theism, "Cosmos" misrepresented the character of the scientific enterprise. Although the stage was set for an enriching experience in science education, what actually occurred was religious theater—an evangelistic crusade for modern Western naturalism.

EPILOGUE
FOLK SCIENCE: THE FACE BEHIND THE MASK

WE ALL HAVE CONCERN FOR MATTERS BEYOND THE limited domain of natural science. Thus we often puzzle about how the results of science may be related to those extrascientific concerns. How, for example, are the results of scientific investigation to be employed as we assemble a comprehensive world view—a perspective in which certain creedal or religious commitments play a prominent role?

In an earlier chapter we strongly discouraged the forced use of natural science to warrant (in the sense of providing a logical or evidential basis for) one's creedal commitments regarding the transcendent realm. We said, for example, that "science held hostage to any ideology or belief system, whether naturalistic or theistic, can no longer function effectively to gain knowledge of the physical universe.

When the epistemic goal of gaining knowledge is replaced by the dogmatic goal of providing warrant for one's personal belief system or for some sectarian creed, the superficial activity that remains may no longer be called natural science. It may be termed *world view warranting* or *creed confirmation,* or one may put it into the category of *folk science,* but it no longer deserves the label of *natural science"* (pp. 41-42).

Picking up on that reference to folk science, we referred in our closing remarks of chapter eight to *creation science* as an example of special creationist folk science, and to Atkins's *The Creation* as an illustration of naturalistic folk science. In this epilogue, then, let us reflect briefly on how this concept of folk science can provide us with fruitful insights into both scientific creationism and evolutionary naturalism—the principals in the contemporary creation-evolution debate.

Folk Sciences and the Creation-Evolution Debate

The distinction between professional natural science and the various strains of folk science is an important one. As defined by conventional practice and exemplified by the professional scientific literature, natural science ordinarily strives to be blind to religious and ideological commitments in its assessment of scientific theories. Self-consciously restricting itself to the domain of the inherent intelligibility of the physical universe, natural science chooses to remain silent on questions concerning the relationship of the material world to other realms of being.

A characteristic property of folk science, however, is its use of knowledge about the material world (whether accurate or not, or whether gained by common experience, amateur science or professional science is irrelevant) for the purpose of confirming a world view—a set of beliefs which provide a stable framework for dealing with the world of experience in a confident and satisfying manner. One's folk science is an integral component of one's world view, and

virtually everyone has a folk science of one sort or another.

Folk science is to be recognized, not necessarily eliminated. Those of us who are educators ought to recognize folk science as serving a function very different from that of professional natural science. The goal of the natural sciences is to gain knowledge concerning the physical world, irrespective of its place in the larger Universe of reality. The incorporation of that knowledge into a comprehensive world view which specifies the existence, character and relative status of God, humankind and the physical universe would be the function of one's folk science.

The contemporary creation-evolution debate may be understood as a shouting match between two competing folk sciences. As the debate is most commonly conducted, the two contenders are evolutionary naturalism and scientific creationism. Evolutionary naturalism is a folk science which seeks to employ the scientific concept of evolutionary development as a warrant for its nontheistic world view. Scientific creationism is a folk science which claims scientific evidence for its scenario of a recent creation by divine fiat. The debate, therefore, is not a contest between natural science and religious belief. It is a confrontation of two folk sciences, each seeking to employ the results of scientific investigation in the support of its own world view.

A portion of that debate—that portion concerned with the analysis of empirical data and the assessment of scientific theories—may fall within the domain of natural science. Questions concerning the duration of cosmic history, the interpretation of the geological record, the temporal succession of life forms, the physical mechanisms required for evolutionary development and like questions are suitable topics for discussion within the context of a science classroom.

We must, however, distinguish these authentically scientific questions from the religious questions which lie at the heart of the folk-science debate and generate most of its emotional energy. The assessment of theories or data relevant to natural science must be distinguished from the evaluation of the creedal assertions of either nat-

uralism or creationism. What is the key to this distinction? Perhaps the most revealing and critical test is to examine the domain, or scope, of a particular statement (or theory, question, speculation, assertion). Is it concerned only with the inherent intelligibility of the physical universe? Is its domain of concern restricted to the properties, behavior or temporal development of material systems irrespective of the existence or activity of nonphysical beings? If so, it is a matter for scientific investigation.

On the other hand, is its principal concern the relationship of the physical world with other realms of being? Does it, for example, function either to confirm or to deny the existence and action of deity? Does its domain of concern include questions about the status of the physical universe relative to deity? Is it concerned with the implications of that status for matters pertaining to the origin, governance, value or purpose of the universe? If so, it is not an appropriate matter for scientific investigation.

Questions concerning the relationship of the physical world to other realms of being are religious and metaphysical questions which must be directed elsewhere—to whatever serves as a person's source of answers to religious questions: parents, cultural traditions, religious institutions, the Bible, classical literature, philosophical speculation, and the like. These are very important questions, and they deserve appropriate consideration. But to be treated adequately they must be clearly distinguished from the more restricted questions that fall within the limited domain of natural science. One of the tragedies of the contemporary creation-evolution debate is, in our judgment, the failure to distinguish questions of inherent intelligibility from questions of external relationship, the failure to distinguish scientific matters from religious matters, the failure to distinguish natural science from folk science.

Evaluating Scientific Creationism as Folk Science

In the second part of this book we presented several case studies

under the heading: "Science Indentured to Creationism." What do these case studies illustrate? In our judgment, each of these critiques functions as a vivid illustration of a scientific-creationist folk science in action.

As a folk science, scientific creationism is concerned to use its perception of the physical world for the purpose of warranting certain creedal commitments. Chief among the creedal propositions to be confirmed by the results of scientific-creationist investigation is a scenario for cosmic history which requires the recent inception (6,000-10,000 years ago) of a mature and fully functioning universe having structure and contents essentially the same as we see at the present moment, except for the geological changes caused by a global flood.

In order to produce results that conform to such severe constraints, creation science must operate in a manner quite different from professional natural science. To be more specific, we believe that our case studies have forcefully documented serious failures of creation science to honor the laudable system of values that are characteristic of the professional scientific community.

Rather than reciting here a list of such failures, we invite readers to evaluate the scientific adequacy of the evidence, arguments and conclusions offered by creation scientists in support of a recent inception of the universe. Employing the value system developed in chapter two, the following questions are especially relevant: (1) Is the claim in question based on empirical investigation or theoretical argumentation that is marked by the appropriate level of craft competence? (2) When data are reported, or when extrapolations beyond the data are offered, is professional integrity being maintained in the manner expected by the scientific community? (3) When theories are being evaluated, is the system of epistemic values being employed in an appropriate manner? Or, on the other hand, has the normal epistemic value system been replaced by another criterion, such as conformity to a position already firmly established by means other than scientific investigation?

On the basis of case studies such as we have presented in the second part of this book, we believe that creation science scores poorly on all three of the above questions. Judged as natural science, the evidences and models offered by the scientific-creationist community fail the test of scientific adequacy.

Why is this the case? What has led to this particular state of affairs? The thesis we offer is this: Because scientific creationism functions principally as a folk science, its concern for matters of craft competence, professional integrity and epistemic values must be given a secondary status relative to the primary goal of providing a scientifically naive community with reassurance that its recent-creation scenario is credible. Its role is not to discover answers to open-ended questions, but to provide the appearance of scientific warrant for answers already established by other means.

Because the answers that creation science seeks to warrant are so closely related to a set of religious beliefs, it has often been suggested that creation science should be categorized as religion rather than as science. While there may be some merit to that suggestion, we judge it more accurate and helpful to classify it as a folk science for which particular beliefs about the physical universe—especially about its formative history—are integral components of a religion-centered tradition.

Once this folk-science identification is recognized, critics are free to evaluate the scientific issues quite independent of the genuinely religious questions, which together comprise the scientific-creationist position. Each of the authors of this book, for example, is wholly committed to the Christian faith, firmly believing that God and the physical universe are related in a way that is profoundly portrayed by the Creator-Creation metaphor. Yet we are also convinced of the scientific inadequacy of the scientific-creationist perspective.

The concept of creation is, we believe, a thoroughly religious matter concerning the identities and interrelationships of God, humanity and the physical world. Furthermore, we judge that the scientific question concerning the physical character and chronology of cosmic history belongs in a distinctly different category and deserves open-ended investigation on its own merits. As whole persons, however, we do seek to integrate these religious and scientific concerns into a single coherent world view. In that genuinely human enterprise we place a high value on both candor and integrity.

Evaluating Evolutionary Naturalism as Folk Science

Our chapter reviewing Atkins's *The Creation* concluded by identifying that book as an exemplar of naturalistic folk science. Reaching that conclusion required no extraordinary insight, however.

Already in the preface Atkins made it clear that his principal aim was to demonstrate, presumably by scientific argumentation alone, that the world's existence and patterned behavior require no Supreme Being. But questions concerning the necessity or non-necessity of a Divine Source for the world's existence or of a Divine Governor for the physical behavior of the universe lie well outside of the domain of natural science. The subject matter of such questions is clearly metaphysical, with profound religious significance. Thus, because the principal question treated in *The Creation* is the metaphysical-religious question of the relationship of the physical universe to a transcendent deity (which Atkins argues does not exist) this book cannot be identified or evaluated as natural science or the product of scientific theorizing alone.

But is it folk science? Indeed it is. It has a definite creedal perspective. It clearly advocates reductive materialism or evolutionary naturalism. But even more to the point, *The Creation* seeks to use the scientific concept of cosmic evolution to provide warrant for that naturalistic creed. It seeks passionately to indenture the results of professional natural science in the service of warranting a metaphysical-religious commitment already in place. We must conclude, therefore, that *The Creation* is an exemplar of the folk science of evolutionary naturalism. This is the category to which it belongs, and any critical

assessment of it must begin with that recognition.

Similar comments apply to Sagan's "Cosmos" television series. The results of natural science were presented not simply as the content of a lesson in science education, but as the evidential basis for a naturalistic religious world view. "Cosmos" was naturalistic folk science in a remarkably provocative and effective form. Its principal agenda was thoroughly religious: to imply that a naturalistic world view is warranted by natural science, to declare naturalism the victor over theism and to inspire a sense of identity and purpose rooted in religious loyalty to the universe itself. Although the forms of religious theater found in "Cosmos" may have been more subtle than what one finds in a fundamentalist revival tent, its evangelistic fervor was nonetheless intense.

As we did in the case of special creationist folk science, we invite the reader to perform a critical evaluation of Atkins's *The Creation*, Sagan's "Cosmos" or any other representative specimen of naturalistic folk science. Because evolutionary naturalism seeks to base its perception of the physical universe firmly on the results of professional natural science, we find relatively few occasions to complain about shortcomings in the areas of craft competence, professional integrity or the employment of an appropriate set of epistemic values. The normal functioning of the professional scientific community provides, we believe, an adequate amount of self-discipline in these matters. However, our chief concern here is to note what we judge to be serious violations of the boundaries of the scientific domain and a general failure to honor certain very important distinctions.

How can naturalistic folk science be distinguished from authentic natural science in the popular literature? We suggest that the following three questions be addressed to the literature under scrutiny:

1. What categories of questions are of principal concern? If a particular discussion is carefully limited to questions regarding the inherent intelligibility of the physical universe and its constituent parts, it is functioning solidly within the restricted domain of natural science.

But if, on the other hand, the principal concerns include some of the basic tenets of naturalism—no deity, no divine action in the world, no transcendent source of value or purpose—the material is likely to be naturalistic folk science.

As a folk science, evolutionary naturalism seeks to employ the scientific concept of evolution to warrant its creed. In some instances this may be accomplished in a rather subtle manner simply by basing the whole discussion on the unstated, but nonetheless effective, presupposition that there is no significant distinction between natural science and evolutionary naturalism. Much of Sagan's "Cosmos," we judge, follows this strategy. In such a context, any discussion of the relevant metaphysical-religious issues is likely to be infrequent or superficial. Atkins's book, on the other hand, is very up-front about its agenda. From the beginning, its anti-theistic agenda is stated explicitly so that there need be no doubt whatsoever concerning its identity as folk-science literature written for persons who wish to believe that their evolutionary naturalism has the blessing of the prestigious professional scientific community.

2. Is the distinction between origin *and* formation *made clear?* As we discussed in chapter one, natural science can fruitfully investigate the formation of various structures within the physical world, but it is incapable of dealing with the ultimate origin of existence, which is, once again, a metaphysical-religious matter. Discussions of cosmic evolution which overlook this formation-origin distinction are likely to function principally as folk science. Without this distinction, any reconstruction of the formative history of the universe tends to function as a "story of origins" in the sense of an explanation of existence itself.

In *The Creation* Atkins is very candid in his claim that we are on the verge of scientifically understanding how this awesome universe could create itself from "absolutely nothing." (What he calls by the name *absolutely nothing*, however, appears to be some nonphysical entity that possesses the capability of self-transformation into this

physical universe. Even self-creating universes, it seems, must begin with some form of "self.") Once again, *The Creation* reveals its folk-science identity.

3. Is the distinction between behavior *and* governance *made clear?* In the absence of a clear delineation of the difference between the scientific description of a thing's *behavior* and the identification of the source of the *governance* of that behavior, natural science is likely to be perceived as if it were a competitor to any theistic perspective. The concept of the "natural" behavior of a physical system would then function as a rival to the concept of divine governance.

In the folk-science literature of evolutionary naturalism, for example, the functioning assumption is that if there is a scientific description (or theory) of the processes involved in the formation of species, then there is no room for a theistic concept of the divine governance of those processes. Readers are led, sometimes openly, sometimes surreptitiously, to adopt an either-or stance: The phenomena that comprise cosmic formation happen *either* as "natural" processes (scientifically describable) *or* as consequences of divine action. Once this "either-or-manship" is in place, then even a scientifically informed reconstruction of the formative history of the universe functions as naturalistic folk science, reassuring all of those persons who wish to believe that the scientific concept of evolution provides warrant for their naturalistic interpretation of physical phenomena.

We hope that the case studies and other discussions in this volume will be helpful in clarifying the character of natural science as presently practiced, and in distinguishing it from two particular strains of folk science that function in contemporary culture. Science, folk science and religion each occupy a legitimate place in the human enterprise, but great mischief is done when their differences go unrecognized. Surely the resurgent creation-evolution debate provides ample evidence for that.

Notes

Introduction: Charting the Course

[1]The historically fruitful partnership of natural science and the Christian faith has been documented by numerous writers. Highly readable accounts can be found in the following recent publications: Charles E. Hummel, *The Galileo Connection: Resolving Conflicts between Science & the Bible* (Downers Grove, Ill.: InterVarsity Press, 1986); David N. Livingstone, *Darwin's Forgotten Defenders: The Encounter between Evangelical Theology and Evolutionary Thought* (Grand Rapids: Eerdmans, 1987); and Colin A. Russell, *Crosscurrents: Interactions between Science & Faith* (Grand Rapids: Eerdmans, 1985).

Chapter 1: Locating the Boundary

[1]See Carl Sagan, *Cosmos* (New York: Random House, 1980), p. 4.

[2]Donald M. Mackay, *The Clockwork Image* (Downers Grove, Ill.: InterVarsity Press, 1974).

[3]If the reader is not well acquainted with the application of the natural sciences to the study of formative history, it may be helpful to consult an introductory textbook in earth science, or geology, or astronomy. Such textbooks ordinarily include a discussion of the ways in which the formative history of the earth or of stars is scientifically investigated.

[4]A similar delineation of the domain of natural science can be found in Howard J.