SPIRIT, METHOD, AND CONTENT IN SCIENCE AND RELIGION: THE THEOLOGICAL PERSPECTIVE OF A GENETICIST

by Lindon Eaves

Abstract. There are three ways in which bridges may be built between science and theology: spirituality, methodology, and content. Spirituality is the power which drives each to address reality and the expectations with which each approaches the pursuit of truth. The methodology of science is summarized in terms of three activities: taxonomy; the hypothetico-deductive cycle; derivative technology. The content of science, especially with respect to the phenomena of givenness, connectedness and openness in the life sciences, is correlated with theological constructs. Attention is drawn to the role of the double helix in biology and a possible parallel is proposed to the function of the icon in religion and theology.

Keywords: anthropology; genetics; methodology; model; spirituality; theology and science.

Background

Any philosophy of science, and any proposal by which theology lays claim to the sciences, has to enable the scientist to recognize himself or herself in the solution. I am neither a theologian nor a philosopher of science, but as one who has been a practicing research geneticist for twenty years and a practicing doubting believer I am in a unique position to judge the authenticity of potential solutions to the relationship between science and faith.

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Science, Faith, and Adaptation

Humanity is engaged in a continuous process of adjustment and adaptation. Our genes and culture bear the marks of past adjustment and provide the raw material of future change. Increasingly, science has laid claim to the adaptive process by surpassing all previous attempts to analyze the mechanisms which brought us to where we are and by providing a powerful apparatus for manipulating and changing reality. The pursuit of truth is part of the process by which humans adapt to the matrix of matter and event in which they find themselves embedded. "We cannot know in advance that the truth will turn out to be what is thought edifying in a given society" (Russell 1961, 95), but the sciences comprise the "cognitive arm" of society, pursued in the spirit that "forewarned is forearmed"—even undesirable truth is better known sooner rather than later. Is there still a legitimate place for theology and religious faith in the adaptive process or should both be relegated to the history of ideas? Is theology a science? What is theology about?

We do not need to ponder too deeply the objectivity or otherwise of "reality." Rather, we define reality operationally as that which commands our attention, compels our adaptation and is ignored at peril to our being. "It makes little difference whether we name it natural selection or God" writes Ralph Burhoe (1981, 21), "so long as we recognize it as that to which we must bow our heads or adapt." The human spirit may rebel at the image of "bowing our head" to any kind of pressure, but Burhoe draws out an important principle, that knowledge and knowing are intimately connected with survival in a strictly biological sense. The a prioris with which we address reality may be as much inherited biologically as they are conditioned culturally. Gerd Theissen (1985, 4) has recently borrowed what is essentially a biologist's view of reality as that which requires adaptation. Science and faith, he argues, are each distinct mechanisms for adapting to different facets of the "central reality." The difference between science and faith is put with crystalline simplicity: "Scientific thought is corrected by reference to facts; faith must contradict the oppressive force of facts. Science subjects itself to the 'facts', faith rebels against them." Faith is—or may sometimes be—the response of living matter to the tyranny of fact. It is, to press an analogy chosen by Theissen himself, a historical "mutation," a living experiment which defies the present. We recall Marx's famous thesis on Feuerbach (quoted by Russell 1961, 749): "Philosophers have only *interpreted* the world in various ways, but the real task is to *alter* it."

Theology is the attempt to supply cognitive structure to the experience and content of faith. It is *fides quaerens intellectum*. The moment

theology begins, it enters a domain which has no favorites. Concessions can only be made if they are grounded in a matrix of experience and meaning which is, in some elusive sense, "public." The attempts of nineteenth-century theologians such as Schleiermacher to give a public dimension to faith were conceived in an age in which the essential quality of "fact" was its power to create and support values which liberate and transcend the present. The twentieth century encountered the power of "fact" to sustain sinister and oppressive values in the historical expressions of dialectical materialism and fascism. Against such "fact," as Theissen would have predicted, faith rebelled with astonishing power and eloquence in the uncompromising stance of dialectical theology. Karl Barth is one such model of the adaptive response of the spirit to the tyranny of fact.

The fragile nuclear peace and the relative prosperity of a society which promotes and exploits the sciences provides a different context for faith and theology. The power of facts is ambiguous. They are neither totally oppressive nor wholly liberating. The tangible and intellectual success of the sciences has left theology with a problem. It is well equipped to challenge the explicit tyranny and exploitation of the third world and inner city. However, it has all but abandoned the intellectual and cultural challenge of the sciences. In doing so, it has condemned a significant part of the human world and has abandoned part of the future.

The Ambivalence of Theology towards the Sciences

Theology has been ambivalent towards the sciences. It has flirted from time to time with the possibility of a public dimension but has equally often retreated behind the walls of confession. Science has assumed theological importance both for its methodology and content. Methodologically, science provides what many see as a paradigm for scholarship. Even though scientists and philosophers of science may still disagree about the distinctive characteristics of scientific method and progress, it is clear that the history of science supplies a number of model systems for analysis of how we advance in our understanding of reality. Thus, we are compelled to ask in the narrow sense, "Is theology a science?" In a broader context, science provides a microcosm of the human condition. It raises the basic questions, "How do we know *anything*?" and "How do we live in a world where the data are incomplete and our models are at best provisional?" Substantively, science presents a number of models for reality which at least need to be compared and integrated with the cognitive claims of theology, if such integration is possible. Science and theology both make some kind of

cosmological claims. Are they inconsistent? Biology and theology both make anthropological claims. Are they irreconcilable?

The dominant exponents of theology in the first half of this century have, at best, been lukewarm in their acceptance of the scientific method. Barth, for example, claims that theology is a science but is not beholden to the rules of science as it is defined by other scholarly disciplines: "If [theology] is ranked as a science, and lays claim to such ranking, this does not mean it must be disturbed or hampered in its own task by regard for what is described as science elsewhere. On the contrary, to the discharge of its own task it must absolutely subordinate and if necessary sacrifice all concern for what is called science elsewhere" (Barth 1975, 8).

By itself, this statement of Barth's position may be defensible. Wolfhart Pannenberg himself criticizes and moves beyond the scientific method as it is conceived by the natural sciences. If such a move can be defended on critical grounds, and if it can even alert scientists to hidden dimensions in their own approach to reality, then a willingness to confront the methods of the natural scientist is productive for the sciences. However, in Barth's hands, the principle ultimately subordinates the empirical data, criticism, and human rationality to the given Word in Revelation. If that is the way theology really wants to go, then it must go without the sciences, the spirit of which is summarized poignantly by Paul Tillich: "You may say again.... What I hear from you sounds like ecstasy; and I want to stay sober. It sounds like mystery, and I want to illuminate what is dark" (Tillich 1963, 70).

At first sight, Tillich is more sympathetic to the data, seeing in the facts of the human condition and the questions it implies the fundamental basis for theological discourse. However, he also stresses the independence of theology from the other sciences: "If nothing is an object of theology which does not concern us ultimately, theology is unconcerned about scientific procedures and results and vice versa. Theology has no right and no obligation to prejudice a physical or historical, sociological or psychological, inquiry. And *no result of such an inquiry can be directly productive or disastrous for theology*" (Tillich 1951, 21; emphasis added).

The essence of both these positions, held consistently by two theologians who diverged so widely in other ways, reinforces the opinion that theology is a science as long as it agrees with the other sciences, but when there is conflict, theology is free to establish its own criteria. There is a danger that the cognitive task of theology, which we construe as inherently "public," may be confused with the affective and experiential issues of "faith" which it seeks to understand. It sets a dangerous epistemological precedent for dogmatics to be treated solely as

"Church Dogmatics." Although it is clear that confessional faith may have a logical structure and be culturally potent, a theology in which "revelation" fails to account for and illuminate reality as universally accessible would be formally indistinguishable from astrology. Such a tenuous view of the relationship between theology and the wider pursuit of truth was parodied in Antony Flew's parable of the invisible gardener (Flew 1955, 96-99) and invites a remark made by Imre Lakatos in an unpublished lecture delivered in Birmingham in the 1970s. Speaking of sociologists and their use of the scientific method he observed: "They are like a soccer team. They play the game, lose, and then shout 'but goals don't count.'" If theology can never be wrong, how are we ever to know when it is right? In what sense, if at all, are the claims of theology determined by empirical data? Under what specifiable circumstances would it be prudent to abandon religious faith as fundamentally inconsistent with the facts?

Scientists may be pleased to hear a theologian of Tillich's stature confirm the hard-won autonomy of science in matters of fact. They are less likely to concede the independence of theology from science implied by Tillich without also agreeing among themselves on the implication that theology is about nothing in reality.

The Cultural Impact of the Sciences

Science is not neutral theologically. Its methods make us question the methods of theology, indeed the very basis of human knowing. Writing of the philosophy of logical analysis, Bertrand Russell crystallizes for many what is also the spirit of the scientific endeavor: "[Philosophers] refuse to believe that there is some 'higher' way of knowing, by which we can discover truths hidden from science and the intellect. For this renunciation they have often been rewarded by the discovery that many questions, formerly obscured by the fog of metaphysics, can be answered with precision, and by objective methods which introduce nothing of the philosopher's temperament except the desire to understand" (Russell 1961, 789).

The fact that science has helped us organize the empirical world coherently and generate productive theories leads us to examine theological propositions which, superficially at least, concern the real world. Science has become a matter for "ultimate concern" at least among those who practice it. Whatever pirouettes may be performed upon the head of the theological pin, it remains that scientists function on the assumption that science has dispatched God from the cosmos. In the early nineteenth century Edgar Allan Poe provided an eloquent presentiment of this cultural impact of science in his "Sonnet to Science":

> Science, true daughter of Old Time thou art!
> Who alterest all things with thy peering eyes.
> Why preyest thou thus upon the poet's heart,
> Vulture, whose wings are dull realities? . . .
> Has thou not dragged Diana from her car,
> And driven the Hamadryad from the wood
> To seek a shelter in some happier star?
> (Poe in Gesner 1983, 179)

The biological sciences have probably had the greatest impact on the way we think about reality, rather than simply an effect on the quality of life. This change began over a century ago with the Darwinian revolution, the essential nature of which, according to Richard Lewontin, was "neither the introduction of evolutionism as a world view (since historically this is not the case) nor the emphasis on natural selection as the main motive force in evolution (since empirically that may not be the case), but rather the replacement of a metaphysical view of variation among organisms by a materialistic view" (Lewontin 1974, 4).

Jürgen Moltmann observed, only twenty years ago, that "Darwinism in its day was bitterly contested by the Christian confessions," but the sciences now have become so technical that they no longer have an ideological impact. "Modern genetics," he writes, "whose technical consequences are beyond our range of vision, does not disturb them, because this is a science of such boundless complexity and cannot turn into a speculative opponent" (Moltman 1967, 323-24). The complexity may be apparent, but also increasingly is the possibility that genetics may become a powerful "speculative opponent" as our understanding of the genetic basis of human values and behavior becomes more refined. The great passion generated in the early 1970s by the publication of research on the genetic basis of intelligence suggests that many basic presuppositions about human nature were, correctly or otherwise, threatened by such work. The current discussion about sociobiology suggests that even some exploratory theories have a powerful cultural impact.

Theologians have not always regarded the empirical world as neither "directly productive" nor "disastrous" for theology. Certainly, Augustine was pleased to appeal to empirical data to refute a theological position of which he did not approve: that the positions of the planets significantly determine human destiny. In Book V of the *City of God* he discusses the observation, attributed to Hippocrates, that some twins showed remarkable concordance in the onset, course, and outcome of disease. "Posidonius the Stoic, who was much given to astrology, used to explain the fact by supposing that they had been born and conceived under the same constellation," but "to adduce [this] manifests the greatest arrogance. . . . [W]e know that twins do not only act

differently, and travel to very different places, but that they also suffer from different kinds of sickness. . . ." (Augustine 1983, 85). Augustine's argument, therefore, is that intrapair differences in twins are far more marked than their similarities, but the similarities in their times of birth are much more marked than their differences. Thus, major differences in the destinies of twins cannot be predicted by trifling differences in their times of birth. Had Augustine lived fourteen centuries later he would have benefited from the more devastating arguments of Francis Galton (1883), who used the similarities and differences within pairs of monozygotic and dizygotic twins (not appreciated by Augustine) to argue for the overwhelming impact of biological inheritance on human destiny.

Gregory of Nyssa saw the scientific theories of his day in a much more positive light than that with which they are viewed by many neo-orthodox theologians. In his treatise "On the Making of Man" (Gregory 1954, 387-427), the biological facts, as far as they were then understood, are productive for his theology because they provide the rule by which absurdities can be exposed and the reasonableness of the Christian worldview be promulgated.

Is theology concerned with data or not? Is it scientific or not? the record is inconsistent. Clearly, if theology tries to examine the empirical basis of its subject matter, it takes a significant risk that it will become indistinguishable from anthropology and history. Pannenberg is one of a handful of theologians in the twentieth century who have chosen to take this risk. At the heart of this symposium lies the attempt to decide whether this step is to be viewed as betrayal, courageous folly, or the shape of things to come.

If Pannenberg's position can be vindicated, even in part, the benefits for theology will be astonishing. Firstly, theology will be grounded in a universal understanding of reality—it will be "about something" that matters to everybody. That does not imply that theology will be popular or that "faith" will become more widespread, but theology will be public in the sense that any science is public. Tillich expresses the profound pastoral concern which may motivate such an exercise in apologetic: "We are asking: How do we make the message heard and seen, and then either be rejected or accepted? The question *cannot* be: How do we communicate the Gospel so that others will accept it?" (Tillich 1959, 201). Secondly, theology will have a foundation for being a creative partner and critic of other sciences which have a major impact on life and thought. As a critic of the sciences from within science, theology can thus sustain its prophetic criticism of culture. As a partner, theology may help us reflect creatively and insightfully on the process and content of scientific inquiry—that is, theology might actu-

ally *improve* science! Hans Kung writes optimistically: "Today more than ever—after so many prejudices have been cleared up and so many misunderstandings on both sides removed—such collaboration can be possible and useful. Thus we have no longer mutual hostility, nor—as in recent times—merely a peaceful coexistence, but a meaningful *critical-dialogic cooperation between theology and natural science*" (Kung 1981, 115).

Pannenberg recognizes that theology has to address two related issues in a scientific and secular culture. The first is the methodological issue: Is theology a science? The second is the substantive issue: Is theology necessary? that is, Is theology about anything which cannot adequately be reduced to the study of history, literature and anthropology? The two issues are closely intertwined since the decision about whether theology is a science will affect our judgment about whether theology is "about" anything and vice-versa. His major work, *Theology and the Philosophy of Science* (1976), addresses the methodological issue and the general substantive issue of the content of theology. *Anthropology in Theological Perspective* (1985) addresses the specific issues of how theological constructs may be empirically necessary to give a complete account of the characteristics and quality of human life.

Central to Pannenberg's analysis is his claim that the secular account of the data is "provisional" and that the "data themselves have a theological dimension" (Pannenberg 1985, 19-20). Before attempting to evaluate that claim in the light of biology it is necessary to outline some of the methodological and substantive issues from a scientific perspective. Then we can try to determine how far it is appropriate to recognize a theological dimension to the methods and content of science.

At a methodological level, we recognize that the understanding of science is important to theology in two senses. First, it is significant because it makes theology address its own methodology. What is the status of theological inquiry? But the scientific method is potentially important theologically for anthropological rather than strictly methodological reasons. The radical ignorance from which science begins the search for truth speaks eloquently of the human condition. And the method by which scientific knowledge grows, if properly understood, may provide a model for the more general adaptation to reality which is the basis of human transformation. That is, the scientific method needs to be considered theologically as a paradigm of faith.

At a substantive level, we recognize the theological salience of science in several ways. First, science appears as the critic of theological claims which are based in false or outmoded models for the empirical universe. That is, science has an "atheological" component. Second, if

theology is to maintain a distinct identity among the other humanities and sciences, we have to understand science as the (current) fabric of theory and data against the background of which theology has to stake its claim to speak uniquely and constructively about the empirical world.

Science in Pursuit of the Icon

Science seeks and exploits icons. An *icon* is part of reality which is nodal for understanding reality as a whole. That is, the icon both gives coherence to existing data and opens up new possibilities for inquiry. I choose the term icon in preference to *model* for several reasons. First, scientists use models in two ways. Some regard the model as little more than a convenient description of reality—many of the mathematical models in statistics function in this way. Such models "work" but their advocates do not claim (or necessarily care) that the terms of their model correspond to fundamental features of reality. Such models are at best preliminary. Many if not most scientists, however, want the modeling process to lead to those fundamental features of reality which "explain" that which was hitherto obscure. David Layzer summarizes the two positions as follows: "Theories, according to Mach, do not *explain* phenomena; they merely *describe* them." But "Copernicus, Kepler, Galileo, Huygens, and Newton regarded themselves as the inheritors of the scientific tradition . . . in which mathematical regularities were not . . . abstractions from the surface appearances of things but the very heart of reality" (Layzer 1984, 10-13). The second reason for preferring icon to model (and perhaps also to *paradigm* [Kuhn 1970]) is because, for biologists at least, the fundamental explanatory principles are not merely mathematical but are a unity of model, matter, and event (experiment). That is, the mathematical or structural model is an analogy for the details of a part of tangible reality which is crucial for understanding the whole. It is the focal part of reality, of which the structural details are known and represented in the model, which together form the icon.

Thus, we may use the term icon to denote constitutive elements of reality which are necessary and irreplaceable for understanding the whole of reality. The icon is part of reality which both crystallizes reality as it is currently known and opens up new horizons for the exploration of reality.

It is important to consider in the theological domain, also, why this term might be used in preference to a number of others. Indeed, Ian Ramsey chooses the term model in preference to *image* precisely because the former has been widely used in scientific and philosophical discourse and the latter has psychological overtones. He argues that

the term model "carries with it natural logical overtones and takes us once into a logical context." He further observes that "by contrast with 'model', 'image' seems to me to have too strong a psychological ancestry, and to beg or by-pass too many epistemological and ontological questions" (Ramsey 1966, 76, n. 2). Model is also the term preferred by many contemporary writers on science and religion (for example, Peacocke 1983, 41-50). However, whatever the dangers to logic may be of importing a term which carries with it baggage from the past, perhaps this is to be preferred to using a term with precise overtones which, nevertheless, fail to capture the sense that it is intended to convey. It is not clear to this writer that the term, model, is adequate to encompass all the functions of the double helix in biology or those of Christ in the Christian tradition.

A theologian might naturally suggest that we use the term *symbol* where I have chosen icon, but the notion of symbol lacks the specificity and historicity which is associated with the double helix and Jesus. Although in Tillich's understanding, symbols are part of reality which have the power to open up reality, we need to be much more explicit about exactly which of the many kinds of symbol is to be understood by the term icon. If we pursue the taxonomy of religious symbols given by Tillich himself (for example 1966, 15-34), we see that most of the kinds of symbol show little parallel with the constitutive elements of reality for which we have reserved the term icon. At this point it is worth repeating Albert Einstein's observation (see below) that only one "word" will solve the complex puzzle of reality. There may be many symbols but only one icon which, in some fundamental sense, makes all others redundant and to which all others ultimately lead. As scientists contemplate *their* icons, they hope that they stand not just before models of reality but the constituents of reality itself. In a tantalizing passage towards the end of Tillich's essay we read "undoubtedly, it might well be the highest aim of theology . . . to find the point where . . . the contrast between reality and symbol is suspended" (1966, 33). The same point appears to be grasped intuitively within western medieval and contemporary mystical traditions. Thomas Merton writes: "There exists some point at which I can meet God in a real and experimental contact with His infinite actuality" (Merton 1972, 37). The denouement of this idea in Tillich (1966, 34) is difficult to follow, but he appears to suggest that, at least from an eschatological perspective, there may be a hope of addressing reality itself even in the religious arena. In the icons of science we encounter the possibility that this is already happening for significant parts of human experience. It is tempting to argue that Jesus functions in this way in understanding the empirical content of a faithful life.

Tillich points out that symbols often outlive their power. The good scientific icon, however, has lasting validity because it identifies that part of the material universe which is a key to the whole and embodies the detailed structure of the element in a form which is coherent and productive. It may be transcended and improved, but is not disposable. It is important to recognize the distinction between that which is transient and provisional in the scientific enterprise and that which, though incomplete, is regarded as "true." The recognition that science starts from ignorance and proceeds by "conjecture and refutation" through a series of theories and hypotheses is clearly a central aspect of scientific epistemology. This quality of science is at the heart of one of the questions science puts to theology: "Is theology a science?" Indeed Pannenberg appears to remind the scientist of this fundamental principle: "To this end, the secular description is accepted as simply a *provisional* version of the objective reality" (Pannenberg 1985, 20). But is this really what the scientist hopes for? The "provisional versions" are stepping stones to the heart of reality. Even if a philosopher of Humian rigor were to point out, for example, that the double helical structure of DNA were in some ultimate sense "provisional," molecular geneticists would probably regard the search for a different structure as unproductive in the absence of a good reason to think otherwise. Indeed, the earth may be flat, but the theory does not produce many good experiments and has not produced much insight. Indeed, the world may have been created in six days, but there are few papers in scientific journals which describe experiments based on that theory. As Claude Bernard observed, "Theories in science are not true or false. They are fertile or sterile" (Eysenck 1965). It may be true, as Pannenberg claims, that the secular model is *incomplete* and "needs to be expanded and deepened by showing that the [data themselves show] a theologically relevant dimension," but many of the most thrilling facets of the secular model are so challenging to theology precisely because they have the ring of truth.

The place of the double helix in biology provides a model system for the interaction between model and matter, the icon, in science. Molecular genetics is unlikely to revise the DNA icon because it has played such a crucial part in making biology a "hard" science. There is no doubt that the tangible reality of DNA is crucial for understanding life. It embodies the principal features of living material. But the establishment of DNA as the central icon of biology comes from realizing the detailed structure of that nodal part of reality. Once James Watson and Francis Crick had "got it right" (1953), DNA became the unifying feature which gave coherence to the facts of reproduction, evolution, chromosome behavior, Mendelian inheritance, protein synthesis,

mutational change, and other processes. Furthermore, the icon became the key to new horizons—the details of gene regulation and biotechnology.

The proposed use of the term icon in both the scientific and the religious contexts obviously has its risks because it may lead to the blurring of issues which need to be kept distinct. However, it may provide productive conceptual parallels between theological and scientific constructs which are mutually enhancing. At the very least, it provides a point of contact between the nodal constructs of biology and theology, but more importantly, it provides a more focused insight concerning the religious significance of specific historical and revelatory events. The New Testament use of the term refers not to a constructed representation (model) of reality but to that part of tangible and historical reality, Christ in the Christian tradition, whom Paul describes in Colossians (1:15) as "the eikon of the invisible God." The "model-matter-experiment" union in the double helix has very strong parallels to how revelatory events function in theology. Can the biologist say, even, that DNA is the "incarnation" of all we know about living matter? Does the role of the double helix in biology help the biologist to understand what the theologian is talking about when Christ is described as he on whom the Spirit descended "*in bodily form*" (Luke 3:22), or he "in whom the whole fullness of the godhead dwelt *bodily*" (Col. 2:9; emphasis added)? Finally, we note that icons in science, just as in religion, have the power to create a community devoted to their exploitation; they evoke both aesthetic and cognitive judgments, and they have their "dark" side in that adherence to the icon may be idolatrous and unproductive. In this sense, Ramsey's desire to purge theological terms of their psychological overtones may also purge them of their vital content. Put another way, the use of terms like model in attempting to build bridges between science and religion may be one reason why the end product is often so profoundly boring!

Hope, Expectation, and the Spirituality of Science

There is a story of an English monk on his deathbed. Having received the last rites and preparing to breathe his last, he drew himself up and expired with the words, "And . . . if there's . . . nothing there . . . when I get there . . . some b . . . is going to pay for it." We cannot explore the relationship between science and faith effectively without recognizing that science has its own spirituality which, at first sight, has some parallels and some conflicts with religion. Like the monk in the story, the scientist works within an ascetic tradition. Like the monk in the story, the scientist has expectations about reality which are the mainsprings of scientific commitment.

At the very mention of the word "spirituality," both scientist and theologian find it hard to suppress an audible groan. To both it speaks of pietism and mysticism which submerge public reason beneath a torrent of personal emotion. However, if we are to have a complete understanding and synthesis of science and faith, we have to recognize that the methods and content of science and religion are grounded in a third dimension which undergirds the human dialogue with reality. *Spirituality* is nothing less than that orientation of the human spirit toward reality which motivates, directs, and sustains our encounter with the unknown. It embodies our assumptions about the nature of reality, the state of mind normative for the pursuit of truth, the appreciation of the barriers to knowledge, and the sacrifices with must be made on the journey. The conflict between science and religion, between reason and faith, is as much a conflict of spirituality as it is a conflict of content.

In its attempt to claim "scientific" objectivity, theology eschews on a day-to-day basis any reference to its grounding in spirituality. Scientific papers simply do not begin that way because, in the public imagination, spirituality is associated with that very subjectivity that science has forsworn. Yet the sacrifice of subjectivity, in a broader context, is itself the spirituality of scholarship. The fact that there is no need to make such fundamentals explicit on a daily basis does not mean that there is no such context or that theology has no obligation to make it explicit once again in dialogue with sciences. Indeed, one contribution theology can make to the dialogue is to draw out from the sciences that spirituality which characterizes the scientific community.

Some of the great theologians of the past have made this context explicit in their writing. It is tempting, but probably mistaken, to see this as a devotional gloss on writing that would otherwise stand alone philosophically. One of the clearest exponents of the spiritual context of theology is Anselm of Aosta. His well-known *Proslogion* only begins to make sense as "argument" in the context in which the author himself has set it. *Inter alia*, we note that the preface contains a statement of his urge to find a better (more economical) argument which "if it were written down, would give pleasure to any who might read it" (1973, 238). He describes his attempt to strip away all except that which is directly relevant to his pursuit of truth, his sense that there are barriers to his understanding in the form of the greatness of the object of his investigation and the limitations imposed by the ("sinful") human condition (1973, lines 27-49). The dialogue between the investigator and reality is expressed in this cultural context in the form of prayer. Anselm approaches reality as if it were best treated as a "nurturing Thou." He sees the resolution of his question as just as much "given" by reality itself—the product of "grace"—as it is wrenched from the reluc-

tant clutches of reality by the relentless assault of the human intellect (see, for example, 1973, lines 158, 227-30). The preamble issues in his famous "credo ut intelligam" which, at first sight, seems like the abrogation of objectivity and the first step on the wide road to self-deception. But from another perspective Anselm raises the important question, "What is it necessary to believe in order that we may understand?" Augustine, an earlier great exponent of the dialogue as a basis for theological discourse, has a similar credo: "I have sought Thee, and have desired to see with my understanding what I believed" (Augustine 1983, 227). His chapters on time in the *Confessions* (1983, 163-75) embody many of the same presuppositions about the nature of reality and how best it is to be explored.

Einstein writes of the affective element in scientific motivation: "I maintain that cosmic religious feeling is the strongest and noblest incitement to scientific research. Only those who realize the immense efforts and, above all, the devotion which pioneer work in theoretical science demands, can grasp the strength of the emotion out of which alone such work, remote as it is from the immediate realities of life, can issue.... You will hardly find one among the profounder sort of scientific minds without a peculiar religious feeling of his own." We also note that Einstein sees this element as most highly developed in the "pure" sciences and as something that few truly appreciate: "Those whose acquaintance with scientific research is derived chiefly from its practical results easily develop a completely false notion of the mentality of the men who, surrounded by a skeptical world, have shown the way to those like-minded with themselves, scattered through the earth and the centuries. Only one who has devoted his life to similar ends can have a vivid realization of what has inspired these men and given them the strength to remain true to their purpose in spite of countless failures" (Einstein 1979, 28).

Einstein hints here at an ascetic tradition of science which has its roots in religion and philosophy. The Platonic Socrates in *Phaedo* observes: "Every seeker after wisdom knows that up to the time philosophy takes it over his soul is a helpless prisoner, chained hand and foot in the body, compelled to view reality not directly but only through its prison bars, and wallowing in utter ignorance.... [Philosophy] points out that observation by means of the senses is entirely deceptive, and she urges the soul to refrain from using them unless it is necessary to do so" (Plato 1974, 135-36). Socrates requires the asceticism of the senses so that the philosopher can better ponder reality in itself. The senses are a distraction from the process of knowing. Einstein (1979) expresses almost the identical statement: "He looks upon individual existence as a sort of prison and wants to experience the universe as a

single significant whole." The scientist today practices a "reverse asceticism" close in spirit to that described by Russell (1961, 789) when he writes of the rewards of *renouncing* the "higher way of knowing." The insistence on "data" and "experiment," the implied determinism of science, are part of the sacrifice which the scientist makes in order to know fundamental truths about the universe. To suggest that the scientist should do something different, or to suggest another way of knowing, is to invite the monk to break his vow of chastity.

The inherent asceticism in science is the price of its rewards. It is accepted because of expectations most scientists share about the structure of reality. Whatever the origin of these expectations, they are real and powerful. Unless they are appreciated, our ability to relate science to faith will be incomplete. There are three features of the scientist's expectations about the world and his or her reasons for trying to understand it. They are, in part, the motivation of the scientific endeavor.

First, rightly or wrongly, scientists believe they are engaged in exposing *reality itself*. Scientists probably do not believe they are playing games with models. They are playing "for keeps," with truth as the prize. However much the reverse may be argued on rational grounds, scientists certainly behave "as if" they take their fundamental findings with ultimate seriousness. Science would lose its appeal *and most, if not all, of its adaptive significance* if we were merely drawing beautiful pictures. There would be nothing to choose between a picture of a unicorn and a picture of the double helix. Einstein articulates the experiential support which the history of science imparts to an approach which treats the *phenomena* as if they reflect an objective and external reality which demands our adaptation. Contrasting the creative freedom of the novelist with that of the scientist, he writes: "[The scientist] may, it is true, propose any word as the solution; but there is only *one* word which really solves the puzzle in all its forms. It is an outcome of faith that nature—as she is perceptible to our five senses—takes the character of such a well-formulated puzzle. The successes reaped up to now by science do, it is true, give a certain encouragement for this faith" (Einstein 1956, 64).

The second implicit expectation which undergirds most scientific activity is the expectation of simplicity, often given operational expression in the principle of parsimony or "Occam's Razor." The most informative theories are those which encompass the greatest range of data with the smallest number of parameters. In statistical modeling this principle is actually given numerical formulation in such coefficients as "Aikake's Information Criterion" (Aikake 1970)—a coefficient which judges the value of a model as an increasing function of

how well it fits the data and a decreasing function of the number of principles in the model. Gottfried von Leibniz expressed this expectation most cogently: "Thus we may say that in whatever manner God might have created the world, it would always have been regular and in a certain order. God, however, has chosen the most perfect that is to say the one which *is at the same time simplest in hypotheses and the richest in phenomena*" (Leibniz 1960, 255). Einstein expresses the same principle in less directly theological terms. "The aim of science is, on the one hand, a comprehension, as *complete* as possible, of the connection between the sense experiences in their totality, and, on the other hand, the accomplishment of this aim *by the use of a minimum of primary concepts and relations*" (Einstein 1956, 63).

Layzer points out that the principle of parsimony is related to, but not necessarily identical with, the principle of "overdetermination," which reflects the scope of data encompassed by a theory. "Overdetermination has a qualitative as well as a quantitative aspect, and the qualitative aspect is more important. Newton's theory is strongly overdetermined not only because it furnishes very accurate predictions of planetary motions but also because it explains, at no extra cost, a host of qualitatively different phenomena" (Layzer 1984, 19). It is this strong appreciation of the importance of overdetermination in the best scientific theories which probably lies behind Lakatos's crucial understanding of the difference between "progress" and "degeneration" in science (for example, Urbach 1974). A "progressive" theory grows by predicting and explaining an ever-widening range of quantitatively and qualitatively different phenomena at little cost in terms of increasing complexity. A "degenerating" theory perishes by the successive accretion of new principles to account for novel and anomalous observations.

Lastly, but not least controversial, is the aesthetic principle. There may be a "logic of scientific discovery" locally, but in a more global fashion the scientist's sense of what is "ugly" keeps alive the quest for a better solution. The sense of what is "beautiful" plays a significant part in deciding when the truth is at hand. A sense of what is "elegant" determines the degree of enthusiasm for a new scientific strategy. The passion for simplicity and the appreciation of beauty are closely allied in scientific spirituality. Perhaps the clearest statement of a scientist's aesthetic sense is found in Watson's own preface to *The Double Helix*, in which he describes "the spirit of an adventure characterized both by youthful arrogance and by the belief that the truth, once found, would be simple as well as pretty" (Watson 1969, ix). We can argue whether the aesthetic principle in science is innate to the scientist or reinforced by applause at the past success of logic and ingenuity. However, we can scarcely deny the power of the aesthetic principle in motivating the

continued search for improvement in an unsatisfactory theory and in our recognition that we have accomplished our scientific goal. Writing about the motivational power of the search for unity and simplicity, Einstein observes: "We do not know whether or not this ambition will ever result in a definite system. If one is asked for his opinion, he is inclined to answer no. While wrestling with the problems, however, one will never give up the hope that this greatest of all aims can really be attained to a very high degree (Einstein 1956, 63-64).

The Shape of Exploration

Others are more qualified than I to perform a detailed analysis of the scientific method. However, any understanding of the relationship between theology and science has to begin with an appreciation of the stages of science. It is, for example, essential in appraising Pannenberg's position to know whereabouts he is in the scientific cycle. Depending on which part of his work is considered, we may get a different answer. To a first approximation, we can identify three main stages of any scientific endeavor. These are the taxonomic phase, the hypothetico-deductive cycle, and the paradigmatic, technological phase. The structure of science is similar to a fractal—a graph which, under successive orders of magnification, resolves into ever smaller components which have that form which is also apparent at a higher level. When we look closely at a scientific enterprise we will find eddies within the overall swirl which have essentially the same components.

The taxonomic phase is regarded by many as "pre-science." Typically, taxonomy is looked down upon by "real" scientists. Biologists, for example, tend to see anthropologists as only engaged in taxonomy. The taxonomic phase has two principal facets: description of reality (phenomenology) and classification of that which is described. It is the phase of deciding what needs to be explained, identifying those contours of reality which demand our special attention, setting the subject-matter of a discipline.

The hypothetico-deductive cycle grows out of taxonomy and consists of "science in earnest." It is this phase which has commanded the most serious attention of philosophers of science because it is usually seen as that aspect of science which appears most of all to set it apart from the humanities, including theology. This is the cycle which we may characterize as "theory and experiment" or "conjecture and refutation." The hypothetico-deductive cycle tries to account for the significant contours of reality in terms of fundamental mechanisms. It is the search for how things "are." If the contours are properly drawn in the first place, the mechanisms may emerge more readily. Badly drawn con-

tours (that is, poor taxonomy) may add only more noise to an already confusing picture. The most effective taxonomy is guided by theoretical principles, as the history of evolutionary taxonomy testifies.

Finally, when mechanisms are understood, science enters the paradigmatic or technological phase. It is the phase of exploitation. More examples are accumulated, details are worked out, implications are drawn. At any time, the alert and prepared mind may encounter a new puzzle which engages its attention and demands new theoretical and experimental treatment.

If this brief analysis reflects the experience of science at all accurately, then we have to ask Professor Pannenberg where his ideas fit in. Do they belong to the taxonomic phase? Is he offering theoretical constructs? Or some kind of strategy for experimentation? My sense is that he is suspended somewhere between taxonomy and theory. But there are occasional hints of experiment. In *Human Nature, Election and History* (1977) he develops the challenging thesis that we cannot understand history in purely political or economic terms. That is, the current contours are wrongly drawn so that the theories predicated upon them cannot predict all the empirical data. He thus argues that the contours may be drawn better if we recognize the empirical necessity of theological constructs. Coming to Pannenberg as a scientist who had read Barth and Tillich, I found it both startling and exciting that a theologian was laying claim to the empirical world in objective as well as existential terms. He writes: "As long as the basis of historical reality is seen in political and economic structures, religious belief can be treated as a secondary, if somewhat strange expression of those supposedly more basic social structures. . . . But if religion itself is taken seriously as basic for the social system, . . . historical continuity (or discontinuity) must then be understood finally in religious terms." He then continues to clarify that this does not require treating religion in supernatural terms, as historians suspect. Rather, "theological language need not represent an authoritarian or speculative imposition upon historical reality as critically established. Theological language can function in a descriptive way, open to examination and revision" (Pannenberg 1977, 86-88). In Pannenberg's mind, theology has clearly entered the public domain—a thesis which is underscored time and again in *Theology and the Philosophy of Science* (1976) and which, indeed, is the motivation of his work.

Biology and the Necessity of Faith

Theologians who try to lay claim to science have a problem because the content of science is continually shifting. Any science is a complex blend of that which is icon, fertile theory, and outmoded hypothesis.

The life sciences are no exception. The double helix is icon; sociobiology is fertile theory; blending inheritance is outmoded. To what should the theologian turn for his science? Should it be the established icons or the fertile theory? Often it is to the simply outmoded. A biologist such as myself, who has devoted much of his professional career to the analysis of genetic and environmental influences on human behavior, experiences frustration in reading Pannenberg's *Anthropology in Theological Perspective*. The work begins, like so much of Pannenberg, in the empirical world: "Modern anthropology no longer [defines] the uniqueness of humanity explicitly in terms of God; rather it defines this uniqueness through reflection on the place of humanity in nature and specifically through a comparison of human existence with that of the higher animals" (Pannenberg 1985, 27). But how "modern" is the anthropology in Pannenberg? Does it address scientific anthropology where it "hurts" most or is it merely an eclectic aggregation of those anthropological ideas which are most convenient for theology? Ideas which play such a crucial part in Pannenberg's anthropology, such as those of Freud and Piaget, belong much more with the humanities than the sciences. At best, they belong to the history of science, to the taxonomic phase along with those early attempts to define the contours of reality which now only live on in the popular imagination and not in the corridors of science. At worst they are destructive distractions which, in the hands of a theologian, bind theology to a worldview which has the same emotional impact on the scientist as a claim to find the empirical base of theology in the findings of psychical research.

To some extent, this eclectic tendency to prefer the "soft" end of the life sciences is rooted in Pannenberg's philosophy of science (*Wissenschaft*) which disavows the paradigms of the natural sciences in favor of an idiographic search for meaning and coherence. There are two ways of viewing this preference. On the one hand, Pannenberg's approach expands and challenges the natural sciences to examine some broader aspects of their data and methods (the "theological dimension," perhaps?). On the other hand, it presents a premature dichotomy between scientific and humanistic epistemology. It softens the challenge to theology from the scientific method by stating, in effect, that the scientific method, as it is embodied in the natural sciences, is not appropriate to theology. The expectation and hope of the sciences is different from this. The scientist is motivated, perhaps with the "arrogance of youth," by a sense that many more aspects of reality could be explored scientifically than are currently realized, if only we had a better understanding of what science was and how better to draw the contours of reality. Pannenberg, it might be argued, has sold out to the humanities. Fortunately, the question is still alive. Philip

Hefner (1988) and Nancey Murphy (1988), for example, have recently attempted to analyze the structure of theological theory from the standpoint of Lakatos's philosophy of science. The point is, that even if theology can show its methods to be consistent with those in the humanities, it will still not be able to lay claim to the hard sciences unless it either shows a further methodological connection to them or convinces the scientist that the data require a layer of analysis which demands another approach.

Where does theology go for its science? It is a common misconception, even among scientists, that science is about looking for the "evidence *for*" something. But science thrives not on asking what is right about a theory but on asking what is wrong with it. Pannenberg has embraced the data in principle, but has not yet embraced it where it hurts most. He accepts as "science" many propositions that are under very hard scientific scrutiny at the moment. We may cite but two examples. First, he deals in universals and seeks that which is characteristic of the species but which delineates *Homo sapiens* from our nearest neighbors in the phylogenetic tree. Second, he regards the most salient features of the species as cultural rather than genetic. The stress on universals is unsatisfactory for two seemingly contradictory reasons. First, the differences between humanity and the other primates can be measured on a variety of scales. On the genetic scale of average differences in DNA, the differences are slight. What the anthropologist sees as the very foundation of the discipline, the biologist sees through a more distant glass and the physicist from still further away. I recall an astronomer remarking that molecular biology was really "rather boring" because it dealt with such a small part of reality. The molecular geneticist feels much the same about anthropology. The other problem with universals is that they are not. Judith Plaskow (1980), for example, has drawn our attention to sex differences in the construction and interpretation of theological themes. The same problem emerges, and has to be taken with equal seriousness, at a level which is even more fundamental. When biologists stand very close to a species, and humanity is no exception, they are struck by diversity. That is, although humans are isomorphic for upwards of 99 percent of their DNA, the remaining 1 percent which is polymorphic (that is, "variable") creates a lot of interest, texture, and excitement for the biologist. Some of these implications are fundamental for an empirical theology, and Pannenberg has skirted around these in an anthropology which is focused on universals. These implications need to be explored briefly.

The genetic diversity of the human species gives the scientist a lever on why we are the way we are. Professor Pannenberg, accepting the a

prioris of cultural anthropology, dismisses sociobiology in half a page (1985, 160), and assuming that there is no other acceptable biological paradigm, leaves a predominantly "cultural" model of the human species as the dominant theme of his anthropology. This thesis needs to be examined and may be questioned in the light of extensive published investigations of human behavior. Those classical dimensions of human behavior—cognition, affect, and sociality—which play such a significant part in theological reflection on anthropology, do not have a life independent of biology. The ability to think, feel, and socialize shows great diversity among members of the species. Where scientists have taken the trouble to look (see, for example, Eaves, Eysenck, and Martin 1989) the dominant causal theme is as much genetic as cultural. A theology which lays claim to science, therefore, has to be prepared for the truth to be different from what it would like. The point is that there is, within a human population, diversity even in the sensitivity of moral judgment and belief in God. It is commonplace to identify the source of such variation with the influence of training (in a behaviorist paradigm) or "sinful bloody-mindedness" in a conservative theological paradigm. However, as Martin and his associates (1986) have shown, the discussion of such differences cannot be isolated from a discussion of the way in which genetic differences operate in human development. Some people appear to be genetically predisposed to adopt "more religious" or "more moral" values than others by the standards of the present culture. So diversity of theological perceptions is not just a problem for the sexes, it is a fundamental problem at the individual level.

There are various possible responses to such data which were exemplified in the discussion of the role of genetic differences in intelligence in the 1970s. Arthur Jensen (1972) documents the political reaction which followed the publication of his article in the *Harvard Educational Review* in 1969. Peter Urbach (1974) provided a scholarly review of the empirical literature as it was seen through the eyes of a philosopher of science. Such controversy presents a real problem for theological anthropology. If the issue can ever be resolved it may make a fundamental difference to the direction that anthropology takes. The scientific facts and theories are not neutral theologically. At the very least, the biological data suggest that the diversity in sensitivity of people to the language of preaching and the symbols of liturgy has to be taken more seriously than has sometimes been the case. Theological language about "election" and "hardness of heart" needs to be re-examined. Pannenberg (for example, 1977) considers the role of the church in history from an eschatological and symbolic perspective which does not require the religious confession of everyone in society.

Second, we may need to re-examine the notion of "sin" in the light of our biological heritage. Perhaps our current range of adaptive social responses reflects where we have come from biologically and is still "out of step" with the norms proclaimed in the Judeo-Christian tradition. This gap between givens of our biological ancestry and our cultural present may be part of the reality that is known theologically as "original" sin.

Are there biological realities which profitably can be handled with theological constructs? Or, at least, can we identify those biological realities which were once the raw material of theological construction? Are there biological realities which are inconsistent with theological constructs past or present? Are there empirical realities which are ignored by biology and history that only theology can cope with? Is there, in Pannenberg's terms, a theological dimension to the data? There may be a perceived danger that we are about to embark on a search for the God of the gaps. In one sense, this may be true. But we are not seeking those gaps in reality which still need an explanation (as DNA gives an explanation of inheritance) so much as those phenomena in the midst of reality to which the language of religion refers and to which religion is the attempt to adapt.

It takes little reflection to see that the icon of the double helix may function theologically as well as scientifically. In the category of biological realities which may provide the raw material for theological construction we may cite three: namely, *givenness*, *connectedness*, and *openness*. To a greater or lesser extent, the DNA encodes part of the moral and spiritual history of our race. At the very *least* it encodes those capacities to acquire and create culture and to behave socially. The affective responses to data in the form of loves and fears are not easily amenable to cognitive processes precisely because they are given by our ontogency and phylogeny. They emerge, as far as our experience is concerned, from our origins; they predate our individual consciousness of the world. Indeed, the "data" on which such responses were based are long since gone and may even have changed. The distinction between cognition and affect as mechanisms of adaptation is probably fundamental and is recognized implicitly by Theissen in his distinction between science and faith. Science is primarily cognitive and is concerned with our colonization of the novel realities that continually demand our individual and corporate attention. It is fundamentally exploratory and experimental. Scientific risk—the process of conjecture and refutation—is the adaptive response to new territory. Faith is also an adaptive response but is primarily affective. It mediates between our evolutionary past and our future. It deals with those adaptive affective responses which form part of that "collective uncon-

scious" which is now better regarded as the molecular image of the lessons of our evolutionary past. Such may be our aesthetic response to sunrise, our sexual response to spring, or the narrow scope of our practical altruism. Using such responses is based on the assumption that our future will have something in common with our past. In theory, this notion is testable empirically because our evolutionary past leaves its marks upon the way genes work (for example, Mather 1966).

The concept of givenness is one to which theology has long laid claim and biology serves merely to underline. Friedrich Schleiermacher's recognition of *absolute dependence* as a fundamental theological construct is a development of a theme which can follow two paths. These appear to be the two paths described by Anselm. In the preface to *Proslogion* he comments on an earlier work: "When I reflected that this consisted in a connected chain of many arguments, I began to ask myself if it would be possible to find one single argument"; he then describes the oblique and elusive quality of his famous ontological argument (Anselm 1973, 238). What is it, in reality, that lies behind the empirical fact that people have an idea of God? We can trace the network of givenness to nameable and describable levels, each of which is empirically necessary to account for the other. Who I am today is the product of my ontogeny and my education. These in turn are given with my history and my phylogeny, etc. And at the highest level, there "has to be" that which is ultimately "given," which encompasses and enables the totality of givenness—"This being is yourself, our Lord and God." In his commentary on Anselm's ontological argument, Barth observes that "what is meant is . . . not the *existere* of objects . . . but the *existere* of Truth itself which is the condition, the basis and indeed the fashioner of all other existence, the simple origin of all objectivity. . ." (Barth 1960, 98). The evolutionary biologist is tempted to speculate that the very constructs with which we approach reality bear the marks of our biological history much as the eye and nervous system of the frog respond most readily to those stimuli which demand its most urgent adaptation. Irenaeus, in responding to the gnostic chain of creation which places the "real God" far from creation, affirms the intimate connection between the reality of God and the creation: " 'And God formed man, taking the clay of the earth, and breathed into his face the breath of life.' It was not angels, therefore, who made us, nor who formed us, nor anyone else, nor any power remotely distant from the Father of all things" (Irenaeus 1985, 487). Theological construction is not necessitated only at the end of some causal chain, or chain of being, but becomes necessary by the very "fact" of givenness—being itself. "It is he who has made us," sings the psalmist, "and not we ourselves" (Ps. 100:3). Following Burhoe, it doesn't matter whether we call it God or natural selection, it is that to which we must bow our heads and adapt.

The connectedness of reality receives its biological focus in the theory of evolution and the molecular basis of life. Our DNA provides the stable identity of the individual through the successive rounds of growth and metabolism; it is the fragile thread of immortality between ourselves and our remotest ancestors; it is the link of kinship between ourselves and the rest of the living world. Gregory of Nyssa observes: "For neither does our being consist altogether in flux and change . . . but according to the more accurate statement some one of our constituent parts is stationary while the rest goes through a process of alteration. . . . But to our soul which is in the likeness of God, it is not that which is subject to flux and change by way of alteration but this stable and unalterable element in our composition is allied" (Gregory 1954, 418).

The immortality of the living world is quite different from that which is presumed in popular Christian religious belief. Whilst none can presume the arrogance of certainty, few biologists would build any personal hopes on their own conscious survival. "You are dust and you shall return to dust" (Gen. 3:19) speaks with renewed power to the biologist for whom consciousness emerges from DNA and is so intimately bound with the organized configuration of matter that characterizes rational life. Rosemary Ruether is one of few theologians to have dealt explicitly and openly with the biological reality of death: "What we know is that death is the cessation of the life process that holds our organism together. Consciousness ceases and the organism itself gradually disintegrates. . . . There is no reason to think of the two as separable, in the sense that one can exist without the other." In a remarkable passage, Ruether uses the connectedness of reality as the foundation for eschatological hope: "What then has happened to 'me'? In effect our existence ceases . . . and dissolves back into the cosmic matrix of matter/energy, from which new centers of the individuation arise. It is this matrix . . . that is 'everlasting' " (Ruether 1983, 257). The emergence of belief in personal immortality is a curiosity of biological and cultural evolution. Is it simply an outmoded model, a primitive solution to the cognitive puzzle of life and death? If this be the case, then why does such a large number of otherwise "rational" people cling to a belief in their personal survival beyond death? To what can such a persistent belief be attributed? Is it an emotional "confidence trick" played by evolution to encourage self-sacrifice? If this is the case, we might expect concern for immortality to decline with advancing years since the evolutionary pressure for sacrifice is likely to be greatest in the reproductive years. Ruether argues on dubious clinical grounds (1983, 235) that the concern for immortality is predominantly male rather than female. Does this imply that making war develops a stronger

belief in immortality than producing the next generation? Such observations run counter to the consensus that women are "more religious" than men. In our own studies we found that men tended to agree more than women with the statement, "There is no survival of any kind after death" (Eaves, Eysenck, and Martin 1989). Theodicy may also be a cultural expression of a more basic adaptation. Theodicy flourishes in religion in spite of all the evidence to the contrary. Evil is the greatest empirical test of the homeliness of reality. Cognition and affect are in conflict, and affect wins. Indeed, we may argue that it "has to win" for the species to continue. Is our "unreasonableness" in such matters supported by our biological heritage? Such a view seems to be implicit in Theissen's careful distinction between the adaptive roles of science and faith (1985, 18-41).

The phenomenon of connectedness corresponds to a sense of connectedness which is highly differentiated in some individuals. Francis of Assisi is a model example. It is clear that there are enormous differences in this sense, reflected in variation between individuals who are "ecologically conscious" and those who are not. Like most other human differences, these probably are partly genetic but no one has yet looked. E. O. Wilson gives a personal account of this sense, and a characteristic evolutionary hypothesis to explain it, in his recent work *Biophilia* (1987).

The openness of reality has perhaps been one of the constructs in which biology offers the most serious challenge to theology, yet that which has in many respects proved most liberating. The principles of evolutionary biology account for the "that" of life; they do not account for the "what" of life. That is, they provide a mechanism to account for the facts of diversity, change, and connectedness; but for the most part they do not account for *which* particular solution to a particular problem evolution adopted. Hence, for example, primates and cephalopods have exceptional eyes, but these are not homologous structures, having been evolved as independent solutions to similar adaptive requirements. The role of chance and uncertainty in evolution has made biologists shy of "teleological" explanations. Probably the greatest problem that biologists have with their colleague Teilhard de Chardin is not his poetry, mysticism, or spirituality, but the overwhelming sense that he knew how things were going to end. Karl Schmitz-Moormann (personal communication), however, has drawn attention to the fact that the *Future of Man* (Teilhard 1964) presented a number of "options" for the future which were contingent for their fulfillment on free human choice. The practice of science requires that we forgo such certainty. Scientists can hope, but they cannot be sure of "what will be hereafter." Popper (1961) argues the same case passion-

ately in *The Poverty of Historicism*. This open aspect of biological reality has been addressed recently by Theissen. In a passage which could easily have been written by a biologist, he writes: "The great progress in the modern theory of evolution lies precisely in the fact that it explains as an interplay of chance and necessity what was earlier interpreted teleologically by analogy with purposeful action.... In the present state of our knowledge we are compelled to assert that it is meaningless to smuggle teleological thought into the theory of evolution. Evolution is open. No one can guarantee that it will lead to a differentiated and higher form of life" (Theissen 1985, 164). Recently, Richard Dawkins has given a cogent and detailed new treatment of the role of chance in producing complex evolutionary outcomes in his book *The Blind Watchmaker* (1986).

In the face of openness, Theissen seems to suggest two theological positions. The first is the "but" and power of faith which challenges and transcends the tyranny of facts. The second is the affirmation that "something will turn up" because in the past "something has turned up"—in the origin of life in the first place, or in the coming of Jesus in another. That is, the past gives us the basis for trusting the future. We cannot have certainty in the future but we have some power over it and new adaptive cultural "mutations" have a good chance of occurring. It is perhaps churlish to point out that the new and successful mutations may be in the direction of atheistic materialism.

As a tangible focus of the dimensions of givenness, connectedness, and openness in the natural world, the double helix provides a universal foundation to some of the ideas expressed in contemporary theology about the relationship between nature and spirit. At a recent seminar, a woman graduate student in biochemistry, speaking to theologians about the double helix, observed that the double helix "spoke of life, hope, and change." In her critique of Reinhold Niebuhr's theology, Judith Plaskow (1980, 70) isolates elements of women's experience which she regards as especially critical for theology. She observes that the experience of pregnancy carries with it the awareness of connectedness with nature and the sense that a woman is especially conscious of her dependence on reality as it is given to her. The experience of motherhood provides the foundation for an experience of creativity. In many respects, Plaskow reinstates here the *theotokos* icon—the classical post-Nicene image which expresses the notion of nature as the benign bearer of spirit (*vas spirituale*), nurturer of humanity (*auxilium Christianorum*), and gateway to the new age (*janua caeli*; see Solesmes 1962, 1857). Powerful though these images are, they nevertheless remain species- and sex-specific. The DNA icon provides a contemporary historical and physical basis for speaking about these realities which transcends the specificity of sex and species.

Biology and Bible: Theological Correlates of Biological Realities

Does biology remove the need for theology, or does it underscore a need for theology? If there is a need, does it come from the data or is it merely a return to some obscure mystical sense? I suggest tentatively that theology might feed on biology, and suggest that some of Pannenberg's ideas may help that process. The clue to where to start is found in Pannenberg's claims about the potential role of theology in history (1977). It is not that *supernatural* processes are required to understand history but that economic and political constructs do not represent adequately the contours of the reality of history. Economic and political theories alone are not dealing with the empirical data at a level which gives anything more than local insight into the mechanisms of historical change. The data cannot be understood without knowledge of the meaning and cultural impact of such religious constructs as *election*, *covenant*, and *judgment*.

How do humans *cope* with the biological and historical realities of givenness, connectedness, and openness? How does reflective and conscious matter respond to the fruits of its search for biological truth? Is it to search for more biological truth? Where will this lead? I hope that one day we shall have a more thorough understanding of the biological basis of human behavior. Perhaps some of the current models of sociobiology may one day have the status of icons. But we shall still be left with the facts of our givenness, connectedness, and openness. These are constructs which describe the way things are; they are realities to which we have to adjust.

The brute facts of givenness, connectedness, and openness address us from our phylogeny, our history, and our individual ontogeny. What are we to do with them so that we are not consumed or intimidated by them? What is our place in this reality? The biblical tradition suggests a number of serious proposals to describe our place in the matrix of reality and to provide the foundation for meeting and developing that reality. Three related concepts which seem to be closest to the heart of the problem are *promise*, *covenant*, and *sacrifice*.

Promise provides the context of security and hope which enables humanity to address the openness of reality in confidence. The promise to Noah that "While the earth remains, seedtime and harvest, cold and heat, summer and winter, day and night shall not cease" (Gen. 8:22) provides both a context and a security for addressing the future. The context, "While earth remains," confines hope to that which concerns us most intimately; it does not pretend concern beyond the confines of the earth in which all human life and history is to be lived. If it is a geocentric hope, it is also a realistic and tangible hope.

The promise to Noah is not concerned with entropy and, indeed, implicitly admits the possibility that one day "the earth might not be." The promise to Abram (Gen. 12:2-9) and the subsequent development of the Patriarchal history enshrines the continuity of human life and the preconditions for history. Promise deals with the given assurances that reality provides.

Covenant draws humanity into the promise, as an agent whose life has implications for the future of the promise. The covenant at Sinai represents a point in human history at which was made the formal connection between promise and law, that is, it draws the necessary connection between the gift of the land—the fulfillment of promise—and the recognition of the just claims of God and neighbor: "Hear therefore, O Israel, and be careful to do them; that it may go well with you, and that you may multiply greatly, as the Lord, the God of your fathers, has promised you, in a land flowing with milk and honey" (Deut. 6:3). Covenant embodies the connectedness of reality and human destiny.

Sacrifice is the human price of promise and covenant. It represents the most intimate connection between humanity and the future. It is the "price" of confidence that the openness of the future can be anticipated with hope rather than despair. It is the human choice which "opens up" the future and extends the possibilities for life. The New Covenant tradition—symbolically portrayed in the last supper and given historical focus in the icon of the living and dying of Jesus—forges an indissoluble cultural link between transition to an age of harmony and fulfillment and the willing self-offering of crucial individuals. In theological terms, such individuals are particular embodiments of the "Spirit" of God.

Pannenberg and Theissen both identify *spirit* as a central construct for understanding human life and history but each seems to emphasize a different component in the concept which can only be held together with the greatest of difficulty. These are the notion of spirit as that which recognizes and accomplishes our harmony with the realities of nature and the notion of spirit as that which drives humanity up and beyond the historical and phylogenetic confines of nature.

Towards the end of *Anthropology*, Pannenberg calls for revision of the traditional concept of spirit. It is not, as past dualism had asserted, a quality independent of matter. It is not consciousness, presumably since consciousness, unlike DNA and culture, is transient and ends with the decay of the central nervous system. It is not "life," because we do not need any special word or principle for life. Pannenberg writes: "The concept 'spirit' as I intend it here . . . is . . . that which alone makes possible both consciousness and subjectivity (in the sense of the unity of

conscious life) and that, at the same time, makes possible the unity of social and cultural life as well as the continuity [connectedness?] of history amid the open-endedness [sic] and incompleteness of its processes." In the next paragraph he then argues: "Common to all these phenomena is the operative presence of a sphere of meaning that *precedes individuals* and both constitutes and transcends their concrete existence. This sphere of meaning *discloses itself* to lived human experience. . . . Human beings even contribute to forming it, but *they do not first bring it into being as such*" (Pannenberg 1985, 520, my emphasis). For Pannenberg, spirit is an empirically necessary construct which describes a significant contour of reality as publicly accessible. Hans Kung has the elements of a similar view: "As the philosopher and the theologian in practice live every day by the 'functioning' of mathematics and the natural sciences, so that mathematician and scientist live in practice—admittedly in a very different way—by the reality that makes possible and sustains the world of their phenomena" (Kung 1981, 115). This reality is not simply that "divine rationality" which is outside reality but necessary to explain a lawful universe. Rather it is the fact of reality itself—the very fact that science has to speak of and deal with data—the things that are given. Spirit is the name which embraces both the empirical phenomena of givenness, connectedness, and openness and the process which makes it possible to adapt to and live at peace with the fact that we are not self-generated, independent, or sure of our destiny.

But such a spirit is not simply the spirit of passive acceptance, because it is also the process of faith which is able to deny and transcend the tyranny of fact in the present. "To this degree," says Theissen, "the experience of the Holy Spirit is a specifically human experience. It brings human beings into conflict with the biological, cultural and cognitive systems in which they live" (Theissen 1985, 166). It is that which makes us deny the reasoned arguments of sociobiology, not intellectually as a coherent account of the phylogeny of the now, but existentially as a pattern to shape the future. It is that which gives humans the quality of "standing up"—*anastasis*—from the matrix of givenness and connectedness and engenders the hope that the future will transcend the past.

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The Bertrand Russell Society announces a call for papers to be presented at its meeting with the Eastern Division of the American Philosophical Association in December 1990. Papers may be on any aspect of Russell's philosophy. They should have a reading time of about one-half hour and should be submitted in triplicate, typed and double spaced with an abstract of not more than 150 words. The name of the author, with address and the title of the paper, should be submitted on a separate page. The submission deadline is April 2, 1990. Papers should be sent to David E. Johnson, Chairman, Philosophers' Committee, The Bertrand Russell Society, Sampson Hall, U.S. Naval Academy, Annapolis, Maryland 21402-5044. Those desiring the return of their papers should enclose a stamped, self-addressed envelope.