of problem involves seeking explanations for a variety of established facts and laws. In solving problems of this type such theories as the kinetic theory of gases and Newton's laws of motion were developed. Once laws and theories are established the possibility for a third kind of problem arises, namely their being called into question by the discovery of new facts. As Kuhn points out, such problems are regarded as puzzles to be solved by revising existing laws and theories or by seeking an explanation why they do not apply to the situations in question.[1] For example, the problem that Boyle's law did not accurately predict the volume of a gas from its pressure at extreme pressures was solved by further developing the kinetic theory of gases. By postulating that gas molecules attract one another and reasoning that at extreme pressures this attraction would be greater than at lower pressures, the discrepancy between volume predicted with Boyle's law and that calculated by experiment was accounted for. When it becomes increasingly difficult to solve such puzzles by the revision of established laws and theories, new theories may be proposed. This leads to the fourth type of problem, choosing between two theories, and to the possibility of a scientific revolution. Examples of this kind of problem are the increasing need of the geocentric theory of the universe to make additional assumptions and its

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[1] Ibid., pp. 35-42, 81-82.

being challenged by the simpler heliocentric theory of Copernicus,[1] or the failure of the theorem of the addition of velocities in the Galilean relativity principle when the speed of light was one of the terms and the eventual replacement of the Galilean principle by Einstein's special theory of relativity.[2]

When the evaluation of the truth of ideas by scientific procedures leads either to the revision of existing laws or theories, or to their rejection and the proposal of new hypotheses, then in relation to old laws and theories the testing procedures constitute the final stage of an instance of scientific inquiry; however, in relation to the ensuing revision or the newly proposed hypotheses the same procedures are an important part of concept formation in that they bring about the recognition of a new problem.

Because scientific inquiry cannot begin without the recognition of a problem, inquiry can be blocked by the attitude we described above as tenacity. The tenacious maintaining of cherished beliefs is nothing less than a commitment to an idea to such an extent that no fact or theory is allowed the chance of refuting it.[3] In contrast to this

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[1]Herbert Butterfield, The Origins of Modern Science (New York: The Macmillan Company, 1957), pp. 21-22.

[2]Albert Einstein, Relativity: The Special and General Theory (New York: Henry Holt, 1920), pp. 14-57.
Generally speaking, the type of problem a given science is most concerned with is an indication of the level of development of that science. While newer sciences, such as the social sciences, tend to deal with problems of the first and second types, the more established sciences are often confronted with problems of types three and four.

[3]The commitment of the scientist to an accepted theory that he believes will someday solve anomalous facts is not the same as tenacity, because, while the latter ignores the facts, the scientist recognizes them as the source of problems he is trying to solve.

tenacity, the scientist makes another kind of commitment, the commitment to scientific inquiry itself. This commitment of the scientist involves, first, the willingness to face the unknown: when a scientist begins to tackle a given problem he is not aware of the solution to which it may lead. That solution may further call into question his accepted ideas. Second, the scientist's commitment involves having the confidence that with the procedures of the scientific method he can solve the problems he recognizes. Therefore, he need not hang on to old ideas out of fear that they are irreplaceable but instead seeks to improve them or replace them with better ideas. Third, commitment to scientific inquiry means that the scientist has confidence in himself, especially in his own perceptual and reasoning abilities, in his ability to correctly use the procedures of science and in his ability to develop any new conceptual and observational procedures that are needed to solve many of the hitherto unsolved problems. Finally, the attitude of commitment to scientific inquiry involves the belief that, even though much of the world is unknown, there is no limit to what can be known. This does not mean that the scientist will solve every problem he is confronted with but, on the one hand, that many of the unsolved problems at any given time will someday be resolved and, on the other hand, that new problems will continue to arise, thus stimulating further inquiry. With this commitment to scientific inquiry the scientist does not ignore contradictions between experience and ideas, like those tenaciously committed to cherished beliefs, but instead recognizes the problems they create as the first step toward further knowledge.

One possible objection to our comparison of the method of science with that of tenacity is that the scientist's commitment to his method is just as tenacious as the absolute commitment to a given idea or belief about the world. There is some truth to this objection, because the scientist's commitment to his method is certainly not a commitment that is easily shaken. However, in spite of this, it is not the same as the tenacious holding of an idea in the face of being contradicted by other ideas or facts. First, the commitment of the scientist to his method is grounded in the general fact that it has been highly successful in solving scientific problems. Second, the scientist is willing to recognize that the method itself may undergo changes; in fact it has undergone changes, as exemplified by the new development of statistical procedures in our century. Finally, through changes in the method of science itself, it is possible that it will evolve in such a way as to lead to a better method of solving problems, a method so different from the method of science as we now know it that it may even be called something else. This means that it is possible, in principle at least, to replace the method of science; hence the commitment of the scientist, although a firm commitment, is not tenacious.

The one thing that a scientist may tend to be tenacious about is that it is possible to achieve some understanding of the nature of the world, of man and of society; in other words the scientist does believe that there are statements that can be supported as true. But this belief, this commitment to gaining knowledge is of quite a different nature than the tenacious affirmation of any one set of ideas as true for all time.

Information gathering.--Once a problem has been recognized, the second scientific procedure is to gather information about the problem that will further define it and help contribute to its solution. The information gathered is both factual and theoretical.[1] Generally as one moves from the first to the fourth type of problem discussed above, one also moves from gathering more factual to gathering more theoretical information.

In the gathering of facts, a basic principle is to compare and contrast various situations in which the phenomenon to be explained occurs. In seeking the major causes of automobile accidents, for example, one could analyze accident reports for such things as time of day, road conditions, locale of the accident and the condition of the driver. If certain facts, A, B, and C were always present when an accident occurred, then these may be causes of the accident. This procedure was defined by John Stuart Mill as the "method of agreement."[2] A second procedure, originally advocated by Mill as the "method of difference," is the comparing of similar situations that are differentiated by the occurrence of the phenomenon to be explained in some situations but not in others. The question asked is, are there other facts that occur when the phenomenon to be explained occurs but do not occur when it does not take place? For example, in examining reports of automobile accidents, one may note that more accidents take place between 4 and 7 P.M. than between 12 noon and 3 P.M. This generates a subproblem of the original, namely, why do

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[1]Cf. Brown and Ghiselli, Scientific Method in Psychology, p. 135.

[2]John Stuart Mill, Philosophy of Scientific Method, ed. Ernest Nagel ("The Hafner Library of Classics"; New York: Hafner Publishing Co., 1950), pp. 211-233. Although Mill's methods have been thoroughly criticized, one still finds them serving as the basis for various ways of analyzing a situation for important variables in the social sciences. Two recent summaries of Mill's methods and some of the problems of using them are given by John C. Townsend, Introduction to Experimental Method (New York: McGraw-Hill Book Company, Inc., 1953), pp. 91-106, and Robert Plutchik, Foundations of Experimental Research (New York: Harper and Row, Publishers, 1968), pp. 147-157.

more accidents occur at one time than at another? By noting further differences in the two situations, one may arrive at an hypothesis that the number of accidents is dependent on the number of cars on the road, the lighting conditions, and the tiredness of the drivers, because there are more cars on the road, poorer lighting and more tired drivers during the 4 to 7 P.M. rush hour than between 12 noon and 3 P.M. This example also illustrates another procedure for examining the data of a situation defined by Mill as the "method of concomitant variation." This method involves the observing of a consistent variation in one phenomenon with the occurrence of another. Thus if one notes that more accidents occur when lighting conditions are poorer, one might hypothesize a functional relationship between the number of accidents and amount of light.

As a scientist is not just concerned with establishing laws that relate facts but seeks theories to explain a variety of established facts and laws, information gathering becomes theoretical as well as factual. The investigator also tends to rely more on the work of other scientists than on his own observation. The inquiry of James D. Watson and Francis Crick to solve the problem of the structure of DNA (deoxyribonucleic acid) gives ample evidence of this more complex kind of information gathering.[1] First, they considered the fact that the chemical composition of DNA was phosphate, sugar and four nitrogenous bases, two of which were purines and two, pyrimidines. Another area of information was the X-ray diffraction data gathered by Maurice Wilkins and Rosalind Franklin. Watson and Crick also took account of Chargaff's rules equating the amount of adenine and thymine and the amount of guanine and cytosine in a molecule

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[1]James D. Watson, The Double Helix (New York: Atheneum, 1968), passim.

of DNA, as well as Linus Pauling's alpha helix structure of proteins, the attempt of V. Vand to form an X-ray diffraction theory, theories on the nature of gene replication and in general the laws of stereo chemistry.

Such a gathering of factual and theoretical information, as was done by Watson and Crick, can only take place when there is a community of scientists working on the same basic set of problems and a free flow of ideas between them. To achieve this a scientist must have enough confidence in his abilities, so that he will make his ideas public. They may in the end prove wrong, but knowledge is built on failures as well as successes. Furthermore, the culture in which a scientist works must permit the making public of new and even revolutionary ideas. The suppression of the work of scientists, because it is contrary to accepted ideas, by religious, political, or even scientific authorities is completely antithetical to the method of science. This does not mean that a scientist has no respect for past scientific achievements and failures that are related to his problem. The community of scientists is historical as well as contemporary. By examining the past in relation to his particular problem the scientist discovers both relevant and irrelevant facts, correct and incorrect formulations of laws and theories. Such information greatly facilitates his own research.

The procedures of information gathering are directly related to a scientist's ability to solve a problem. Brown and Ghiselli state this exceptionally well when they write: "We cannot overemphasize the fact that scientific genius in solving any problem is not the result of lucky inspiration, nor is it born from exposing the problems to a brilliant but vacuous mind. It depends upon a rich store of conceptual and factual knowledge arranged comprehensively in terms of an over-all theoretical framework."[1] The rich store of factual and conceptual information required in scientific inquiry supports Nash's contention that education plays an important role in developing a scientist's ability to solve problems.[2] But more important, perhaps, is the attitude of the scientist that commits him to hard work. To be a successful scientist does not come easily as is indicated by Michael Polanyi's anecdote of the great Russian experimental psychologist, Pavlov: "asked by his pupils in jest what they should do to become 'a Pavlov,' the master answered in all seriousness: 'Get up in the morning with your problem before you. Breakfast with it. Go to the laboratory with it. Eat your lunch with it. Keep it before you after dinner. Go to bed with it in your mind. Dream about it.' "[3]

Simplification.--During the gathering of information about a particular problem, a third general procedure sometimes naturally occurs, the procedure of simplification. This procedure may be a reformulating of a problem in a more limited and specific form. The discovery of DNA first began as the problem of the "secret of life," continued as the problem of the nature of the genes, was further narrowed to the problem of the structure of DNA, which was finally solved by solving the still more specific problem of the structure and relationship of the nitrogenous bases. Simplification can also take place by factoring a major problem into a number of subproblems, each with the smallest number of

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[1]Brown and Ghiselli, Scientific Method in Psychology, p. 151.

[2]Nash, The Nature of the Natural Sciences, p. 343.

[3]Michael Polanyi, Personal Knowledge (New York: Harper & Row, Publishers, Harper Torchbooks, 1964), p. 127.

possible variables to be tested out.[1] In our example of seeking the major causes of automobile accidents, after some fact gathering, the general problem might be subdivided into problems like the kinds of road conditions, weather conditions and driver conditions that contribute to most accidents. The solving of these problems will contribute to the solution of the more general problem of the causes of automobile accidents. A third simplification procedure is what Herbert A. Simon calls "planning," which involves omitting many details of the problem by abstracting what are considered to be the most essential variables, solving the problem in terms of those features alone and then using this solution as a guide or plan for the solution of the full problem.[2]

Undergirding the procedure of simplification is the belief of the scientist that much of the world can be understood in terms of relatively simple laws and theories. As Nash points out, in formulating laws and theories science ignores numerous factors that influence a given empirical situation. "The raw phenomena are complicated and variable; the ideal law, which only sketches them, offers an ideal simple statement about 'ideal' phenomena."[3] This abstracting from the real world, however, is not so much a problem as it is a key to success in science. For simply to duplicate an entire situation would not only be impossible but also a pointless task; it would not explain anything, no predictions could be made and one would be no closer to controlling

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[1]Herbert A. Simon, "Thinking by Computers," Mind and Cosmos: Essays in Contemporary Science and Philosophy, ed. Robert G. Colodny (Pittsburgh: University of Pittsburgh Press, 1966), p. 15.

[2]Ibid., pp. 14-15.

[3]Nash, The Nature of the Natural Sciences, p. 56.

things than when one started, because he would not know which aspect of the total situation to manipulate. Only by selecting out of the situation the significant facts, establishing relatively simple but correct correlations between facts and then explaining the correlations by theories with fairly simple logical formulas and models, does one understand what takes place in the world. In one sense then, scientific inquiry can be regarded as a process of simplification.

Concept reformulation.--As factual and theoretical information is being gathered and the initial problem is being simplified, a fourth kind of procedure starts to take place, concept reformulation. It is the procedure that results in new ideas, which are first proposed as hypotheses and have the possibility of becoming, if confirmed, laws and theories.

The first maxim of concept reformulation is to make analogies. An analogy is basically the transferring of a concept from one situation to another. It is the foundation principle of model building in science. A small but important analogy used by Watson and Crick was their assumption that the structures of proteins and DNA were enough alike to search for a helix as the structure of DNA after Pauling had proposed the alpha helix for proteins. The kinetic theory of gases was based on an analogy that postulated molecules in random motion in much the same manner as elastic billiard balls. An analogy between the functioning of the human brain and a computer is one of the cornerstones of the science of cybernetics. Analogies thus play an important role in scientific concept formation in that they provide a mechanism to reformulate concepts in one problem situation in terms of concepts from another setting. It is important to note that the primary function of analogy is to suggest new concepts which are hypotheses yet to be tested. It is not a means of establishing the validity of an hypothesis. There is always the tendency, once we have pictured something in terms that are familiar to us, to believe that we have explained it. This tendency must be avoided, because it cuts off scientific inquiry before it is fully completed.

A second maxim of concept reformulation is to assume the opposite. Some of the greatest advances in science have been based on this principle. For example, the basic assumption in Aristotelian dynamics was that the natural state of a body was at rest; this was reversed by Galileo who assumed the natural state of a body was in motion and that bodies will continue in motion unless something intervenes to stop them, the principle of inertia. In our century, another great scientific advance was made when Einstein denied the notion that the velocity of light varied in relation to the velocity of its frame of reference, as implied by the theorem of the addition of velocities in classical physics, and instead asserted that the velocity of light remains constant regardless of the velocity of the frame of reference. On this assumption he developed his special theory of relativity.

The effectiveness of these procedures of concept reformulation depends in part on the amount of factual and conceptual material that has been gathered by the scientist. The more information a scientist has the greater will be his possible sources of analogy and the more chance he will have to try affirming the opposite. Possible laws and theories in science are not formed out of nothing. They are based on what the scientist already knows. It is because of this that we have called the above maxims, maxims of concept reformulation.

The application of the maxims of concept reformulation, like those of recognizing a problem, gathering information, and simplification, will be blocked unless a specific attitude is also present in the scientist. The attitude required is that of being open to fresh viewpoints and free from bondage to the tradition of a given science. This attitude is especially characteristic of young scientists, and many major scientific discoveries are made before their discoverer is much over thirty. One example is the four principal characters in the discovery of the structure of DNA: Francis Crick and Maurice Wilkins were in their mid-thirties, Rosalind Franklin was thirty-two and James Watson, twenty-five. Being open to fresh viewpoints is also a characteristic of scientists who transfer from one field to another. Lavoisier was a businessman, Dalton, a meteorologist and Kekulé, an architect before they turned to make major contributions to chemistry.[1]

Subconscious concept formation.--So far we have maintained that the procedures of recognizing a problem, gathering information, simplification and reformulation are the basic procedures through which new concepts are formed in science. There is still one final major characteristic of scientific concept formation that is not a deliberate procedure but which plays a role in all of the procedures so far discussed, subliminal thinking. This feature is exemplified in the numerous instances in which after much deliberate work on a problem, a scientist will stop work, only to discover that when he is involved in something else the solution comes to him. While Poincaré was boarding a bus some distance from home and his work, he made the discovery that the transformations he had used to define Fuchsian functions were identical to those

[1]Nash, The Nature of the Natural Sciences, p. 346.

of non-Euclidean geometry. Kekulé's dream of a serpent chasing its tail led him to the discovery of the benzene ring. The period in which such solutions suddenly come to light is often called a period of incubation, which is supposed to follow the gathering of facts and deliberate attempts at concept reformulation. During this time the mind continues to work at a subliminal or subconscious level. Only when the solution occurs does it come to consciousness.

This understanding of the feature of science exemplified in the experience of Poincaré and Kekulé is inappropriately described, however, when it is regarded as only a separate period of incubation. For the mind does not function at a subconscious level only after a problem has been recognized, information gathering completed and deliberate concept reformulation attempted. The mind also functions subconsciously while these procedures are going on.[1] The functioning subconsciously in the recognition of a problem is often indicated by the feeling that something is wrong before we can explicitly state what it is. Such a feeling was had by the subjects of Brunner's card playing experiment upon observing black fours of hearts and red sixes of spades even when they did not recognize what the cards actually were.[2] That the mind functions subconsciously in the gathering of information is indicated by the phenomenon of hypernesia. A person enters a room and in a short time observes all he can. After leaving the room, he may consciously recall ten or twelve items. However, under hypnosis it is discovered that he can recall ten times as many objects as he could recall in a normal state.

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[1]Lawrence S. Kubie, Neurotic Distortion of the Creative Process (Lawrence, Kansas: University of Kansas Press, 1958), pp. 50-51.

[2]Cf. *supra*, pp. 38-40.

The explanation is that he has observed and stored information without being consciously aware of it. That the mind is able to make analogies that can lead to new scientific theories at a subconscious level is illustrated by Kekulé's dream in which the serpent swallowing its tail was a suggestive analogy for the structure of benzene. In short, one feature of scientific inquiry is that the mind continually functions both subconsciously and consciously in the procedures of problem recognition, information gathering and reformulation of concepts that lead eventually to an hypothesis or a suggested solution to the problem.

Just as these procedures can be restricted at a conscious level if they are not accompanied by attitudes of commitment to inquiry, hard work and openness to fresh viewpoints, they can be hindered at the subconscious level of thinking by commitments to previous ideas, which are so well ingrained that we are unaware of them but which nontheless function as unexpressed biases that prejudice the outcome of inquiry. We can be tenacious without being aware of it. Likewise, external authorities can exercise so strong a hold over a person that he responds automatically to shut out problems and information that might challenge accepted ideas. The best way to combat such subconscious blocks to inquiry is to prevent them from forming. This can only be done through the education of people in such a way that the various attitudes we have discussed as essential features of scientific method become both consciously and subconsciously the guiding principles of inquiry. For only when such attitudes are present can the procedures of problem recognition, information gathering and concept reformulation function effectively, both consciously and subconsciously, to form suggested solutions to problems that can then be evaluated by further procedures and criteria of the method of science.

## Scientific Evaluation

In this section we shall be concerned, first, with various kinds of evaluation in science and shall indicate how the kind of evaluation made and the criteria employed are partly dependent on whether what is being evaluated is a datum-fact, a law or a theory. Second, we shall discuss the most important criterion for evaluating laws and theories, the ability to lead to predictions of facts that can be perceived in controlled observation.

Evaluation of data-facts.--In chapter II we indicated that phenomena may be perceived either by themselves, in which case they can be called data, or in a significant relationship with scientific concepts, in which case they can be called facts. The major question to be answered here is how data are evaluated as significant or not, in other words, how they become facts.

A datum is judged significant and, hence, becomes a fact if it can serve to confirm or disconfirm a proposed scientific law or theory. A fact for the double helix structure of DNA is the diffraction pattern of an X-ray photograph of crystalline DNA. A fact for the theoretical concept of an electron jump emitting a given wave length of radiation in the Bohr theory of the atom is a line occurring in a certain position on a spectrum of hydrogen. Facts for Boyle's gas law are the instrument readings indicating temperature, pressure and volume. Facts for a law stating a correlation between intelligence and college performance are scores on the Wechsler or Revised Stanford-Binet tests and college grades.

All the facts in the above examples can serve to confirm or disconfirm a given law or theory only if they are validly related to that law or theory. The question of validity is often raised in the social sciences when tests that present facts on intelligence, personality traits and the like are questioned as to whether or not they really measure what they are supposed to. Likewise, even with well supported laws in the natural sciences, such as Boyle's law, it is possible to raise the question as to whether or not a given instrument reading is really a reading of the temperature, pressure or volume of a gas. When one considers the facts for abstract theories, such as a line on a hydrogen spectrum, it is an important question whether the asserted relationship between that line and the hypothesis of an unobservable electron jumping orbits is valid or not.

The validity of such asserted relationships depends on the rules of correspondence by which these relationships are made. Unfortunately this is usually the least explicitly formulated part of a theory. As Nagel points out, while

> theories in the sciences . . . are generally formulated with painstaking care and that the relations of theoretical notions to each other . . . are stated with great precision . . . , rules of correspondence for connecting theoretical with experimental ideas generally receive no explicit formulation; and in actual practice the coordinations are comparatively loose and imprecise.[1]

However, an example given by Nagel about how an electron jump in the Bohr theory is related to a line on a hydrogen spectrum does indicate how postulated theoretical entities are correlated with facts.

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[1]Ernest Nagel, The Structure of Science (New York: Harcourt, Brace & World, Inc., 1961), p. 99.

> On the basis of the electromagnetic theory of light, a line in the spectrum of an element is associated with an electromagnetic wave whose length can be calculated, in accordance with the assumptions of the theory, from experimental data on the position of the spectral line. On the other hand, the Bohr theory associates the wave length of a light ray emitted by an atom with the jump of an electron from one of its permissible orbits to another such orbit. In consequence, the theoretical notion of an electron jump is linked to the experimental notion of a spectral line.[1]

In this example theoretical notion A is associated with observed fact B and theoretical notion C is related to theoretical notion A; hence theoretical notion C is judged to be related to observed fact B, which has the potential for confirming or disconfirming theoretical notion C. This fairly explicit statement of a rule of correspondence, however, rests on further connections whose rules are not explicitly stated, namely the rules that give the grounds for relating electromagnetic wave length to position on a spectral line and electron jump to wave length. These rules must also be expressed before the datum of a spectral line can be evaluated as significant and, hence, as a fact for the theoretical notion of electron jump. All this serves to indicate a need for the further development of the nature of rules of correspondence. Without such rules it is extremely difficult to judge whether or not data are significant and, hence, facts that can be used to confirm or disconfirm proposed laws and theories.

Evaluation of laws.--While data are evaluated as to whether or not they can serve as facts on the basis of their ability for indicating the truth or falsity of laws and theories, laws and theories are evaluated as true or false in accordance with whether or not they can lead to predictions of facts and in accordance with other criteria. This

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[1] Ibid., p. 95.

means that there is an unavoidable circularity in the evaluation of scientific concepts by relating laws and theories to facts. It is just this circularity that leads from time to time to intense rivalries between two mutually consistent theories that each explain a large body of fact and to scientific revolutions.[1] However, in the normal course of science, when the scientist is operating within a conceptual scheme that helps to determine what obviously are the facts, the ability to predict such facts is one of the criteria for evaluating the truth of laws and theories that are hypothesized through the procedures of concept formation.

To examine the process of evaluating laws and theories more closely, let us first begin with a proposed conjunctive, empirical law that asserts a universal relation of independence-dependence between two classes of facts, whenever A occurs it is followed by B. To evaluate the truth of this hypothesis, one must first infer from it a singular predictive proposition. This proposition, first, loads the terms of the law with facts that can be observed. Second, on the basis of the relationship expressed in the proposed law, when an instance of A occurs it predicts the occurrence of an instance of B. If an instance of B does occur, the predictive proposition is true. If not, the predictive proposition is false. If the predictive proposition is true, the truth of the law is also confirmed; if false, the truth of the law is disconfirmed. At first it may seem that the result of the experiment is exactly the same for both the predictive proposition and the law. This, however, is not so. A predictive proposition is a singular proposition; its truth

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[1]Cf. <u>infra</u>, pp. 105-108.

or falsity is absolutely determined by the experiment. A law, on the other hand, is a proposition that is held to be valid for all time, for all instances in which the relationship might be repeated. Thus the truth of one predictive porposition can only partially confirm the truth of the proposed law.[1] To confirm the truth of an hypothesized law a number of predictive propositions of the same type would need to be true. The more instances of such confirmation, the more assurance the scientist has that his law is true. He can never have complete assurance, however, because the number of possible predictive propositions he can derive from the law and the number of corresponding experiments he could conduct are infinite. Thus, at best, the truth of a law can be reasonably assured but will always remain tentative. This is one of the basic notions of the scientific method: the truth established by it is always tentative and not absolute truth.[2]

Similarly, if a predictive proposition derived from the law is found to be false, this does not automatically falsify the proposed law. Falsification depends partly on whether any prior predictive propositions have been made and whether or not they have been fulfilled. Even if the first predictive proposition is not fulfilled in an experiment, before

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[1]This distinction corresponds to that of "terminating" and "non-terminating" judgments made by C. I. Lewis, An Analysis of Knowledge and Valuation (LaSalle, Illinois: The Open Court Publishing Company, 1946), pp. 182-185.

[2]The question of the grounds from which one can infer that, after a number of predictive propositions are fulfilled, one can expect the fulfillment of further predictive propositions of the same kind has been labeled the problem of induction. However, it is a problem only if what is sought is absolute truth. Since the scientist is content with tentative truth, even to the point of being willing to radically revise or discard a theory, the question can be raised whether the problem of induction is more a problem for the philosopher than for the scientist.

it can be used to falsify the law from which it is derived it must be determined that the facts are validly related to the law being tested and that nothing is wrong with the observation or experiment. To do this a few more predictive propositions and their corresponding experiments must be made. If failure is consistent, it would falisfy the proposed law. If, however, after a number of predictive propositions and their corresponding experiments, it is found that 75% of the predictions are fulfilled while 25% are not, the proposed law that A is followed by B would be falsified as a universal law, but it might be restated as a probabilistic law. This could mean that there is some unknown variable affecting the relation of A and B.[1]

In some cases, after a law has been quite successful in generating fulfilled predictive propositions so that its truth is tentatively established, a failure of a predictive proposition may not question the truth of the law but limit its scope. One well known case of this is the limitation in scope of Boyle's law. The law, that if the temperature is constant $V = k/P$ where k is a constant for a given gas, was experimentally confirmed by Boyle. However, with the development of more precise measuring techniques it was found that in some circumstances gases behave in ways markedly at variance with Boyle's law and that at all temperatures there are minute but measurable deviations from predictions based on the law. Did this serve to falsify the law, in which case it would no longer be used? By no means. Boyle's law is still used as a rough approximation of the way gases behave, just as a crude map of a terrain might not be entirely accurate but still adequate within limits.

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[1]Cf. <u>supra</u>, pp. 61-62.

Laws are not only evaluated as to their truth; in some cases the important evaluation concerns their scope.[1]

So far we have been discussing the evaluation of the truth and scope of laws according to the criterion of their ability to lead to singular propositions, the predictions of which are fulfilled in controlled observation. There is, however, another criterion for evaluating the truth of a law, namely its coherence with other laws and theories. Some, like Henry Margenau, feel that this criterion is important, because it gives the scientist a confidence in the law that cannot be given by even a large number of experimental confirmations.[2] Margenau distinguishes between inductive or correlation demonstration of the truth of a law and its deductive or exact demonstration. With inductive or correlation demonstration, which is achieved by inferring predictions and testing them against observations, a law can at best be declared true with a high degree of probability. With the deduction of a law from more comprehensive and well established theories, however, only a few predictions need be experimentally verified before the scientist is willing to accept the law as true. Taking Boyle's law, he says that via inductive demonstration the best one can do is affirm that $P = k/V$ has a correlation coefficient that is close to 1. But the more

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[1]Cf. Stephen Toulmin, The Philosophy of Science (New York: Harper & Row, Publishers, Harper Torchbooks, 1960), pp. 86-87.

[2]Henry Margenau, Open Vistas: Philosophical Perspectives of Modern Science (New Haven: Yale University Press, 1964), pp. 66-73. E. Bright Wilson, Jr. expresses the same idea, "although all science is fundamentally empirical, it is easy to put too much confidence in a curve or formula fitted to some observed points but unsupported by any conceptual scheme. . . . Purely empirical formulas should not be trusted too far from the data on which they are based. A good theory can help considerably." Quoted without reference by Plutchik, Foundations of Experimental Research, p. 122.

advanced student of science will, according to Margenau, require more than this before he is assured of the truth of Boyle's law:

> he will think of the law as implied by, or as a special case of, a more general proposition called the perfect gas law, or as a consequence of the equation of state for real gases, and he will even see this in the framework of the kinetic theory or of statistical mechanics. Having already confronted situations which led him to accept the validity of the laws of particle mechanics, and regarding the passage from particle mechanics to statistical mechanics as a simple and reasonable one, he thinks of the analytic consequences of that theory as true, and his a priori expectation, when confirmed by a very small number of positive instances supporting Boyle's law, engenders in him an assurance concerning the outcome of future experiments that is far beyond justification by the inductive probabilities mentioned.[1]

This type of deductive system seems to be the basis for what is called a "crucial" experiment, which need be conducted only once to verify or falsify a proposed law. Such experiments are dependent on a strict deductive system, for instance, a mathematical system in which the terms of the law are precisely defined, as well as on the existence of measuring instruments that are judged sufficiently reliable for accurate observation. Hence, such experiments are more likely to be found in the physical than in the social sciences.

Summarizing, the evaluation of proposed laws in science proceeds in two directions, downward to facts and upward to more comprehensive laws and theories. However, if laws are to be evaluated according to the criterion of whether or not they can be inferred from more comprehensive theories, their truth rests in part on the truth of the theories from which they are inferred.

<u>Evaluation of theories</u>.--Like laws, theories are evaluated as to whether or not they are true or false and according to their scope. Also

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[1]Margenau, <u>Open Vistas . . .</u>, p. 68.

the same criteria used to evaluate laws are used to evaluate theories, namely the ability to lead to predictions of facts and coherence with other accepted laws and theories. However, there may be occasions when two different theories offered to explain the same phenomena, are both true according to these criteria. When theories then compete, they are evaluated for their usefulness according to the criteria of simplicity and fruitfulness in stimulating further research.

Although the truth and scope of a theory are established by the same two criteria used to evaluate laws, because theories are generally more comprehensive, their evaluation is more complex. Because a law expresses a single kind of uniform relationship between facts, the predictive propositions derived from it deal constantly with the same classes of phenomena. Boyle's law is always concerned with temperature, pressure and volume. Theories, however, are expected to lead to propositions that predict a wide variety of facts. The Watson-Crick model of DNA leads not only to predictions of X-ray diffraction patterns but also to predictions of the way in which gene replication is accomplished. Likewise, while a law is judged coherent if it is derived from one major theory, a theory is judged coherent by its implication of a variety of laws. The kinetic theory of gases not only implies Boyle's law, but also Charles', Dalton's and Avogadro's gas laws.

In the evaluation of theories, the criterion of coherence has an important implication for that of predicting facts. One of the ways a theory leads to propositions that predict facts is via laws that are inferred from it. When this happens, the fulfillment of predictive propositions supports the truth not only of a law but also of the theory from which it is inferred. It must be remembered, however, that the route from a theory through one law to one set of facts is not sufficient to establish the truth of a theory. A theory must lead through a number of laws to a variety of facts.

When a theory is established as true by its ability to predict facts and its coherence with other laws and theories and then comes up against facts that are not in accord with the theory, one of three things can happen. First, the new facts can serve to limit the scope of the theory. For example, Newtonian physics is generally regarded as true although its predictions of velocities are not as precise as those made by the special theory of relativity. Second, the new facts can be regarded as insignificant. In this manner the phlogiston theory, which asserted that in combustion the element phlogiston was lost, was able to maintain itself even when an actual increase in weight was measured in the residue of a burned substance.[1] Third, if the facts contradicting the theory are regarded as significant, they may be treated as problems to be solved by the further articulation of the theory. However, if after a number of attempts such problems remain unsolved, a new theory may be formed that explains not only the facts that contradict the old theory but also many of the facts and laws that the old theory explained. When this happens competition between theories ensues.

When theories compete, their evaluation cannot be accomplished simply by the two criteria we have been considering. If the criterion of ability to lead to predictive propositions is used, it may be

[1]Butterfield points out that what we have called the denial of significance to such facts was itself "remarkable evidence of the fact that at this time the results of weighing and measuring were not the decisive factors in the formation of chemical doctrine," The Origins of Modern Science, p. 196.

discovered that both theories lead to many of the same facts. In a sense both are true.[1] Even if each theory leads to facts that the other one does not lead to, each theory can still maintain itself by saying that the facts accounted for by the other theory but not by itself are actually insignificant. Thus each theory becomes a closed system, dictating what it considers to be the facts and establishing its truth on the basis of its ability to lead to predictions of those facts. There is, as Kuhn points out, a circularity involved that makes normal evaluation procedures inadequate for determining which of the rival theories is more acceptable.[2] Therefore, if competing theories are to be evaluated, other criteria must be used against which each can be compared. Two criteria often used in situations like this are simplicity and fruitfulness.

The criterion of simplicity sometimes includes an idea of beauty. However, appeals to beauty are at best problematic in evaluating a theory, because what is considered beautiful can vary quite widely between individuals, groups and cultures. Sometimes an appeal to beauty may actually stand in the way of science. The belief that the orbits of the planets had to be perfect circles, based on an idea of what was truly beautiful, was contrary to what turned out to be correct in terms of gravitational theory. Because of the problems involved, it seems best to regard

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[1]Henry Nelson Wieman writes that an often ignored characteristic of scientific knowledge is that "many different theories are equally true and equally correct as descriptions of the universe or any part of it." Man's Ultimate Commitment (Carbondale, Illinois: Southern Illinois University Press, Arcturus Books, 1958), p. 148. He then goes on to list criteria for selecting between such theories that are similar to ours, namely simplicity, fertility and aesthetic appeal, although we criticize the last one.

[2]Kuhn, The Structure of Scientific Revolutions, p. 93.

beauty not so much as a criterion for evaluating theories but as a guiding principle in the formation of new theories. It is in this sense that beauty was appealed to by Watson and Crick, when they looked at their model of the double helix and thought that "a structure this pretty just had to exist."[1] However, in evaluating the truth of their theory of DNA they used the criteria of coherence with the laws of stereo chemisty and the ability to predict X-ray diffraction patterns.

The criterion of simplicty can be used to evaluate competing theories when it refers to the minimum number of assumptions necessary for a theory. Simplicity in this sense seems to have been the criterion on which the heliocentric theory of the universe finally won the competition with the geocentric theory. Both theories accounted for the facts, but as time went on the geocentric theory had to introduce an ever greater number of assumptions to maintain itself. It finally became so complex that its usefulness was jeopardized, and the simpler Copernican theory won the battle.

In addition to simplicity the criterion of fruitfulness can be used to evaluate competing theories as to their usefulness. Fruitfulness is the ability to lead to new facts, laws and theories. While both competing theories may explain facts and laws already known, one may hold out more promise as a guide for future scientific research. That theory which is the most promising as a guide to the discovery of further knowledge is apt to be selected as more useful than its competitor.[2]

When one theory wins out over its rival on the grounds that it

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[1]Watson, <u>The Double Helix</u>, p. 205.

[2]For a more complete account of evaluating competing scientific theories, cf. Kuhn, <u>The Structure of Scientific Revolutions</u>, pp. 151-158.

is simpler or more fruitful, the losing theory is not thereby shown to be false. What actually happens is a change and maybe even a revolution in a scientific conceptual scheme that gives the scientist a different outlook on the world than the one he previously had. Although the old way may fall into disuse, it can still be regarded as true, because truth depends on the ability of a theory within a framework of mutually consistent laws and theories to lead to predictions of facts that can be confirmed in controlled observations. Truth, however, as we have tried to indicate, is not the only way in which theories are evaluated. After their truth is established, the acceptance of a theory may depend more on its scope, that is, on the precision with which it predicts the facts and on its usefulness in a particular science.

Scientific experiments.--Of all the criteria for evaluating laws and theories, the ability to lead to predictions of facts is the most important. Although the criterion of coherence is helpful in establishing confidence in a law or theory, still a coherent system of laws and theories may be simply a total fiction, a gross logical illusion. Also, before the criteria that evaluate the usefulness of a theory can be appealed to, a theory must be established as tentatively true by its ability to lead to predictions of at least a few facts. Because the truth of a law or theory is dependent on the fulfillment of the predictions to which it leads, it is important to inquire how single predictive propositions are fulfilled or not fulfilled. This brings us to the place of controlled observation or experiment in the evaluation of scientific concepts.

Observation plays a double role in scientific inquiry. As we have seen it is one way of gathering information in the process of forming new concepts.[1] The second role played by observation is in experiments developed to test predictions made on the basis of proposed laws and theories. In order to keep this section fairly simple and also relevant to the kind of experiment we shall consider later in evaluating the truth of ideas about God, let us take as our basic example that a few observations have been made of students from well-to-do homes doing well in college; this suggests the hypothesis that there is a high degree of correlation between the economic level of the family and a student's college academic achievement.[2]

In trying to evaluate this hypothesis experimentally, the scientist must make a number of decisions and solve a number of problems that have a bearing on the results of any experiment.[3] The first of these problems is to connect the rather vague terms of the hypothesis, economic level of the family and college academic achievement, with terms that designate observable and measurable results.[4] Economic level can be connected with the yearly annual income of the family. However, it may also depend on the number of members in the family, the cost of living

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[1]Cf. *supra*, pp. 85-88.

[2]For our present purpose it is not important whether or not this observation is reasonable or of any social importance; we are interested only in showing how such an observation is scientifically confirmed or disconfirmed.

[3]In what follows we are relying heavily on Plutchik's *Foundations of Experimental Research*, where the role of the scientist as a decision maker is stressed. Cf. especially pp. 30-34 for Plutchik's preliminary discussion of the major kinds of decisions, "decisions about definitions," "decisions about sampling," "decisions about the type of experiment," "experimental design decisions," "decisions about measurement," "statistical and mathematical decisions" and "decisions about generalizing." He then discusses each of these more fully in succeeding chapters.

[4]This problem is basically the same as the determining of facts for an electron jump in the Bohr theory of the atom. Cf. *supra*, pp. 97-98.

where the family lives, and the family's total assets (savings, stocks, bonds and property) as well as its debts. All these would have to be computed together to arrrive at an observable indicator of economic level of the family. College academic success can be connected with college grades. Here a slightly different problem arises, because the standards of grading college students are not uniform but vary with professors and institutions. One possible way to solve this problem is to use standardized tests to measure college academic achievement, such as the Graduate Record Examinations in major fields, but such tests would have to be truly standardized, that is, adequately represent the major alternatives that could be studied in a given field. Our brief attempt to operationally define economic level of the family and college academic success indicates that the decision concerning what the terms of a proposed law mean is not an easy one.

A second decision the scientist must make is how to select subjects for the experiments. The problem here is that subjects who measure the same regarding the economic level of their families may be different in other respects that are related to college performance. Such factors as the student's motivation, study habits, college living conditions and sex may all have a bearing on college performance and thus may invalidate any results that correlate family economic level with college achievement.[1] The control of other possible variables can be achieved by various sampling techniques employed in the selection of subjects. One approach is to

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[1]There is a similar need to control extraneous variables in the natural sciences, e.g., the requirement of keeping the temperature and amount of gas constant in experiments regarding Boyle's law. Although such control is generally easier in the natural sciences, the problem is the same as the one faced in the social sciences.

select subjects to form matching groups. In our illustration these would vary only with respect to family economic level but would be alike in such matters as motivation, study habits, college living conditions and so on. Although matching groups in such a manner is possible in some cases, it might be extremely difficult in the experiment we are considering. Another approach that would be more suitable is that of random sampling. The principle behind random sampling is that all members from a population from which the sample is made (for example, all high school seniors in New York City who have registered for college) have an equal opportunity to be selected. A list is made of such students, arranged in alphabetical order, and every 100th student is selected. The idea is that although students vary in such factors as motivation, study habits and so on, when they are selected in this manner and then grouped according to family economic level, each group will have an equal chance of representing these other factors. When the groups are then treated statistically as a unit, these extraneous variables are expected to cancel each other out.[1] A third possible sampling technique is a combination of the first two. It is called stratified sampling. The general population from which the sample is drawn is first divided into subgroups according to possible extraneous but influential variables. In the case we are considering it might be possible to divide the population into those who in college will live in college dormitories and those who will live at home. Then from each of these subpopulations random sampling

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[1]Random sampling is especially useful in cancelling out variables that might influence the results but are unknown; they are called chance factors. Cf. the discussion of chance and "significance," <u>infra</u>, pp. 113-115; also Marion J. Levy, Jr., <u>Levy's Nine Laws of the Disillusionment of the True Liberal</u> [Chicago: University of Chicago Press, 1970], Law no. 9: "Only God can make a random selection."

techniques can be used to cancel out other possible variables.

A third decision the scientist must make is how many values of his independent variable, in this case family economic level, he wishes to include in his experiment. This decision will primarily depend on whether he is evaluating a proposed conjunctive law or a proposed functional law. To observe a conjunctive relationship, he need only observe two values. Usually such observation attempts to see whether the presence or absence of one variable is related to the presence or absence of another variable, but conjunctive relationships concerning family economic level and college academic achievement may be indicated by selecting two values on a scale, for example per capita net assets corrected in relation to the cost of living of $2,000 and $8,000, and seeing if there is a similar difference in a scale measuring college performance. If one, however, desired to test for a functional relationship between the two variables, one would have to select at least three values, such as $2,000, $5,000 and $8,000, and divide the subjects accordingly. Then, on the basis of measured college performance, one could plot a line or curve on a graph that might or might not indicate a functional relationship. Experiments dealing with two values are called factorial or bivalent while those handling three or more values for each variable are functional or multivalent experiments.[1]

When groups of subjects are used in experiments evaluating the validity of an hypothesis, the scientist must make a decision concerning

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[1]Cf. Townsend, Introduction to Experimental Method, pp. 83-84, and Plutchik, Foundations of Experimental Research, pp. 53-61. All experiments to confirm predictions derived from hypotheses of relationships will be either of these types, even when the scientist may wish to observe the interaction between three or more variables in "parametric" experiments, cf. ibid., pp. 61-64.

the type of statistical analysis he will use to analyze the data gathered. Two necessary facts that must be determined by such analysis are, first, the measurement of the central tendency of the group which is the average of all individual measurements made in each group, and second, the measurment of group variability from the average or the standard deviation. The standard deviation can in turn be used as a unit of measurement for constructing a scale on which to measure the quantitative difference between two groups.[1]

Above we indicated that one important problem in experimental evaluation of proposed laws and theories is the control of variables other than those the scientist wishes to observe. We indicated that one way to do this was by the random sampling of subjects. This, however, means that the extraneous variables are acting along with the variables to be tested, and the question arises whether the results of an experiment are influenced by these extraneous variables to the point that they, and not the key variable tested, are responsible for the results. This is the problem of chance. In the example we have been using, is the difference in college performance, measured in terms of the standard deviation, between groups with economic levels of $2,000 and $8,000 actually due to differences in family economic levels, or might it be due to extraneous variables or chance? This question is usually phrased in the social sciences as, is the measured difference significant? On the basis of the work of the statistician, Ronald A. Fisher, the level of significance (sometimes called the level of confidence) is generally set at 5%. This means that, when the proper statistical procedures are

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[1]This is basically a process of selecting a unit of that quality which is measured, in this case college performance. Cf. <u>supra</u>, pp. 59-60.

applied, the measured difference in college performance between the $2,000 and $8,000 groups could occur in only five cases out of one hundred as the result of chance factors. If the measured difference occurred only this seldom, one could conclude that it is significant, that is, most probably not due to chance factors but to a difference in family economic level.[1]

The procedures to determine whether differences between groups are significant or not depend on whether the experiment is bivalent or multivalent, that is, whether each variable has two measured values, or three or more measured values. It also depends on the number of variables. Finally it depends on the size of the samples. If two variables, each with two values are predicted to be related on the basis of a proposed conjunctive law, then with samples of more than forty or fifty people the "z test" can be used to calculate the level of significance. If the sample groups are smaller, the "t test" should be used. If there are three variables as in parametric observations, to evaluate a proposed conjunctive law a procedure called "analysis of variance" that uses the "f test" can be applied. If the proposed law asserts a functional relationship that requires the measurement of three or more values for each variable, the "method of least squares" can be

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[1]In the example we are using, if it were found that differences in college academic achievement varied significantly with family economic level, what would be confirmed is a correlation but not necessarily a causal law, cf. supra, pp. 63-65. While family economic level might be a condition of such things as pre-college educational opportunities, e.g., private schools, and hence perhaps an indirect cause of college achievement, it is also possible that family economic level and college academic success are both dependent variables of other factors, e.g., personality characteristics such as willingness to work hard or imagination, or cultural factors, such as the "Protestant ethic," "Chinese family loyalty," or "Jewish assertiveness."

used to determine whether the relation of the values of one variable to those of the other variable is statistically significant or due to chance. The point is that the statistical procedures used depend on the type of experiment made, which in turn partly depends on whether the proposed hypothesis asserts a conjunctive or functional law. If statistical procedures determine that the predicted result is significant, the predictive proposition is true and the hypothesis partly confirmed. If the procedures indicate that the result is probably due to chance, the predictive proposition is not fulfilled and the proposed law is disconfirmed.[1]

The fact that the scientist in conducting experiments must make decisions regarding definitions of the terms of the hypothesis, techniques of measurement, control of extraneous variables, selection of subjects, type of experiment, number of variables, number of values for each variable and the type of statistical procedure to determine if the results are significant, means that the scientist himself is deeply involved in the experiment. The decisions he makes can influence its outcome, and if the decisions are not appropriate, one can question whether the results of the experiment can be used to evaluate a proposed law or theory. Scientific knowledge cannot be assumed to be purely objective, if by objective it is meant that the scientist plays no part in determining the results of the experiment. The decisions he makes indicate that scientific knowledge is, in Polanyi's terms, "personal knowledge." However, "personal knowledge" does not mean that the results of experiments are

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[1]For a summary of statistical procedures for determining the arithmetic mean, standard deviations and the tests for determining whether or not observed and measured results are significant, cf. Plutchik, Foundations of Experimental Research, pp. 88-143.

purely subjective, dependent solely on an individual scientist.[1]

That the scientist's decisions are crucial for the outcome of an experiment indicates that the scientist himself is a variable that must be controlled. There are two ways in which this can be accomplished. The first has to do with the attitude of the individual scientist. In the section on concept formation we stressed the importance of the scientist not being so fully committed to a given law or theory that he is unable to recognize problems and seek new ideas as solutions to problems. His commitment is to the method itself rather than to any single idea. This same commitment to method must be carried over into concept evaluation. However, now it means that the scientist must detach himself from the very idea he is proposing, just as he detaches himself from previous ideas in forming it. Although the idea is his own and although he may have a large stake in it, in evaluating it he must seek to determine every possible way in which it might be falsified. Evaluation of scientific concepts is critical evaluation.

In spite of a scientist's conscious effort to detach himself from his hypothesis, subconscious desires to see it confirmed may subtly influence his decisions. Therefore, a second procedure must be used to control the variable of the scientist. In reporting an experiment and its result, the scientist must be explicit about the decisions he has made and the grounds for making them. When he does this, his reasoning can be evaluated by other scientists not so personally involved with the proposed law or theory, and his experiments can be repeated by them. If his decisions are accepted as appropriate by other members of his

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[1]Cf. Polanyi's distinguishing of "personal" from both "objective" and "subjective" knowledge, <u>Personal Knowledge</u>, pp. 300-303.

scientific community and they are able to repeat his experiments with the same results, then the knowledge obtained, whether it confirms or disconfirms the hypothesis, can be judged free from subjective bias. Even though it is personal knowledge, because decisions on the part of the scientist are involved, it is in a sense objective knowledge, because of the conscious effort to achieve an attitude of detachment and because the decisions made and the results obtained are agreed on by a number of scientists.[1]

In concluding this section on the evaluation of scientific concepts, we may briefly summarize the requirements that must be met to experimentally confirm the truth of an hypothesis developed by the procedures of concept formation. Assuming that the concept is a fairly abstract theory, the first step in evaluation is to determine subordinate laws that are implied by the theory. Second, from these laws specific predictive propositions should be logically derived. Third, the terms of the propositions should be adequately represented in the experimental situation. Fourth, bias due to extraneous variables, inadequate sampling, poor measuring techniques, inappropriate statistical analysis, in other words bias due to faulty decisions by the experimenter should be eliminated. Finally, the predictions of the propositions that have been translated into the experiment should take place. If the results of the experiment are not as predicted, if the decisions made

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[1]By "objective" we mean knowledge that meets the criterion of "intersubjective testability" as presented by Ian G. Barbour, Issues in Science and Religion (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1966), pp. 182-185. According to Harold K. Schilling, Science and Religion: An Interpretation of Two Communities (New York: Charles Scribner's Sons, 1962), p. 251, the term "intersubjective testability" seems to have originated with Herbert Feigl, "The Scientific Outlook: Naturalism and Humanism," American Quarterly, I (Summer, 1949), 139-140.

in conducting the experiment are not appropriate, if the experimental situation does not adequately represent the terms of the proposition, if the proposition does not follow logically from the law, if the law does not follow logically from the theory, the hypothesis cannot be regarded as confirmed. The evaluation of scientific concepts, though achieved by definite procedures of the method of science, is not a simple but a rather complex process. In the following chapters we shall see if this process and the procedures of scientific concept formation can be used to develop and test theological ideas about God.

# CHAPTER IV

## TOWARDS A CONCEPT OF GOD OPEN TO EXAMINATION BY THE METHOD OF SCIENCE

> The desperate need of our time is for a faith that can direct man's commitment to the creative source of all human good as it works in the temporal world, open to rational-empirical search and to service by modern technology.
>
> Henry Nelson Wieman

The basic questions of this dissertation are: can the method of science be used to develop and evaluate ideas about God? What kind of understanding of God does one arrive at if one attempts to use the method of science in this way? In Chapter I we defined our basic terms, "science," "religion" and "theology," and indicated why it is appropriate to explore these questions. In Chapter II we discussed the nature of experience and certain types of concepts of science. In Chapter III we outlined the general method, consisting of procedures, attitudes and criteria, used in developing and evaluating scientific concepts. Now we turn to see whether this same method can be used in theology to develop a theory of God that can be evaluated by scientific criteria.

To do this we shall have to recognize that some limits must be placed on theology by science and also that, if the method of science is to be used, it must be within limits dictated by the subject matter of theology. In specifying these limits we shall be stating some of the basic presuppositions of a conceptual scheme for a possible scientific theology.[1]

Since we are exploring the possibility of using the method of science in theological inquiry, we cannot do what has often been done and distinguish theology from disciplines normally called the sciences by appealing to the method of inquiry employed. Instead we must distinguish theology that attempts to be scientific from other sciences in the same manner that the sciences are normally separated from one another, namely by the kinds of questions asked.[2] Physics, for example, asks questions concerning the spatial and temporal location as well as the motion of various kinds of phenomena, while behavioral psychology asks questions concerning the responses made by animals and men to certain stimuli. A theology that attempts to employ the general method of science can also be distinguished from other forms of scientific inquiry by the kinds of questions it asks, and it is these questions that set the limits within which the method of science must be used.

The questions asked in theological inquiry stem from the nature of religion, which in Chapter I, following Frederick Ferré, we defined

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[1]Regarding the following discussion of a conceptual scheme for a scientific theology in relation to the schemes of the various sciences, cf. <u>supra</u>, pp. 41-48, esp. 41-42, 47-48.

[2]The kinds of questions asked are not the only way in which the sciences are distinguished from one another, because the questions themselves are often related to dominant theories and the techniques employed in applying those theories, what Thomas Kuhn calls "paradigms" or "exemplars," which are an important part of the "disciplinary matrix" of a given science, <u>The Structure of Scientific Revolutions</u> (2nd ed., enlarged; Chicago: The University of Chicago Press, 1970), pp. 181-191. However, we would not go so far as to say that in every case some paradigm determines the questions asked. Although this happens in well developed sciences, in a developing science questions may be asked prior to the development of a paradigm theory, and such questions may be dependent on common sense concepts, philosophical ideas, or theological notions, which is the case in our attempt to develop a scientific theology.

as one's most comprehensive and intensive valuing.[1] Specifically, theology asks what is the proper object of man's most intensive and comprehensive valuing; what does it mean to value any such object; and what are the implications of religious valuing for our lives? Something is valued or consciously desired because it is considered to be important for our lives in some way or other. The object of religious valuing, however, is not just important; it is considered to be the most important thing in our lives, that upon which all other things of value depend. Hence, theology seeks to know what properly is the most important thing in our lives.

Theology asks what properly is most important and not just what is most important, because to consider something important and hence of value does not necessarily mean that it is good.[2] For a particular person or group of people, that which is considered to be most important and is hence the object of their religious valuing may be evil; it is possible to have a religion or religious cult that worships the "devil." But for the most part in the religions of the western world that which is considered to be the proper object of religious valuing is most important because it is also believed to be the greatest good. It is considered to be the greatest good because it is that upon which all other good depends

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[1]*Supra*, pp. 5-6.

[2]Asking what is most important and hence the central focus of various existing religions and religious traditions is a concern of the theologian insofar as in examining various current beliefs he might gain some insights into what is properly the most important; however, the examining of what various men and groups do value most intensively and comprehensively (rather than what they should properly value in this manner) seems to be the appropriate task of such disciplines as history of religion, literature of religion, sociology of religion and psychology of religion.

and by which evil is avoided or overcome. Again in the religions of the west the greatest good is generally called God, or is given some title equivalent to "God." Hence, theological inquiry asks the question, who or what is God?

When God is considered as the greatest good, then the question "who or what is God?" cannot be separated from the questions "what is good?" and "what is evil?", because God is considered as the bringer of good and the deliverer from evil. Thus theological inquiry, if it is to come to any understanding of the nature of God, must also seek to answer questions concerning the nature of good and evil. These three questions--"what is good?", "what is evil?" and "what is the greatest good or God?"--form the primary lines along which theological inquiry is conducted and are what distinguishes theology from other kinds of inquiry.[1] When one explores the possibility of using the method of science in theology, the method of science must be used within the limits suggested by these questions.

However, the method of science itself places certain limits upon inquiry that seeks to use it to help answer questions concerning good, evil and whatever saves man from evil and brings about his good. In our discussion of science we have paid considerable attention to experience and its relation to scientific concepts, to the role of observation in the gathering of information for the development of hypotheses, and to the refinement of observation in the designing of experiments to test hypotheses. The importance of experience and observation in science is indicated by our definition of the word "science," in which the

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[1]<u>Supra</u>, p. 32.

characteristic that distinguishes science from other types of inquiry is controlled observation.[1] If the method of science is to have any possible use in theological inquiry, that which theology investigates must in principle be perceivable in controlled observation.

This has a number of implications concerning the questions asked by theology. First, whatever is good, evil, and the greatest good or God must be found within space-time existence and not beyond space and time. Second, whatever is good, evil or God must be isolatable, so that, for example, if one hypothesizes that God brings about something good, the bringing about of that something good cannot be attributed to other entities or processes, or to chance. Finally, the terms "good," "evil" and "greatest good" or "God" must be connected not only to exceptional events in space and time but to events that occur with enough regularity as to be observable by any number of qualified observers when the proper conditions are met. Only if good, evil and God can be understood in terms of these requirements of controlled observation can the method of science be used to develop and evaluate ideas about God. To explore how this might be done will be the task of this and the following two chapters.

## Good and Evil

In seeking to understand good and evil as something observable, we are seeking for data, observable phenomena that are not linked to any specific theory about good and evil or about how they come about. The phenomena we shall be concerned with are what men value. However, before

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[1] *Supra*, pp. 4-5.

we proceed too far it will be necessary to analyze our data of men's values in terms of what is good and evil and hence in terms of some theoretical framework which allows for hypotheses concerning the source of good and evil. Gradually we shall attempt to refine our initial data into facts against which hypotheses about the source of human good, which is the greatest good or God, can be tested.[1]

The data of scientific theological inquiry can be found by asking "what do men actually value?", when valuing means the conscious desiring of something. We discover that men consciously desire any number of things, such as food, clothing, shelter, sex, friendship, love, knowledge, freedom, orderliness and justice. Some of these things are desired for their own worth; they are intrinsic values. Others are desired as means to the realization of ends and are hence instrumental values. Still others, for example knowledge, may be sought either as instrumental or as intrinsic values.

Such values are observable in the sense that one can observe their being consciously desired. This observation may be an introspection of one's own conscious desiring, a listening to reports of other people's introspection, or an observation of the actions of others in seeking something.

Our observations of what people value yield only unrefined data, because each of the values we have mentioned may be either good or evil.

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[1]The following discussion of good and evil, as well as that of the greater good and greatest good, has its roots in the thought of Henry Nelson Wieman, especially in The Source of Human Good (Carbondale, Illinois: Southern Illinois University Press, Arcturus Books, 1964), and The Directive in History (Boston: The Beacon Press, 1949), pp. 3-75. However, I have attempted to develop what I take to be Wieman's approach in my own way and at points with important, distinctive offshoots from Wieman's position.

Food, for example, is good in that without it one could not live, but too much food can itself lead to an early death. Likewise, friendship is generally good, but there are times when friendship can become burdensome in that it captures the people involved in a certain rut from which they cannot break free. Simply to seek what men value is only a first step toward coming to an understanding of the good and evil that can be observed.[1]

This same point can be reached via the observation that not all men value the same things at the same time, and that quite often what one man or group of men values is in conflict with what others value. When values come into conflict the conflict need not be evil. As we shall see later, a certain kind of conflict is good. However, when values are in conflict there is nothing in the nature of the conflicting values themselves that determines whether the conflict is going to result in good or evil. What is valued by different men at different times cannot by itself be taken as observable good or evil.

How can one determine when values held by men are good and when they are evil? One possible way is to select certain values as universal, that is, as values that under every circumstance are considered to be good. Such values are selected not arbitrarily but because they have some ability to help organize the life of an individual, a group or a nation; for example, the values of liberty and justice for all help unite a nation in a common quest. When this happens the values themselves become good and deserve the allegiance of all members of a given society. However, allegiance to such values is not always good, because it does not solve

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[1]Cf. Wieman, The Source of Human Good, pp. 24-25.

the problem of what to do when the guiding values of one individual or society conflict with the guiding values of another. Even though they may serve as goals that organize an entire culture, when another culture is organized around a different set of goals, unswerving allegiance by those of each culture to their own set of values can lead to the kind of conflict in which individuals, nations and even the values themselves are destroyed. Hence, although under some circumstances such values may be good, if they are given allegiance as good in every circumstance, they can actually lead to evil. Ultimate allegiance to any envisioned set of values only increases the problem of the conflict between values or different sets of value; it does not solve it.

The solution to the double problem, first, how to determine when what is valued is good and when it is evil and, second, how to settle conflicts between different sets of values in such a way that the conflicts are not destructive, is already implied in our discussion. What must now be made clear is an understanding of evil as that which destroys, for we have been judging values sought by different individuals, groups and societies to be evil when they are held in such a way as to be destructive of other values. Thus, food, which is normally good in that it sustains life, can become evil, because when eating becomes obsessive it cancels out other values, including good health and perhaps such values as a good appearance, friendships and so on. Also, such values as freedom and knowledge, which under most conditions are good, can become evil, because they can be held so dearly that they become rallying cries for the destruction of the values prized by other men, and of the men and societies who desire them.

Turning this around from an understanding of evil to an understanding of good, we can say that whatever is consciously desired by men is good insofar as it serves to support other values. The criterion here is mutual support. If the many values held by individuals and societies tend to support one another, then each value in the system as well as the total system of value is good. Further, if a conflict between two values or systems of values can be settled in such a way that the outcome would be a new system in which the once divergent values would support rather than compete with one another, such a conflict would itself be good.[1]

Ideally speaking, the greatest good for man would be a system of values of such scope that everything sought by every man would support whatever was desired by every other man. However, this is not the actual state of affairs in the world. What we observe are sets of values that

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[1]This notion of good and evil is grounded in Wieman's distinction between individual and social good, The Directive in History, pp. 34-35. For Wieman there is a good that is strictly related to the individual and is marked by "a positive expressive sign." There is also a second level of good that is social, where the good of an individual supports and enhances the good of other individuals. In our interpretation we have used the term value for that which is consciously desired by either an individual or a group of individuals, and in a sense this seems to correspond to Wieman's first level of good. We have pointed out that what is valued can be good or evil and that the criterion of good is the ability of values to support one another either within an individual or between individuals, which is similar to Wieman's conception of good at the second level or social good. However, Wieman also points out that social good might be moral or immoral: "thousands of people might live together in a civilization that lasted for hundreds of years, the good I [one] of each supporting that of the others; yet the only moral persons might be those who fought the whole system." Ibid., p. 35. This provides the starting point for his discussion of a third level of good, the moral law, which states, "act so as to meet the conditions under which symbolized meaning is created and thereby also man himself, his society and his history, with the appreciable world expanding." "Symbolized meaning" in its broadest sense means "a structure of interrelatedness pertaining to events. . . ." Ibid., p. 114. We shall develop this same idea in our discussion of the need for a continual movement toward greater good, in terms of which we can understand how values that are normally good may become evil, infra, pp. 128-130.

more or less mutually support one another, and at the same time, are in conflict with other sets of values. The values of a democratic way of life in contrast to the communistic way is one example. Another is the values of many white middle-class Americans in contrast to the values held by many blacks. In each case there are systems of mutually supporting values and to that extent each system and its values are good; however, there is also a conflict between the systems of value. This conflict can lead to the partial or total destruction of one system or the other, in which case the result would be evil, or it can lead to a new system of values that includes as many of the values of the originally opposed systems as possible, in which case the conflict would issue in a greater good than before. In the actual world then, what one hopes for is an increase in mutual support between values and systems of values and a decrease in the kind of conflict that is destructive of values. Since it is the ability of values to mutually support one another that makes them good, the increase in mutual support may be called "greater good." Unless greater good is continually sought, conflicts between values will tend to be destructive and values that are good insofar as they support one another in a limited context will become evil and destructive in a broader context of value.

## Greater Good and Evil

When we analyze greater good more closely, however, something interesting seems to happen. The greater good occurs when conflicting values or sets of values are reorganized or transformed in such a way as to mutually support one another. As a result of this transforming process old values are revised or new values come into being; the revised old values or the new values provide an expanded system in which the original conflicting values can now mutually support one another. However, quite often, perhaps always, in this process something which was good in the original systems is lost or destroyed, because when each of the original systems is transformed into a new system that includes many of the original values of the conflicting systems, some of the values of the original systems are left out. Now if the destruction of values is evil, then it seems as if the movement toward greater good also contains within it some evil.

Is this, however, really the same as the evil that results from a conflict between values or sets of values in which one person or group attempts to destroy the values of others? In a sense it is, because something that was once good is lost. However, when the conflict results in the destruction of the values of one of the parties involved the evil seems to be greater than when the conflict yields a new system in which the values of both parties can mutually support one another, even though some values may be lost. Put another way, in one case the conflict actually blocks the movement toward greater good, and this blocking of an increase in the mutually supportive relations between values is really the evil to be avoided. In the other case evil is actually a part of the movement toward the greater good, perhaps even a necessary part of that movement, because it seems impossible, at least when one is looking at the actual world rather than some ideal state of affairs, to resolve a conflict between sets of values in such a way that opposing values support one another where they did not before, without something being lost. When this happens, the loss is truly evil; but because it is evil, and hence something to be avoided, it can also serve to spark a new movement toward a still greater good.[1]

## Four Dimensions of Life

Our understanding of values and of good, evil and the greater good, will be further illuminated if we take a brief look at them in four dimensions of life--the cognitive, aesthetic, social and personal dimensions. As we do this we also shall see how instances of the greater good can be observed and hence can be considered as data for a possible scientific theology.

In the cognitive dimension what are consciously desired or valued are observations of phenomena, and ideas. Observations and ideas are good when they are related to one another in such a way that the ideas explain how the phenomena occur and the observed phenomena support the ideas. Ideas are also good when they can be linked to other ideas in ways that are mutually supportive. In other words, in the cognitive dimension the good is truth, and truth is established according to the two basic criteria we discussed in our outline of the scientific method, the correspondence of ideas with observed phenomena and the coherence

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[1]Cf. Wieman, The Source of Human Good, pp. 86-87. The recognition that in the movement toward greater good there is always some evil in the sense that values which were good in old systems are now lost is perhaps what Wieman is trying to express when he writes that the "increase in good is not merely an increase that leaves the human mind unchanged; it is the actual, progressive creation of the human mind as one strand of those conjunctions which embody an increasing measure of good at the first two levels. This we remember, may be either moral or immoral and perhaps it is always both." The Directive in History, pp. 60-61.

A further distinction between evil in these two cases is that in one case the destruction of values is against the will of one of the parties in the conflict while in the other case both parties are willing to allow the loss of some values in the hopes of gaining a greater good. Cf. infra, pp. 187-191 on the kind of commitment required for the attainment of greater good.

of ideas with other ideas.[1] The greater good in the cognitive dimension is the continual increase of these relations between ideas and between ideas and phenomena. In the process that leads to such an increase some of the existing ideas that are valued may be replaced by ideas that better explain phenomena or resolve conflicts between currently held ideas. The replacement of an idea may be evil for some if it still explains certain phenomena, but the greater evil would be the blocking of a movement toward more comprehensive systems of coherent ideas that correspond more closely to observed phenomena.[2]

In the aesthetic dimension what is valued is the experience of felt quality and the structures of art, for example, the rhythm and rhyme patterns of poetry, the color and forms of a painting and the sequence of related events in a novel. These structures are not necessarily good in themselves but become good insofar as they evoke felt quality in the viewer or reader, that is, insofar as they link up to the audience's own feelings about the world and support and enhance those feelings. The structures of art are also good when they support and enhance other artistic structures, for example, the supportive relationships between music and body movement in ballet or between music, poetry, plot and

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[1] *Supra*, pp. 98-105.

[2] Such a blocking may occur when certain ideas are absolutized as true for all time, in which case those holding the ideas may seek to repress or destroy in an inquisitional fashion all who value ideas that do not fit into the absolutized system. One way of absolutizing an idea is to argue that it points to a trans-empirical reality and hence cannot be tested by the empirical or experimental method, Wieman, *The Source of Human Good*, p. 178. Such a tactic is sometimes employed in theology in the face of new theories arising in science; however, from our viewpoint, which is exploring the possibility of scientific theology, such absolutizing is not only contrary to the scientific notion of the tentativeness of all ideas but also leads to much of the evil committed in the name of religion.

personalities in opera. The good in the aesthetic dimension that is supportive of relationships between artistic structures and felt quality may be called beauty. The greater good consists of revisions of existing artistic forms and newly developed structures that lead to increases in depth and breadth of felt quality. In the process that leads to revised and newly developed forms some of the old structures and felt qualities may be lost, and in a sense this is evil. But the greater evil is valuing one structure or set of structures so much that the further unfolding of felt quality is blocked. When this happens what was once beautiful becomes ugly.[1]

In the social dimension what is valued is relationships with other people and the structures that support these relationships, for example, moral codes, social conventions and institutions. Relationships between people are not necessarily good but may be evil. They are good when they are supportive of all parties involved in the relationship, which means the maintaining of the physical and psychological existence of each person in such a way as to affirm and enhance his unique individuality. Evil in this dimension occurs when the existence of human beings as unique individuals is hindered. To kill someone is the most extreme case of such evil, but the perverting of unique individuals by forcing persons to conform to a rather narrow set of social conventions is also evil. It is not that the social conventions are always evil; in fact they usually help maintain supportive kinds of relationships between the members of a society. However, when the

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[1]Cf. ibid., p. 138, where ugliness is evil when "it is the repulsiveness of aesthetic form so ordered as to distract attention from further aesthetic form and to hinder the wider and deeper exposure of quality in the world."

membership of societies changes, what were once good social conventions may become inadequate to their task, and unless they are transformed they can become evil. The greater good in the social dimension is the continual emergence of new and revised social structures to allow for an ever widening range of expression of the unique individuality of all persons. In the course of this movement toward greater good some old structures may be lost. Also it may be necessary to hinder certain individuals or groups who have developed relationships that are destructive of other people. This means that not only must criminals be hindered but also those who, through an excessive application of the law, try to prevent expressions of unique individuality manifest in various acts of protest. The imprisonment of criminals or the attempt to curb the excesses of law and order enthusiasts are in themselves evil in that patterns of behavior valued by some are thwarted.[1] But the greater evil would be to permit these same patterns to block the development of new social structures that would support a wider diversity of life styles.

In the personal dimension of life what is valued are a variety of beliefs, emotions and behavioral patterns. Any particular thing valued is not necessarily good or evil. Beliefs, emotions and behavior patterns are good insofar as they support one another so that the person is integrated within himself and with his world. In actuality no one ever seems to achieve a state of total integration, or if such a state is thought to be achieved (for example, in the case of the mystic) it is not maintained for long. What more likely happens is that an

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[1]Rather than destroying the murderer, which would be just as evil as his act of murder, one should seek ways to transform him into a person whose life patterns support rather than destroy other people.

individual reaches states of partial integration, only to have these states challenged by aspects of his personality or world that do not fit that state. Hence he is forced to move from one level of integration, which is good, to a more expanded or higher level. This is a movement toward greater good, and in the personal dimension it may be called growth, when the term "growth" means not just physical but also psychological development of a person. In the process of this growth, certain beliefs, attitudes and behavior patterns may be revised or eliminated. As in the other dimensions something is lost in the movement toward greater good, and the loss is evil. But once again, the greater evil would be to hinder or block the movement toward more complete integrations of personality by the tenacious hanging on to a less comprehensive state of integration already attained.

Although each of the four dimensions of life we have been considering is distinguishable from the other three, still in all there is discernable a common structure of good, evil and the greater good. It is possible to express this common structure as a structure involving the minds of men and the world external but related to human minds. In the four dimensions the human mind is represented by the theories and laws of science; the various structures of art; the moral codes, social conventions and institutions of a society; and the patterns of thoughts, feelings and actions that make up an individual personality. The world external but related to the human mind is what is indicated by sense experience, by felt quality, by the experience of one's fellow human beings in a common community, and by the total life experience of each individual personality. With this understanding of the human mind and the world external to but relative to the human mind it is possible to give a general description of good, evil and the greater good. The good is the establishment of relations of mutual support within the human mind, between minds and between minds and the external world.[1] It must be recognized that in our actual lives such relations of mutual support are established within limited spheres. When in broader contexts they are still affirmed to the point that it is necessary to deny, hinder and even destroy other values not encompassed within a limited sphere of relationships, then what is normally good can become evil. Hence, one cannot be satisfied with any existing state of mind in relation to other minds and the external world. One must constantly seek greater good in the form of more comprehensive systems of relations.

This greater good is something that is capable of being observed. One observes the coming into being of more comprehensive systems of relations in the revision of existing scientific theories and the development of new theories, and in the corresponding increase in knowledge of the world.[2] One also observes it in the refinement of existing art forms and the creation of new forms of art, and in the corresponding growth of the world as felt. One observes it in the revision and replacement of moral codes, social customs and institutions in ways that

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[1]What we have called relations of mutual support may be called, as Wieman does, "meaning": "meaning is a structure of interrelatedness pertaining to events of such sort that when a few of these events impinge upon the organism the individual can know and even feel what the other events have been, and will be, so far as they belong to this structure." The Directive in History, p. 114, also p. 24.

[2]What we are claiming is observed here in regard to science must not be confused with what other sciences observe. Each science observes certain phenomena and tries to account for these in terms of some theory. What we are observing is the phenomena being related to some theory as one total event, and especially the emergence of new theories in relation to existent or new phenomena in various sciences.

permit the growth of more extensive, co-operative human communities. One observes it in the growth and development of each human personality from a newborn infant to an adult member of a society.

In briefly stating how the expansion of the human mind in relation to other minds and the non-human world is observable, we have been sketching some of the data upon which a scientific theology might be based. These data are still imprecise and will have to be refined into scientific facts perceivable in controlled observation. This we shall attempt to accomplish in Chapter VI, but for the present a more immediate question must claim our attention, namely, how is it that greater good comes about?

## The Greatest Good -- God

Keeping in mind the limits placed on our inquiry by science, we can ask, is there something in space-time existence that not only accounts for the good now present in the various dimensions of life but that also continuously brings about new and more comprehensive relationships of support between what is valued by various men, groups and societies, and in this manner overcomes the evil of destructive conflicts between values? If there is such a thing--some object, ideal, event or process--which is the source of greater good, it can be regarded as the greatest good, which in theistic religions is call "God." The discovery of the nature of whatever in existence overcomes evil and brings about the greater good is the primary task of a theology that tries to be scientific.

A general hypothesis about the nature of the greatest good, proposed by Henry Nelson Wieman in numerous writings, is that it is a process of interaction occurring among human beings as well as between human beings and the rest of the world, a process that can be called "creative interchange."[1] However, simply hypothesizing such a process is not enough. If Wieman's hypothesis is to be tested we must also suggest what creative interchange might be and how it expands men's minds and the world relative to men's minds. Our intention is to explore the possibility of doing this with the method of science. We shall try to indicate how one might scientifically develop and test ideas about creative interchange as the source of greater good. If this can be done, we shall have an understanding of how the greatest good, God, is open to investigation by the method of science and hence how scientific theology might be done.[2]

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[1]"Creative interchange" is only one of the many terms used by Wieman to designate this process. For example, in his earliest major work on it he used the terms "creative good" and "creative event," The Source of Human Good, pp. 54-83, et passim, and also "creative intercommunication," pp. 104, 179, "creative interaction," pp. 219-220, and "creativity," pp. 115, 152, although in a "technical postscript" he distinguishes the "creative event" as the concrete reality from "creativity" as the structure or form of this event, p. 299. In Man's Ultimate Commitment (Carbondale, Illinois: Southern Illinois University Press, Arcturus Books, 1958), "creativity," p. 76, et passim is used interchangeably with "creative interchange," p. 50, for which one can substitute "creative communication," pp. 22-25. Here also, "creativity" and "creative interchange" seem to be synonymous with "creative transformation," pp. 3-4. However, in other places "creative transformation" is distinguished from "creative interchange" and "creativity," as a result is distinguished from its cause, "Knowledge, Religious and Otherwise," The Journal of Religion, XXXVIII (January, 1958), 24, and Religious Inquiry: Some Explorations (Boston: Beacon Press, 1968), pp. 16, 22-24. We shall argue that this distinction between what creative interchange is and what it produces is crucial if one wishes to use the method of science to investigate the nature of God conceived of as the process of creative interchange, infra, pp. 141-146.

Concerning our own terminology, we shall primarily use "creative interchange," but shall also use as synonyms "creativity" and "creative process."

[2]For the rest of this and the next two chapters we shall assume that the connection between creative interchange and God or the greatest

As Wieman presents it there are two things about creative interchange as a concept of God that make it possible to employ the method of science. The first is that this idea is only tentative, which is grounded theologically in Wieman's distinction between God as God actually is, or that which demands our ultimate commitment, and God as conceptualized by us, or that which we believe demands our ultimate commitment.[1] The distinction between God as God actually is and our concept of God enables us to accept in theology the scientific notion of the tentativeness of all our concepts, with no theory being established as true for all time but every theory undergoing further testing against the facts, further refinement and revision, with the possibility of its being replaced by a better theory. The second thing about creative interchange is that it is something hypothesized to exist in space and time and is, therefore, something that in principle can be investigated by the method of science.[2]

Accordingly, Wieman is able to suggest a method of religious inquiry to develop and test ideas about God that is basically the same as the general method of science, which we outlined in Chapter III.[3]

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good is theologically appropriate; in Chapter VII, however, we shall attempt to answer the question, why call creative interchange "God"?

[1]Wieman, Man's Ultimate Commitment, pp. 20-22; Religious Inquiry: Some Explorations, pp. 79-82. Ultimate commitment as used here is the same as "valuing most intensively and comprehensively," supra, p. 6.

[2]Even in some of his early attempts to develop a method of religious inquiry that could be at least empirical, if not scientific, Wieman emphasized the necessity of God's existing in space-time, The Wrestle of Religion with Truth (New York: The Macmillan Co., 1927), pp. 59-60.

[3]Wieman, "Knowledge, Religious and Otherwise," The Journal of Religion, pp. 13, 19-22.

First, an innovating suggestion or hypothesis emerges in the mind, in our case the hypothesis that God, conceived as the process of creative interchange, brings about greater good. Second, the terms of the hypothesis, namely "creative interchange" and "greater good," are defined in such a manner "that it is possible to gather evidence to indicate the truth or error of the proposition under consideration."[1] In other words, rules of correspondence or operational definitions that relate the terms of the hypothesis to what can be perceived with the senses are developed. Third, the initial insight is evaluated in terms of its logical coherence with other propositions known to be true. Finally, the logical structure derived from the insight is applied "in such a way as to yield predictable consequences under specified conditions. The predictable consequences must be certain selected data entering conscious awareness when the specified conditions are present and not entering conscious awareness when the specified conditions are not present."[2]

Although he develops an understanding of God that in principle allows the nature of God to be investigated by the scientific method, Wieman does not, as far as I can see, carry out this investigation. Specifically, he does not develop his ideas about God as creative interchange to the point where he can predict the kind of observable facts that occur in repeatable, controlled experiments. Instead in both his early and recent writings he falls back on an approach that makes use of careful common sense observations, and is hence empirical but not

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[1]Ibid., p. 20.

[2]Ibid., pp. 21-22. In keeping with our own distinction between data and facts, when we develop the predictable consequences of ideas about creative interchange we shall call them "facts."

scientific. For example, in The Wrestle of Religion with Truth Wieman outlines the method of religious inquiry as the experimental method, prevalent in science, which first attempts to formulate a proposition that predicts the occurrence of observable phenomena and then carries out an experiment in which the phenomena can occur. But he then admits that in religious inquiry it is impossible to achieve the accuracy demanded in the scientific method, and hence he is forced to investigate his propositions about God--as the behavior in the universe that brings about the maximum increase of human good when a man's life is properly adjusted to it--with "the experimental methods of common sense."[1] This means conducting living experiments, as the prophets and the saints did and as exemplified in the life and death of Jesus who, according to Wieman, with his life made an experiment to test the hypothesis that the behavior in the universe called God would respond to and support love--an experiment whose results are not yet all in.[2] Such living experiments might be useful in helping to test an idea, but they are not the controlled experiments of the method of science. Thus, what Wieman is attempting to use is better called an empirical rather than a scientific method.

In his later writings Wieman does not seem to move beyond this empirical method, even though in "Knowledge, Religious and Otherwise" he outlines the method presented above, that is strikingly like the method of science, even to the point of saying that the predictable consequences of theological hypotheses must be "certain selected data

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[1]Wieman, The Wrestle of Religion with Truth, p. 63.

[2]Ibid., pp. 66-67.

entering conscious awareness when the specified conditions are present and not entering conscious awareness when the specified conditions are not present."[1] But by "predictable consequences" Wieman means "the 'creative transformation' of the individual in the wholeness of his being," which includes "expanding more or less continuously the range of what can be appreciated, understood, and controlled by the total unified self; increasing the depth of appreciative understanding which we can have of other individuals; and enlarging the capacity to learn appreciatively from the experience of others across the barrier of diversity and estrangement."[2] The problem with this is that it is only another formulation of the greater good, which we have already presented. We are again at the point where our theological inquiry can indeed become empirical, because what is predicted can be observed in the manner we specified above,[3] but we are not yet at the point of scientific inquiry, because neither the process of creative interchange nor its consequences have been specified in precise enough manner to permit controlled observations to take place.

To take this further step from empirical to scientific inquiry three things must be done which Wieman does not do. The first is that God must clearly be distinguishable from what God brings about. In terms of our hypothesis about God, the process of creative interchange must be distinguished from the greater good or from expansions of men's minds and the world relative to men's minds. In Wieman's writings,

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[1]Wieman, "Knowledge, Religious and Otherwise," The Journal of Religion, pp. 21-22.

[2]Ibid., p. 24.

[3]Supra, pp. 135-136.

however, such a distinction is not clearly made, especially in his two major descriptions of creative interchange as a four-part process.

> The first part of this interchange is that the individuals, groups, or peoples derive from one another an understanding of the values each seeks, which are different for each party.
> The second part of the interchange is that these goal-seeking activities, which each comes to understand as activating the other party, are modified and integrated into the system of activities which activate each participant.
> The third part of the interchange is that the valuing consciousness of each party is then expanded, because the system of activities for which he lives has come to include, in modified form, some of the activities which activate each participant.
> The fourth part of the interchange is that relations of mutual support and mutual understanding become more extensive than they would have been if this interchange had not occurred.[1]

In analyzing these four stages, one can ask, is what Wieman describes actually what goes on at each stage or is it only a description of what results at each stage, with the final two results being equivalent to what we have already described as expansions of men's minds and the world related to men's minds in the social dimension? The first two stages would then be intermediate results of a process leading to such expansions.[2] That what Wieman describes is best understood as the results

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[1]Wieman, Religious Inquiry: Some Explorations, pp. 22-23; cf. The Source of Human Good, pp. 58-65.

[2]That Wieman himself sometimes considers the last two parts of the fourfold process as the results of creative interchange is perhaps indicated by his speaking in several places of a twofold process that is identical to the first two stages of the four part process, "Knowledge, Religious and Otherwise," The Journal of Religion, p. 23; Intellectual Foundation of Faith (New York: Philosophical Library, 1961), p. 9; and Man's Ultimate Commitment, p. 22. In the first two of these references, however, what seems to be stated are the results of the process. Only in the last reference is the wording such to indicate that what is being talked about is the process itself, with two aspects; "one aspect is the understanding in some measure of the original experience of the other person. The other aspect is the integration of what one gets from others in such a way as to create progressively the original experience which is oneself." Ibid. Yet, even here, one can ask, just what goes on in understanding the other and in integrating what is

of creative interchange and not as the process itself is indicated by the fact that concerning each stage as Wieman describes it in the above passage the question can be asked, how does this come about? How do the parties derive from one another an understanding of the values each seeks? How are these modified and integrated into the existing system of activities of each party? How is it determined that the valuing consciousness of each party is then expanded? How is it determined that relations of mutual support are more extensive than before?

Wieman tries to overcome this problem when, in another major statement about the fourfold creative process, he writes that the stages or "subevents are emergings, integratings, expandings, deepenings, that is, they are not accomplished facts."[1] Granted that they are not accomplished facts in the sense that one ever reaches a complete integration of all of one's own values and those of all other men, still as a result of creative interchange, one reaches levels or plateaus when it is recognized that the valuing consciousnesses of the parties involved are indeed expanded more than before and hence that some greater good has been realized. Of course, these plateaus are only short stops before one is again taken up into a new instance of creativity. But, even though Wieman correctly speaks of creative interchange as a dynamic and ongoing process, the use of the present participle form still adds little to our understanding of what actually happens in the emergings, integratings, expandings and deepenings. In carefully looking at Wieman's statements on the nature of this process, one is forced to conclude that he

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derived from the other? It is the further specification of the meaning of these terms that is necessary if one is to use the method of science.

[1]Wieman, The Source of Human Good, p. 68.

constantly defines creative interchange in terms of its results or the results of each of its stages. If this conclusion is correct, then it is extremely difficult to distinguish between God and what God brings about. Such a distinction must be made before one can test ideas about God according to expected results perceivable in controlled observation.

The problem we are attempting to point out might become clearer if we briefly consider the similarity between Wieman's understanding of creative interchange and the method of defining abstract concepts developed in American pragmatism, and first enunciated by Charles S. Peirce in his famous pragmatic maxim: "consider what effects, that might conceivably have practical bearings, we conceive the object of our conception to have. Then our conception of these effects is the whole of our conception of the object."[1] William James made an important distinction in this definition, writing "the whole 'meaning' of a conception expresses itself in practical consequences, consequences either in the shape of conduct to be recommended, or in that of experiences to be expected, if the conception be true. . . ."[2] This addition by James implies that operational definitions may take two forms: an abstract term may be defined either in terms of operations to be performed or in terms of the results expected when the operations are performed. When the term to be defined signifies a quality or an attribute, then the second form seems to be the appropriate one. For example, Peirce defined "hardness" as the ability of an object to scratch another surface

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[1]Charles Sanders Peirce, Collected Papers, ed. Charles Hartshorne and Paul Weiss (Cambridge, Mass.: The Belknap Press of Harvard University Press, 1965), Vol. V, §§2, 402.

[2]Ibid., §2.

without being scratched itself.[1] In the social sciences, when intelligence is considered as a personal attribute, it can be defined in terms of results on an intelligence test.[2] Wieman, however, does not consider creative interchange to be a quality or an attribute but a process. It thus seems more appropriate not to define it in terms of results expected but in terms of "the shape of conduct to be recommended" or, better still, in terms of an activity in which human beings can participate. Of course, such participation is supposed to lead to certain results that are observable by those viewing the process. These observable results, as we shall see later, are the facts against which our hypothesis about the process of creative interchange, which will include further hypotheses as to its nature, can be tested. But the results themselves cannot define the nature of the process of creative interchange.[3]

At least at one point in his writings Wieman himself seems to make the distinction we have been seeking between creativity and its results, although he confuses the distinction by prefixing both with the word "creative." In "Knowledge, Religious and Otherwise," after defining the consequences to be expected if the hypothesis about God as "creative interchange" is true, he sums up his point:

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[1]Ibid., 403.

[2]Cf. a similar understanding of creativity by some social scientists, infra, pp. 192-193.

[3]In Chapter VII we shall see how the results provide an operational definition of "greater good," infra, pp. 200-212. It is because we have made a distinction between greater good and creative interchange, which is hypothesized to bring about greater good, that we say here that "creative interchange" cannot be defined in terms of its results.

> To distinguish these developments from other kinds, I shall call them collectively the "creative transformation" of the individual in the wholeness of his being. If creative interchange as above defined produces creative transformation of the individual, then the observation of this consequence is empirical evidence that creative interchange is the greatest good and the saving power in human life.[1]

This separation of process from its product must be maintained if we are to be able to use the method of science, which involves controlled observation, to test ideas about God as the process of creative interchange.

The second thing that must be done, if the method of science rather than just the empirical method is to be used in theology, is to specify more precisely the transformation or expansion of men's minds and the world relative to men's minds that creative interchange is supposed to bring, as well as the possible nature of the creative process itself. Regarding what creative interchange is supposed to produce, we must concretize our own formulation of the greater good and Wieman's attempts to formulate this transformation in terms of expanding what can be appreciated, known and controlled. However, in my opinion, Wieman again blocks the movement toward greater precision, this time by asserting that the transformation resulting from creativity does not "mean the creative work of man whether in art or science or social organization or technology or in any other area of human achievment. Not man's creative work but the creative transformation of man himself is what I mean."[2] What Wieman is probably trying to guard against here

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[1]Wieman, "Knowledge, Religious and Otherwise," The Journal of Religion, p. 24. Shortly after this, however, he again confuses the process and its results by speaking "of this transformation as a kind of creativity. . . ." Ibid., p. 25.

[2]Ibid. Cf. also Wieman, Man's Ultimate Commitment, p. 3: "By

is the reduction of the creative process to a strictly human activity. However, in so doing he prevents himself from more precisely specifying what the transformation of man's mind is in terms of what can be observed. The transformation or expansion of a person's mind that results from creativity is not something that can be observed in and of itself, for it is something internal to each person; it can only be observed when it is expressed in something that is shared with others--a new scientific theory or work of art, for example. Such things, which Wieman calls creative works, are actually the observable indicators of the transformation of which he is speaking. They are not the result of some process that is strictly human as opposed to the divine creative process; rather, we shall contend, they are the visible manifestations of the results of the divine process when men participate in it.[1] We shall support this contention in Chapter VII. If it can be now assumed

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creativity I do not mean creative work whether in art or science or technology or social organization or in any other area of human achievement. To be sure, creative work may accompany the kind of creativity which I shall discuss. But I shall be examining not creative work but the creative transformation of the individual in the wholeness of his being. Not the activity by which the individual produces innovations, but the transformation of the individual himself when this change is of the kind here called creative is what I mean by creativity."

[1]Support for our position comes from those who have studied creativity by looking primarily at the products of creativity, e.g., inventions, solutions to specific problems or test scores, but who still see the basic result of creativity as an expansion of men's minds. Rollo May writes, creative persons "are the ones who enlarge human consciousness," in "The Nature of Creativity," Creativity and Its Cultivation, ed. Harold H. Anderson (New York: Harper and Brothers, Publishers, 1959), p. 57; and Brewster Ghiselin contends, "a creative product is intrinsically a confirguration of the mind, a presentation of constellated meaning, which at the time of its appearance in the mind was new in the sense of being unique, without a specific precedent," in "Ultimate Criteria for Two Levels of Creativity," Scientific Creativity: Its Recognition and Development, ed. Calvin W. Taylor and Frank Barron (New York: John Wiley & Sons, Inc., 1963), p. 36.

as legitimate to consider specific new theories in science, particular new solutions to practical problems and new developments in art, in social organization or in technology as the visible signs of men's expanded minds and of the world relative to men's minds, then we have a way of being more precise as to what we can expect to happen if our ideas about creative interchange are correct.

Third, if the method of science is to be used to develop and evaluate ideas about creative interchange, we would be wise to focus our investigation on only one of the four dimensions of life in which creative interchange is hypothesized to bring about greater good. As we have already seen in noting what Wieman expects to happen when creative interchange occurs, he correctly assumes that this process is operative in all areas of life. As a result of creative interchange in the cognitive dimension one can expect the development of new intellectual structures so that one can see what he could not see before; in the aesthetic dimension one expects the development of new art forms that permit one to feel what could not be felt before; in the social dimension one expects that the relations of mutual support will become more extensive, thus allowing for a growth in breath and depth of community.[1] However, this comprehensiveness in Wieman's thought concerning the areas in which creative interchange functions can become a drawback in attempting to study creative interchange scientifically, because what is needed prior to comprehensiveness in our theory is the kind of refinement in what is expected that allows controlled observation to take place. Therefore, we shall limit our development of a possible theory of creative

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[1]Cf. Wieman, The Source of Human Good, pp. 61-62, 64, and Wieman, Religious Inquiry: Some Explorations, p. 23.

interchange and of the facts that are to be expected to occur if our ideas about creative interchange are correct to the cognitive dimension of life. This limiting makes the very important assumption that the structure of creative interchange is the same in all dimensions, so that the results of our study in the cognitive dimension can be generalized to the other three dimensions we have been considering. We shall attempt to support this basic assumption by showing how what we discover about the nature of creative interchange as it operates in the cognitive dimension might be generalized, in the latter part of Chapter VI.

Briefly summarizing this chapter: we have introduced a conceptual scheme or a way of looking at the world that takes into account both the basic questions raised by theology and the limits placed on an inquiry that attempts to answer such questions by the method of science. We have accordingly outlined in very broad terms the nature of good, evil and the greater good in the cognitive, aesthetic, social and personal dimensions of life, suggesting that in its broadest formulation the greater good is continual expansions of men's minds and the world relative to men's minds. Then, following Henry Nelson Wieman, we hypothesized that God, or what brings about this greater good, may be conceptualized as the process of creative interchange. Because this process is hypothesized to exist in space-time, it is possible in principle to investigate its nature with the method of science. However, if one is to develop ideas about creative interchange that are subject to evaluation through controlled observation of the method of science, three things must be done. First, we pointed out that creative interchange must be clearly separated from what it is expected to produce, that is, from the greater good. Second, because the results of creative interchange must be observable, we suggested that what Wieman calls the "creative works of man" are perhaps best considered as outward and hence observable indicators of some internal expansion or transformation of the minds of men. Third, we suggested that to simplify our study we focus on attempts to develop hypotheses about the nature of creative interchange and to test these hypotheses in the cognitive dimension of life. In the next chapter we shall proceed to develop a possible theory of creative interchange, and in Chapter VI we shall indicate how such a theory might be tested by the method of science.

# CHAPTER V

## DEVELOPING A POSSIBLE THEORY OF CREATIVE INTERCHANGE

> The truly divine thing in science is not the universe as viewed in the form of theories which scientists have chosen and tested at any given time. . . . The truly divine thing is the creativity which produces in the human mind the theories which can meet the tests of prediction.
>
> Henry Nelson Wieman

In the last chapter we suggested the hypothesis that the process of creative interchange saves man from evil and brings about the greater good, when that greater good is conceived of as continual expansions of men's minds and the world relative to men's minds. The truth of this hypothesis can be neither scientifically confirmed nor disconfirmed until we specify more precisely what creative interchange and its results are in such a way that its operation can be perceived in controlled observation. However, since the creative process seems to be quite complex, as affirmed by Wieman and supported by various studies, a simple operational definition is impossible. What is needed is a comprehensive theory of creative interchange that not only delineates the nature of the process but also takes into account the conditions under which it most effectively operates. And the theory must include not only abstract formulations but rules of correspondence that link the various aspects of creative interchange to observable activities in which human beings can participate and the results of which can be observed in controlled experiments. This must be done if all three requirements of a scientific theology stated at the beginning of the last chapter are to be met, namely that the term "God" must not only refer to something existing in space-time, but to something that regularly occurs and is isolatable from other occurrences. Only if these requirements are met, can controlled observation, which is the key distinguishing feature of the method of science, take place.[1]

The major problem now before us is to develop a theory of creative interchange, and it is here that the central question of our dissertation comes into sharp focus. For if a possible theory of creative interchange can be developed and tested by using the method of science, and if it can be argued that it is theologically appropriate to call creative interchange "God," then we have answered our double question: can the method of science be used to develop and test ideas about God, and what kind of understanding of God does one arrive at? The important issue is not to completely develop a confirmed theory of creative interchange but only to move in that direction by first, gathering further information about this process, second, on the basis of this information developing some hypotheses and, third, showing how these hypotheses might be tested in controlled experiments. If we succeed in doing these three things we shall have indicated by example how the method of science might be used to develop and test ideas about creative interchange, that is, about God.

## Gathering Information about Creative Interchange

In gathering information about creative interchange one obvious

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[1] *Supra*, pp. 122-123.

source is the thought of Wieman himself, especially his statements about the possible structure of this process having two or four parts. A second possible source is the large number of studies on creativity conducted in the social sciences, most of them since 1950.[1] When one

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[1]The extent to which creativity has been studied in the social sciences is indicated in Taher A. Razik, Bibliography of Creativity Studies and Related Areas (Buffalo: State University of New York, 1965), which in 451 pages lists the titles of 4,176 studies from 1744 to December, 1964; a summary of more recent work is Sidney J. Parnes, "The Literature of Creativity," The Journal of Creative Behavior, I (Winter, 1967), 52-109 and (Spring, 1967), 191-240.

While some historical and cultural studies have been conducted, e.g., Sister M. E. Dye, "An Inquiry into Creativity and Its Nurturing Climate: an Exploratory Study," Dissertation Abstracts, XXV, 1 (1964), 320, referred to in Parnes, "The Literature of Creativity," The Journal of Creative Behavior, pp. 208-209, Margaret Mead, Coming of Age in Samoa in From the South Seas (New York: William Morrow & Company, 1939), pp. 22-27, and E. Paul Torrance, "Education and Creativity," Creativity: Progress and Potential, ed. Calvin W. Taylor (New York: McGraw-Hill Book Company, 1964), pp. 77-78, the most prevalent kind of study is of individuals or small groups of individuals. Such studies are either introspective, the most famous one being that of Henri Poincaré, "Mathematical Creation," Science and Method in The Foundations of Science, trans. George B. Halsted (Lancaster, Pa.: The Science Press, 1946), pp. 383-394, and Brewster Ghiselin (ed.), The Creative Process (New York: The New American Library, Mentor Books, 1960), which contains statements by scientists and artists such as Albert Einstein, Carl Jung, Vincent van Gogh and D. H. Lawrence; or are made from outside by the social scientist's observation of people engaged in creativity. Many findings of this last kind of study can be found in Calvin W. Taylor and Frank Barron (eds.), Scientific Creativity: Its Recognition and Development (New York: John Wiley & Sons, Inc., 1963), Calvin W. Taylor (ed.), Creativity: Progress and Potential, Calvin W. Taylor (ed.), Widening Horizons in Creativity (New York: John Wiley and Sons, Inc., 1964), Calvin W. Taylor and Frank E. Williams (eds.), Instructional Media and Creativity (New York: John Wiley and Sons, Inc., 1966), all of which report the findings of the University of Utah research conferences on creativity, and Harold H. Anderson (ed.), Creativity and Its Cultivation (New York: Harper & Brothers Publishers, 1959), Sidney J. Parnes and Harold F. Harding (eds.), A Source Book for Creative Thinking (New York: Charles Scribner's Sons, 1962), Howard E. Gruber, Glenn Terrell and Michael Wertheimer (eds.), Contemporary Approaches to Creative Thinking (New York: Atherton Press, 1963), and Ross L. Mooney and Taher A. Razik (eds.), Explorations in Creativity (New York: Harper & Row, Publishers, 1967). Among the several journals containing reports of studies on creativity, perhaps the most important is The Journal of Creative Behavior (Buffalo, N. Y.: The Creative Education Foundation, Inc., 1967-).

begins to examine these studies and the thought of Wieman, one is struck by some similarities concerning the basic structure of creativity as a multistage process, and one is further, and at first surprisingly, struck by the similarity between these structures of creativity and that of the general method of science as presented in Chapter III.[1] The similarities in structure indicate the possibility that the theology of Wieman, the studies in creativity by some social scientists, and the method of science may all be at least partly accurate conceptual representations of the same basic reality, and hence possible sources of further information concerning the nature of creative interchange.

The similarity in structure between our formulation of the general method of science, based on the writings of scientists and philosophers of science, and the structure of creativity suggested by some social scientists is attested to by a simple comparison. The structure of our method of science consists of several basic procedures: formulation of a problem, gathering of information, simplification, reformulation of concepts producing an hypothesis (all of these employing unconscious as well as conscious thinking), and finally the evaluation of hypotheses using especially the procedure of controlled observation or experimentation.[2] For the most part this method compares positively with a study by J. Rossman that analyzed 700 productive inventors and indicates seven stages of creativity: 1) observation of a need or difficulty, 2) analysis of the need, 3) survey of all available information, 4) formulation

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[1]This second similarity was especially striking to me as my research and formulation of the method of science had been substantially completed before I undertook gathering information on creativity from studies conducted by social scientists.

[2]*Supra*, pp. 80-118.

of objective solutions, 5) critical analysis of the solutions, 6) birth of the new invention--the idea proper, and 7) experimentation to test out the idea.[1] It also compares favorably with the most popular text used for helping persons to engage in the creative process, Alex F. Osborn's Applied Imagination: Principles and Procedures of Creative Thinking, in which the structure of creativity is: "1. Orientation: Pointing up the problem. 2. Preparation: Gathering pertinent data. 3. Analysis: Breaking down the relevant material. 4. Ideation: Piling up alternatives by way of ideas. 5. Incubation: Letting up, to invite illumination. 6. Synthesis: Putting the pieces together. 7. Evaluation: Judging the resultant ideas."[2]

There are two possible reasons for this similarity between our general method of science and the structures of creativity suggested by Rossman and Osborn. The first is that some of the historical roots of those discussing the method of science and those studying the creative process seem to be the same. Two men in particular, Graham Wallas and John Dewey, who did most of their work in the 1920's and 1930's, seem to have been influential in both areas.[3] The second reason is that most

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[1]J. Rossman, The Psychology of the Inventor (Washington, D. C.: Inventors Publishing Company, 1931), referred to in J. P. Guilford, "Intellectual Factors in Productive Thinking," Explorations in Creativity, ed. Mooney and Razik, p. 97.

[2]Alexander F. Osborn, Applied Imagination: Principles and Procedures of Creative Thinking (rev. ed.; New York: Charles Scribner's Sons, 1957), p. 115. Osborn then uses this structure in his discussion of the creative process, ibid., pp. 123-179.

[3]Graham Wallas, The Art of Thought (New York: Harcourt, Brace and Company, 1926), pp. 79-107 suggests the stages of preparation, incubation, illumination and verification, while John Dewey, How We Think, (Boston: D. C. Heath and Company, 1933), pp. 106-118, analyzes the phases of reflective thought in response to a confused situation as 1) immediate suggestions of possible solutions, which if blocked by the

of the studies of the creative process conducted by social scientists have used other scientists as their subject matter. Since the subjects of studies use the procedures and criteria of the method of science as well as holding certain attitudes associated with this method, it is not surprising that those who use them as subject matter in studying the creative process arrive at a structure of creativity that looks quite like the method of science. Whether it is called the method of science or the creative process, what is actually being studied is that which seems to consistently give rise to new ideas that resolve conflicts, usually in the cognitive dimension.

Besides the similarities in structure between the method of science and some formulations of the stages of the creative process, if one carefully examines Wieman's description of the fourfold creative process, one can also see some similarity between the first three subevents and the procedures of the general method of science that we have outlined.[1]

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situation or counter-suggestions lead to 2) an intellectualization of the felt difficulty into a problem, 3) the use of an hypothesis to initiate and guide the collection of factual material, 4) reasoning or the mental elaboration of the hypothesis and 5) testing the hypothesis by observation or experiment to see if the actual results agree with the rationally deduced results. Cf. also John Dewey, Logic: The Theory of Inquiry (New York: Holt, Rinehart and Winston, 1938), pp. 101-119.

The influence of these two men is indicated by the similarities between the structure of thought suggested by them and the above referred to structures of the method of science and creativity, as well as by the various references to them by others writing on the method of science, e.g., W. I. B. Beveridge, The Art of Scientific Investigation (New York: Random House, Vintage Books, 1950), and on creativity, e.g., J. P. Guilford, "Intellectual Factors in Productive Thinking," Explorations in Creativity, ed. Mooney and Razik, pp. 95-106. However, a thorough historical study, which is beyond the scope of our investigation, would be necessary to substantiate the degree of their influence.

[1]Cf. Henry Nelson Wieman, The Source of Human Good (Carbondale, Illinois: Southern Illinois University Press, Arcturus Books, 1964), pp. 58-69, and Wieman, Religious Inquiry: Some Explorations (Boston: Beacon Press, 1968), pp. 22-23, 209-210.

The first part or subevent of Wieman's creative interchange, is the "emerging awareness of qualitative meaning derived from other persons through communication." While Wieman seems to be speaking here in terms of what we have called the aesthetic dimension and we are now concerned primarily with the cognitive dimension, still the structure is comparable with one aspect of the method of science, namely the deriving of ideas from other persons that serve to challenge existing ideas and hence create a problem. In science, challenges to existing theory might also come through an interchange with the physical world, that is through experiences had in controlled observation that are not expected in terms of existing theory. This second way in which a problem might be generated is also referred to in Wieman's discussion of the creative process as involving the interaction between humans and the environment.[1]

The second subevent, that of integrating what is derived from others or from the physical world with what one already has, we have expressed in our discussion of the stages of information gathering and the generation of new concepts in the method of science. Although Wieman does not explicitly discuss the necessity of gathering further conceptual or perceptual information in order to provide material from which new integrating structures can be generated, he does recognize what has often been called an "incubation stage" in which the subconscious mind plays a role: "this integrating is largely subconscious, unplanned and uncontrolled by the individual, save only as he may provide conditions favorable to its occurrence."[2] Our analysis of the general method of science,

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[1]Wieman, The Source of Human Good, p. 66.

[2]*Ibid*., p. 59.

while recognizing the role of the subconscious in all stages of concept formation and evaluation also indicated specific procedures that could be used to facilitate the generation of new integrating concepts. These procedures might be regarded as possible subprocesses of the creative process.

Wieman's third subevent, "the expanding and enriching of the appreciable world by a new structure of interrelatedness pertaining to events,"[1] is similar to the evaluation stage in our outline of the method of science, as is clearly, although perhaps unintentionally, indicated by Wieman when he makes a general prediction that uses the criterion of empirical verification: "if there has been intercommunication of meanings and if they have been creatively integrated, the individual sees what he could not see before; he feels what he could not feel."[2] In terms of our analysis of the greater good for man, there are actually two predictions concerning the expansion of the world relative to men's minds that are made, one in the cognitive dimension and one in the aesthetic dimension. If one examines the fourth subevent of Wieman's fourfold creative process, one discovers another similar prediction of something that is observable, this time in what we have called the social dimension, namely the "widening and deepening community between

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[1] Ibid., p. 61.

[2] Ibid., pp. 61-62. One must acknowledge, as we have continually done, the difference between empirical and scientific, the latter involving the seeing or observation of something under controlled conditions. This distinction is important here, for Wieman's prediction is not a scientific one. Yet, the point we are trying to make still holds, that a part of the creative process itself involves the evaluation of what is produced in the earlier stages of the process, and in the cognitive dimension this evaluation involves the expectation of something observable, either empirically or scientifically.

those who participate in the total creative event."[1]

If the basic stages of the creative process as formulated by Wieman are similar to some of the basic procedures of the method of science, one wonders why Wieman himself did not explicitly connect them together, perhaps using ideas about the method of science to help elaborate the nature of the creative process, and in turn using his insights into creativity to inform the method of science. Instead of this, Wieman at times goes so far as to separate explicitly the process by which new ideas are formed from that by which they are evaluated, calling the former creativity and the latter reason. He does this in speaking about evaluating ideas: "we shall be thinking of reason not as the creation of insight but as the method and operations by which true statements are tested and distinguished from false statements."[2] And he makes the same clear cut distinction when speaking of the creation of ideas, when he says that "the truly divine thing in science . . . is the creativity which produces in the human mind the theories which can meet the tests of prediction."[3]

It is perhaps to maintain some distinction between reason, which includes the method of science, as that by which ideas are evaluated and the creative process as that which produces new ideas that Wieman often speaks of a twofold rather than a fourfold creative process. For example, in writing about creative interchange in what we have called the personal

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[1] Ibid., p. 64.

[2] Henry Nelson Wieman, Man's Ultimate Commitment (Carbondale, Illinois: Southern Illinois University Press, Arcturus Books, 1958), p. 137.

[3] Ibid., p. 149.

dimension, Wieman says it has two aspects: "One aspect is the understanding in some measure of the original experience of the other person. The other aspect is the integration of what one gets from others in such a way as to create progressively the original experience which is oneself."[1] However, even here, if one looks closely, the separation between that which produces something new and that which evaluates what is so produced is not as clear cut as Wieman's above statements would indicate, for "as to create progressively the original experience which is oneself" may be interpreted as a prediction of what is to be expected if creative interchange has taken place.

Not only is it difficult to see a clear distinction between creativity as the producer of new ideas and that by which ideas are evaluated, which in the cognitive dimension includes both the empirical method and the method of science, if one considers all of Wieman's thought; it can also be argued that they cannot be so neatly separated, because the evaluation of existing ideas is an important part of the first stage of the creative process as well as being the stage in which newly formed integrating ideas are evaluated. The evaluation of ideas is the way in which existing theoretical frameworks are partially broken down to permit the reception of new experiences and concepts.

If one limits the method of science strictly to the evaluation of newly proposed hypotheses, then perhaps one can distinguish between creative interchange as the producer of new insights and the method of

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[1]Ibid., pp. 22-23. By "original experience" Wieman means the "individuality of the other person," that which "is distinguished from the clichés, the stale conventions, and the automatic reactions which everyone reproduces in himself in order to adjust to the established order." Ibid., p. 23. Cf. also Henry Nelson Wieman, Intellectual Foundation of Faith (New York: Philosophical Library, 1961), p. 9.

science as the means of evaluating them. However, if one describes the method of science as we have done, so that it includes both the formation and the evaluation of concepts, then one cannot fail to note that, in the cognitive dimension at least, the basic procedures of the method of science are parallel to the stages of Wieman's creative process. Both, along with studies conducted in the social sciences on creativity, seem to be attempts to conceptualize the same basic reality, and all three--Wieman's thought, studies in the social sciences and the general method of science--may be ragarded as possible sources for further ideas about the nature of the creative process.

If this is indeed the case, however, an interesting problem arises concerning what we are trying to do in this dissertation. We are exploring the possibility of using the method of science to develop and evaluate ideas about God. We have, following Wieman, suggested that God can be conceived of as the process of creative interchange. Now we have noted the similarity between the basic procedures of the method of science and the stages of creativity as suggested by Wieman and are suggesting the method of science as a possible source of ideas about God. We find ourselves, thus, in the surprising position of suggesting that not only does the method of science provide the manner of inquiry for a scientific theology but that it may also shed some light on the nature of the subject matter of theology. Carrying this to the extreme we seem to be suggesting the possibility that the method of science be used to investigate a process represented by the method of science. How can this be done? Are we not in a rather peculiar logical circle, for how can we use the method of science to investigate God as the creative process (that is, perhaps as the method of science) if we do not already know what the method of science (that is, the creative process) is?

We cannot resolve this problem at present, but there are some thoughts concerning it that may give us further insight into how the method of science can be used in a scientific theology. First, it is not that we have no knowledge either of God as the creative process or of the method of science, or that we have complete knowledge of these. Rather we have considerable knowledge already of the method of science and also some knowledge of the creative process, so that the seeking of further knowledge of either of these with the aid of the method of science is really an attempt to elaborate and refine our current understanding.

Second, taking the method of science alone, the knowledge that we currently have of the structure of the scientific method has been gained through the use of that method.[1] The method of science was not just born in the state we have it today; it was developed in the process of inquiry into the nature of the universe, of man and society, and it is still being elaborated and refined. As the scientist goes about his work, he is actually engaged in inquiry at two levels. At one level he

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[1]This is essentially the same as John Dewey's thesis about how the structures of inquiry arise and come to be known, although while Dewey is talking about logical or rational inquiry in general we are speaking about a specific kind of inquiry, namely scientific inquiry. It will be helpful to give Dewey's formulation of this point: "The theory, in summary form, is that all logical forms (with their characteristic properties) arise within the operation of inquiry and are concerned with control of inquiry so that it may yield warranted assertions. This conception implies much more than that logical forms are disclosed or come to light when we reflect upon processes of inquiry that are in use. Of course it means that; but it also means that the forms originate in operations of inquiry. To employ a convenient expression, it means that while inquiry into inquiry is the causa cognoscendi of logical forms, primary inquiry is itself causa essendi of the forms which inquiry into inquiry discloses." Logic: The Theory of Inquiry, pp. 3-4.

is investigating the problem at hand, such as the nature of the atom, or the influence of the environment on the life of man. At the second level he is also more or less aware of the procedures, criteria and attitudes he is using in this investigation. He may find that some of his procedures are helpful in solving the problem at hand and some of them are not. If the latter is the case he will seek to develop others until either he can solve his problem or until he is forced to give up.[1]

Now, in suggesting that it may be possible to use the method of science as we now understand it to gain further insights into the method of science, we are really suggesting that this second level of inquiry be made explicit and that it be conducted not only by those who are engaged in first level inquiry with the method of science but by other scientists who use those engaged in first level inquiry as subject matter in the investigation of the nature of the method of science. In fact this may actually be what many social scientists have done when they have selected certain scientists as the subjects of studies into the nature of the creative process. Thus to suggest that the method of science be used to study the method of science really means that some scientists using the method as it is already understood can investigate the inquiry of other scientists to gain further insights into what it is that brings about knowledge, whether it be called the method of science or the creative process.

Finally, if one is to suggest that the method of science be used in this way to investigate the method of science, one must indicate what is to be expected if ideas about the method of science are true. Even

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[1]Cf. <u>supra</u>, pp. 84-85.

when the scientist working at level one is only partially aware of the procedures he is using, he still is implicitly employing a criterion as to whether his ideas about the method of science are correct. That criterion is the ability to solve the problem at hand. Formulated another way, it is the production of knowledge in the form of theories and laws that enable one to explain, and in some cases predict and control the phenomena being studied. If our ideas about the method of science are correct, then when the method as understood is practiced it should continually increase our knowledge of the physical world, man and society more than when that method is not practiced or when some other method of inquiry is used.

The crucial question at this point is, where does this prediction come from? Does it come from the method of science? In a sense it does, for the prediction is based on the aims of science, namely to explain and where possible predict and control what happens in the world. However, these goals, as we have indicated in Chapter I, are not unique to the method of science but also are found in other forms of inquiry. This indicates that the prediction of knowledge is not solely based on the method of science but on some framework that may include the method of science but is more comprehensive.[1] This broader framework becomes clear if we reformulate the prediction that the method of science is supposed to increase knowledge in the following manner: what is expected is that this method, as understood, will establish to a greater degree than any other method relations of mutual support between ideas and

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[1] <u>Supra</u>., p. 4. What the method of science itself contributes to this framework is that whatever is predicted be specifiable as something perceivable in controlled observation.

between ideas and the world we experience with our senses. But the prediction formulated in these terms is precisely what in the previous chapter we expressed as the greater good in the cognitive dimension.

Once this is recognized the logical circle we alluded to above is broken; we are not suggesting that the method of science in and of itself be used to investigate the method of science. What we are really suggesting is that within a broader philosophical framework, or better within the theological framework outlined in Chapter IV, it is possible to use the method of science to investigate what it is that brings about increases in knowledge, when knowledge is conceived of as relations of mutual support between ideas and between ideas and what is experienced with the senses. We are suggesting in this dissertation that what brings about this greater good in the cognitive dimension is the process of creative interchange; and since the method of science itself is thought to bring about knowledge—indeed the success of science is evidence that it does this perhaps better than any other method of inquiry—the method of science, along with Wieman's thought and the studies conducted by social scientists, can be considered as a source of ideas about the possible nature of creative interchange. However, these ideas about the possible nature of creative interchange, whatever their source, will have to meet the test of the prediction of increase in knowledge, when our understanding of knowledge is developed in such a way as to indicate that which is perceivable under conditions of controlled observation.[1]

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[1]The specification of how increases in knowledge are perceivable in controlled observation is undertaken <u>infra</u>, pp. 200-212.

## Formulating Hypotheses about Creative Interchange

Keeping our three major sources of ideas about the creative process in mind, what kind of possible theory of creative interchange can we generate? We shall be concerned primarily with two things. First, starting with Wieman's understanding of a fourfold creative process and specifically with the idea of a threefold process in the cognitive dimension, we shall attempt to expand this understanding with information from our other two sources. This will help us to accomplish our second task, the defining of creative interchange in operational terms, that is, in terms of subprocesses or activities in which human beings can engage.

Creative interchange: interaction.--According to Wieman's understanding of the creative process, it is first of all a social process that is characterized as a kind of interchange. Operationally defined in terms of what can be observed, "interchange" means that the creative process involves two or more parties. In the cognitive dimension, at the most abstract level, these parties are different conceptual schemes and the phenomena ordered by them. More concretely, these schemes are embodied in human beings, in individuals but also in groups such as religious and ethnic groups, nations or even entire cultures. Creative interchange, however, is not solely restricted to living human beings who communicate to one another face to face. One of the parties may be present in the form of a book, or a painting or some other work that represents a part of himself. Also, one of the parties involved may be non-human. A group of scientists, for example, may engage in an interchange with certain aspects of the physical world that leads to an elaboration or revision of scientific theory, that is, to an expansion or transformation of the scientists' minds and the world as known to them.

If one of the parties in creative interchange can be non-human, can all the parties be so? Is there not a creative process going on in the world apart from human participation? Most thinkers, including theologians, have asserted that there is, and in science such a process might be expressed in terms of evolutionary theory, which holds that there are variations within organisms that in interaction with the environment are either supported or destroyed—the process of random variation and natural selection. Our theory, based on Wieman, does not take this form of creative interchange into account, because our understanding of the results of creative interchange is formulated in terms of the greater good for men.[1] The results are some alteration in man and in the world related to man. Hence, in our development of a possible theory of creative interchange at least one of the parties involved must be human.

A further question concerning the interaction in creative interchange is, is there an upper limit to the number of parties that can be

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[1]At times Wieman himself speaks of creativity at the subhuman level and relates it to evolution, e.g., Religious Inquiry: Some Explorations, p. 193. He also in at least one place specifies a structure of creative interchange involving "the subhuman organism and the human organism at the submental level" and the environment, The Source of Human Good, p. 66. However, since he formulates the basic religious question as "what operates in human existence to save man from his self-destructive and degenerative propensities and direct human life toward the fullest content of value which human existence can ever embody?" and "not about what operates in the total universe, or in the totality of all being, or in being itself?" Religious Inquiry: Some Explorations, pp. 18-19, his answer is not a cosmic or ontological creativity but "creative communication or interchange between individuals and peoples." Ibid., p. 22, also pp. 197ff.

involved at any one time? If we take seriously Wieman's understanding of creativity as that in which each party can come to know and appreciate the unique thoughts, feelings and actions of the others, it would seem that the smaller the group (or at least the fewer the number of conceptual schemes represented), the more likely the interchange will result in expanding and transforming the minds of those involved.

Even with only a few parties involved the process can still become quite complex. Because Wieman speaks of a multifold creative process and other studies indicate it to be a process that proceeds through at least three stages, it is quite possible that the composition of the group may vary throughout the various stages. For example, in deriving new ideas party A may be engaged with party B. Then, in attempting to solve the problem created by the derived new ideas, A may seek information from C and D, which may be other persons, books, or aspects of the non-human world. Next, on the basis of this further information, A may generate some new ideas that resolve his problem; in this stage he may be alone, not in direct interchange with other parties, although he may engage in an internal dialogue with ideas from B, C and D. Finally, in evaluating his new idea that solves the problem A may come back into interchange with B. Now if one moves from viewing the interchange strictly from the standpoint of A to the positions of B, C and D, one can imagine these other parties also being involved in an instance of creative interchange that was initiated by A but that also takes them into contact with still other parties. Thus, the process of creative interchange can be visualized as a large net with each party represented as a terminal point of two or more strands and the interaction being represented by the connecting threads.

When creative interchange is pictured in this manner, its complexity is recognized; however, this complexity creates a problem for the scientific study of the process, because it cannot be adequately represented in a situation in which controlled observation takes place. Therefore, it will be necessary to simplify our understanding of the process, assuming that the structure of creative interchange is the same, regardless of the number of parties involved and regardless of the variation in parties at different stages, so that in an experiment we can limit the number of actively participating parties and can keep them constant throughout the various possible stages of the process.[1]

Creative interchange: stages and subprocesses.--Following Wieman, the creative process is not only a kind of interaction but has a certain structure that can be specified in terms of various stages. This structure distinguishes creative interchange from other kinds of interaction between men that are not creative.[2]

In the cognitive dimension one can view creative interchange as a threefold process in which the parties involved first derive from one another and from the external physical world new ideas and sense data, second, integrate these insights into their existing conceptual schemes which requires the modification or transformation of both what is old and what is new, and, third, see things that could not be seen before

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[1]This assumption is based on our belief that the number of parties involved in creative interchange, i.e., the size of the group, is not an integral part of the process itself, although it may be an important condition for the most effective operation of the process. Cf. infra, p. 197.

[2]Wieman, Man's Ultimate Commitment, pp. 23-25.

their minds were transformed.[1] As we have already indicated, however, each of these stages represents not so much an activity or a process as a result.[2] We are still left with the questions, how are new insights derived, how are they integrated and how does one determine whether the prediction that with integrated insights one can see what he could not see before is fulfilled? In an attempt to answer these questions we shall hypothesize a set of subprocesses that operationally define Wieman's creative interchange in terms of activities in which humans can engage.

How are new ideas and sense experiences derived from other parties and the physical world in creative interchange? Our minds are constantly being stimulated by external physical objects and events, by bodily states and by ideas from other minds. Many of the resulting experiences fit our existing conceptual schemes--our set of theories and laws about the way things are. When this happens the existing scheme is reinforced, but because nothing new enters the mind an interchange that is creative does not take place. However, even when a given stimulus from the external world or another mind does not fit our existing conceptual schemes creative interchange is not necessarily initiated, because our mind set may be so strong that the stimulus is not even experienced, or if it is experienced and noted to be something unexpected it may be judged to be insignificant. The problem for us, then, is how do interacting parties become receptive to ideas and data that are

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[1]This threefold process stems from Wieman's fourfold process if one acknowledges that his third and fourth subevents or stages are expectations of what happens in various dimensions of life as a result of creative interchange, <u>supra</u>, pp. 158-159.

[2]<u>Supra</u>, pp. 142-143.

different and hence challenge their present conceptual schemes?

What is required is some activity that can be engaged in to break down our existing conceptual schemes at least to the extent that new ideas and sense experiences can be received. In the cognitive dimension the scientific evaluation of ideas as we have outlined it presents us with two subprocesses that might possibly fill this function. Employing the criteria of logical coherence between ideas and the prediction of facts, scientific evaluation supports the truth of a theory by seeing if other theories and laws logically fit with it and if observable phenomena expected on the basis of the theory actually do occur. In the breaking down of existing conceptual schemes, however, the emphasis is placed not so much on the confirmation as on the disconfirmation of ideas already believed to be true. Thus the first subprocess or activity is to derive from the existing conceptual scheme ideas and expected facts that would not fit with the scheme. This could be done by deriving all the possible ideas that are coherent in terms of the existing schemes as well as all the facts that one would expect if the scheme were correct and then, by using the principle of affirming the opposite, stating the ideas and facts that if found would not fit the scheme. The second subprocess is then the active seeking out of disconfirming ideas and facts. Because one knows what they would be and is looking for them, one is more likely to discover and accept them if they are presented by other parties involved in the interchange or by stimuli from the physical world.

When these two subprocesses are engaged in by all the parties involved a problem is likely to be created, marked by the conflict between the old conceptual scheme of each party and the new ideas and sense data. The first stage of the interchange—what Wieman calls the deriving of the values, in this case knowledge, from the other parties--is thus completed.

The second basic stage in the creative process is integrating the insights derived from other parties with existing conceptual schemes in such a way as to resolve the problem created. How is this accomplished? The general process of integration seems to include a number of subprocesses or activities, which may be classified as gathering information, simplifying the problem and generating new ideas that serve as possible solutions.[1]

The gathering of information seems to involve two basic activities. The first is recalling and transferring to a new situation information already obtained and stored in the brain. Every person continuously gathers a wide range of factual and theoretical information. This is always done in some definite context, often a problem arising within some conceptual scheme. However, if information gathered in one context is to be transferred to a new problem situation where it might be useful, the person gathering information must also be able to retain and recall it in a bits-and-pieces fashion, divorced from the context in which it was first gathered. Otherwise the use of the information in a new situation might be blocked.[2]

The recalling in various contexts of information already gathered seems to be what is referred to as "intelligence," which is measured by

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[1]Cf. our discussion of the procedures of concept formation in the general method of science, <u>supra</u>, pp. 85-96.

[2]Cf. Guilford, "Intellectual Factors in Productive Thinking," <u>Explorations in Creativity</u>, ed. Mooney and Razik, p. 100.

course examinations stressing content and by intelligence tests that stress the understanding of word meanings. Intelligence by itself does not refer to the using of that information in the creative process; rather it primarily means the repeating of what is already learned.[1] Yet without a large store of factual and conceptual information and the ability to recall that stored information to consciousness, it is not likely that the creative process will be successful.[2]

The second basic subprocess in gathering information is the active search for further information that is directly relevant to the problem at hand. Some indication of how this kind of information gathering is conducted has been given in our discussion of it in the general method of science.[3] Basically it is a continual seeking of further new data and ideas either from other parties already involved in the interchange, the same parties whose ideas helped create the original problem, or with new parties in the form of persons, books or aspects of the physical world.

In active information gathering a possible key factor may be the attitude of the parties involved. An experiment by Ray Hyman indicates that there is a significant difference in the solutions to certain

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[1]Cf. J. W. Getzels and P. W. Jackson, "The Highly Intelligent and the Highly Creative Adolescent," Scientific Creativity: Its Recognition and Development, ed. Taylor and Barron, pp. 161-172, who according to their criteria have shown that the highly intelligent student is not necessarily the highly creative student.

[2]That the gathering of information is partly the recalling of information already obtained explains why with some problems an active information gathering stage seems to be skipped; persons go immediately from the formulation of a problem to subprocesses that help generate new ideas as possible solutions. It is not that no information is needed but that it has already been gathered in other contexts.

[3]*Supra*, pp. 85-89.

problems, which seems to be dependent on whether the gathering of information was done "critically" or "constructively." Groups of engineers, under controlled conditions, were asked to consider previous solutions to the problem of devising "an automatic warehousing system that would handle and sort up to 500 different products along a common conveyor belt."[1] Half the thirty-six engineers used in the experiment evaluated previous possible solutions to this problem "critically," listing all the possible disadvantages of these solutions; the other half evaluated previous solutions "constructively," listing all the advantages of these solutions. The results were that when the groups were asked to provide their own solutions to the same problem, the solutions provided by the constructive information gathering groups "were rated significantly more creative (by judges who were working with no knowledge of the source of these solutions) than the solutions provided by the critical groups," and this finding held true when the groups were asked to offer solutions to a totally unrelated problem.[2]

In the gathering of information in the process of creative interchange one of the key requirements seems to be not only a large store of information but a wide variety of data and ideas; such variety is essential for forming new perspectives on the problem and facilitates the generation of new ideas as possible solutions. If the parties involved

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[1]Ray Hyman, Creativity and the Prepared Mind ("Research Monograph, Number 1"; Washington, D. C.: The National Art Education Association, 1965), p. 11.

[2]*Ibid.*, pp. 11-12. A repeat of this experiment with university students using a different set of problems did not replicate these results; however, Hyman believes that the difficulty may be that the problem chosen affected the outcome, *ibid.*, pp. 12-13. Thus the effect of "critical" versus "constructive" information gathering is still hypothetical and in need of additional testing.

come from a variety of backgrounds, it will be easier to gather a wide range of information than if they are all from the same discipline. The variety permits the possible yoking of hitherto unrelated fields which may lead to the developing of a greater number of analogies that might be helpful in solving the problem at hand.

As information is being gathered, there is another set of subprocesses which can be engaged in called simplifying the problem. In our discussion of the method of science we suggested three ways of simplifying a problem: limiting it, subdividing it into more specific problems and "planning."[1] Another possible subprocess of simplification is what can be called "abstraction," that is, reformulating a problem in a more general form. This subprocess can sometimes lead to the gathering of information from a wider field and to the suggesting of a wider variety of novel ideas as solutions than if the problem remains formulated in specific terms. For example, suppose we are concerned with the problem of air pollution caused by automobiles. With this specific formulation one might try to invent devices that can be used on cars to cut down harmful exhaust emissions. However, one can also abstract from this specific formulation in a number of ways. One can say that the problem is not with the automobile but with the internal combustion engine and its fuel; perhaps what is needed is a new kind of engine that runs on a fuel that does not produce harmful exhaust. One might abstract in a different direction by noting that what is involved is a vehicle to move people from one place to another. This suggests the possibility of other means for doing this. By developing better systems of public

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[1]<u>Supra</u>, pp. 89-91.

transportation one might not only move people more efficiently but also with less pollution. One can go even further and say the basic problem is not the kind of vehicle used but how people are transported from place to place. In this extremely abstract form one is able to go beyond even present understandings of vehicular transportation and generate all kinds of possible solutions, which today may be science-fiction but which in twenty years might be real solutions, for example, transporting people on energy beams or by small vehicles generated by energy originating from their own bodies but magnified in some way. The point is not that these solutions might work but that by abstracting from a specific problem to a more general formulation a wider field of information can be examined, and this may result in a greater number of possible solutions to the problem.[1]

A third set of subprocesses in the integration stage of creative interchange is the generation of new ideas that serve as possible solutions to the original problem. Both our discussion of concept reformulation in the general method of science and that of the nature of scientific theories indicated the importance of developing suggestive analogies.[2] In extensive research in creative problem solving William J. J. Gordon and his associates at Cambridge, Massachusetts have developed four different kinds of analogies as mechanisms that "are to be regarded

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[1]For an example of a similar abstraction process that led to a solution, cf. the inventor who in developing a new altimeter moved from a "mechanical mare's nest of interlocking selsyns, little gears, and wheels" to noticing that springs are essential, to the foundation spring, to springiness, "The damn problem is a spring and an altimeter." William J. J. Gordon, Synectics: The Development of Creative Capacity (London: Collier-Macmillan Ltd., Collier Books, 1968), pp. 15-18.

[2]*Supra*, pp. 67-68, 91-92.

as specific and reproducible mental processes, tools to initiate the motion of creative process and to sustain and renew that motion."[1] The first of these is personal analogy or personal identification with the actual elements of a problem, for example, a chemist imagining that he is one of the molecules he is studying. The second is direct analogy or the comparison of parallel facts and ideas from different areas of knowledge; often direct analogies for physical inventions are derived from the way biological organisms function, as illustrated by Alexander Graham Bell's recollection, "It struck me that the bones of the human ear were very massive, indeed, as compared with the delicate thin membrane that operated them, and the thought occurred that if a membrane so delicate could move bones relatively so massive, why should not a thicker and stouter piece of membrane move my piece of steel. And the telephone was conceived."[2] The third kind of analogical activity is what Gordon calls symbolic analogy, an esthetically satisfying image which, though technologically inaccurate, offers a compressed description of the problem in unfamiliar terms that leads to new ideas as possible solutions. An example is the analogy, developed by one synectics group, of the Indian rope trick which led to the solution of how to invent a jack that

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[1]Gordon, Synectics: The Development of Creative Capacity, pp. 37-38. Although in this passage Gordon regards synectics mechanisms as tools to initiate, sustain and renew the creative process, at another point he writes, "When Synectics groups, through the use of the Synectics mechanisms, repeatedly solve problems more efficiently than could be expected from past experience or probability alone, this implies that the mechanisms constitute at least some elements of creative process." Ibid., p. 57. The four types of analogy are presented in detail with examples by Gordon, ibid., pp. 38-53.

[2]Catherine MacKenzie, Alexander Graham Bell (New York: Houghton Mifflin, 1928), pp. 72-73, quoted by Gordon, Synectics: The Development of Creative Capacity, p. 42.

would fit into a box four inches by four inches and yet extend upward three feet and hold four tons.[1] The final kind of analogy, fantasy analogy, is based on Freud's wish-fulfillment theory of art and involves imagining "the best of all possible worlds, a helpful universe permitting the most satisfying possible viewpoint leading to the most elegant of all possible solutions."[2] Such fantasy often suggests possible solutions which can then be worked on in terms of what is possible considering existing conditions to solve the original problem.

What we have been doing is hypothesizing subprocesses or activities in which human beings can engage in order to develop possible solutions to problems that arise in the first major stage of creative interchange. The subprocesses hypothesized in the areas of gathering information, simplifying the problem and generating solutions operationally define the second of Wieman's stages of the creative process, the integrating of what is derived from the other and the conceptual scheme that one already has. However, what is generated in this stage are only possible solutions. We are left with the question, how is it determined whether one or more of the solutions generated actually integrates the new insights and the older conceptual scheme? This takes us to the third stage of creative interchange, evaluation.

In the evaluation stage of creative interchange the first subprocess is the selection of one possible solution out of the many solutions that are likely to be generated during the previous stage. In any given problem there are often many ways one can move toward a resolution; yet,

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[1] _Ibid._, pp. 47-48.

[2] _Ibid._, p. 51.

quite often one way in particular "feels" like the most appropriate one to choose. This "feeling" of rightness has been called the "eureka experience" or the "hedonic response," and, according to Gordon, can be relied upon as a heuristic device in the selection of one solution out of many for further evaluation.[1] The feeling of rightness itself is not the test of whether or not a possible solution is correct; yet, when evaluated, the solution that feels right is often correct. A possible explanation for this is that at the subconscious level the mind has already moved ahead to the evaluation of solutions generated at the previous stage, with the solution that "feels" right being the one toward which subconscious evaluation is most favorable.[2]

Once a solution is selected conscious evaluation takes place by participating in the same subprocesses that helped to break down the initial conceptual scheme. Only now they are used more positively in an attempt to confirm a new idea rather than disconfirm existing accepted ideas. First, on the basis of the solution generated the hitherto unintegrated ideas and data are logically derived; if this can be done the criterion of coherency is met. Second, if phenomena are predicted as facts from the generated solution, some kind of experiment is carried out to see if such phenomena actually do occur as expected. In other words, in the cognitive dimension at least, the evaluation subprocesses can be hypothesized to be basically those of the method of science.

If the selected solution is not acceptable after such evaluation, a recycling process begins in the creative process. First, other

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[1] Ibid., pp. 132-136.

[2] Cf. the role of the subconscious in scientific concept formation, supra, pp. 93-95.

solutions that have already been generated are selected for evaluation. If there are no more such solutions, one cycles back to the subprocesses of analogy to see if further solutions can be generated. If no more can be generated one re-engages in the subprocesses of information gathering. If the store of information is exhausted one may attempt to reformulate the problem. In complex problems this recycling may continue for some time before an integrating solution is finally reached that unites the original conceptual scheme held by each party in the interchange with the new ideas or sense data derived from the other party in a logically coherent manner and in a way that what is experienced can be expected to occur.

Even if upon evaluation one of the selected possible solutions is considered correct in that it solves the original problem, creative interchange is not necessarily completed, for there may be more than one correct solution to the problem. Once again a recycling process is necessary to see if there is actually more than one correct solution. If there is, a new problem arises, for it may be that even with more than one correct solution still it is necessary to select one out from among the others. This cannot be done, however, by the normal evaluation subprocesses, for they already have been engaged in and have determined that more than one generated solution does bring together the ideas and experiences of the parties involved that originally did not fit together. The situation is like that which sometimes occurs in science, when two different theories explain the same set of phenomena. When this happens, the two theories are then evaluated according to their fruitfulness in stimulating further inquiry. This suggests that when creative interchange produces several correct solutions to the original problem the best one is that which opens up the greatest possibility of further creative interchange.[1]

The point we are making must be emphasized if one is to avoid a great danger that all too often seems to be implied in the goal of some of the research into creativity by the social sciences. The goal seems to be to understand the nature of the creative process and its conditions so that one can engage in it to further certain envisioned values held dear by men, for example, the achievement of greater success in business, or the preservation and promotion of a particular way of life.[2] In such cases creative interchange can be so engaged in that it does not

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[1]On fruitfulness as a criterion for evaluating competing theories in science, cf. supra, pp. 107-108. Also, Wieman says essentially the same thing about the best results of creative interchange in the aesthetic dimension: "true beauty is aesthetic form. . . . releasing the freedom of human action, the range and keeness of human appreciation, the fulness of intercommunication and the creative transformation that unfold the depth of quality in the world." The Source of Human Good, p. 139. Thus an increase in beauty as a result of creative interchange can lead to further creative interchange. Some social scientists make the same point when they agree with A. O. Gambel that a "truly creative product or contribution has a characteristic of being itself creative in the sense that it generates additional creative activity. Other creative contributions follow in its wake. For example, an important new scientific theory provides new solutions to problems hitherto unsolved, new perceptions of problems hitherto unperceived, and new discoveries." Quoted by Hubert E. Brogden and Thomas B. Sprecher, "Criteria of Creativity," Creativity: Progress and Potential, ed. Taylor, pp. 164-165.

[2]Cf. a statement published in 1959 and made by one of the most influential men in initiating and sustaining social scientific studies of creativity. Asking why there is a felt need for greater creative performance and for more knowledge about the nature of creativity, J. P. Guilford writes, "The most urgent reason is that we are in a mortal struggle for the survival of our way of life in the world. The military aspect of this struggle, with its race to develop new weapons and new strategies, has called for a stepped-up rate of invention. Having reached a state of stalemate with respect to military preparedness, we encounter challenges on all intellectual fronts, scientific and cultural as well as economic and political." "Traits of Creativity," Creativity and Its Cultivation, ed. Anderson, p. 142.

produce results that open up an even wider range of possibility for further engagement in the creative process. What are produced instead are solutions to certain kinds of problems that can indeed stifle further creativity, for example, the development of more sophisticated weapons of war.[1] Hence it is extremely important to always engage in creative interchange not simply for the purpose of resolving the problem at hand but for the sake of further creative interchange itself. This is why one must not be satisfied with the first solution that is evaluated to have resolved the differences in ideas and experiences between the parties involved. One must seek solutions that not only resolve the differences in this instance but that also allow the parties involved to understand each other at increasingly deeper levels, so that new differences emerge and further instances of the creative process are initiated.

<u>Hypotheses about creative interchange</u>.--All that we have said so far in this section, although it has been derived from the thought of

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[1]Of course the problem here is much more complex than we have presented it; not only can it be argued that the development of the most horrible weapons of war, such as the atomic bomb, is one way to prevent war and ensure peace, but also that the development of such weapons spawns, as by-products, many things that may be of benefit to men. Against these arguments, however, we maintain that just as great a benefit--if not greater benefit--will come to man if different groups, instead of seeking to preserve and promote their own ways of life over against all others, would engage in the kind of interchange whose structure we are hypothesizing. This too would ensure peace without the risk of someone using the weapons of war to destroy, and it could also produce all that produced as beneficial by-products of military technology: atomic energy to provide electricity, for example, could have been a result of creative interchange without first producing the atomic bomb. The fundamental issue seems to be whether men will continue to allow themselves to be primarily motivated to engage in the creative process to preserve and promote only their own interests, or whether they will engage in this process for its own sake as we are suggesting. Here, although the development of our scientific-theological conceptual scheme began with considering what men value and what is good for men, we have arrived at the point of suggesting, in our own way, that "man's chief end is to glorify God and do his will."

Wieman, our study of the method of science and the research carried on by social scientists, must still be considered as hypothetical; it must still be evaluated to see whether or not our understanding of creative interchange is correct. In order to suggest how such evaluation might be carried out by the method of science, which we shall do in the next chapter, some definite hypotheses about creative interchange must be stated.

First, regarding the interaction in creative interchange, the question can be raised whether it is necessary at every stage. For example, in the generation of new ideas in the second stage, even in groups trained in brainstorming, which is supposed to allow a completely free flow of ideas between the members of a group, studies by Donald Taylor and his associates have indicated that more ideas are produced per person when individuals brainstorm alone than when in groups.[1] Among the possible reasons for this, one may be the simple fact that in a group not everyone can speak at once. Also, sometimes in a group a person's own free flow may be interrupted because someone else is suggesting ideas that go in an entirely different direction. Or it may be that the fear of disapproval cannot be entirely eliminated, even in the most open of groups, and hence some are more reluctant to

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[1]Donald W. Taylor, Paul C. Berry and Clifford H. Block, "Does Group Participation When Using Brainstorming Facilitate or Inhibit Creative Thinking?" Administrative Science Quarterly, III (June, 1958), 23-24; M. D. Dunnette, J. Campbell and K. Jaastad, "The Effect of Group Participation on Brainstorming Effectiveness for Two Industrial Samples," Journal of Applied Psychology, XLVII (February, 1963), 30-37. Wieman recognizes this same thing when he points out that, after many meanings have been communicated from one party in the interchange to others, there comes a time of withdrawal: "A period of loneliness and quiet provides for incubation and creative transformation by novel unification." The Source of Human Good, p. 60, also p. 232.

state their ideas in such interchange than when alone. Whatever the reason, Taylor's studies suggest that in the subprocesses for generating new ideas as possible solutions, the physical presence of others may be an important factor. If this is so, creative interchange may be most facilitated at this stage by a formal breaking off of interchange with others, although it must be remembered that even when a person is alone there is still an internalized interaction with other parties. In order to test this we hypothesize that external interchange between parties involved in all stages except when new solutions are being generated expands the minds of men to a greater degree than when no external interchange takes place or when it takes place at every stage.

Second, regarding the basic stages of creative interchange, the question can be raised whether the stages must be kept absolutely distinct from one another. There is support for the distinct separation of the generation of new ideas from their evaluation in the repeated experimental confirmations of Alex Osborn's principle of deferred judgment.[1] Also, Ray Hyman's studies concerning critical versus constructive attitudes in the gathering of information indicate that subprocesses employed in the first stage involving evaluation should not be used in the gathering of information.[2] Such studies indicate that the first and third basic stages of the creative process as we have sketched it should

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[1]A. Meadow, S. J. Parnes and H. Reese, "Influence of Brainstorming Instructions and Problem Sequence on a Creative Problem Solving Test," Journal of Applied Psychology, XLIII (December, 1959), 413-416; S. J. Parnes and A. Meadow, "Effects of Brainstorming Instructions on Creative Problem-solving by Trained and Untrained Subjects," Journal of Educational Psychology, L (August, 1959), 171-176; E. Weisskopf-Joelson and T. S. Eliseo, "An Experimental Study of the Effectiveness of Brainstorming," Journal of Applied Psychology, XLV (February, 1961), 45-49.

[2]Supra, pp. 173-174.

be consciously separated from the second stage. This can be tested if formulated in terms of the hypothesis that by consciously keeping the stages of the creative process distinct the minds of men will be expanded to a greater degree than when no such effort is made.

Like the ideas of interaction and stages, our suggested subprocesses must also be tested. By formulating the following hypotheses we move one step forward in indicating how they might be tested by the method of science. First, we hypothesize that when the parties involved in interchange consciously engage in the subprocesses enumerated above in each of the stages, the minds of men will be expanded more than when these are not consciously engaged in. However, if such an hypothesis is tested and supported it would be only the first step in scientifically evaluating the hypothesized subprocesses of creative interchange, because although engagement in all the subprocesses might expand the minds of those involved in interchange more than non-engagement, some subprocesses might be more crucial than others. To see whether or not the subprocesses in the second stage are necessary to the process one can hypothesize that the minds of those engaging in all the subprocesses will be expanded more than the minds of those engaged only in the evaluation subprocesses of the first and third stages. Going one step further, if this hypothesis is supported, one could ask if one of the three sets of subprocesses in the second stage--gathering information, simplifying, and generating new ideas--is more important than the others, and thus, for example, formulate the hypothesis that the minds of those engaging in all the subprocesses will be expanded more than the minds of those engaging in all the subprocesses but the four types of analogy to generate new ideas. One then could raise a further question concerning the importance of clearly separating sets of subprocesses in the second, integrating stage, as Lawrence Kubie does when he maintains that the gathering of data should be "free from any drive prematurely to systematize the data or to formulate hypotheses prematurely."[1] One could test this with the hypothesis that the minds of those engaging in all the subprocesses and clearly keeping the information gathering subprocesses of the second stage distinct from the simplifying the problem and the generation of new ideas subprocesses will be expanded more than the minds of those engaging in all the subprocesses but not keeping the subprocesses of the second stage distinct from one another. Finally, one can also test the importance of the order of the subprocesses in the various stages; for example one can hypothesize that the minds of those who engage in all the subprocesses of creative interchange with information gathering preceding simplifying the problem will be expanded more than the minds of those who engage in all the subprocesses with simplifying the problem preceding information gathering. If we are trying to gain knowledge about the structure of creativity, we must not only be concerned with the subprocesses that might make up that structure but also with their arrangement.

Although our presentation of a possible theory of creative interchange has been relatively brief, it is now possible to see how complex such a theory can be. There are many more specific hypotheses that could be stated. However, our purpose is not to try to develop a complete theory and state all the possible hypotheses, but only, by the partial development of a possible theory and the statement of a few

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[1] Lawrence S. Kubie, "Blocks to Creativity," Explorations in Creativity, ed. Mooney and Razik, p. 39.

specific hypotheses, to show how the method of science might be used to develop and test ideas about God.

## Commitment to and Conditions of Creativity

If we are to be able to scientifically evaluate hypotheses about the nature of creative interchange like the ones we have just suggested, we must have some idea of what it means to be committed to this process and of some of the conditions that might affect its operation.

In Man's Ultimate Commitment Wieman states the basic religious problem as follows: "what operates in human life with such character and power that it will transform man as he cannot transform himself, to save him from the depths of evil and endow him with the greatest good, provided that he give himself over to it with whatsoever completeness of self-giving is possible for him?"[1] In the previous chapter we discussed the nature of good and evil, and formulated the greater good to which man is saved as the continual transformation of men's minds and the world relative to men's minds.[2] We have also been considering the possible nature of the process of creative interchange, which we have hypothesized is what continually transforms man and thus saves him from evil. However, before our analysis is complete we must discuss what Wieman means by the last phrase of the quoted statement, because the primary condition for the effective operation of creative interchange is that men commit themselves to it as much as they possibly can.

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[1]Wieman, Man's Ultimate Commitment, p. 11.

[2]Where Wieman in the quoted passage speaks of man being endowed with "the greatest good" we have used the term "greater good," so that the term "greatest good" can refer to the process that indeed transforms man, i.e., to God.

Three levels of commitment.--In explicating what "commitment" means, Wieman distinguishes between two levels of commitment. At the deeper level commitment is "to whatever does in truth operate in human life to make life better." To say that man is committed at this level "means that man holds himself open to further insights which may correct his present beliefs."[1] At the other level, commitment is to that which, after careful inquiry, man believes does operate to bring about a better life. He commits himself to God so understood "without reservation, with the understanding that if he is in error, he gives his error as the best he has, to be corrected by the truth when and if the truth is discovered."[2]

When Wieman calls people to commit themselves to creative interchange, he is calling for the second kind of commitment, that is, a commitment to God according to the best understanding that he, Wieman, after careful inquiry has been able to formulate. Only if commitment is made that is as complete as humanly possible in all areas of life, can creative interchange operate most effectively to save men from evil and bring about greater good. Two things must be said about this commitment to creative interchange. The first is that it is a life commitment, which means both that it involves a person's entire life and that it may involve the risking of one's life, because the commitment is made on the basis of our best knowledge of what saves men and this knowledge

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[1]Wieman, Religious Inquiry: Some Explorations, p. 80.

[2]Ibid., p. 81. One can note the structural similarity of this two level commitment and the commitment of the scientist, who at one level is committed to the pursuit of knowledge while at another level he is committed to the theories that up to the present have been established as true but which may in the future be called into question.

is fallible. The second thing is that the commitment to creative interchange, although a life commitment, is made with the understanding that one is also at the same time commiting himself to further inquiry into the nature of God, because in the total giving of one's life to creative interchange one may possibly discover that this is not what saves men from evil and brings about greater good, and such a discovery may be extremely important for other men and future generations.

Both these aspects of commitment to creative interchange are illustrated by Wieman in an adaptation of an illustration from William James about a group of men lost in a blizzard on a mountain.[1] They do not know which direction to go, but if they stay where they are they will freeze to death. After examining all the possible directions to the best of their ability, they choose the one they think most likely to take them down the mountain and commit themselves to it, going down in a line. Such a commitment is a life commitment in both senses indicated above: first it involves their entire being as they have no other choice, and second, it involves the risk of life, especially of the leaders who if they are wrong may fall over the cliff. At the same time this commitment may yield knowledge about the proper way, because even if they are wrong and some of the leaders fall over the edge, others who profit from the original mistake are more likely to find their way down.

While we are in complete agreement with Wieman concerning both levels of religious commitment, we must also make it clear that neither of these is now our concern; instead we are concerned with what may be

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[1]Henry Nelson Wieman, "Knowledge, Religious and Otherwise," The Journal of Religion, XXXVIII (January, 1958), 17-18.

called a third level of commitment, namely the kind of commitment required in inquiry to gain the evidence of an understanding of God on the basis of which we can commit our lives at Wieman's second level of commitment. The kind of commitment we are talking about not only occurs before a life commitment is made but also alongside that life commitment in the gathering of further evidence as to the nature of God. Yet it is not exactly the same as the life commitment, because it is more circumscribed as to the degree to which one's life is committed and hence involves less risk. What we are trying to point out can be illustrated by carrying Wieman's story of the men on the mountain one step further. In terms of that story the third level of commitment first involves the gathering of the initial evidence as to what might be the best possible way. But it also involves gathering more evidence as the men go down the mountain in such a way that the risk of life on the part of the leaders is minimized. As the men go down the mountain continuous experimentation can be carried on. The lead man would continually throw a rock, tied to a rope, in front of him, much the same way a blind man uses a cane. If the rock falls loose, he has evidence that the path is still there; if it falls tight he has evidence that there is danger; he might have thrown it into a crevasse or over a cliff. The throwing of the rock is not foolproof; unknown factors may cause this experiment to give erroneous information. Nevertheless, it may provide crucial information so that the commitment to the way down the mountain might be altered in time to avoid a more serious error that leads to death for one of the leaders.

This illustration gives us an image of the kind of commitment to creative interchange we will be concerned with in the following chapter;

it is the commitment to creative interchange at the level of scientific experimentation. This commitment is engaging in the interaction, stages and subprocesses we have hypothesized to be a part of the total creative process for the sole purpose of testing these hypotheses. This commitment at the level of scientific experiments is not a substitute for Wieman's two levels of commitment, but instead hopefully it will help us to better understand the nature of God as creative interchange thus giving us a firmer basis for a life commitment. Furthermore, even though we commit ourselves as much as is humanly possible to creative interchange in all areas of life, we can still carry on the commitment to scientific experiments about the nature of creative interchange, which in turn may revise a part or all of our understanding of that which saves men from evil and brings about the greater good.

Commitment as supplying the conditions of creativity.--While for the purposes of scientific inquiry into the nature of creative interchange, commitment may be defined as the engagement in the interaction, stages and subprocesses hypothesized to be a part of the total creative process, it also has another dimension, namely the seeking out and supplying of further conditions hypothesized to be necessary for the effective operation of the creative process. In Wieman's opinion, the sciences, especially the social sciences, should aid in the seeking out of the conditions necessary for the effective operation of creativity.[1] Since 1950 this has been one of the primary tasks of a group of psychologists, who through observation, hypothesis and experimentation have sought out conditions of four types--mental abilities, personality traits,

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[1]Wieman, Religious Inquiry: Some Explorations, pp. 26-27.

social climate and physical climate. Some, like Bernard Hinton, have even gone so far as to suggest that a model of creativity can be based on such conditions.[1] We do not accept the notion that the creative process can be defined solely as a set of conditions, because it is possible to further analyze some of the conditions in terms of subprocesses. Still, the four basic types of conditions provide a structure by which one can categorize variables that may affect the outcome of experiments designed to test our above hypotheses. Hence we shall view the following conditions as factors that at least need to be controlled if such experiments are to be effectively conducted.

By using factor analysis in examining men in the sciences and arts who were judged to be creative by their peers, J. P. Guilford and others have discovered a number of mental aptitudes or abilities that seem to be conditions of creativity.[2] In our proposed theory of the creative process as a set of stages and subprocesses, many of these abilities can be associated with various subprocesses. Guilford, for example, associates the mental aptitudes of fluency, flexibility and originality with divergent thinking, which in our proposed theory is the generation of new ideas through the analogy subprocesses. Likewise, being sensitive to problems, which Guilford regards as an evaluative ability, is expressed in more detail in our proposed theory by those subprocesses hypothesized to be involved in deriving new insights and

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[1]Bernard L. Hinton, "A Model for the Study of Creative Problem Solving," Journal of Creative Behavior, II (Spring, 1968), 133-142.

[2]J. P. Guilford, "Traits of Creativity," Creativity and Its Cultivation, ed. Anderson, pp. 145-149; in addition to numerous articles, Guilford's work is well summed up in his book, The Nature of Intelligence (New York: McGraw-Hill, 1967).

forming a problem.

The basic difficulty with viewing creativity in terms of mental abilities is that in psychological testing they are determined after the fact and tell us little about what goes on in the creative process itself. Fluency of ideas, for example, is assessed by the number of ideas produced as solutions to a given problem, but it tells us nothing about how those ideas are produced or why one person is more fluent than another. To say that one is more fluent than another because he is more creative is tautological, because creativity has been partly defined as the ability to produce a large number of ideas as possible solutions to a given problem. The problem here is the same as the one we had earlier with Wieman, defining something solely in terms of its results.[1] In our view, we hypothesize that one person is more fluent than another in producing new possible solutions to problems because he engages, either consciously or unconsciously, in the subprocess of analogy. This hypothesis may be in error, or it may not indicate all that is involved in generating new ideas. But if it is supported in experiments it tells us more about the creative process than saying a person who is creative is fluent, flexible or original.

There is, however, an experimental use for the mental abilities derived through factor analysis and the tests devised to measure them. In order to establish a controlled experiment, the experimental and control groups can be balanced according to such mental abilities. The assumption behind this is that some persons are already engaging in certain subprocesses of creative interchange more effectively than others,

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[1]*Supra*, pp. 141-146.

perhaps without being fully aware of it. Such persons might be discovered through tests that determine such things as sensitivity to problems, and fluency, flexibility and originality in generating new ideas; and the presence or absence of these traits in various groups in the experiment can be controlled.

Besides mental aptitudes or abilities, those studying creativity generally recognize that emotional factors or personality traits are important conditions of creative interchange.[1] Some of these traits seem to be present throughout all the stages and subprocesses we have hypothesized. Perhaps the most important personality trait of this type is what Carl Rogers calls an "internal locus of evaluation," or in other words self-confidence.[2] Another is persistence. Curiosity also seems to be an emotional quality that combines with, or perhaps helps explain, persistence in seeking out problems, gathering information, generating possible solutions and evaluating generated solutions.

Other personality traits are perhaps more closely linked with some stages and subprocesses but not with others. Criticalness or the ability to see disadvantages in existing ideas, the willingness to be wrong, and detachment from one's own ideas are emotional qualities more closely associated with the evaluative subprocesses of the first and

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[1]Cf., e.g., Erich Fromm, "The Creative Attitude," Creativity and Its Cultivation, ed. Anderson, pp. 48-54; Carl R. Rogers, "Toward a Theory of Creativity," Creativity and Its Cultivation, ed. Anderson, pp. 75-76; Abraham H. Maslow, "Creativity in Self-Actualizing People," Creativity and Its Cultivation, ed. Anderson, pp. 85-88. For how emotional factors also play a role at the unconscious level, cf. A. H. Maslow, "Emotional Blocks to Creativity," A Source Book for Creative Thinking, ed. Parnes and Harding, pp. 93-103; and Lawrence S. Kubie, Neurotic Distortion of the Creative Process (Lawrence, Kansas: University of Kansas Press, 1958).

[2]Rogers, "Toward a Theory of Creativity," Creativity and Its Cultivation, ed. Anderson, p. 76.

third stages of creativity as we have presented it, while openness to others and the world is probably more closely related to the gathering of information and the generation of new ideas in the second stage.

As with mental abilities, these personality traits will be more important for us as possible variables that need to be controlled rather than as independent variables to be tested. To determine whether or not they are present in subjects participating in experiments, one can make use of psychological tests, such as personality inventories or the Rorschach test, assuming of course that these tests actually do register the variables in question.

A third set of conditions that seems to help promote the effective operation of creative interchange can be classified under the general notion of social climate. A review of the literature of social scientific studies of creativity indicates that social climate may refer to the setting of interpersonal relations in a company, a scientific laboratory, or school; to family background; or to the culture in which one is raised and lives. In each of these areas it is not possible to isolate a definite climate that is supportive of creative interchange as opposed to climates that are not supportive. However, one can conceive of different actual social climates more or less forming a continuum, with an open environment characterized by pluralism and permissiveness, and more supportive of creativity at one end and a closed environment marked by domination and intolerance of the individual, and less supportive of creativity at the other end.[1] When such a continuum is

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[1]Cf. Harold H. Anderson, "Creativity as Personality Development," Creativity and Its Cultivation, ed. Anderson, pp. 139-141; however, an open environment may also be highly structured, as is indicated by the study of Sister M. E. Dye, "An Inquiry into Creativity and Its

projected, however, one must specify exactly that to which it applies. For although a culture or a nation may on the whole be totalitarian, there may be areas in that culture where there is a high degree of freedom and hence also creativity. For example, in the Soviet Union physical scientists, operating in a fairly permissive environment, are leaders in acquiring new knowledge in their field, while biological scientists, who seem to be more limited by certain ideological beliefs, are not generally regarded as being on the frontiers of their area of inquiry. If one applies the open-closed continuum one must be specific as to just what aspect of the social environment he is talking about.

Many studies of the social climate attempt to correlate social climate factors to mental abilities and personality traits.[1] The goal of such studies seems to be primarily to learn how one might, through providing the proper climate, help to develop individuals with mental abilities and personality traits that facilitate their engagement in the creative process. Hence, while such studies may be useful in gaining an understanding of how to supply these latter two types of conditions

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Nurturing Climate: an Exploratory Study," The Journal of Creative Behavior, pp. 208-209, who concludes that "there is a relationship of interdependence between creativity and democratic climate. . . ." A "democratic climate" is characterized by a high degree of both freedom and order, as opposed to an "authoritarian climate," which is high in order but low in freedom, and a "laissez-faire climate," which is high in freedom and low in order.

[1]For a conscious statement of this general approach to the study of creativity, cf. J. H. McPherson, "Environment and Training for Creativity," Creativity: Progress and Potential, ed. Taylor, pp. 130-131; two examples are Jacob W. Getzels and Phillip W. Jackson, "Family Environment and Cognitive Style: A Study of the Sources of Highly Intelligent and of Highly Creative Adolescents," Explorations in Creativity, ed. Mooney and Razik, pp. 135-148; and P. S. Weisberg and K. J. Springer, "Environmental Factors in Creative Function," Archives of General Psychiatry, V (December, 1961), 64-74.

they may not be as important for us in controlling these conditions, since mental abilities and personality traits can be controlled by the techniques of sampling. Nevertheless, since studies about the relation of social climate conditions to mental abilities and personality traits are still in their infancy, by balancing groups according to family environment and cultural situations we can provide a further degree of control in our experimentation.

The physical climate includes such variables as the size of the group and the length of time in which the various stages and subprocesses are engaged. In our discussion of interaction we indicated both the effect on the outcome of creative interchange that the number of people involved might have and also the possibility that in some of the stages, perhaps especially in the generating of new ideas, external interchange with others might best be broken off.[1] Concerning the variable of time, studies by Sidney J. Parnes on the generation of new possible solutions using the techniques of brainstorming indicate that more ideas are produced in the latter half or third of brainstorming sessions than in the first half or two-thirds.[2] Yet, there might be a point beyond which further continued effort at generating solutions meets with diminishing returns. Furthermore, studies concerning the time needed in various stages for the maximum effectiveness of creative interchange must be correlated with the difficulty of the problem. Further studies must still be made concerning these possible physical conditions for the

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[1] Supra, pp. 183-184.

[2] Sidney J. Parnes, "Effects of Extended Effort in Creative Problem-solving," Journal of Educational Psychology, LII (June, 1961), 117-122.

effective operation of the creative process; however, those that have been made do indicate that group size and the time involved in interchange at various stages are important factors. Hence they should be controlled in any experiments that test hypotheses about the nature of the creative process. Such experiments, including the facts that are expected to occur in them, their design and their generalizability, will be the subject of the following chapter.

# CHAPTER VI

## EVALUATING IDEAS ABOUT GOD AS CREATIVE INTERCHANGE

> To summarize: incoherent facts are unified by science into a consistent whole with the use of reason.
>
> It seems to me that there is also an incoherent rhapsody of unique and troubling religious data which human understanding is called upon to organize into an orderly and satisfying pattern. What are the brute facts of religion?
>
> Henry Margenau

The aim of this chapter is to indicate how the hypotheses about the nature of creative interchange, which we developed in the last chapter, can be evaluated by the method of science, focusing on the evaluation of their truth by the predicting of observable phenomena and the conducting of experiments to see if the expected phenomena occur.[1] First, we shall examine what kind of phenomena are to be expected to occur if our hypotheses about the nature of creative interchange are correct. The phenomena predicted will be based on a refinement of our basic data, namely the expansion of men's minds and the world relative to human minds, and we shall consider these data when refined as the facts of a scientific theology. Second, an experiment will be designed that will either produce or not produce the expected facts, depending on the validity of our hypotheses. Finally, the generalizability of such an

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[1]Although this is not the only way hypotheses are evaluated in science, *supra*, pp. 96-118, it is the most crucial one, because the distinguishing feature of science is the prediction of phenomena perceivable under the conditions of controlled observation.

experiment and its results will be considered. It will not be the purpose of this chapter, or of the dissertation, to actually carry out the designed experiment, because we are interested only in exploring how the method of science might be used to evaluate proposed ideas about God, when God is viewed as the process of creative interchange.

## The Facts of Scientific Theology

According to our discussion in Chapter IV, the general result of the effective operation of creative interchange is continual expansions of men's minds and the world relative to men's minds in four dimensions, the cognitive, aesthetic, social and personal. We argued that this result, which we referred to as the greater good, was something observable; it could be observed in the coming into being of new scientific theories, art forms, social structures and patterns of personality. But such things as a major scientific theory do not occur every day, and if we are to use the method of science to test hypotheses about creative interchange we cannot be content with specifying the expected results in terms of infrequently occurring phenomena. What we must do is specify phenomena that are not only observable but that are of a type that occur with enough frequency and regularity that they can be expected in controlled, experimental situations. The specification of regular and frequent phenomena constitutes an operational definition of expansions of men's minds and the world relative to men's minds. In doing this, however, a number of issues must be dealt with.

The first issue in operationally defining expansions of men's minds and the world relative to men's minds we have already considered in Chapter IV, when we concluded that it was best to limit our consideration of the expected results of creative interchange to the cognitive dimension.[1] This does not mean that we should not expect results to occur in the other dimensions, but only that for the purposes of testing our hypotheses about the nature of the creative process we can consider, first, only those expected in the cognitive dimension. In saying this we have applied a general principle in scientifically evaluating hypotheses about creativity: not all that is thought to be a result of creative interchange need be used as facts in such an evaluation.

The second issue is that our proposed theory implies that the operation of creative interchange is continuous and also that its result, the greater good, is not something that occurs only once for a person or group but is something that is ongoing. However, if one is to evaluate ideas about the creative process in terms of results expected and perceivable under experimental conditions, the results must be something discrete and complete in themselves. Because of this it becomes necessary to regard the process of creative interchange as operating in spurts, producing at the end of each spurt a definite, observable result before it continues anew toward further expansions of men's minds and the world relative to men's minds. The need to have discrete observable results from an ongoing process has been the reason why we now speak of expansion<u>s</u> of men's minds rather than using the singular form, expansion of men's minds.

How can one observe discrete expansions of men's minds in the cognitive dimension? An expansion of a person's mind itself is

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[1] <u>Supra</u>, pp. 148-149.

observable only insofar as it is communicated to other persons; it may be observed when a person verbally communicates new ideas. An expansion of a man's mind may also be communicated by his behavior, by his acting in a new way, different from the way he previously acted. Finally, an expansion may be communicated or become observable via certain physical products, such as a mechanical invention, a newly developed medicine, a new painting or architectural style. In Chapter IV, in disagreement with Wieman, we indicated that what he called the "creative works" of men may be regarded as specific, observable manifestations of internal expansions brought about by the divine creative process.[1]

All these observable indicators of an internal expansion of men's minds may be understood as the results of the creative process, but if we are to test our hypotheses about the nature of creativity we cannot be content even with these kinds of results. We must seek an indicator of expansions of men's minds that is perceivable under the conditions of controlled observation. To move in this direction we first suggest that in the cognitive dimension the observable results to be expected if our hypotheses about creative interchange are correct are new ideas that serve as solutions to specific problems. This operational definition of expansions of men's minds is helpful, however, only if we further specify what is meant by "new" and "solutions to problems."

Newness of an idea is one of the criteria used by social scientists to evaluate whether or not an idea is the result of creativity, but they usually define "new" in such a way as to prohibit the carrying out of controlled experiments and hence limit themselves to naturalistic,

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[1] *Supra*, pp. 146-148.

observational studies. Brewster Ghiselin, for example, defines a new idea as something that has never occurred before in the history of human thought. In speaking of the ultimate criteria of creativity and viewing a creative product as "intrinsically a configuration of the mind, a presentation of constellated meaning, which at the time of its appearance in the mind was new in the sense of being unique, without specific precedent," Ghiselin continues that to discover whether or not a given product is creative we must first know its constituent elements and its constellation of these elements and then "we must determine which of these, if any, are original . . . in the absolute sense of priority in the time of their introduction into the sphere of human thought."[1] In other words, a result of creativity is an idea or set of ideas that has never occurred before.

We do not deny that such new ideas are the result of the creative process. In fact ideas that are novel in the history of human thought point to the most spectacular instances of creative interchange having taken place. Major scientific breakthroughs, such as Darwin's theory of evolution, Einstein's theories of relativity and the Watson-Crick model of DNA are examples of such results. In theology, perhaps Wieman's idea that God is the process of creative interchange is an example of an idea that is new in this sense. However, not everything thought to be a result of creative interchange can be something against which ideas about creative interchange can be experimentally tested. If one is seeking to test ideas about creative interchange in controlled

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[1]Brewster Ghiselin, "Ultimate Criteria for Two Levels of Creativity," Scientific Creativity: Its Recognition and Development, ed. Calvin W. Taylor and Frank Barron (New York: John Wiley & Sons, Inc., 1963), pp. 36-37.

experiments Ghiselin's understanding of "new" is problematic in two respects. First, it is extremely difficult to determine whether an idea is really "new" in this sense, because it would involve knowledge of the whole history of human thought. Second, not only are those ideas which do seem to be original in the history of human thought relatively rare, but when they do occur it is usually as the result of a rather extended instance of the creative process, occurring over a period of months or even years. Because of this, it seems impossible to expect that such ideas would occur in a controlled experiment conducted over a relatively short span of time. If Ghiselin's understanding of "new" were used and new ideas that solved problems were predicted, it is highly unlikely that any hypothesis about creative interchange could be supported in controlled experiments. However, the fault would not be with the hypotheses but with too strict a criterion against which they were evaluated.

A more relaxed understanding of "new" is employed by experimental psychologists who follow the lead of E. Paul Torrance.[1] Instead of speaking of what is completely new they define "new" as what is rare or statistically infrequent. Instead of considering the whole history of thought, they consider only a limited group, usually a group working on a specific set of problems. Here a new idea is a solution to a problem produced in a limited group, which occurs infrequently compared to the occurrence of other possible solutions; and persons who produce such statistically infrequent solutions are regarded as more creative than

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[1]E.g., the understanding of "original" in E. Paul Torrance, Guiding Creative Talent (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962), pp. 215, 218.

other persons in the group.[1]

Such an understanding of "new" is useful in a number of ways in the scientific study of the creative process. First, it is helpful in selecting out those individuals in a given population who engage most effectively in this process; the discovery of such persons is itself one of the major goals of many social scientists. Second, in initial studies of creativity, the isolation of the most obvious instances of the working of the creative process, in the form of those individuals who produce more original ideas than others, is helpful in gathering information that leads to the suggesting of hypotheses about the nature of creative interchange. We ourselves have used some of the results of such studies in formulating our hypotheses. Finally, when this understanding of "new" is employed in tests that measure the mental ability of "originality," it is helpful in the selection of subjects for experiments and thus in controlling a factor that might have an influence on the experimental outcome.[2]

However, when it comes to the testing of our hypotheses, the prediction of statistically infrequent ideas may again be too restrictive a criterion, for we may find that there are ideas resulting from

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[1]Besides the production of statistically infrequent ideas, which is sometimes labeled "originality," three other criteria used by social scientists are the number of problems recognized in a particular situation, called "sensitivity to problems," the number of ideas produced as possible solutions to problems, called "fluency," and the variety of ideas produced, called "flexibility." These "traits" originally discovered in persons thought to be creative by factor analysis have become embodied in some of the standard "creativity" tests. Cf. J. P. Guilford, "Creativity: Its Measurement and Development," _A Source Book for Creative Thinking_, ed. Sidney J. Parnes and Harold F. Harding (New York: Charles Scribner's Sons, 1962), pp. 156-160.

[2]_Supra_, pp. 193-194.

creative interchange among a group of people that are indeed new but are also produced simultaneously by many people and not just by a very small number of persons in a large population. In fact, if our hypotheses are correct, and if people are trained to participate in creative interchange so understood, we might expect that many of those so trained will find their minds expanded in much the same way, that is, arrive at the same new ideas. But if this happened, these ideas would not be statistically infrequent. Therefore, while the statistical infrequency understanding of "new" may be helpful in the initial, exploratory studies of creativity by helping us focus on the more obvious manifestations of this process, in order to test hypotheses about creative interchange suggested by such studies, another understanding of "new" is required.

The understanding of "new" we shall use is not new in the history of thought or statistically infrequent in a given population but new to a particular situation, in which a group of individuals is engaged in interchange. In such a situation an idea may be totally new to those involved but it need not be so; one or more of the persons involved may have already expressed the idea in other situations. What would be new in such a case would be the idea's being related to the particular problem around which an instance of interchange centered. If this happens, one possible clue of the newness of an idea is whether or not the parties involved have ever engaged in interchange concerning the problem being discussed, and according to our proposed theory of creative interchange new problems originate when the parties involved derive from one another and from the physical world ideas and sense data that are new for each respective party. Hence, we seem to have a string of new items expected at the various stages of creative interchange. At the first stage it is new ideas or sense data which in turn create a problem that is new for the parties involved. In seeking to resolve the problem, further new ideas are generated, although what is really new may be their relationship to the problem itself. If such ideas do indeed solve the problem at hand, then the instance of interchange is terminated and is judged to have been creative.

This brings us to the second major characteristic of the type of result expected if our hypotheses about the nature of creative interchange are correct. Even though in the course of interchange the parties involved may arrive at ideas that are new to them, in the sense that they have never thought of them before in relation to the particular problem situation, such ideas are not the expected facts of scientific theology unless they also solve the problem at hand. The new idea must bring together in an integrated manner the ideas and data each party derives from the others and his own old conceptual scheme. Ideas that resolve specific conflicts between persons holding different ideas and experiencing different phenomena are what is meant when we say that the expected results of creative interchange are new ideas that solve problems.

Some social scientists wish to add more restrictive criteria before they will accept a solution to a problem as creative. Ghiselin, for example, proposes that the "measure of a creative product be the extent to which it restructures our universe of understanding," and Lacklen suggests that something can be evaluated as a result of creativity according to "the extent of the area of science that the contribution underlies: the more creative the contribution, the wider its effects."[1] Similarly, A. O. Gamble believes that something should be considered a result of creativity according to its "breadth of applicability," which means that a "truly creative product or contribution has a characteristic of being itself creative in the sense that it generates additional creative activity. Other creative contributions follow in its wake. For example, an important new scientific theory provides new solutions to problems hitherto unsolved, new perceptions of problems hitherto unperceived, and new discoveries."[2] Gamble then notes that his criterion could provide the basis for measuring levels or degrees of creativity with the lowest level being the solution of the immediate problem and the highest being the opening up of a wide range of related problems.

The problem with these more restrictive criteria is the same as we had with Ghiselin's restrictive understanding of "new." Although they specify possible results of creative interchange, they do not indicate results that occur with enough frequency and regularity to be expected in experimental situations. Experiments, if they are to take place, must be limited in the time over which they occur, the number of persons involved, the amount of information that can be gathered and the difficulty of the problem being considered, while the results that would score high on a scale, like the one suggested by Gamble, are more likely to come from an instance of the creative process that has occurred over

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[1]Quoted without reference by Calvin W. Taylor, "Introduction," Creativity: Progress and Potential, ed. Calvin W. Taylor (New York: McGraw-Hill Book Company, 1964), p. 6.

[2]Quoted by Hubert E. Brogden and Thomas B. Sprecher, "Criteria of Creativity," Creativity: Progress and Potential, ed. Taylor, pp. 164-165.

a long range of time, involved a large number of persons, a large amount of information and difficult problems. Hence we must simply say that the expected results of creative interchange, if our hypotheses are correct, are solutions to a particular problem that were not present as such at the beginning of an instance of interchange and hence solutions that are new.

These solutions can be predicted as the result of a particular kind of situation that, when it occurs, promotes instances of interchange that have the potential of becoming creative. Such situations occur when two or more parties confront one another with alternative ways of explaining the same phenomena, of performing the same task, of reaching the same goal, or even with alternative goals or sets of values to be reached.

It is possible to embody such situations in standardized problems, an example of which is the "Change of Work Procedure Problem" developed by Norman R. F. Maier in order to test hypotheses about the creative process and its conditions.[1] The "Change of Work Procedure

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[1]Norman R. F. Maier, Principles of Human Relations (New York: John Wiley & Sons, Inc., 1952), pp. 153-157. For the use of this problem in actual experiments of creative problem solving cf. Norman R. F. Maier and Allen R. Solem, "Improving Solutions by Turning Choice Situations into Problems," Personnel Psychology, XV (Summer, 1962), 151-157.

Among the several types of problems used in studies of creativity, the "Change of Work Procedure Problem" is one of the few that takes into account that the creative process is an interchange process in which differences between parties serve to initiate a possible instance of creativity. Many other problems simply ask for solutions to an already stated problem that does not involve any conflict, e.g., the "Tourist" problem, which asks that a group devise ways of getting more Europeans to come to this country, or the "Hanger" and "Broom" problems, which ask members of a group to list as many uses as they can for these items. Problems such as these, which do not really seem very creative, make up many of the standard creativity tests that are intended to measure such mental abilities as fluency, flexibility and

Problem" is role played by a group of four subjects. Three act as workers on an assembly line, each performing one job, and rotating jobs every hour, which helps to alleviate boredom. The fourth subject acts as a foreman, who on the advice of an efficiency expert suggests a change of work procedure from the rotation of jobs to each person performing only the task he does best. The two alternative work procedures, each with its advantages and disadvantages, create the problem to be resolved by further interchange between workmen and foremen.[1]

Maier points out three possible types of solutions to this problem. The first is to continue in the old procedure of rotation with perhaps minor variations such as helping each other or additional training. The second is to adopt the new procedure, suggested by the foreman, of each man working at his best position with perhaps minor variations such as rest pauses or music. The third is to find an alternative that maximizes the advantages of both ways while minimizing their disadvantages, for example, having two men rotate, having all rotate between their two best positions or having all rotate but each spending more time at his best position. Maier calls solutions of the third type

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originality. Inasmuch as these abilities might influence the outcome of an experiment, the test problems that measure them can be used in the selection of experimental and control groups that are equal in mental abilities, but such problems cannot be used as a means of evaluating ideas about the creative process as a whole, such as the relation of various stages and subprocesses to one another.

For a discussion of the various problems used in studies of creativity, cf. Salavatore V. Zagona, Joe E. Willis and William J. MacKinnon, "Group Effectiveness in Creative Problem-solving tasks: an Examination of Relevant Variables," Journal of Psychology, LXII (January, 1966), 114-117.

[1]For the detailed role playing instructions that fixes the position of each man and the reasons for each preferring either the old or the new work procedure, cf. Maier, Principles of Human Relations, pp. 154-156.

"integrative" solutions to the problem.[1]

The "integrative" kind of solution to the "Change of Work Procedure Problem" embodies our understanding of the kind of result to be expected if hypotheses about creative interchange are correct. First, it solves the conflict resulting from alternative approaches in a manner that is helpful to all the parties involved, and second, it is the kind of solution that is new in the sense of not being present at the outset of the interchange in relation to the particular situation. Thus, the "Change of Work Procedure Problem" can be used as a standard problem in testing our hypotheses about the nature of creative interchange, with the predicted facts being "integrative" solutions to this problem.

What is actually predicted is not simply the occurrence of "integrative" solutions but a significant number of such solutions, because as our examples above indicated there is no one correct "integrative" solution to the "Change of Work Procedure Problem." Also, it is possible in principle for a group not consciously participating in creative interchange to produce such solutions to this problem. However, it can be expected that if a group engages in creative interchange, and has a correct understanding of the nature of this process, then such a group will produce a significantly greater number of "integrative" solutions than a group not consciously engaged in creative interchange.

This is the final step in our development of the facts of a scientific theology by operationally defining "expansions of men's minds." In terms of the type of phenomena that can be regularly observed by those qualified to conduct an experiment, "expansions of

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[1]Maier and Solem, Personnel Psychology, p. 153.

men's minds" means the generation of "integrative solutions" to the "Change of Work Procedure Problem." What is predicted in an experiment if our hypotheses about creative interchange are correct is that a significantly greater number of such solutions will be produced by groups engaged in creative interchange as it is specified by our hypotheses than by groups not so engaged. Of course, as we have continually pointed out, this is not the only kind of result to be expected if our hypotheses about creative interchange are correct, but it is the kind of result that is perceivable under conditions of controlled observation. And this is the most important thing in attempting to test ideas about God by the method of science.

## Designing an Experiment

In the previous chapter we proposed a number of hypotheses concerning the nature of creative interchange, predicting that, if they were correct and creative interchange was accordingly engaged in, the minds of men would be expanded.[1] Now that we have operationally defined "expansions of men's minds" in terms of the number of integrative solutions to the "Change of Work Procedure Problem" each of these hypotheses can be converted into a specific predictive proposition. Taking one of the hypotheses concerning subprocesses as an example, we can predict that four man groups who consciously engage in the analogy subprocess--in either personal, direct, symbolic or fantasy analogy--will produce a significantly greater number of integrative solutions to the "Change of Work Procedure Problem" than groups not engaging in this hypothesized

[1] Supra, pp. 182-187.

subprocess.

The simplest kind of experiment to design in order to test this proposition would be to compare experimental groups engaging in the analogy subprocess with control groups not engaging in any of the hypothesized subprocesses of creative interchange. Such a design might run into difficulties, however, if the relationship between the various subprocesses is as important as any of the subprocesses themselves. It may be that unless all aspects of creative interchange are working together in a certain manner it is not likely that men's minds will be significantly expanded. Indeed, our hypothesis of distinguishable stages in the creative process implies a certain arrangement between subprocesses and also that all the stages, each with it subprocesses, must be engaged in before an instance of creative interchange is complete. If this is so, then the testing of groups engaged in only one subprocess by itself against groups engaged in no subprocesses at all will do little to either help confirm or disconfirm our proposed theory of the nature of the creative process.[1]

To really determine if the analogy subprocess is a crucial part of the total creative process, we must design an experiment that compares groups engaged in all the hypothesized stages and subprocesses, including the analogy subprocess, with groups that engage in all the

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[1]This is what sometimes occurs in other sciences, namely that a comprehensive theory cannot be tested piecemeal but that its various aspects must be tested in relation to one another. If one aspect is formulated in terms of an hypothesis to be tested, the testing can only take place if the rest of the theory is assumed to be true. Cf. also Ray Hyman, Creativity and the Prepared Mind ("Research Monograph Number 1"; Washington D. C.: The National Art Education Association, 1965), p. 19, who stresses that one cannot understand the various aspects of creativity in isolation from their functioning in the total system.

hypothesized stages and subprocesses except the analogy subprocess. To further test the relationship between stages and subprocesses one could in the same experiment have groups engaged only in the subprocesses of the first and third stages but not in those of the second stage, which includes the information gathering and simplifying the problem subprocesses as well as the analogy subprocess. Finally, as a control there could be groups engaged in none of the hypothesized subprocesses, at least consciously. The predictive proposition then would be that groups consciously engaged in all the hypothesized stages and subprocesses will produce a significantly greater number of integrative solutions to the "Change of Work Procedure Problem" than groups consciously engaged in all the stages and subprocesses except the analogy subprocess, groups consciously engaged only in the subprocesses of the first and third stages, and groups consciously engaged in none of the hypothesized stages and subprocesses. Of course, groups representing other combinations of hypothesized stages and subprocesses could be included; however, the four kinds of groups we have suggested exemplify the kind of experiment that can be designed to test ideas about creative interchange.

In setting up an experiment to test this predictive proposition three things are necessary: to control possible extraneous variables that might influence the expected outcome; to supply that which is specified in the proposition as the independent variable, the various combinations of stages and subprocesses; and to determine and measure the occurrence of the dependent variable, that which is expected if the proposition is correct, in this case the number of integrative solutions to the "Change of Work Procedure Problem."

Controlling extraneous variables.--In the last chapter we briefly described four kinds of possible conditions of creativity: mental abilities, personality traits, social and physical climate.[1] We also indicated that such possible conditions would have to be controlled in any experiment testing hypotheses about subprocesses of creative interchange. Besides these variables, three other factors that might possibly affect the outcome of any experiment are intelligence, sex and the kind of information present in the subjects. To control these extraneous variables the method of stratified sampling may be used.

Beginning with a sufficiently large population, for example, male freshmen college students from New York City universities, one could select a large group, the members of which were essentially the same regarding mental abilities and personality traits thought to be associated with creativity, intelligence, social and family background, and the subjects studied in high school. Creative mental abilities could be measured by a battery of tests such as the ones developed by J. P. Guilford or E. Paul Torrance.[2] Personality characteristics could be

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[1]Supra, pp. 191-198.

[2]Cf. J. P. Guilford, R. C. Wilson and P. R. Christensen, A Factor-Analytic Study of Creative Thinking. I. Hypotheses and Description of Tests (Los Angeles: University of Southern California Press, 1951); J. P. Guilford and P. R. Merrifield, The Structure of Intellect Model: Its Uses and Implications (Los Angeles: University of Southern California Press, 1960); E. Paul Torrance, Guiding Creative Talent (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962), pp. 22-43 for a summary of the varieties of tests used in assessing creativity and pp. 213-253 for a survey of the Minnesota Tests of Creative Thinking which can be used for assessing some of the creative thinking abilities of children from kindergarten through graduate school; R. J. Goldman, "The Minnesota Tests of Creative Thinking," Explorations in Creativity, ed. Ross L. Mooney and Taher A. Razik (New York: Harper & Row, Publishers, 1967), pp. 267-280. In an analysis of some of these creativity tests Calvin W. Taylor and John L. Holland, "Development and Application of Tests of Creativity," Explorations in Creativity, ed. Mooney and Razik, p. 225, concluded that while many of them do measure intellectual processes and non-intellecutal characteristics different from those measured by intelligence tests,

determined by one of the standard personality inventories, perhaps those administered to incoming college freshmen, and the Rorschach test could be used to determine the presence of subconscious emotional traits. Intelligence could be assessed by the Scholastic Aptitude Test that is generally administered to high school seniors. Family background, including such items as the educational background of the parents and economic level calculated in terms of per capita income, as well as subjects studied in high school could be obtained through short questionnaires.

Two key assumptions in this selection process are that the various tests and questionnaires used actually do measure what they are supposed to measure, and that the responses given by the selected subjects represent typical performances and truthful responses.

After a homogeneous population has been selected in this manner, one hundred sixty groups of four persons each can be randomly selected. Through random selection any unknown or unforeseen extraneous variable will have an equal opportunity of appearing in any four man group, and if the factor is prevalent in a large percentage of the population its possible influence on the outcome ought to be statistically cancelled out.[1]

Another factor, introduced into the experiment by the selection of four man groups, is the natural interaction that takes place between individuals in a group. Even though all persons in each group may be

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there is still uncertainty concerning the degree to which creativity tests are valid predictors of creative performance; in spite of this, however, they may still be helpful to us in controlling extraneous variables.

[1]<u>Supra</u>, p. 111.

alike in regard to the factors just considered, the interaction between these complex sets of factors in a group may be such as to predispose some groups toward a more successful engagement in the creative process than others. Therefore, after the groups are randomly selected, it is desirable that they be put through a set of problem solving tasks making use of problems like the "Change of Work Procedure Problem" to determine each group's ability to produce integrative type solutions. On the basis of problem solving ability, four matching sets of twenty groups (each group with four men) can be selected for the actual experiment.

The selection of four man groups is itself a control of one possibly important physical climate factor thought to be related to this creative process, group size. The other important factor, the length of time in which creative interchange is engaged, can be controlled in the course of the experiment itself.

Supplying the independent variable.--If we follow the experimental design suggested above, the supplying of the independent variable is itself a complex task. We cannot, for example, supply all the hypothesized stages and subprocesses of creative interchange to our first experimental group in the same manner as in many experiments in the social sciences, where the subjects are given a simple set of instructions with the opportunity to ask questions in order to make sure they understand what they are supposed to do.[1] To supply our proposed independent

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[1]E.g., L. Richard Hoffman, Ernest Harburg and Norman R. F. Maier, "Differences and Disagreement as Factors in Creative Group Problem Solving," Journal of Abnormal and Social Psychology, LXIV (March, 1961), 212, an experiment using the "Change of Work Procedure Problem" in which via instructions one group of foremen was induced to be dominant, i.e., to argue strongly for the change of work procedure, while another group of role playing foremen was instructed to have a considerate attitude toward the workmen, and one group of workmen was instructed to strongly

variable a more extensive training program is required.

Precedents for such a training program are already in existence. Perhaps the best known is the creative problem solving course taught at the University of Buffalo, New York. Making use of Alex F. Osborn's Applied Imagination as a textbook, a Student Workbook and a companion Instructor's Manual, as well as a workshop technique that gives the student ample opportunity to practice what is taught, this course attempts to train into its students a number of procedures and attitudes thought to be connected with creative problem solving.[1] A second training program given to selected business and industrial groups has been developed by William J. J. Gordon and his associates at Cambridge, Massachusetts, and is called "synectics," which means "the joining together of different and apparently irrelevant elements."[2] While the Buffalo course is geared to primarily train individuals, although it does this through group instruction, the synectics program is oriented toward training the most effective type of group to engage in creative problem solving. In this sense it is perhaps closer to our understanding of the creative process

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resist the new procedure while the other group was given instructions that allowed weaker support for the old work procedure.

[1]Sidney J. Parnes, "The Creative Problem-Solving Course and Institute at the University of Buffalo," A Source Book for Creative Thinking, ed. Parnes and Harding, pp. 307-323. For an evaluation of the ability of the methods used in this course to supply attitudes and procedures thought to be associated with creativity, cf. Sidney J. Parnes and Arnold Meadow, "Evaluation of Persistence of Effects Produced by a Creative Problem Solving Course," Psychological Reports, VII (October, 1960), 357-361; Sidney J. Parnes, "Can Creativity be Increased?" A Sourcebook for Creative Thinking, ed. Parnes and Harding, pp. 185-191. On the tests used, groups taking the course did significantly better than groups not taking the course; both experimental and control groups were randomly selected and matched for intelligence.

[2]William J. J. Gordon, Synectics: The Development of Creative Capacity (London: Collier-Macmillan Ltd., Collier Books, 1968), p. 3.

as a kind of interchange than is the Buffalo course. Another difference between the two programs is that, while the Buffalo course is concerned with both the teaching of attitudes and procedures or activities thought to be associated with the creative process, the synectics program is more oriented toward procedures or activities. Although it gives attention to what we have called mental abilities and personality traits, it does not attempt to regulate these through training but through the selection of subjects to be trained.[1] Once a synectics group is selected, training proceeds at the rate of one week a month for twelve months. During this time groups become practiced in "making the strange familiar" or converting a problem as initially presented into one that is understood, and in "making the familiar strange" or the distorting, inverting or transposing of the usual way of looking at things into a new point of view that might serve as a solution to the problem under consideration. Specific mechanisms or activities for making the familiar strange are the four types of analogy specified in our predictive proposition.[2]

One problem with training programs like those at Buffalo, New York, and Cambridge, Massachusetts, is the time required on the part of those who participate. Since we are suggesting using students from a

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[1]After an initial screening process by the company using the synectics program, candidates are interviewed singly over a period of eight to ten hours, during which they are evaluated according to the criteria of metaphoric capacity, attitude of assistance, kinesthetic coordination, willingness to take risks, emotional maturity (which involves childlike surprise, wonder and infinite curiosity about the world), the capacity to generalize, commitment to a project or concept and the willingness to fight for ideas, non-status orientation, and complementarity to other candidates being considered to form a particular group, ibid., pp. 62-74.

[2]Ibid., pp. 33-53. Cf. also George M. Prince, "The Operational Mechanisms of Synectics," The Journal of Creative Behavior, II (Winter, 1968), 1-13.

number of universities in New York City, expecting these subjects to take an extensive training course may be unreasonable. A more serious problem may be that the effectiveness of such training programs would depend in part on the teachers. In experiments requiring the training of a large number of subjects and hence a number of teachers, experimental differences could result because of the varying abilities of different teachers, thus questioning the validity of any results from the experiment itself.

One way to overcome both these difficulties is to train subjects through the use of "auto-instructional" materials, such as the ones developed by Richard S. Crutchfield and his associates to train fifth and sixth grade children in the procedures and attitudes thought to be essential in creative problem solving. The materials, a series of sixteen booklets require three to four weeks at thirty minutes a day to complete and are constructed to provide many of the subprocesses we have hypothesized as parts of creative interchange. They are devised

> not only to give the reader repeated experiences in the solution of interesting problems, but also directly to instruct him in helpful strategies or heuristic procedures for creative problem-solving, by showing him how he can use them in concrete problems. The procedures pertain to the formulation of the problem, the generation of many ideas, the search for uncommon ideas, the transformation of the problem in new ways, the evaluation of hypotheses, the sensitivity to odd and discrepant facts, and the openness to metaphorical and analogical hints leading to solutions.[1]

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[1]Richard S. Crutchfield, "Instructing the Individual in Creative Thinking," Explorations in Creativity, ed. Mooney and Razik, p. 201; also Richard S. Crutchfield, "Creative Thinking in Children: Its Teaching and Testing," Intelligence: Perspectives 1965, Orville G. Brim, Jr., Richard S. Crutchfield and Wayne H. Holtzman (New York: Harcourt, Brace & World, Inc., 1966), pp. 33-64; M. V. Covington, R. S. Crutchfield and L. Davies, The Productive Thinking Program. Series I: General Problem Solving (Berkeley, California: Educational Innovation, Inc., 1966).

The effectiveness of Crutchfield's "auto-instructional" materials has been partially validated experimentally; it was judged effective in supplying the procedures thought to be associated with creative problem solving, although it was not as effective in supplying attitudes thought to be associated with this process. Since in our experiment we are regarding attitudes as one of the types of extraneous variables to be controlled in sampling and are seeking to supply only activities (Crutchfield's procedures) in which a person can engage, these experimental findings support the possibility of using materials like those devised by Crutchfield to train the groups of subjects selected for our experiment and in this manner to supply the independent variable to be tested.[1]

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[1]In contrast to the physical sciences it has been necessary to design our experiment using human beings as media through which the independent variable is expressed. Even with careful attempts to control extraneous variables, because of the complexity of any individual, we can never be completely certain that the supplied variable will manifest itself in the form desired. Hence, the results of a single experiment have a tentativeness that is not the case in the physical sciences but is often the situation in the social sciences.

As more information about the nature of creative interchange is obtained through studies with human subjects, it may be possible to test hypotheses about creativity using non-human media, e.g., computer information processing programs. Such attempts are being pioneered by men like Allen Newell, J. C. Shaw and Herbert A. Simon, who point out, "we would have a satisfactory theory of creative thought if we could design and build some mechanisms that could think creatively (exhibit behavior just like that of a human carrying on creative activity), and if we could state the general principles on which the mechanisms were built and operated." "The Process of Creative Thinking," Contemporary Approaches to Creative Thinking, ed. Howard E. Gruber, Glenn Terrell and Michael Wertheimer (New York: Atherton Press, 1962), p. 64. Some of the programs developed by these men seem to exhibit some aspects of the creative process at the purely rational level, e.g., the "Logic Theorist" program; others are not only logical but consider data fed into the computer, analyzing it with the heuristics of the program and producing a solution to a particular problem, e.g., the "Design of Electric Motors" program. Ibid., pp. 67-70. Whether or not the creative process as we have presented it can be completely simulated in computer programs is an open question; the main problem would be to program a conflict situation with more than one party involved. Could two or more computers engage in interchange with one another?

In an experiment to test our suggested predictive proposition, four different sets of auto-instructional materials will need to be devised: one set to supply all the hypothesized stages and subprocesses, one to supply all but the analogy subprocess, one to supply the subprocesses of the first and third but not the second stage, and one set for the control group that will help them feel involved in the experiment but will not supply them with any specific stages or subprocesses.

The experiment.--As soon as the selected four man groups have completed the auto-instructional materials, they will be brought in sets of four to the location of the experiment. Four identical rooms will be provided, so that the four different representations of the independent variable can always be in effect simultaneously. Each session will last one hour and will be audio taped in order to have a means of checking whether the groups actually do engage in the hypothesized stages and subprocesses as expected.

Each four man group will be presented with the "Change of Work Procedure Problem" and the role playing instructions. As part of the instructions the three kinds of solutions to this problem will be presented, and every group will be asked to produce as many "integrative" solutions as possible.[1] Next, each of the four groups will be instructed to act according to what was in the auto-instructional materials. Hence we will have four different groups operating simultaneously in the same physical climate, with the other extraneous variables controlled through stratified sampling, each group representing one of the four alternatives specified in the predictive proposition. Because twenty sets of four

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[1] Supra, pp. 209-211.

groups each were originally selected, this experiment can be easily repeated twenty times.

Determining and measuring the dependent variable.--The dependent variable in our experiment is the number of integrative solutions to the "Change of Work Procedure Problem." Our predictive proposition is that groups engaging in all the stages and subprocesses of creative interchange, including the analogy subprocess, will produce a significantly greater number of solutions to this problem than any of the other groups.

In measuring this dependent variable, the major problem is determining whether or not the solutions offered by the various groups are really integrative. This is complicated by the fact that there is no single correct integrative solution; although one can predict the occurrence of a greater number of integrative solutions if hypotheses about creative interchange are correct than if they are incorrect, one cannot foresee what the specific solutions themselves will be. Hence they can be judged as integrative or not only after they have been produced by groups participating in the experiment.[1] Perhaps the best way of determining whether solutions are integrative or not is to employ a panel of judges who are acquainted with what is known about the creative process and the kinds of results it is expected to produce as well as with the "Change of Work Procedure Problem" and the three possible types of solutions. Even with such a panel, however, it must be recognized that differences will probably arise as to whether a given solution is integrative or not and hence with the number of such solutions produced

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[1]Of course, when the experiment is repeated several times, one is apt to find a repetition of certain integrative solutions; hence, once such solutions are identified the evaluation of the results of later experiments will be easier.

by any group. Yet, if it is remembered that what is at stake is not the absolute number of solutions that are integrative but a relative comparison between groups, and if each judge evaluates each of the four groups, then any variation between judges as to what constitutes an integrative solution will be applied to every group. The result should be that, regardless of differences concerning the exact number of integrative solutions, the comparison between experimental and control groups by various judges should be similar.

The number of integrative solutions produced in the opinion of the judges by both experimental and control groups has little meaning by itself. What is importnat is the difference in the number of solutions produced by the different kinds of groups, and especially whether that difference is statistically significant, that is not simply attributable to chance. The appropriate statistical procedure to use for the experiment we have designed is the analysis of variance with the "f test," which will compare the variability between the number of solutions produced by groups of the same type (for example, all twenty groups engaged in all stages and subprocesses) with the variability between the number of solutions produced by different type groups.[1]

## Generalizing the Experiment and Its Results

The basic question of our dissertation is can the method of science be used to develop and test ideas about God? We are suggesting the possibility that it can if God is conceptualized as the process of

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[1]Cf. Robert Plutchik, Foundations of Experimental Research (New York: Harper & Row, Publishers, 1968), pp. 108-111; and *supra*, pp. 114-115.

creative interchange, and we have attempted to show how the method of science might be used to develop and test ideas about creative interchange. Since this is our basic purpose we are not as concerned with whether the results of experiments like the one we have designed are positive or negative as we are with whether or not either kind of result would really serve to help confirm or disconfirm our proposed theory.

Let us assume that our experiment has been conducted and that the results are negative, that there is no significant difference in the number of integrative solutions to the "Change of Work Procedure Problem" produced by the various types of groups. Before acknowledging that our predictive proposition is falsified we might wish to examine the experiment itself to make sure that nothing was wrong with the design and that we had done our best to eliminate any possible influence due to extraneous variables, poor selection of subjects, inadequate supplying of the independent variable, inadequate judging of the occurrence of the dependent variable or the improper use of statistical techniques. If everything checked out, we still might wish to repeat the experiment with another group of subjects and judges with the expectation that the original results would be replicated. Having done this we could conclude that our predictive proposition was indeed false.

What would be falsified, however, is only the predictive proposition concerning the "Change of Work Procedure Problem" and not our initial hypothesis that when men engage in the analogy subprocess proposed in our creative interchange theory, their minds and the world relative to their minds are significantly expanded. For the falisfication of the predictive proposition to contribute to the disconfirmation of this hypothesis, we would have to satisfy ourselves that our operational definition of "expansions of men's minds and the world relative to men's minds" in terms of "integrative" solutions to the "Change of Work Procedure Problem" was indeed appropriate. If it were, then our hypothesis would be disconfirmed.

This would initiate an experimental testing of the other hypotheses concerning creative interchange that we have proposed and possibly the development of further hypotheses. If all these additional attempts to specify the nature of the creative process meet with failure, the question could be raised as to whether there actually is such a process that continually expands men's minds in the cognitive dimension. This question, however, would be asked from the point of view of one seeking to gain knowledge about creative interchange by the method of science; and it could be countered by asking whether the method of science, which tests ideas in controlled experiments, is indeed the appropriate method for investigating the nature of the process of creative interchange. In other words, continual failure could lead one to the conclusion that the method of science could not be used to develop and test ideas about God so conceived.

Let us now assume that our designed experiment was conducted and the results were positive. The validity of such results for the verification of our predictive proposition would of course depend on the experiment being properly designed and conducted. Repeating the experiment with different subjects and obtaining the same results would give additional support to the truth of the predictive proposition. If the predictive proposition were continually verified, then it would support our hypothesis that engaging in the analogy subprocess of creative interchange continually expands men's minds <u>only if</u> the operational definition of men's minds in terms of "integrative" solutions to the "Change of Work Procedure Problem" was appropriate. If it were appropriate then we would have established a probabilistic, conjunctive, causal law concerning the relationship between the analogy subprocess and the expansion of men's minds and the world relative to men's minds.[1]

The establishment of such a law is the confirmation of only one aspect of the total proposed theory of creative interchange. For the total theory to be supported experimental evidence would have to confirm all the hypotheses concerning subprocesses, stages and the interaction of creative interchange. If all the hypotheses were confirmed, then the theory would be supported to the extent that one could say that there is a process called creative interchange that brings about expansions of men's minds and the world relative to men's minds in the cognitive dimension. We could also conclude that the method of science can be used to develop and test ideas about God, when God is conceptualized as the process of creative interchange, in terms of how God is expected to operate in the cognitive dimension of life. However, after all this our theory has not been confirmed or disconfirmed in the aesthetic, social or personal dimensions, where God is also expected to save men from evil and continually bring about greater good.

Assuming now that our theory of creative interchange has been confirmed through scientific testing in the cognitive dimension, the problem of whether or not it can be generalized to the other dimensions of life is really twofold: first, whether or not the proposed theory

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[1]Cf. <u>supra</u>, pp. 55-65. The statistical probability of this relationship would be based on the level of significance, calculated with the "f test," remaining constant in replications of our experiment. On the level of significance, cf. <u>supra</u>, pp. 113-114.

itself can be generalized, and second, whether or not the method of science can be used to investigate the nature of creative interchange in these other dimensions. The two aspects of the problem are separable, because on the one hand, one may find support for our proposed theory in other dimensions of life that is not based on the method of science but on another method of inquiry, and on the other hand, one may find that the method of science can be used to investigate the proposed theory in the other dimensions only to discover that the proposed theory is not supported thereby. Of these two aspects, the second is most important for us right now, since our basic question is whether or not the method of science can be used to develop and test ideas about God.

Although the applicability of the method of science to investigate ideas about creative interchange in the other dimensions is crucial for our discussion of the possibility of scientific theology, we have not at this point done sufficient research to answer it either affirmatively or negatively. The work we have done, however, has helped to clarify some of the issues that must be considered, and it has also indicated one possible way of using the method of science to test ideas about creative interchange in the social dimension.[1]

The first major issue is the nature of the facts expected in these other dimensions if our ideas about creative interchange are correct. In Chapter IV we defined the greater good as the continual increase of relations of mutual support within the human mind, between

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[1]Although the issues we are discussing concern all the dimensions of life, we shall consider them only in relation to the social dimension. My present state of knowledge and the limitation of space permit only a few brief comments on these issues in the personal and aesthetic dimensions, *infra*, pp. 235-236.

minds and between minds and the external world. In the social dimension what is expected is an expansion of those structures that make for a wider and deeper community between human beings. Such expansions can be observed in revisions of existing moral codes, customs and institutions and in the coming into being of similar new structures in society. However, because these results take considerable time to emerge, hence indicating an instance of the working of the creative process over a large span of time, they cannot be expected to occur in controlled experiments.

What regularly occurring results, perceivable in controlled observation, might one expect in the social dimension if our hypotheses about creative interchange are correct? One possible answer to this question can be developed if we return briefly to the "Change of Work Procedure Problem." When we considered this problem in the cognitive dimension we suggested that the expansion of men's minds and the world relative to men's minds could be operationally defined in terms of the number of "integrative" solutions to this problem, and that this provided us with facts that were perceivable in controlled observation. Such solutions, however, are not the only possible outcome of creative interchange over such a problem. Might it not be possible for one to expect that the successful reaching of resolutions which take into account the original positions of all involved would also bring the parties involved into closer community with one another? This might be a by-product in the case of the "Change of Work Procedure Problem"; however, in problems that are concerned explicitly with human relations, the most important issue may be the establishment of wider and deeper community.

What we have been saying seems to agree with Wieman, who in what is perhaps his most recent statement of the fourfold creative process, also gives us a lead on how to understand "wider and deeper community" in such a way as to perceive it under controlled conditions. After stating the first three stages as gaining from the other some sense of what the other person knows, values and controls, integrating this with what one already has, and expanding the range of what one knows, controls and values, he writes: "The fourth part is a consequence of these first three parts. It is a wider and deeper community of understanding between the persons and peoples who have been engaged in this kind of interaction. They have more fellow-feeling for one another, a greater community of interest, more concern for one another, and more ability to cooperate."[1]

How can one determine whether there is a wider and deeper community of understanding in the sense just described as a result of creative interchange? One way might be to observe the subsequent behavior of those involved, looking for greater cooperation and signs of increased concern. This has two drawbacks, however, one being the possibility that behavior does not always manifest how one person feels towards another, and the second being that the observation of behavior subsequent to an instance of creative interchange would probably take a longer period of time than could be allowed for in a controlled experiment. Another way of determining if community has been widened and deepened might be to let those involved in a possible instance of creative interchange tell us how they feel toward one another after it

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[1]Henry Nelson Wieman, Religious Inquiry: Some Explorations (Boston: Beacon Press, 1968), pp. 209-210.

is over. This also has two drawbacks, the first being that individuals are not always truthful in telling how they feel toward others, and the second being that many people find it difficult to assess their feelings. The first drawback might be overcome by allowing persons to express themselves in isolation from the others, assuring them that their feelings are being requested only for the purpose of testing ideas about creative interchange and will be kept entirely confidential. The second drawback is more difficult, because the feelings expressed may not be very specific; simply to say, for example, that one now has greater respect or more concern for the others involved in the interchange will not give us the precise facts we are seeking in the social dimension.

What is needed is a way to precisely determine people's attitudes and to measure the extent to which people have a greater or lesser concern and appreciation for one another. According to L. L. Thurstone and E. J. Chave it is not only possible to do this but also to measure shifts in such attitudes.[1] The basic procedure is to establish a scale of equally appearing intervals for a particular attitude, with one end of the scale representing the most negative feeling, the middle a neutral feeling and the other end the most positive feeling. The different points on the scale are represented by different opinions or verbal statements of the attitude.

To establish such a scale for the attitude of concern of one person for another, the first task would be to develop or collect about

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[1]L. L. Thurstone and E. J. Chave, The Measurement of Attitude (Chicago: The University of Chicago Press, 1929); also the collected essays in L. L. Thurstone, The Measurement of Values (Chicago: The University of Chicago Press, 1959), especially the essay, "Attitudes Can Be Measured," pp. 215-233.

one hundred verbal statements representing different degrees of concern, for example, from "He could starve to death and it wouldn't bother me" on one end to "His well being is more important than my own" on the other end of the scale. It is important not just to gather extreme opinions like these but statements representing all degrees of concern. Next, each opinion statement would be placed on a card and sets of cards distributed to about five hundred persons. Each person would be asked to sort his cards into eleven piles, so that pile eleven contains opinions expressing the greatest degree of concern while pile one contains statements expressing the least amount of concern. The persons are to do the sorting without regard to their own beliefs as to how people ought to feel toward one another. The next step is to calculate the exact scale value for each statement. The basis of this is the proportion of people judging a particular statement to express greater concern than all the other statements; the exact quantitative difference can be calculated according to Thurstone's "law of comparative judgment."[1] The scaled statements are then checked by the objective criteria of "ambiguity" and "irrelevance."[2] Finally a list of twenty to thirty statements is selected in such a manner that they are evenly graduated along the scale from one to eleven. This list is thus a scale that can measure with some precision the degree of concern one person has for another.

Such an attitude scale could be used in experiments testing hypotheses about creative interchange to measure any shift in concern before

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[1]For equations of this law, cf. Thurstone, The Measurement of Values, pp. 41-47.

[2]*Ibid.*, pp. 229-231; also Thurstone and Chave, The Measurement of Attitude, pp. 44-56.

and after interchange as hypothesized was engaged in. The prediction is that there will be a significant difference between experimental and control groups, with members of the former shifting toward greater concern for one another while those in the latter group would not experience as great a shift. In the social dimension a significant difference between groups or the lack of it would be the expected fact that could verify or falisfy a predictive proposition about creative interchange. Assuming that the attitude of concern adequately represents the expansion of men's minds in the social dimension, the verification or falsification of a predictive proposition would help confirm or disconfirm one of our hypotheses about creativity.

The second major issue in attempting to use the method of science to test ideas about creative interchange in the social dimension is to design an experiment that could conceivably produce shifts in attitude like the one we have just described. Here a major difficulty arises concerning the course we took in the cognitive dimension with the "Change of Work Procedure Problem." That problem could be role played, and this seemed appropriate as long as what was expected was solutions to the problem itself. However, if what is expected is a shift in attitude, it is not reasonable to expect such a shift to occur in an artificial situation. The advantage of the role playing procedure is that it allows us to set up a controlled experiment at our own time and place. The question is, can we work out a way in which our hypotheses about creative interchange can be tested in real life situations and still maintain control of all the important variables that might affect the outcome?

The difficulty is not with the selecting of subjects and forming groups in such a way that extraneous variables are controlled. The same procedures used above are also appropriate here. The problem is structuring a situation in which creative interchange could be engaged in concerning real life problems in human relations, but in which place and time could be controlled and possible changes in attitudes measured. One possibility might be to bring together groups of people who were known to be antagonistic toward one another, and representing different views on a set of problems, for example, labor and management groups, groups from different religious traditions or urban blacks and suburban whites.

Taking the last pair, for example, one could construct scales of concern of whites for blacks and blacks for whites. Two scales would probably be needed, because each group might use different verbal expressions of concern. Using these scales all who measured three (a score of one would express the least concern) could be selected from large populations. From these a further sampling could be made so that groups would be matched according to the mental abilities and personality traits discussed above. Care would have to be taken, however, to make sure that the tests used to determine these abilities and traits were appropriate for blacks as well as whites. From a population of blacks that was homogeneous regarding their attitude of concern for whites, and mental abilities and personality traits thought to be associated with creativity, four groups of twenty persons each could be randomly selected. These groups would then be supplied the independent variable to be tested via auto-instructional materials in the same manner as outlined in our experiment in the cognitive dimension. The same procedure would be used in regard to whites.

The experiment itself would bring blacks and whites, who until now had not had any contact with one another, together. The four different types of groups would be divided into four man groups of two whites and two blacks each. Each group would be instructed to engage in interchange according to what had been learned via the auto-instructional materials. The subject would be the question of race, and each group would be instructed to develop and try to resolve as many issues as possible. A time limit of two hours would be set, and the discussions would be audio recorded.

After the experiment, all the whites and blacks would be asked to respond to a second scale of concern toward the other group. If our hypothesis is correct, one could expect a significant difference in the shift from the level of three to a higher level of concern between groups engaged in all the subprocesses of creative interchange and the other types of groups. Such a significant difference would indicate that creative interchange as hypothesized does indeed deepen community among men. In this manner it might be possible to scientifically test our various hypotheses about creative interchange in the social as well as the cognitive dimension.

In this chapter we have been concerned with whether or not the method of science can be used to test hypotheses about the nature of creative interchange. We have attempted to indicate in some detail the possibility of doing this in the cognitive dimension and have also suggested a possible way in the social dimension. In each case we have indicated that the crucial issues to be considered are the nature of the facts to be expected and the designing of a controlled experiment in which the expected facts might occur. In the personal dimension an approach similar to the one we have just considered in the social dimension also might be possible, with the expected fact being a change in attitude concerning oneself in the direction of greater self-confidence or a higher estimate of self-worth. At this time we cannot say whether or not the method of science can be employed in the aesthetic dimension, where what is expected if creative interchange is engaged in is an increase in structures that release a wider range of felt quality. Again the crucial issue is, how does one determine either an increase in artistic forms or a growth of felt quality in specific controlled situations?[1]

Therefore, we must conclude that the use of the method of science to test ideas about creative interchange may be possible in some dimensions of life but not in others. This does not mean that in the other dimensions there would be no way of evaluating ideas about creativity. Other methods of inquiry might still be used, and the findings of these methods could be compared with those on creative interchange in the cognitive and social dimensions achieved by the method of science.

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[1]Research in this dimension can begin with the work of Catherine Patrick, who in a series of observational studies of artists and poets identified the four stages of creative thought proposed by Graham Wallas, preparation, incubation, illumination and verification. Catherine Patrick, "Creative Thought in Poets," Archives of Psychology, XXVI, No. 178 (April, 1935), 1-74; Catherine Patrick, "Creative Thought in Artists," Journal of Psychology, IV (July, 1937), 35-73; and Catherine Patrick, "Whole and Part Relationship in Creative Thought," American Journal of Psychology, LIV (January, 1941), 128-131. Further work has been done by Viktor Lowenfeld, who has related creative activity in art to personality development, Creative and Mental Growth (rev. ed.; New York: The MacMillan Company, 1952). Finally the work of Kenneth R. Beittel can be considered. Kenneth R. Beittel, "Creativity in the Visual Arts in Higher Education: Criteria, Predictors, Experimentation, and their Interactions," Widening Horizons in Creativity, ed. Calvin W. Taylor and Frank Barron (New York: John Wiley & Sons, 1965), pp. 379-395; Kenneth R. Beittel, "Instructional Media for Creativity in the Visual Arts," Instructional Media and Creativity, ed. Calvin W. Taylor (New York: John Wiley & Sons, 1966), pp. 227-307; and Kenneth R. Beittel, Effect of Self-Reflective Training in Art on the Capacity for Creative Action ("NAEA Occasional Paper #2"; Washington, D. C.: The National Art Education Association, 1968).

In such a manner a theory of creative interchange as it operates in all areas of life could become established. While the method of science itself may not be generalizable to all the dimensions of life, the findings about creative interchange through experiments like those we have suggested might be generalizable.

Even it it could be shown how the method of science could be used to test ideas about creative interchange in all the dimensions of life, one final problem would have to be considered before we could conclude that the method of science can be used to develop and test ideas about God. For it can be argued that while the method of science might be used to investigate the social process of creative interchange between men and between men and the non-human world, it cannot be used to investigate the nature of God, because creative interchange is not God. The question of why call creative interchange "God" must be answered, and this will be the subject of our concluding chapter.

# CHAPTER VII

## THEOLOGICAL JUSTIFICATION OF CREATIVE INTERCHANGE AS GOD

> . . . . Wisdom and love constitute the process necessary to sustain the human level of existence in the form of the human mind, human community, human knowledge, and power and control. Without wisdom and love the human level of existence disintegrates into irreconcilable conflicts and confusion or else freezes into a changeless order unable to meet changing conditions and unable to include the demands of unique individuality in persons and in other cultures.
>
> Henry Nelson Wieman

In Chapter IV we presented an understanding of God as that which brings about greater good. Then, in the process of exploring how the method of science might be used to develop and test ideas about God, we substituted for the term "God" the term "creative interchange" and for the term "greater good," "the continual expansion of men's minds and the world relative to men's minds" in the cognitive, aesthetic, social and personal dimensions. This allowed us to develop a possible theory of creative interchange, consisting of several hypotheses, and to indicate how the hypotheses in such a theory might be tested in controlled scientific experiments. In this manner we indicated how ideas about creative interchange might be developed and tested by the method of science. Throughout this exploration we have assumed that our initial substitution of the notion of creative interchange for God was justified. However, this assumption can be challenged with the question, why call creative interchange "God"? Unless this challenge is met it is impossible to give a positive answer to the basic question of our dissertation: can the method of science be used to develop and evaluate ideas about God?

The question of why call creative interchange "God" is a theological question and, hence, must be answered on theological grounds. One possible way to do this is to analyze how the term "God" is used in different existing religions and religious traditions, and out of such analysis to develop criteria by which to judge whether or not creative interchange can be called God. Such an approach is far beyond the scope of this present work. Another way is to begin with our initial definition of "religion," and from this definition develop the criteria that can serve as a basis for answering our question. This will be the approach we shall take. However, in so doing we shall discover that more than one concept of God might meet the criteria based on our definition. Thus we shall be faced with the further question, if creative interchange can be called "God" according to the criteria implied in our definition of religion, why is it a better understanding of God than some other concept?

## God as the Object of Man's Most Comprehensive and Intensive Valuing

In Chapter I, following Frederick Ferré, we suggested that "religion is one's way of valuing most comprehensively and intensively."[1] "Valuing" means the conscious desiring of something. "Comprehensive" refers to that which has a bearing on all of one's life, while "intensive" refers to that which is most important, that which is "sacred," of

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[1]Supra, p. 6; Frederick Ferré, Basic Modern Philosophy of Religion (New York: Charles Scribner's Sons, 1967), p. 69; for full explanation of the meaning of the terms of the definition, cf. ibid., pp. 59-69.

"ultimate concern" or to which "ultimate commitment" is made. As Ferré points out, that which is considered to be most comprehensive in its bearing on man's life and also of greatest importance need not be designated "God" (some religious traditions are non-theistic); nevertheless, if something is to be called "God" it must meet the criteria of comprehensiveness and importance implied in this definition.

Is creative interchange a process that is inclusive in its bearing on man's life? We think it is, because according to our proposed theory it is operative in all the dimensions of life. It is that which brings about new knowledge and thus expands the known world; it brings about new forms of art and increases the range of what can be aesthetically appreciated; it brings about new patterns of human relations that deepen the feeling of community between men and is responsible for the emergence of new moral insights, customs and social institutions that support such relations between individuals, groups, nations and cultures; it brings about the growth of each personality, continually integrating new experiences, patterns of behavior and thoughts with an individual's past history. In short, according to our theory, creative interchange is that which is responsible for the development of the human mind and the world relative to the human mind, or in other words, it is that which operates to sustain and promote the further expansion of history. Thus it has a bearing on every person's life and on all that happens in the human race and between the human race and the rest of the world.[1]

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[1]It must be acknowledged that our theory of the creative process does not include the idea of cosmic creation or that of creation in the non-human world apart from man. This has already been pointed out as a limitation of our particular theory of creativity, <u>supra</u>, pp. 166-167. Cf. also our further comments on this matter, <u>infra</u>, pp. 257-258.

It must be emphasized that we have not said that creative interchange is history, or that it is the sole cause of everything that happens in the various dimensions of human life. It is related to all the dimensions of life but only in a specific way. It is not responsible for all that happens but only for the expansion of the minds of men and the world relative to the human mind. According to our analysis in Chapter IV, it is that which saves men from evil and continually brings about greater good, and is hence worthy of being called the "greatest good." As the "greatest good," creative interchange meets the criterion of importance specified in our definition of religion. Because it meets this criterion and also that of comprehensiveness, it is theologically justifiable to call creative interchange, "God."[1]

The argument that we have just advanced for calling creative interchange "God" is dependent on two things. The first is that our initial discussion of good, evil and the greater good is adequate. The basic criterion of goodness is mutual support: what is valued by men is good when it exists in relations of mutual support with other values; it is evil when it contributes to the destruction of other values. The greater good is the continual expansion of relations of mutual support in the various dimensions of life, or in other words, the continual expansion of men's minds and the world relative to men's minds. This analysis will have to be carefully scrutinized by other scholars. As it

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[1]Cf. Henry Nelson Wieman's justification of creativity as ultimate in two senses: "It is metaphysically ultimate because it is logically prior to all other knowledge and experience; it is religiously ultimate and valuationally (axiologically) ultimate because it brings forth the greatest human good which man can ever experience on condition that man accepts it as his savior and creator and allows himself to be creatively transformed by it." Man's Ultimate Commitment (Carbondale, Illinois: Southern Illinois University Press, Arcturus Books, 1958), p. 92.

now stands it is the best we can offer at present. Its main strength is that it takes into account the scientific requirement that the greater good be something in existence capable of being observed by men, while at the same time it prohibits the absolutizing of any particular envisioned value or set of values as the one eternal and universal good.

The second thing that our argument depends on is the actual, continual bringing about of greater good by the process of creative interchange, as presented in this dissertation. Whether or not creative interchange is the greatest good and hence can be called "God," is not simply a logical issue but is also an empirical one. The final answer can only come if creative interchange continually does in all areas of life what we have hypothesized it to do, saves men from the kinds of conflicts that result in the destruction of life or the stagnation in which the will of some is imposed on others and continually expands the minds of men so that an increasing variety of mutually sustaining values is developed. It is not that we expect a time when this expansion will be completed and the maximum of good for men fully established.[1] Rather, we will be theologically justified in calling creative interchange "God" if in our everyday lives this process continually brings about greater good.

There is, however, one important requirement that must be met before it can be empirically determined whether or not creative interchange actually brings about greater good. Men must commit themselves to it in all areas of their lives. There is a danger of limited commitment to creative interchange, in the sense that it is engaged in only to

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[1]Thus we are not suggesting a form of eschatological verification, such as is expressed by John Hick, Faith and Knowledge (Ithaca, New York: Cornell University Press, 1961), pp. 160-163, the purpose of which is to vindicate the cognitive meaningfulness of theistic assertions.

further certain values held dear by a particular individual or group. One of the shortcomings of vision among some social scientists is that they are investigating the nature of the creative process in order to make it serve limited ends. Some say, for example, that men must seek out creative individuals and further the creative capacities of all, so that the United States can maintain its position as the number one power in the world. Such attempts to use creative interchange to serve one's own limited goals will only lead to destruction. Instead of being the way of integrating the diverse values of various societies and cultures, when creative interchange is harnessed to one particular envisioned set of values, it becomes the way to develop the means for one society to destroy what is valued by other societies, in some cases even to the point of destroying life itself. Or, when creative interchange is made to serve only limited ends, it can lead to the kind of conflict in which all suffer. In traditional Christian terms, the use of creative interchange to serve only one's own interests is a rebellion against the greatest good and brings about the judgment of God.[1]

To actually discover if creative interchange is related to all areas of life in such a manner that it continually brings about greater good thus depends on a commitment to this process as that which is most important in all areas of life. In this sense, faith in God is a condition for knowledge of God. This faith or commitment is basically the same as that given in a scientific experiment. It is the engaging in creative interchange as understood and supplying the conditions that are thought to further this process. Through such commitment one hopes to

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[1]Cf. <u>supra</u>, pp. 181-182.

gain further knowledge about the nature of the creative process. The key difference between commitment to creative interchange in experiments and the commitment of which we are now speaking is that the latter is broadened to all areas of life. It is not that commitment to creative interchange is more intense; we do not engage in the process any more vigorously than in scientific experiments. It is that it now includes all real life situations that have the potential of yielding a problem that can be transformed into a further expansion of men's minds and the world relative to the human mind. Through such a commitment one also can gain further knowledge about the nature of creative interchange, not scientific knowledge but knowledge through personal experience. One can discover if creative interchange as understood is that which continually brings about greater good and is hence worthy of being called God. Thus this commitment becomes what in Wieman's terms is a commitment to whatever in truth saves men from evil and brings about greater good. It may be that what does this is not creative interchange as we have presented it in our proposed theory, but something else. It may be that something else is more deserving of being called God. But this can only be discovered through a commitment to what we believe God to be.[1] Only thus can the process of creative interchange be theologically justified as that which is most important to all of life.

## Competing Theological Paradigms

It must be stressed at this point that our major concern is a concept of God; we are not concerned as much with the question of the

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[1]Cf. *supra*, pp. 188-191 on the three levels of commitment.

existence of God as we are with how the nature of God might be understood. Of course, the failure of continual efforts to specify the nature of God might lead to the question of the existence of God.[1]

Because we are concerned with a concept of God as the process of creative interchange and are presently trying to theologically justify such a concept, indicating how it attempts to describe what is most important to all of life, it must be recognized that there are other concepts of God that claim to do the same thing. Furthermore, those advocating other concepts of God can also claim that only if people commit themselves to God as understood by them will people come to know that which saves men from evil to the best possible existence. In other words, there is more than one understanding of God that meets the criteria of comprehensiveness and importance implied in our definition of religion. Why then is our concept of God as the process of creative interchange better than any other theistic concept? When this question is raised we are placed in a position not unlike the scientist who has two general theories that purport to explain the same realm of experience; we are engaged in what Thomas Kuhn describes as a struggle between "paradigms."

According to Kuhn, paradigms are "universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners."[2] The most important feature of such achievements is that they have both a substantive aspect, which states something about the nature of the universe, and a methodological aspect,

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[1]Cf. supra, p. 226.

[2]Thomas S. Kuhn, The Structure of Scientific Revolutions (2nd ed., enlarged; Chicago: The University of Chicago Press, 1970), p. viii.

which defines the methods, problems and standards for acceptable solutions. This notion of a paradigm can also be applied to theology. We have suggested such a paradigm, a theological theory about the nature of God, which not only purports to describe God, the substantive aspect, but also the method by which knowledge of God is to be developed and evaluated, namely the method of science. There are other theological paradigms that not only offer a description of the nature of God but also a method as to how knowledge of God is achieved.[1] In our culture the most common one is that of traditional supernatural Christianity, which views God as the supreme spiritual being who discloses himself to men in certain historical events, as reported in the Bible and interpreted by the leaders of the church. We shall consider the competition between our paradigm and that of supernatural Christianity in order to raise the basic issues involved in theologically justifying any concept of God as the best concept available.

If it is possible to speak of theological paradigms in the same manner that one speaks of scientific paradigms, three criteria can be employed to decide which of two theological paradigms is better. In order to justify calling creative interchange God, it will have to be shown, first, that conceptualizing God in this manner solves certain problems that the paradigm of traditional supernaturalism cannot solve, second, that many of the important ideas about God expressed in traditional supernaturalism can be translated in our paradigm, and finally, that in our time the paradigm that conceives of God as the process of creative interchange and can possibly use the method of science in

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[1]Some of these we discussed in our introductory chapter, supra, pp. 16-30.

theological inquiry holds out more promise for the future of theology than a paradigm such as traditional supernaturalism.[1]

Problems within paradigms.--Traditional supernaturalism conceptualizes God as an entity or being, the Supreme Being, all good, all powerful, all wise and all loving, a being who is beyond existence in space and time, and therefore beyond investigation by ordinary human ways of knowing, including the method of science. This Supreme Being is known, however, through breakthroughs into space and time in which he reveals himself in certain historical situations and individuals, primarily in Jesus Christ.

This theological paradigm, in spite of the power it has had in western religious thought leaves certain problems concerning the relation of God so conceptualized to the world. Konstantin Kolenda states four such problems:

> The puzzle of omnipresence: How can a particular entity, God, be everywhere at the same time? The paradox of Christianity: How can the eternal God have a temporal manifestation? The mystery of divine intervention: How can the Unchanging react to events in the world? The problem of evil and the need for theodicy: How does the infinite reach of God's power fail to prevent evil? Why does the perfect reality of God require the existence of an imperfect world?[2]

If God is understood as the process of creative interchange each of these problems can be resolved. The problem of omnipresence results from God being conceptualized as a particular entity. As long as God is

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[1]Cf. a similar set of issues raised by Thomas Kuhn in his discussion of how a conversion to a new paradigm in science is induced and how resisted, The Structure of Scientific Revolutions, pp. 152-159. Cf. also our own discussion of the evaluation of competing scientific theories, supra, pp. 105-108.

[2]Konstantin Kolenda, "Thinking the Unthinkable: Logical Conflicts in the Traditional Concept of God," Journal for the Scientific Study of Religion, VIII (Spring, 1969), p. 73.

understood this way there will always be the puzzle of how he can be everywhere at the same time. However, creative interchange is not such an entity but a process, a pattern of activity which can manifest itself in many places at the same time. It is omnipresent in the sense that wherever there are two or more parties and at least one of them is human, creative interchange is possible.

"The paradox of Christianity" is resolved in a similar manner, if the term "eternal" is taken to mean for all time and not beyond time, which a theological-scientific conceptual scheme will not allow. Just as the laws of science, which describe patterns of activity, claim to describe something that is constant for all time, yet something which has a countless number of particular instances, so our theory of crea-interchange proposes a pattern of interaction consisting of several stages and subprocesses as constant for all time but with many specific manifestations. Of course the structure we have proposed must be confirmed in all the dimensions of life, where possible scientifically, otherwise empirically. But even if our theory does not adequately specify the structure of creative interchange, still it is logically possible for the creative process to have an eternal structure that continually manifests itself in space and time.

If the process of creative interchange has an unchanging structure, it can still react to events in the world in the sense that it responds to conditions for its effective operation being provided. Indeed, according to our theory, it is dependent on a variety of conditions for its most effective operation, the most important being the commitment of men to creative interchange as understood in all areas of life. When commitment is made to the total process, further creative interchange is continually promoted, in the sense that the best solutions to problems are those that give rise to further problems and lead men into another instance of creative interchange. Furthermore, when commitment is made and other important conditions supplied, the process in turn may promote the conditions; by engaging in creative interchange men may find that their mental abilities and emotional traits associated with this process are enhanced and that the supportive community between men is widened and deepened, and it becomes easier to engage in further instances of the creative process. In this way the creative process reacts to at least some events in the world, namely human beings.

As long as God is regarded as both infinite in power and goodness, the latter involving love for men, evil will always be a problem. The theological-scientific conceptual scheme that understands God as creative interchange considers evil as something that can be observed whenever relations between values are such as to destroy the values of at least one party; hence, evil is a real part of life and not an illusion. Because evil is real, one is forced to choose between conceiving of God as all powerful and conceiving of God as all good. In our claim that creative interchange is the greatest good we take the latter alternative. Having done this we are in a position not only to understand the nature of evil but also how it might be controlled and perhaps even eliminated.

Evil is the destruction of value; however, there are two kinds of evil, that in which one person or group seeks to totally destroy the values of others, and that which partially destroys the existing values of both interacting parties to permit an expansion of the minds and hence, in the end, an increase in what can be valued. Evil of the second kind, which is the breakdown of the existing order of things, whether that order be cognitive, aesthetic, social or personal, is actually the first stage of the process of creative interchange; hence it is not truly evil but the first step toward greater good. What is truly evil results from the refusal to permit a certain amount of breakdown in the old order so that room can be made for the new, for the blocking of the creative process can result in the kind of conflict in which the parties involved try to destroy one another. This blocking the creative process is in traditional theology the sin of rebellion against God. However, permitting the breakdown of the old order can also be undesirable if it is not recognized that such a breakdown is only the first stage of creative interchange; if the creative process is blocked after the breaking down of the old occurs, the result is apt to be anarchy in which all structure is destroyed. After the old order is broken down so that the new can enter in, creative interchange must be allowed to continue until both the old and the new are integrated in a way that enhances each to the fullest possible extent. In this, of course, some of the original order may be lost, and this itself is evil; however, if commitment to creative interchange continues this can spark a new instance of the creative process that leads to still greater good. With this understanding of evil as the result of the blocking of creative interchange at any point in the process from beginning to end and even after an instance of creative interchange is completed, we are in a position to understand not only how evil arises but also how it can be overcome. It can be overcome by commitment to creative interchange in all areas of life, when commitment means engaging in the subprocesses of creative interchange as they are best understood to date and as supplying any conditions which scientific inquiry has shown facilitate this process.

In resolving these four problems of traditional supernaturalism we have also been able to affirm certain traditional theological attributes of God for creative interchange, namely omnipresence, eternality, changelessness and goodness. However, it must be noted that in this process what some of these words indicate now is perhaps different from what they stood for in the traditional understanding of God. For example, "eternity" does not mean beyond time but for all time, and the "goodness" of God refers to the creative process bringing about greater good if man commits himself to it, rather than saving man to some paradise. What has brought about these shifts in meaning is the requirement that a scientific theology must develop its concepts in reference to what is observable in space-time; our conceptual scheme is thus that of a "naturalistic" theology. With the shifts in the meaning of key words, the problems of traditional supernaturalism have in effect been reformulated, and this is what has permitted their resolution. Such is also the case with competing scientific paradigms; the new scheme, by allowing things to be seen in a new way, redefines and resolves problems present in the older way of viewing certain aspects of the world.

Although a new paradigm may resolve persistent problems in the old way of understanding something, quite often those supporting the older paradigm can point to problems in the new conceptual scheme that were not present in the old. Unless the new paradigm can also resolve these problems or else show why they are not important, it cannot be considered as better than the old scheme.

There are two problems that someone affirming the paradigm of traditional supernaturalism can raise concerning our conceptual scheme of creative interchange which have a direct bearing on the question, why call creative interchange God? The first is the problem of whether or not the creative process we have proposed in our theory is nothing but a human process. If it is nothing but a human process, then we should not call it God, because God is supposed to be something other than man.

This problem cannot be ignored, for in indicating how the method of science might be used to investigate ideas about creative interchange we have operationally defined creative interchange in terms of subprocesses or activities in which men can engage. In doing this we seem to come very close to viewing creative interchange as something strictly human. This is reinforced by the fact that the social scientists, whom we have used as one of the sources of ideas about creative interchange and its conditions, do regard it as something human, either as a kind of thinking or as a capacity to be developed. Both the supernaturalist theologian and the social scientist would thus probably accuse us of doing the same thing, of pretending to investigate the nature of God when we are only investigating the nature of man. This would not deny the importance of what we are doing, for we may still be concerned with what saves man from evil and brings about greater good. What is questioned, however, is that this is done by God, for some may wish to argue that salvation from evil and the bringing of greater good is the work of man and not something other than man.[1]

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[1]Another possibility is to acknowledge that the creative process is indeed something human, but because it is still that which saves man from evil and brings about greater good it can appropriately be called "God," or at least be referred to as the divine aspect of man. Such a position would be akin to the religious humanism of John Dewey, who considers God to be the "active relation between the ideal and the actual," between natural forces, including man, that generate and support ideal possibilities and are in turn guided by these possibilities towards the

To meet this criticism we must first reformulate the problem so that it is posed not in terms of the paradigm of traditional supernaturalism but it terms of our paradigm of creative interchange. For underlying the problem as posed by traditional supernaturalism is the view that God is something other than man. This understanding of God is compatible with the notion that God is a particular entity or being. When God is conceived of as a personal being, it is easy to consider him as being other than man, a different kind of personal being than man is. However, our paradigm of creative interchange does not conceptualize God as a being but as a process of interaction between men and between men and the rest of the world. If God is conceptualized as such a process it is quite difficult, if not impossible, to conceive of God as being something that is clearly separate from man. But this does not mean that the creative process is simply a human process, for, although it is not something other than man, it is possible to argue that it is more than man, and hence, worthy of being called "God."

There are two reasons for regarding the process of creative interchange as something more than man. The first is that men can reject it or commit themselves to it. Of course, according to our analysis many seem to engage in creative interchange without being aware of it; this is

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realization of increased value, A Common Faith (New Haven: Yale University Press, 1934), p. 51.

In what follows in our text, however, we shall attempt to state why God or the divine is something more than human, following a line of thought similar to that of Henry Nelson Wieman. For the subtle differences between Dewey's and Wieman's position in an analysis of the controversy that ensued when Wieman misinterpreted Dewey's brief statements about God as being in accord with his own position, cf. Marvin Shaw, Naturalism and the Divine: the Foundations of Naturalistic Theism in the Philosophies of Santayana and Dewey (unpublished Ph.D. dissertation, Dept. of Religion, Columbia University, 1968), pp. 283-293.

our explanation of the results of tests that claim to measure what social scientists call mental abilities. In theological terms this unconscious participation in the process may be understood as man being made in the image of God; man is so structured physically and through the development of language and culture that he has the capability for creative interchange. However, men can still reject this process, refusing to participate in it and thus hindering its effective operation; or they can choose to participate in creative interchange in only some areas of life, using it to further their own particular ends; or they can choose to commit themselves as completely as humanly possible, engaging in creative interchange in all areas of life.

On the other hand, while men can commit themselves to creative interchange or not, creative interchange is constantly presenting itself to men, calling them so to speak to participate in it. It does this through the continual presentation of new experiences and ideas to individuals and communities. Men can ignore these new experiences or ideas; they can even actively battle against them as experiences that are not real or ideas that are not true. But if they accept the new experiences and ideas, which call into question their existing conceptual schemes, they are accepting the invitation to creative interchange. This continual invitation, even though it may be and has been ignored or rebelled against, is one way of describing what in more traditional Christian terms has been called "prevenient grace."

The freedom to ignore or commit oneself to creative interchange and the continual invitation from this process constitute the first major reason for maintaining that we are referring to something that is not merely human but is more than human.

The second major reason is that the specific outcome of any particular instance of creative interchange cannot be foreseen or controlled by men. Of course, as we have pointed out, creative interchange is at least partly dependent on men for its most effective operation, and in this sense men can control it. In fact, this kind of control seems to be the basis for gaining further knowledge about the creative process in scientific experiments, because the testing of our ideas about creative interchange involves the isolating of stages, subprocesses and conditions, and the ability to engage or not engage in all of them or any combination of them at will. Yet, even here, the specific outcome of such engagements in creative interchange cannot be foreseen or predicted by those involved; people in interaction over problems like the "Change of Work Procedure Problem" do not know in advance what specific integrative solutions they will arrive at.[1] What can be predicted, whether in experiments or real life situations, is that engaging in the creative process will bring about greater good or expansions of human minds and the world relative to human minds. However, the exact nature of that expansion, what new ideas or experiences, what new aesthetic structures or felt quality, what new patterns of social relations and expressions of community, what new developments of personality—these cannot be predicted. Even if the structure of creativity is fully known and accordingly participated in, what creative interchange will specifically bring about cannot be foreseen or controlled. Hence, as Wieman

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[1]Of course, those observing a series of experiments may observe the reoccurrence of certain solutions to the "Change of Work Procedure Problem" or similar problems, and hence be able to predict specific solutions in future experiments; however, these observers are not the ones engaging in creative interchange in the experiment itself.

says, "creativity is more than human in the sense of doing what man cannot do when human doing is defined as producing what man intends and imagines before it occurs."[1] And because it is more than human, it is appropriate to call creative interchange "God."

The second problem that someone from the paradigm of traditional supernaturalism can raise concerning our calling creative interchange "God" is that we are only able to speak of a creativity within space and time and neglect the traditional notion of God as the creator of the universe at the beginning of time or as bringing his creation to a final culmination at the end of time. In this sense we cannot speak of God as the "alpha and omega" but only of God as being involved with everything in between insofar as good is increased. We accept this criticism as valid, for it points to one of the limitations placed on a theology that attempts to be scientific. The God that can be investigated by the method of science is the God operative within space and time and not beyond. However, from the point of view of our paradigm, we can point out that the problem of ultimate origins or ends in the temporal sense is not that important. It does not really matter how the world originally came into being. What really matters is here and now. Unless we can gain knowledge of how God is operative in our present everyday life and commit ourselves to God so understood, we are apt to find ourselves contributing more and more to the destruction of the world we live in rather than allowing the life we have to be preserved and enhanced. The understanding of God as the creative process, open to investigation by the method of science, provides a way to gain the knowledge required to

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[1]Wieman, Man's Ultimate Commitment, p. 76.

commit ourselves to that which saves man from evil and brings about greater good.[1]

This second problem can come to us in another form, however. It can be pointed out that our notion of God as creative interchange between men and between men and the rest of the world does not take into account the traditional notion of God as creator of the universe in the sense of presently creating and recreating the physical world and also the vegetable and animal worlds apart from man. Further our theory of creativity does not take into account the original physical creation of man himself. We can respond to this by saying that the creative process does indeed create the physical and non-human universe through an interaction between the old and the new. There seems to be a cosmic creative interchange between the various elements of the world that continually renews all forms of life and from time to time creates new forms of existence. However, in saying this we must admit that our own particular theory does not attempt to describe this kind of creativity. Perhaps our own theory will need to be incorporated into a theory that is more comprehensive.[2] Yet we do not feel that this is as important as stressing that the divine creativity is something that operates between men and between men and the rest of the world. From the human point of view it does not matter so much what is going on in the vast and distant parts of the

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[1]Of course, the traditional supernaturalist can reply that what happens in this world is not really important; the salvation that God brings is to some other realm of being entirely. In the final analysis then, we discover that there is a difference not only in how God is conceptualized in the paradigms of traditional supernaturalism and creative interchange but also a crucial difference in what is considered good and evil for men and especially, what is the greatest good that is possible.

[2]One possibility is relating our theory of creative interchange to the scientific theory of evolution, as suggested <u>supra</u>, p. 167.

universe; neither is it so important how mankind itself came into being. What is important is that with the coming of mankind, and especially with the rise of modern science, life on this planet and perhaps also in our solar system is inextricably bound up with what man does. Man cannot ignore the fact that he is responsible for the furtherance not only of his own life but of all that exists on earth; he has the power to destroy--even to destroy completely--or to preserve and promote. Hence, while it is perhaps intellectually desirable to indicate how our theory of creative interchange may be a part of a more comprehensive theory that takes into account all of creation, what seems to us to have priority is the further seeking out of how God operates in relation to human existence, to seek to understand as fully as possible the nature of that which saves man from evil and brings about greater good for man and for all that to which man is related.[1]

Translating from the old into the new paradigm.--In the competition between theological paradigms not only is a new paradigm judged according to whether or not it can resolve persistent problems in the old paradigm while at the same time meeting its own problems; it is also judged by whether or not it can translate ideas from the old paradigm into the new scheme. We must hence indicate how at least some of the major ideas of traditional supernaturalism fit into our scientific-theological conceptual scheme of creative interchange.

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[1]E.g., the continued existence of certain species of wildlife is now dependent on man; although these species are reproduced through a process of biological creation, that process itself has been interferred with by man. Only if man's mind is expanded through creative interchange with his environment so that he appreciates the value of the life that he has endangered and then discovers ways to preserve and further such life will the biological creation of certain species continue.

This is part of what is expected to happen when a new scientific paradigm replaces an old one. For example, basic notions such as "space" and "time" are carried over from Newtonian physics into Einstein's theories of relativity; however, it is important to note that in the translation from one paradigm to another such concepts undergo changes in their meaning, simply because their meaning is in part dependent upon the total conceptual scheme in which they are used.[1] Therefore, although we will be using some of the same words, their meanings will be modified. Perhaps this has already been noted in our carrying over into the paradigm of creative interchange such traditional theological terms as "sin" and "prevenient grace." It has also occurred when we spoke of God as "omnipresent," "eternal," "unchangeable" and "all good." Even our basic idea of God as creativity has its origin in the traditional notion of God the creator, as well as the idea that the creator saves man from evil and brings about the greatest good for man that is possible. All these are translations of ideas from traditional Christian theism into our new conceptual scheme, but all have been altered in the translation.

Let us briefly see how this also works with two further concepts about God in traditional supernatural Christianity as they are translated into our paradigm of creative interchange, the concepts that God is all wise and all loving, or more simply that God is wisdom and love. The manner in which Henry Nelson Wieman speaks of love and wisdom makes it possible to regard these terms in conjunction with one another as a way of describing the process of creative interchange:

> wisdom is defined as the search for coherence in the development of the individual, in social development and in knowledge. Love

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[1]Cf. Kuhn, The Structure of Scientific Revolutions, pp. 142-143.

> is the desire to bring into each of these forms of coherence the innovations relevant to each kind of development. Development means expanding the range and coherence of what can be known, controlled, and valued by the individual in community with others.[1]

In other words, love is the activity of reaching out for new perceptions and ideas, deriving them from other human beings and the non-human world. It is the first basic stage of creative interchange. Wisdom is the search for a new coherence, a new integration. It is the second and third stages of the creative process, namely the generation of new possible integrative solutions to the problems raised by the innovations sought by love and the evaluation of possible solutions until some new pattern of coherence between ideas and between ideas and experience is reached. This is love and wisdom in the cognitive dimension of life. It is also operative in the other three dimensions as the reaching out for what is new and the integrating of the new with the old.

In traditional theology God has from time to time been identified with wisdom, wisdom meaning the most profound order of things; and in Christian thought this understanding of wisdom has been carried over into viewing Christ, the manifestation of God, as the divine _logos_. More common in Christian thought, God is love. When we bring together this traditional idea with Wieman's notion of love as the seeking of innovations, we arrive at the idea expressed by Jesus' exhortation to love our enemies. For the seeking of innovations is the seeking of that which is different, which does not fit the present order of things, and then the attempt to embrace that which is different in a new order. The love of the enemy in the sense of seeking that which is different is

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[1]Henry Nelson Wieman, _Religious Inquiry: Some Explorations_ (Boston: Beacon Press, 1968), pp. 123-124.

possibly a way of expressing in terms of creative interchange the idea that the God of love forgives those who are opposed to him.

In translating the traditional ideas of God as wisdom and God as love into our paradigm of creative interchange, two things happen. First, we are able to more precisely understand what these terms mean. They are not simply vague, emotionally charged words but terms referring to a definite set of activities in which men can participate and through which they are saved from evil toward ever greater good. On the other hand, by relating our fairly precise but unemotional concept of creative interchange to the traditional ideas of wisdom and love our concept gains a connotative richness, so that it may not only satisfy men's intellects but also their feelings and perhaps may even move them to action. To inspire men to commitment to God, it is not only necessary that theology seek to discover and communicate as clearly as humanly possible what God is; it is also necessary for theology to communicate the nature of God in such a way that men respond with their whole being to participate in that which saves from evil and brings about greater good.[1]

There is one major difference between the understanding of a God of love and wisdom in terms of creative interchange and in terms of traditional supernaturalism. The latter conceptualizes God as a being who is wise and loves. Because such a being cannot be observed in space and time it is necessary to conceptually construct a supernatural realm in which God can exist. This not only leads to some of the logical problems mentioned by Kolenda; it is a much more complex conceptual scheme

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[1]Here we are agreeing with those who see a variety of functions for theological language besides the cognitive function, while at the same time stressing that it is crucial that theological language also be cognitive. Cf. <u>supra</u>, pp. 24-26.

than the one which views God as creative interchange. For when we speak of a God of love and wisdom in terms of creative interchange we are speaking of the subprocesses of loving and being wise, of taking in the new and integrating the new with the old. It is possible to observe instances of such processes in space and time. In this sense the conceptual scheme of creative interchange is not only different but also simpler than that of traditional supernaturalism, although it can speak of God in some of the same terms. In the competition between theological paradigms this is another reason for choosing in favor of creative interchange as offering the better understanding of God.[1]

The promise for the future of theology.--The final criterion that must be met in the competition between theological paradigms is to show that the new paradigm offers more promise for the future of theology than other alternatives. In this regard we believe that the paradigm of creative interchange, which includes both a particular understanding of God and a method of how knowledge about the nature of God must be achieved, offers more hope for the future of theology than that of traditional supernatural Christianity. It does one thing that we believe is crucial in our times, but that traditional supernaturalism has not been able to do: it positively relates religion and science.

This positive relationship has been established primarily through the development of a scientific-theological conceptual scheme, which raises the basic theological questions concerning what is good, evil and the greater good for man and then indicates how the method of science might be used to develop and test ideas about what saves men from evil

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[1]Cf. supra, p. 107, where the criterion of simplicity is used in deciding between competing scientific theories.

and brings about greater good. In developing this conceptual scheme we have also indicated two further ways in which theology and science come together, namely that the method of science also serves as one source of ideas about what brings about the greater good in the cognitive dimension, and that the social sciences provide some of the experimental techniques for testing proposed ideas about the nature of God. The use of techniques provided by the social sciences means that the positive relationship between theology and science is not simply abstract and intellectual but that it can be a concrete working relationship between theologians and scientists.

In our scientific-theological scheme we have indicated how the method of science might be used to develop and test ideas about God, when God is understood as that which saves men from evil and brings about greater human good. Thus we have presented a way in which science can be of service to religion in that it helps religion to understand the nature of the object of man's most intensive and comprehensive valuing. However, we have not yet indicated how in terms of our conceptual scheme theology can guide the scientist concerning that to which he should be religiously committed, so that science itself can be properly used for the good rather than to the detriment of man. We cannot engage in a lengthy analysis at this point concerning this matter, but we can indicate a guiding principle for the scientist concerning his religion: what the scientist does in his own particular field he ought also to do in all areas of his life. In his search for knowledge he more or less engages, either consciously or unconsciously, in the creative process. He is thus already in touch with God. But the danger of the scientist's existing relation to God is that it is limited if he engages in creative interchange only to the extent that it brings about increases in knowledge and through knowledge increases in control over the physical world, man and society. Such a limiting of creativity, using it to serve only particular values desired by men distorts the good sought, in this case knowledge, and allows it to be used for evil ends. Only when commitment is made to creativity in all the dimensions of life and in every situation can one avoid the destructiveness that can result from the discoveries of science. The scientist and all men must engage in creative interchange as it seeks to bring about relations of mutual support between such basic values as knowledge, beauty, supportive social relations and integrated but unique individual human beings. This is the guidance that a scientific theology can offer in answer to the basic religious question raised by many scientists and others as well, to what can we commit ourselves to avoid destruction and bring about the greatest possible benefit for all mankind?

In attempting to answer the question of this present chapter--why call creative interchange "God"?--we indicated that creative interchange is something that is related to all aspects of life and is what is most important in that it saves man from evil and brings about greater human good. Hence it is something worthy of being the object of man's most comprehensive and intensive valuing. We then suggested that, in addition to meeting the basic criteria implied in our definition of religion, we must also show why the paradigm of God as creative interchange is better than other theological paradigms which also meet the basic criteria. Taking traditional supernaturalism as an example we indicated the issues that had to be raised and met, explaining how the paradigm of creative interchange resolves certain persistent problems in that of supernaturalism, how it meets some problems raised by supernaturalism in return, how some of the basic ideas about God in supernaturalism can be translated into the paradigm of creative interchange, and how the paradigm of creative interchange offers more promise for the future of theology in today's scientific age. To all this, however, someone from another theological paradigm can ask, what is the source of your criteria for determining which of two competing paradigms is better? To this question we must admit that the criteria we have been using are taken over from the method of science and are actually a part of the scientific-theological conceptual scheme about which we are reflecting. In the competition between paradigms, one cannot step outside the conceptual scheme for which one is arguing; even the criteria for competition are a part of that scheme. Hence, it must be allowed that those arguing for other theological paradigms have the right to advance their own criteria for judging between theological positions.

If in the competition between theological conceptual schemes even the criteria used are a part of one scheme or the other, then all any proponent of a theological system can do is to present his position as completely as possible. In doing this he is indicating to his competitors and other readers how he thinks theology should be done, and if the paradigm is a new one he is also indicating what he thinks the future of theology should be. This is essentially what has been attempted in this dissertation. We have attempted to present an approach that might be called "scientific theology," an understanding of God as the creative process, the nature of which is in principle open to investigation by the method of science; and we have explored how the method of science might possibly be used to develop and evaluate ideas about

God so conceived.

Our exploration of the possibility of a scientific theology has grown out of the desire for a constructive relationship between religion and science. In seeking this relationship the ideas we have suggested concerning the nature of science, the nature of God and how the concept of God and the method of science might fit together may not be entirely adequate. But perhaps our ideas in themselves are not the most important thing. More important is that they might serve to stimulate further inquiry into the possibility of scientific theology--inquiry that hopefully will be conducted with the conviction that such a theology just might be possible. In the final analysis then, the answer to whether or not the method of science can be used to develop and test ideas about God may actually depend on whether or not enough people are willing to take a constructive approach that attempts to work out this kind of theology. If it can be done, we will have one way in which the scientist and theologian can assist one another in discovering the nature of God, of that which will save us from harming or destroying one another and the rest of the world, and instead will continually bring about the greatest good possible, provided that we offer every aspect of our lives in religious commitment. Echoing the conviction of Henry Nelson Wieman quoted at the outset of this dissertation, "in the age of science the ruling commitment of religion and the knowledge and power of science must work together if human life is to continue."[1]

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[1]Wieman, Religious Inquiry: Some Explorations, p. 27.

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