PERSPECTIVES on Science and Christian Faith

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In this issue . . .

"The fear of the Lord is the beginning of Wisdom."
Psalm 111:10

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4. All manuscripts should be typed double-spaced on good quality $8\frac{1}{2} \times 11$ paper.
5. References should be collected at the end.
6. Figures or diagrams should be clear, black and white, line ink drawings or glossy photographs suitable for direct reproduction. Captions should be provided separately.

REGULAR PAPERS are major treatments of a particular subject relating science and the Christian position. Such papers should be at least 10 manuscript pages in length *but not more than 20 pages.* Publication for such papers should normally take 12 to 18 months from the time of acceptance.

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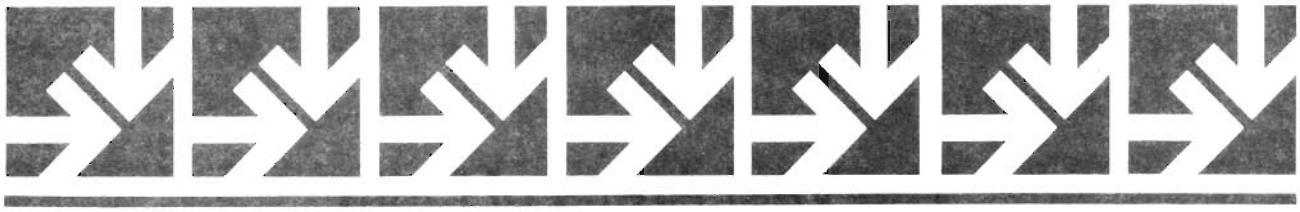

Putting Things in Perspective

As we grapple with the issues of science and faith we often long for simple, black-and-white answers to questions that are really beyond the comprehension of our finite human minds. For some who think they have arrived at the true solution, these answers are in the realm of a "simple faith"; such people often resolve the issues by dogmatic, private interpretations of the Bible and other theological literature, and they ridicule any in science who disagree with them. For others, the answers are based on the current fads in scientific theory and supreme confidence in the human mind, so that faith is merely a crutch that is only needed by people with lesser minds. In this issue of *Perspectives on Science and Christian Faith*, several authors discuss some of the parameters of issues that are often ignored by those who "know" all the answers.

John Templeton and Robert Herrmann discuss the importance of faith in all cultures, past and present. They remind us that a careful study of history demonstrates that most of the pioneers in the early stages of science were people of faith. In the twentieth century, and especially in recent years, there has been a renewal of at least some personal faith commitment in even the most exact sciences. The rationalism that dominated the nineteenth century is no longer so satsifying for many of the scientists of our day.

Jack Haas examines one particular episode in this interplay of faith and science as he considers the early response to Albert Einstein's theory of relativity by theologians and scientists of diverse religious backgrounds. Much of this response provides an important background for more recent discussions of the relationship between theology and scientific theory.

On an even more specific note, Perry Phillips examines the historical and scientific components of a hypothesis that had only brief and limited acceptance in the scientific community. Unfortunately, this hypothesis was accepted all too eagerly by some of the recent-creationists to support their position. The story of the 15.7 light year universe should caution all of us that we must not be too quick to accept the latest scientific (or theological) fad as *the* proof or even *a* proof of the validity of our pet theory.

Robert Newman, by examining several mathematical models and by elaborating on his own computer program, concludes that the very complexity of the simplest, hypothetical life form argues for design rather than accident. Accidents do happen, but the amazing complexity of even the "self-reproducing automata" and the astronomically small probability of their occurrence by chance makes it easier to believe in design rather than chance.

But what do we do with controversy and disagreement when either doctrinal/spiritual purity or scientific competence is questioned? Gareth Jones discusses ways to cope with controversy from a standard of Christian principles. While concerned primarily with controversy within the Christian community, the emphasis (from Scripture) that Professor Jones places on humility, patience, kindness, and acceptance needs to govern all of our discussions of controversial issues.

In the Communications section of this issue, David Young examines Augustine's "literal" interpretation of Genesis. In contrast to the more rigid recent-creationists of the late twentieth century, Augustine saw no problem with physical death prior to Adam's fall, nor did he see any restrictive temporal character to the days of creation. And Augustine could hardly be accused of "compromising" with Darwinian evolution!

In the light of recent court decisions centering around the question of "what is religion?", Raymond Seeger discusses the question of "what is science?" with particular reference to the thoughts of Langdon Gilkey.

You may notice a new addition to *Perspectives* this issue. Celebrating our 40th anniversary of the journal, we are introducing the "layperson's insert," *SEARCH: Scientists Who Serve God*, in this issue. As we have made this insert detachable (just pull gently at the middle staple), we hope that you will take advantage of this opportunity to pass *SEARCH* along to a pastor, a fellow scientist, or a friend who wishes to know more about the ASA and the relationship between science and Christian faith.

WLB

The Vast Arena of Faith

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Faith is the great common denominator of all cultures—both primitive and civilized. It is seen as the ultimate mediator of justice in the way we live our lives and relate to other persons. It is also seen to be intimately associated with mankind's search for truth, whether in the realm of science or theology. The history of science reveals a high level of faith on the part of its progenitors, and after a long period of rationalist rejection of faith, there is in this century a renewal of appreciation for the personal commitment to an external objective reality in scientific knowing. A symbiosis of science and faith has been viewed, especially by a group of prominent scientists, as a promising future direction.

The Pervasive Belief in a Higher Law of Conduct

One of the most perceptive writers of our century was C.S. Lewis, Oxford don and Cambridge professor. In his book *Mere Christianity*, Lewis opens his arguments for the Christian faith with a discussion of right and wrong as a clue to the meaning of the universe.[1] He observes that we all, in our human relationships, operate as though there were common standards of right and wrong. Furthermore, we see this to be a universal phenomenon common to the ancient Egyptians, Babylonians, Hindus, Chinese, Greeks and Romans, and to our own present-day culture. Admittedly, there are differences in degree at certain points, but all agree that, for example, selfishness should never be admired. Secondly, he notes that we all have in common the recognition that our standards are higher than we can achieve. We all accept the fact, in the way we react to our standards, that we should do better even if we don't want to. Of course, we often have good excuses. In fact, they come so quickly and in such profusion that they are, Lewis says, a proof of how deeply we believe in right and wrong, or in what he calls the Law of Human Nature. Concerning these two points, Lewis concludes:

> First, human beings, all over the earth, have this curious idea that they ought to behave in a certain way, and cannot really get rid of it. Secondly, that they don't in fact behave in that way. They know the Law of Nature; they break it. These two facts are the foundation of all clear thinking about ourselves and the universe we live in.[2]

Now what is most interesting about right and wrong is that the small differences in moral code between cultures are distinguishable in a way which allows us to speak of moral progress. That is, in the course of history some civilizations have achieved a higher moral code than others, often through the influence of a great reformer, as did England in the sixteenth century through the influence of men like Thomas Cranmer. But the moment you admit that one set of moral ideas is superior to another, you are, in fact, measuring them both by a standard, saying that one of them conforms to that standard better than the other. The logical conclusion, then, is that there must exist some universal, absolute standard to which all of our moral concepts relate.

Furthermore, this absolute standard, this Law of Human Nature, is quite distinct from natural laws

dealing with things like gravity or heredity or chemistry. For there is no sense in which we can disobey the laws of gravity, but there is overwhelming evidence that we can, and do, break the Law of Human Nature. Lewis concludes:

> Men ought to be unselfish, ought to be fair. Not that men are unselfish, nor that they like being unselfish, but they ought to be. The Moral Law, or Law of Human Nature, is not simply a fact about human behaviour in the same way as the Law of Gravitation is, or may be, simply a fact about how heavy objects behave. On the other hand, it is not a mere fancy, for we cannot get rid of the idea, and most of the things we say and think about men would be reduced to nonsense if we did. And it is not simply a statement about how we should like men to behave for our own convenience; for the behaviour we call bad or unfair is not exactly the same as the behaviour we find inconvenient, and may even be the opposite. Consequently, this Rule of Right and Wrong, or Law of Human Nature, or whatever you call it, must somehow or other be a real thing—a thing that is really there, not made up by ourselves. And yet it is not a fact in the ordinary sense, in the same way as our actual behaviour is a fact. It begins to look as if we shall have to admit that there is more than one kind of reality; that, in this particular case, there is something above and beyond the ordinary facts of men's behaviour, and yet quite definitely real—a real law, which none of us made, but which we find pressing on us.[3]

This phenomenon of universal moral sense is also recognized by the mathematical physicist John Polkinghorne in his book, *The Way the World Is*.[4] He notes that there is within us a remarkable sense of hope in the face of a world of mixed goodness and terror. It is a sense which derives ultimately from our faith in a Transcendent Power with whom we have to deal. In our age there are voices which have explained away these feelings as mere superstitions from a bygone era when the theistic view was almost universal. But, on the contrary, their validity as transcendent experience is argued for from a variety of sociological standpoints. Sociologist Peter Berger, in his book *A Rumor of Angels*, introduces five phenomena or "signals of transcendence" which serve as pointers toward a religious explanation of human behavior.[5] One of these is the human faith in order, a faith closely related to man's fundamental trust of reality. The example he gives is of a young child awaking in the night, crying perhaps because of a bad dream. His mother goes to him to give comfort and reassurance, taking him in her arms, lighting the lamp, and saying words like "Don't be afraid, it's all right." But, of course we know, in a world full of cancer and famine and terrorism, all is not right. Is this, then, a monstrous deception? Of course not. It is the appropriate behavior which we all would encourage. But it is appropriate, fundamentally, because we believe in the religious dimension. We believe that there is an Order in the affairs of men, a Power which is ultimately concerned for our good. In Berger's words:

> In the observable human propensity to order reality there is an intrinsic impulse to give cosmic scope to this order, an impulse that implies not only that human order in some way corresponds to an order that transcends it, but that this transcendent order is of such a character that man can trust himself and his destiny to it. There is a variety of human roles that represent this conception of order, but the most fundamental is the parental role. Every parent (or, at any rate, every parent who loves his child) takes upon himself the representation of a universe that is ultimately in order and ultimately trustworthy. This representation can be justified only within a religious (strictly speaking a supernatural) frame of reference. In this frame of reference the natural world within which we are born, love, and die is not the only world, but only the foreground of another world in which love is not annihilated in death, and in which, therefore, the trust in the power of love to banish chaos is justified. Thus man's ordering propensity implies a transcendent order, and each ordering gesture is a signal of this transcendence. The parental role is not based on a loving lie. On the contrary, it is a witness to the ultimate truth of man's situation in reality. In that case, it is perfectly possible (even, if one is so inclined, in Freudian terms) to analyze religion as a cosmic projection of the child's experience of the protective order of parental love. What is projected is, however, itself a reflection, an imitation, of ultimate reality. Religion, then, is not only (from the point of view of empirical reason) a projection of human order, but (from the point of view of what might be called inductive faith) the ultimately true vindication of human order.[6]

Hardy looks to a new era of exploration, to a "truer biology" which "will not sell its soul to physics and chemistry for quick results."

The Breadth of Religious Experience in Modern Culture

Among significant scientific contributors to our understanding of modern religious experience, the late Sir Alistair Hardy, Oxford marine biologist and ecologist, stands almost without peer. Social anthropologists had worked with a variety of primitive tribes for the past 20 years, and some had reported remarkable accounts of spiritual awareness among primitive communities.[8] Psychologist William James, in his pioneering study of religious feeling, *The Varieties of Religious Experience* written in 1902, presented an earlier view of the religious impulse, especially in the context of Protestant Christianity of an evangelical emphasis.[9] But only Hardy had researched the question of religious experience in the broad sweep of contemporary British society, and in a period when most of his scientific peers were reductionists who regarded the feelings of religion as mere by-products of the chemical processes within the brain. Hardy's conviction of the importance and reality of spiritual experience was part of him throughout his career as a biologist. By the time he had achieved the position of President of the Zo-

ology Section of the British Association in 1949, he felt constrained to express publicly his dissatisfaction with the tendency of his colleagues to reduce all of biology to materialistic, mechanistic explanation.

In 1965 he published *The Living Stream*, a reexamination of evolutionary theory which proposed a much stronger contribution by human consciousness and acquired knowledge in human evolution.[10] Intrinsic to this process, and perhaps foundational to it, is the religious dimension. Like one of his contemporaries, Michael Polanyi, Alistair Hardy believed that science and religion had much to offer each other. He spoke of the goal of a "scientific theology"—a natural theology—which will enlighten us about the place of Divine Power in human affairs. And he pointed out to his contemporaries that the history of science demonstrated the importance of that goal. In his words:

> The whole history of science has been a direct search for God, deliberate and conscious, until well into the eighteenth century. . . . Copernicus, Kepler, Galileo, Newton, Leibnitz and the rest did not merely believe in God in an orthodox sort of way: they believed that their work told humanity more about God than had been known before. Their incentive in working at all was a desire to know God; and they regarded their discoveries as not only proving his existence, but as revealing more and more of his nature. . . .[11]

Indeed, what was sorely needed, Hardy said, was an extensive natural history of religion. And so, in 1969, he founded the Religious Experience Research Unit at Manchester College. In the ensuing years he systematically compiled and classified data on religious experiences in Britain and concluded, on analysis of some eighteen hundred first-hand accounts, that thirty percent of that population had a significant religious experience. Furthermore, the experience was not limited to the uneducated or unsophisticated. In fact, over fifty-six percent of the better educated gave similar reports. His conclusion, set forth in part in the 1979 book, *The Spiritual Nature of Man*, is that religion is something deeply rooted in human nature but stifled and repressed by the materialism of our day.[12] Indeed, his best analysis would lead us to believe that religious experience is an essential component of human consciousness, an intrinsic part of the evolutionary origin of mankind. As Hardy puts it, "the living stream of evolution is as much Divine as physical in nature."[13]

In the final pages of *The Living Stream*, Hardy turns his focus to his colleagues in biology who still fail to see the deep significance of the spiritual in all of experience. He looks to a new era of exploration, to a "truer biology" which "will not sell its soul to physics and chemistry for quick results." The fields yet to conquer are challenging indeed. He mentions consciousness, memory, feelings of purpose and joy, the sense of the sacred, the sense of right and wrong, and the appreciation of beauty.[14] We are left with the feeling that, on that basis, we have barely begun our science—so great is the breadth of spiritual experience.

Science Opens a Vast Framework of Belief

The Beginnings of Science

Faith has been a common element in the experience of divergent nationalities and cultures throughout history and is also the experience of a cross-section of economic and educational groups in contemporary society. But it also has had a profound impact upon the practice of science. Indeed, the beginnings of science were earmarked by an almost complete solidarity of religious conviction among its practitioners. Furthermore, their convictions were characterized by a heightened level of spiritual insight and an appreciation of God's creation so extraordinary that their fledgling discipline brought about what is rightly termed the "scientific revolution."

The reason for the profound success of the scientific enterprise was, in the view of philosopher-scientist Walter Thorson, directly traceable to these theological roots.[15] Scientists were taking God's creation seriously, in a way foreign to the medieval church. The truth about the physical world was not only fascinating to explore but, in the view of these devout men, a valid

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description of a genuine reality. If theologians of the period regarded the physical world as only a kind of papier-maché stage-prop for playing out the drama of salvation, believing scientists saw it instead as a valid source of blessing with its own integrity and spiritual opportunity. Here was a place to be explored to seek appreciation of the Divine Artist's handiwork.

The historical roots of the scientific revolution lie in a philosophical tradition called nominalism, which stressed openness to divine revelation and took particular exception to the competing philosophy of rationalism. The major point of contention was that rationalists raised human reason to the level of absolute truth and spoke of the *a priori* necessity of rational order. The nominalists argued that there is no necessary rational order in the universe; it is as it happens to be. That is, the universe is contingent, subject to the will of the Creator. The forms reason gives to our study of the world are conveniences which at best agree with reality and at worst are only inventions of our minds. Hooykaas, in his *Religion and the Rise of Modern Science*, points out that, with the exception of Descartes and one or two others, all the early scientists embraced the nominalist view.[16] Apparently, these Christian men saw in nominalism an encouragement for their science, but in rationalism they saw instead obstruction. Thorson explains the situation as follows:

> First, these early scientists emphasized their appreciation of the intellectual humility and openness of the nominalist view—and contrasted it with the arrogance of rationalism as they had encountered it. They stressed the idea that rationalism fosters pride and an overconfident dogmatism, and they never tired of pointing out that this produces both error and a closed mind. Francis Bacon epitomized this attitude when he insisted that if a man wishes to know reality, he must abandon the dogmatic confidence of his pride in reason alone and sit down humbly before the revelation of God, whether that were the book of Scripture or the book of nature. This parallel between scientific and religious knowledge, both of which are to be acquired by "reading the revelation of God," and not by *a priori* reason, is a favorite and important emphasis of the early scientists. The parallel has been deliberately ignored by secular accounts of the scientific revolution, which identify empiricism i.e., sense experience as the important ingredient. Professor Hooykaas shows us that for the early scientists the relevant issue is not empiricism per se, but the nominalist tradition, which emphasized contact with reality itself as the only source of truth. These early thinkers thought of themselves as "empiricists" with respect to Scripture as well as with respect to creation. It is an attitude we need to examine deeply if we claim to believe in revelation.
>
> The second attitude which appears to have been fostered by this nominalism of early scientists entails, not a complete rejection of the validity of reason, but its acceptance as a useful tool of the human mind. . . . earlier thrusts of nominalism had sometimes denied all validity to abstract reasoning; this new nominalism retains reason, but gives it a human place, not a divine one. It is a useful skill, like our perceptive skills, but it must not be made into an absolute, and it must be educated by constant encounter with reality. The importance and fruitfulness of this attitude cannot possibly be over-estimated.
>
> Third, and partly as a result of the first two attitudes, this nominalism creates or heightens the distinction between truth as an objective reality, existing independently and outside myself, and my knowledge of the truth, which involves the interpretation, by my reason, of my experience of that reality. This was important for the early scientists, who were keenly aware that they had much to learn before they could competently think the Creator's thoughts after Him. They clearly saw that the main mistake of rationalist thought is to confuse the rational representation of truth with truth itself, and they understood that this mistake fosters dogmatism and pride.[17]

Faith Lost—The Rise of Modern Philosophy

If the faith of the pioneers of science was such a motivating force for the scientific revolution, what was the reason for its demise as the prime mover of science only a few centuries later? Most philosophers would identify the mathematician Descartes as the originator of the modern scientific philosophical tradition, a tradition which claimed as its central tenet the autonomy of the human mind. In this Descartes did not deny the existence of Divine revelation, but what he did deny was the idea that philosophy could rest upon commitments to presuppositions and ideas derived from revelation. As Thorson describes Descartes' role:

> He defined the task of philosophy as the establishment of an intelligible knowledge of the world without presupposing any religious or personal beliefs. The ground for doing so he took to be the knower himself, and from this ground he proposed not only to derive all knowledge but also to establish it with

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> certainty. It is an odd fact that, in spite of wild variations as to methodology and conclusions, the tradition of modern philosophy has tacitly accepted the task defined by Descartes as a legitimate one.[18]

According to Thorson, the path from Descartes' program to modern philosophy had as its key landmark the philosophical critique of Immanuel Kant, whose concern was to establish that our knowledge can be true objective knowledge of a real external world.[19] He proposed that although our minds do impose a rational form on knowledge, the content of that knowledge derives from our experience of an external objective reality and is therefore not just the invention of our minds. Kant therefore accepted the Cartesian requirement for rational certainty, and then tried to achieve objectivity by restricting the contribution of our personal involvement in knowledge to a logical, rational form. The end result was that objectivity became identified with impersonality; the surest way to arrive at objective truth was to avoid personal involvement. The price that was paid for this kind of objectivity was very heavy. Scientific knowledge was stripped of its human personal component. As Thorson expresses it:

> There is a price for this sort of "objectivity": if what is objective is necessarily impersonal, then by its very nature what is personal cannot truly be objective. That other half of the Cartesian polarity, the existential ego, to whose "reality" we are all committed de facto—that other half cannot be ignored; so we have the emergence of existentialist philosophy as a fundamentally schizophrenic reaction to the positivist ideals. What began as a polarization in Descartes between the self as knower and the object of his knowledge, eventually became a radical dualism in thought. Tragically, "objectivity" went with one pole, but "meaning" with the other, and modern man has not found it possible to reunite them. Within the Cartesian program, it is impossible.[20]

Faith Revived—All Truth Involves Personal Commitment

A great breakthrough in our modern understanding of the nature of truth occurred with the 1966 publication of what Michael Polanyi called his "philosophy of personal knowledge."[21] Polanyi was a physical chemist who in his later years turned his mind to the question of how, in fact, we arrive at truth. He, too, noted that modern thought had created a dualism between fact and meaning, between truth and value, which he felt held dire consequences for the future of our civilization. There had been the beginnings of change in the attitude toward modern philosophy with the insistence of Albert Einstein that all our knowledge at whatever level involves an inseparable intertwining of theoretical and empirical elements. Einstein argued that though knowledge starts and ends with experience, there is no logical path to that knowledge through deduction from observations, since there is no logical bridge between our ideas and our experience. As Thomas Torrance explains in his *Belief in Science and in Christian Faith*, what Einstein proposed was that we employ an "intuitive" mode of apprehension, resting on a sympathetic understanding of nature, to penetrate the intelligible features inherent in nature.[22] Einstein restored a way of thinking which is not tied exclusively to visible connections, but which penetrates beneath or behind appearances to an unseen relatedness inherent in nature that determines appearances. In Einstein's own words, "God does not wear his heart on his sleeve."[23] Einstein held a powerful conviction of the intelligibility of nature, and this controlling belief was at the very core of his religious experience.[24]

Apparently, these Christian men saw in nominalism an encouragement for their science, but in rationalism they saw instead obstruction.

It is interesting that Einstein's conclusions were born out of his appreciation of the basic change in the whole structure of physical science ushered in especially by the work of another deeply religious scientist, James Clerk Maxwell. Torrance, in *A Dynamical Theory of the Electromagnetic Field*, says of Maxwell's contribution that it was so revolutionary in concept and so completely counter to the obsession of other scientists for mechanical models that it took some time for his unitary theory of electricity, light, and magnetism to be accepted.[25] Even his close friend, Sir William Thomson (Lord Kelvin), stated that in departing from mechanical models, Maxwell had lapsed into mysticism. Torrance gives us a character sketch of Maxwell that demonstrates how essential the faith component was to the freedom with which Maxwell hypothesized and formulated theories:

> From his earliest days at Edinburgh Academy and Edinburgh University Clerk Maxwell had been fascinated with the relation of geometrical forms to motion, and developed new modes of thought, which he put very successfully into effect in several areas of scientific research and theory, in his explanation of the stability of Saturn's rings, in his dynamical theory of gases, in his work in colour vision and colour photography, and above all in his theoretical clarification of our understanding of electricity and magnetism and light through combining them in one electromagnetic theory. From his earliest studies, however, Clerk Maxwell also came to realise the limited applicability of merely analytical mathematics to account for the dynamic modes of connection found in nature, so that even though he himself went further than any other between Newton and Einstein in the rigorous application of mathematical equations to natural phenomena and their behaviour, he was persistently aware of 'the vastness of nature and narrowness of our symbolical sciences'. No human science, he felt, could ever really match

> up in its theoretical connections to the real modes of connection existing in nature, for valid as they may be in mathematical and symbolic systems, they were true only up to a point and could only be accepted by men of science, as well as by men of faith, in so far as they were allowed to point human scientific inquiry beyond its own limits to that hidden region where thought weds fact, and where the mental operation of the mathematician and the physical action of nature are seen in their true relation. That is to say, as Clerk Maxwell himself understood it, physical science cannot be rightly pursued without taking into account an all-important metaphysical reference to the ultimate ground of nature's origin in the Creator. Thus while Clerk Maxwell never intruded his theological, and deeply evangelical convictions, into his physical and theoretical science, he clearly allowed his Christian belief in God the Creator and Sustainer of the universe to exercise some regulative control in his judgment as to the appropriateness and tenability of his scientific theories, that is, as to whether they measured up as far as possible to 'the riches of creation'. It was in that spirit that he put forward his own theories, always with reserve and always with the demand that they must be put to the test of fact, for his Christian faith would not allow him to fence off any area from critical clarification or to make any other claim for his theories than that they were of a provisional and revisable nature.[26]

These two great scientists, then, were part of the foundation upon which Michael Polanyi built his philosophy of personal knowledge. What Polanyi noted as a common feature of all scientific theorizing is that belief in, and commitment to, scientific theories as potentially true has always been a critical aspect of scientific discovery. What often appeals to us most forcefully is the sense of rational holism which a good theory conveys. But the essential feature is not the power of the rational mind to deal with the abstract, but rather the fact that there are *persons* who take seriously that theory's capacity to describe the world. It is in the actions of these scientists, within the framework of personal commitment, that the fruit of science is born. The powerful conclusion we are driven to by Polanyi's extensive analysis is that even in science there is no such thing as abstract knowledge. It is knowledge only when it is held by someone and acted upon as part of a larger whole.

The most telling feature of the idea of personal knowledge is revealed by Polanyi's analysis of what he calls tacit knowledge. He notes that underneath the judgemental and perceptual skills which are applied by the scientist are a whole set of inarticulate skills and arts which are an essential part of our theorizing. Criteria like symmetry, simplicity, elegance, fruitfulness, and satisfaction are not susceptible to logical scrutiny, but they form a significant component of our theorizing. These tacit components may be viewed in the aggregate as different aspects of what the scientist often terms beauty; the sense of which we are often unaware as we seek to build a theoretical framework for our observations. In Thorson's words:

> Our sense, and the collective tradition, of beauty—and hence the character of our tacit criteria—is capable of change and development; but unmistakably it is a sense of beauty which moves us to prefer some theories to others, and even to heuristically commit ourselves to them, even though as yet we have no clear conception of their consequences. Now it is a surprising thing that this general expectation regarding reality is not disappointed far more often than it is rewarded, but on the contrary it seems to have a real power to evoke creative vision within the human mind.[27]

Polanyi was also very concerned to point out that the concept of personal knowledge does not represent a leap into existentialism, but instead involves a radical reappraisal of the concept of objectivity. To appreciate his argument, we must go back to the fundamental Judeo-Christian understanding of faith in its relationship to sight and reason. In its purest form, the thrust of this understanding is that it is the *object* of faith which substantiates and extends our faith. If in medieval times that understanding was perverted to signify some special forms of insight, some wisdom divinely infused apart from evidential grounds of knowledge, we must recognize it for the error that it was. In the words of T.F. Torrance:

> Faith 'sees' not with any special faculty of vision on the part of the observer, but with the powers of the reality seen. That is another way of saying that faith is correlated with the intrinsic rationality of the object and its self-evidencing reality and revealing power, which applies in different measure to the functioning of perception and the functioning of faith.[28]

Belief, then, is objectively grounded. The believer has as his object either another person or some other reality independent of himself. A person behaves rationally when he interacts with the other and does not confuse it with himself. This is, Polanyi says, the way all meaning arises, when we look away from ourselves to something else. His illustration is the use of a stick to explore a cave, or the use of a cane by a blind man. The holder is only vaguely aware of the stick in his hand, because all his concentration is focused on the objects contacted through the stick. This *from/to* relation is also illustrated by the reading of a book. In Torrance's words:

> In reading a book we do not focus our attention on the letters and sentences themselves merely as marks on paper, nor do we treat them as some way of giving expression to ourselves, but we attend to that to which they refer beyond, for it is in that objective reference that their significance lies.[29]

Polanyi's astounding conclusion is:

> Truth is something that can be thought of only by believing it.[30]

But what of the object of our belief? According to Polanyi, belief consists of a cognitive assent to some aspect of reality, a response to a pattern imprinted in the world around us. This is not just any jumble of

observations; it must be a coherent pattern or an orderly structure to which we react by way of acknowledgement and assent.[31] This kind of objectivity also brings to the process of scientific truth-gathering a liberating open-mindedness, since belief arises in our minds through the force of reality and its intrinsic intelligibility. That is, ours is a journey of discovery, a looking forward to new truth which now is only partially grasped. That is why we can refer to it as faith, for it is directed to a larger reality yet unseen. As Torrance says:

> Belief, as Polanyi understands it . . . is tied up with the fact that we know more than we can tell, that our basic affirmations indicate more than we can specify.[32]

Scientific belief, in this view, also has an element of exclusiveness. For if we believe one thing, that immediately excludes a range of other things. When some theoretical structure receives sufficient support to be defined in terms of a natural law, it achieves a high degree of exclusiveness which approaches universal acknowledgement. Yet it is still less than absolute as an aspect of truth, for it refers to a reality, as Polanyi says, beyond that which we can completely specify. Indeed, the implication of much of what we have said is that the reality beyond is staggeringly large.

Finally, we should note that scientific belief as so described is not unlike theological knowing in the Christian sense. The grace of God comes to us in Jesus Christ unconditionally, but carries with it unconditional obligations, so that faith that is founded on grace involves elements of both freedom and compulsion. What Polanyi says of scientific belief is equally true theologically:

> Every belief is both a free gift and a payment of tribute exacted from us.[33]

The salient features of both kinds of knowing are the essential participation of persons and the commitment to an external reality which is required of them.

Prospects for a New Syncretism Between Theology and Science

Beyond this, one could reasonably speculate that science approached in this attitude of open expectancy may not only enhance the rate and quality of scientific discovery, but will also be catalytic in its effect on other approaches to knowledge. Ralph Wendell Burhoe, in his edited volume, *Science and Human Values in the 21st Century*, sees a tremendous future for such an informed theology:

> Let us look at some of the potentials for a theology informed positively by the sciences. . . . There is beginning to arise in the twentieth century a group of scientists who are seers of the unseen hand that rules human destiny. These men have not been very much heard, seen, or understood by the general public or by the religious communities. . . . Gradually, the growing wisdom of the scientific seers or prophets will probably get through to leaders of the Christian community as significant confirmations and extensions of their historic faith. For in reality these scientists are declarers of what the transcendent reality will permit and what it will reject, and hence what is good or bad for each and every living being or system, and what man must do to be saved for fulfilment in higher levels of order or organization or life. I prophesy that from this source man is most likely to find an enlarged vision of purpose and hope, for the credible myth of human meaning in the scheme of things.
>
> What I am trying to suggest here is that the art of religion, like the technology or art of medicine, will be best informed and most able to function adequately in an age of radically new science and technology when that religion is itself informed by currently credible knowledge provided by the sciences.[34]

This syncretism has been the heart's desire of a growing group of scientists, some of whom have reached the pinnacle of success in their chosen field.

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Rustum Roy, in his book *Experimenting with Truth*, mentions a number of those who, in his words, have arrived "at a position affirming the Beyond in the midst of equations, galaxies, or conducting electrons, or new organic synthesis of DNA helices."[35] Among these are A.N. Whitehead, mathematician and philosopher; Sir James Jeans, the British astronomer; Michael Polanyi, Hungarian physical chemist turned philosopher; James Conant, chemist and President of Harvard University; Charles Coulson, mathematician and chemist at Oxford; Charles Townes, physics Nobelist; Sir Alistair Hardy, marine biologist and Templeton Prize recipient; and Carl Friedrich von Weizäcker, physicist and younger associate of Werner Heisenberg. Heisenberg himself provides a probing autobiography of his search of the Beyond in a book with that very theme, *Physics and Beyond*.[36] But Heisenberg brings yet another important dimension of faith into his science; faith as the essential basis of ethics and values.

Heisenberg had been the discoverer of the uncertainty principle, a momentous discovery which excluded the possibility that both position and

momentum of elementary particles could simultaneously be known. His discovery, for which he received the Nobel Prize in 1932, had meant the end of classical physics and rigid determinism, and had propelled the physical sciences into the quantum world. It is perhaps not surprising, then, that Heisenberg should have some interest in those aspects of reality which go beyond science, just as the quantum world presented vast philosophical changes for the practitioners of classical physics. In fact, Heisenberg's writings prove him to be a profound thinker and a deeply sensitive human being. The story of his growth, his choice of physics, his education in pre-war Germany at Munich and Göttingen, his close relationship to Niels Bohr, the inventor of quantum theory, to Wolfgang Pauli, Carl Friedrich von Weizäcker and Hans Euler, and the description of the very difficult war years inside Germany, are all fascinating. But his religious views are still more arresting.

Once, in a conversation with Pauli and Paul Dirac, the question of Einstein's talk about God came up, with the expression of considerable surprise that he would have such strong ties to a religious tradition. Someone commented that the equally famous Max Planck was even more religious. Heisenberg then elaborated on Planck's views with some obvious sympathy but also with a very important reservation:

> Planck considers science and religion compatible because, in his view, they refer to quite distinct facets of reality. Science deals with the objective, material world. It invites us to make accurate statements about objective reality and to grasp its interconnections. Religion, on the other hand, deals with the world of values. It considers what ought to be or what we ought to do, not what is. . . . In short, the conflict between the two, which has been raging since the eighteenth century, seems founded on a misunderstanding, or more precisely, on a confusion of the images and parables of religion with scientific statements. This view, which I know so well from my parents, associates the two realms with the objective and subjective aspects of the world respectively. But I must confess that I myself do not feel altogether happy about this separation. I doubt whether human societies can live with so sharp a distinction between knowledge and faith.[37]

At a later point in his book, Heisenberg states it as his belief that the problem of values implies a "compass by which man must steer his ship through life."[38] This compass, he says, is "the central order," the "one" with which we communicate in the language of religion. This religion, he feels, must win out, for the very idea of truth is involved with the reality of religious experiences.

And so, we have come back to the theme of right and wrong, of human values as an essential but also integral element in our knowing, whether in a scientific or in a theological frame of reference. And what seems increasingly evident is the interconnection of faith and truth as a universal principle, embracing the whole realm of human experience in all times and places, pointing us to the One who constitutes the physical universe and also pervades our very being. As St. Paul said to the Athenians long ago, of "The Unknown God":

> He is not far from each of us, for in him we live and move and have our being.[39]

REFERENCES

[1]Lewis, C.S. *Mere Christianity* (New York: Macmillan, 1960).
[2]*Ibid.*, p. 21.
[3]*Ibid.*, p. 30.
[4]Polkinghorne, John. *The Way the World Is* (Grand Rapids: Eerdmans, 1983), pp. 27, 28.
[5]Berger, Peter L. *A Rumor of Angels* (New York: Doubleday, 1970).
[6]*Ibid.*, pp. 56, 57.
[7]*Ibid.*, p. 65.
[8]Evans-Pritchard, Edward E. *Nuer Religion* (Oxford: Clarendon Press, 1956).
[9]James, William. *The Varieties of Religious Experience* (New York: Longmans, 1902).
[10]Hardy, Alistair. *The Living Stream* (London: Collins, 1965).
[11]*Ibid.*, p. 269.
[12]Hardy, Alistair. *The Spiritual Nature of Man* (Oxford: Oxford University Press, 1979).
[13]Hardy, Alistair. *The Living Stream*, p. 283.
[14]*Ibid.*, p. 284.
[15]Thorson, W.R. "Spiritual Dimensions of Science" in *Horizons of Science*, C.F.H. Henry, ed. (New York: Harper and Row, 1978).
[16]Hooykaas, R. *Religion and the Rise of Modern Science* (Edinburgh: Scottish Academic Press, 1973).
[17]Thorson, W.R. *op. cit.*, pp. 241, 242.
[18]Thorson, W.R. "Science as the Natural Philosophy of the Christian," *Journal of the American Scientific Affiliation* 33, 67 (1981).
[19]*Ibid.*, p. 70.
[20]*Ibid.*
[21]Polanyi, Michael. *Personal Knowledge: An Introduction to Post-Critical Philosophy* (New York: Harper and Row, 1966).
[22]Torrance, T.F. "The Framework of Belief" in *Belief in Science and in Christian Life*, T.F. Torrance, ed. (Edinburgh: Handsel Press, 1980), p. 9.
[23]Northrop, F.S.C. *Man, Nature and God*, 1962, p. 209f.
[24]Einstein, A. *Out of My Later Years* (Secaucus, NJ: Citadel Press, 1950), pp. 30, 60.
[25]Torrance, T.F. *A Dynamical Theory of the Electromagnetic Field* (Edinburgh: Scottish Academic Press, 1982), pp. ix–x.
[26]*Ibid.*
[27]Thorson, W.R. "The Biblical Insights of Michael Polanyi," *Journal of the American Scientific Affilation* 33, 135 (1981).
[28]Torrance, T.F. *Belief in Science and in Christian Life*, p. 10.
[29]*Ibid.*, p. 11.
[30]Polanyi, Michael. *Personal Knowledge*, p. 305.
[31]*Ibid.*, pp. 33–48.
[32]Torrance, T.F. *Belief in Science and in Christian Life*, p. 15.
[33]Polanyi, Michael. *Personal Knowledge*, p. 16.
[34]Burhoe, Ralph W. (ed.). *Science and Human Values in the 21st Century* (Philadelphia: Westminster Press, 1971).
[35]Roy, Rustum. *Experimenting with Truth* (New York: Pergamon, 1981), pp. 154–155.
[36]Heisenberg, W. *Physics and Beyond* (New York: Harper and Row, 1971).
[37]*Ibid.*, pp. 82–83.
[38]*Ibid.*, pp. 214–217.
[39]*Holy Bible*, Revised Standard Version, Acts 17:27, 28.

Relativity and Christian Thought: The Early Response

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The last decade has witnessed a renewed interest in applying the thought of Albert Einstein to theology and various science/Christianity issues. Curiously, this interest has virtually ignored the extensive religious discussion which followed verification of relativity by scientific teams studying the solar eclipse of 1919. The survey of English language periodicals and books in this paper indicates that relativity was the focus of a lively, wide-ranging discussion by churchmen and scientists of various religious backgrounds. Although the reactions were at times superficial, inaccurate or conflicting, basic themes developed in these early evaluations are found in today's discussion in spite of changes in theological climate and attitudes toward the relation between science and Christian faith.

Introduction

The desire to relate Christian faith and the scientific enterprise has a long and varied history. One traditional meeting point of faith and science has involved Christian reaction to dramatic changes in scientific perspective. Few would argue against the assertion that the early twentieth century work of Albert Einstein changed the way that we view nature. In postulating a four-dimensional universe, he removed classical notions of absolute space, time and motion. The "new physics" developed by Einstein and his contemporaries espoused concepts of space and time, mass and energy, waves and particles and their interrelations which radically altered our perspective of the atom and the cosmos. These concepts have, in turn, raised foundational philosophical questions concerning the basic nature of science and the relation of science to Christianity.

Papers dealing with the religious implications of relativity appeared shortly after the public announcement of the first successful measurements of the bending of starlight by the sun. Religious discussion continued at a lively pace until the early 1930's. From that point until the 1970's interest was at a minimum. Recently, there has been a revival of interest in Einstein's thought and the significance that his work holds for theology and theistic world views encompassing science.[1]

In evaluating early reactions to relativity there is a factor not usually associated with scientific discovery. In most cases, a scientist receives attention at the time that his work is published but soon fades from public view, even though his science may endure. Uniquely, Albert Einstein was to remain in the public eye until his

death in 1955. In this paper, I will examine the early religious response to relativity and discuss ways that relativity was thought to bear on questions involving science and Christian faith. In addition, I will seek to establish links between early interpretations and current interests. By focusing on this early period we can avoid the confusing and sometimes vitriolic reaction that arose later when Einstein made public statements on religious and philosophical issues.

Einstein the Legend

Although he had published his major papers on relativity over the period of 1905–1915, Albert Einstein did not come to world prominence until November 7, 1919 with the headlines in the London *Times* "Revolution in Science/New Theory of the Universe/Newtonian Ideas Overthrown/Space 'Warped'."[2] The article reported a joint Meeting of the Royal and Astronomical Societies held on the previous day, where the results obtained by British observers of the total eclipse of the previous May were formally presented.[3] The *New York Times* published a full and accurate report on November 9, and from that year until his death the *New York Times Index* had at least one record of his name, often with respect to topics unconnected with science. Einstein's rise to fame was rapid, and endured throughout his life.[4] He had a lifelong interest in philosophy, was an excellent amateur violinist, wrote occasionally about religion, was a passionate advocate of pacifism, had deep concern for moral Zionism, and was an outspoken opponent of Hitler.[5]

The Scientific Context

The twentieth century revolution in physics came in various stages through the work of Maxwell, Planck, Einstein, Bohr, Schrodinger, de Broglie, Heisenberg and others. As the nineteenth century drew to a close, classical physics garbed in the clothes of Newton and Euclid was confident that all the essentials of nature were understood and that all that remained were minor adjustments and filling in the gaps. The world was made of solid material particles; physical phenomena could be analyzed by breaking them into their component parts localized in time and space; nature could be visualized in observable or easily imaginable images.

The world view developed in the early part of the twentieth century showed that matter was not composed of inert hard particles; indeed, the negative particles surrounding the nucleus were found to have both mass and wave properties and their position in space was describable only in statistical terms by using complex mathematical equations. This new perspective on the micro-world was accompanied by an equally mind-boggling change in the cosmos. Light traveled in curved lines, and therefore space was curved. Gravitation is not a pull of attraction between two portions of matter, but rather the "warpage," which matter produces in the space-time continuum. In Einstein's world, gravitation appears not as an esoteric force, but rather as a mathematical necessity of the geometry of the space-time continuum. This new perspective interpreted the cosmos in "relational" terms, in contrast to the "container" perspective of the old physics.

Einstein's mysterious new theory required interpretation for the masses, and scientists the world over were called upon to offer expertise to newspapers, magazines, and audiences large and small. More than one hundred books on the subject appeared within a year.[6] Arthur Eddington's influential *Space, Time and Gravitation* provided an early (1920) popular explanation of relativity and was to be widely quoted by religious writers of the period. He concluded his work with these words:

> It [relativity] has unified the great laws, which by the precision of their formulation and the exactness of their application have won the proud place which physical science holds today. And yet, in regard to the nature of things, this knowledge is only an empty shell—a form of symbols. It is knowledge of structural form, and not knowledge of content. All through the physical world runs the unknown content, which must surely be the stuff of our consciousness. Here is a hint of aspects deep within the world of physics, and yet unattainable by the methods of

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> physics. And, moreover, we have found that where science has progressed the farthest, the mind has but regained from nature that which the mind has put into nature.[7]

The Religious Climate in England and America

The 1920's were a time of conflict for the Protestant church in America. Issues raised by late nineteenth-century desire to develop a synthesis of Christian faith and modern thought had come to a head. Conservatives saw a shift in the "locus of authority" from the Bible to scientific and historical critical methodology, and lamented the erosion of traditional ideas in ethics, morals and social questions stemming from the new ways of thinking.[8] Theological liberals (Modernists) and evangelical conservatives found themselves unable to find a middle ground and new denominations, seminaries, mission agencies and colleges were formed as the old institutions were lost to the liberals. While England and the American South were spared the schisms of the American North, the issues were still heatedly debated.

As the nineteenth century drew to a close, classical physics garbed in the clothes of Newton and Euclid was confident that all the essentials of nature were understood and that all that remained were minor adjustments and filling in the gaps.

The dominant scientific issue was evolution. Clergy, theologians, scientists and laymen—liberal and conservative alike—obsessively addressed the topic in a flood of books and articles in learned and popular religious literature. One mark of the conservative was a disdain for evolution in any form. It was but a short step to what Bernard Ramm described as

> hyperorthodoxy [which] assumed that unsaved man is in open rebellion against God and will use science as well as anything else to oppose Christianity. The Bible it asserted was not in conflict with true science, but obviously in conflict with most of the world's practicing scientists. These scientists unsaved and antichristian must be written off the record in science as well as in religion.[9]

However, Ramm observed that the Roman Catholic scholars of the day had worked out a "set of principles setting forth the boundaries of science, the boundaries of theology, and the canons of interpretation" which allowed them to avoid the excesses of conservative Protestantism.[10]

If conservatives had problems with evolution, their liberal counterparts were not particularly pleased with a science which they felt led to a technology that devalued human labor and increased the power to wage war. Since conservative Christianity of that period placed almost total emphasis on evangelism and the defense of the faith, there was little encouragement for the serious study of science or for the integrative concerns found today. Thus, few conservatives had the background in science and mathematics to engage in fruitful discussion of the new physics.

The Philosophical Mood

The early part of the twentieth century saw the "New Realism" as the most significant philosophical development in English-speaking countries.[11] Realism during this period stood for the view that one can have knowledge of a real world which exists independently of our view of it. The "New Realism" arose in revolt against the twin evils of "idealism," for which the world is in some sense mind-dependent, and "materialism," for which matter was all. Realist metaphysicians recognized: (1) the reality of the world in space and time; (2) Mind, or the act of knowing, as one factor in reality among others; (3) a closer connection with science than in the past; (4) the notion of process; and (5) various levels of understanding in nature extending to the levels of spirit, and even deity.

Although many of the realists were indifferent or hostile to religion, realism provided no inherent disposition against religion. Thomistic philosophy, and other theistic philosophies of this period, incorporated realism in their systems.

The Response To Relativity

An Overview

A wide spectrum of religious response to relativity appeared in the period following observational verification in the solar eclipse of 1919. Over twenty periodicals from America and England offered articles from a broad range of Protestant, Catholic and non-theistic perspectives. The famous and not so famous were drawn to discuss the religious implications of this revolutionary scientific change. At the very least, readers of journals of religious thought were exposed to unprecedented levels of mathematics.

The periodical literature reflected for the most part the views of clerics, theologians and philosophers of religion. Practicing scientists had their day in the "science and religion" books which appeared in great number during this period. The British scientific journal *Nature* provided an important forum for early scientific and philosophical discussion.

Generally, American and English religious conservatives ignored Einstein; a few were critical of relativity itself or the interpretations which others had drawn. The quality of the response in the religious journals varied widely in terms of scientific accuracy, and philosophic and theological acumen. The greatest depth of interaction came from the university centers of England, which had a tradition of dialogue between theologians and scientists not possible in American intellectual circles where theology was (and still is) kept separate from the other disciplines.

The period between the world wars saw unparalleled progress in many areas of the physical sciences, it was also a time when many scientists vigorously addressed the philosophical and religious implications of the new science. Prominent figures such as Haldane, Jeans, Russell, Whitehead, Weyl, and Planck lectured and wrote papers and books which stimulated a spirited response on the part of clerics and philosophers. Sometimes writers used the term "metaphysics" to avoid the use of religiously colored words in scientific journals, or to avoid offending the sensitivities of anti-theistic editors. For other writers deity, god, and gods were terms which had little connection with the triune God of Holy Scripture.

The Initial Reaction

The journal *Nature* played an important early role in discussions of the scientific and philosophical implications of relativity. London University philosopher H. Wildon Carr's pioneering papers, "The Metaphysical Aspects of Relativity" and "Metaphysics and Materialism," stimulated a vigorous debate carried on in the Letters to The Editor section of *Nature*.[12]

Many commentators of the early period were enthusiastic about the potential that relativity offered for Christian thought. Theologian Orrock Colloque wrote: "The new Einstein theory of relativity will doubtless prove of tremendous interest to Catholic theologians since it deals, as does theology, with the fundamental nature of matter, space and time."[13] Jesuit Leslie Walker wrote: "it is highly probable that the theory of Einstein and the philosophy of Aristotle and St. Thomas will harmonize, since both claim to be based on the same foundation of sound common sense." Walker further noted that "the theory of Einstein is not a revolution, but as far as the notions of space and time are concerned, is a return to conceptions which modern philosophy has rashly disregarded."[14] H. Wildon Carr felt that relativity was going to produce "a revolution in religious thought."[15] Catholic theologian T.O. Patterson found that Scholastic methods were "quite developed for coping with the discursive side of relativity theory" since each system claims "an empirical foundation." Patterson proudly noted that "Scholastic philosophy has always postulated the relationship of space, motion and time"—something that "relativist writers claim to have discovered."[16]

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British M.P. Austin Hopkinson observed "how much simpler is the conception of divinity now possible due to the formulation of the general theory of relativity," and found in the new physics "a shadow of a dream of God which is more satisfying than the traditional anthropomorphisms."[17] Albert Clarke Wyckoff wrote "No scientific position since the birth of the new era has meant so much to Theism." For Wyckoff, "Theism's golden opportunity awaits."[18]

Other writers, if not as enthusiastic, at least found no conflict between Christianity and relativity. F.J. McConnell, Pittsburg Methodist Episcopal Church Bishop, observed: "there is nothing in Einstein . . . to forbid or discount theism," and "nothing in the Einstein doctrine of space which would deprive the theist of the right to think of the Divine Mind as absolute in relation to space."[19] A Catholic theologian stated that "although a readjustment of notions of space and time was required, their objective character such as understood in the scholastic sense was not impaired."[20]

Some commentators were skeptical of the correlations which were being drawn. British philosopher C. Dawes Hicks, co-editor of the *Hibbert Journal* felt that the "bearing of relativity on philosophical [and religious] problems had been exaggerated and misunderstood."[21] A suspicious American Methodist cleric cited the quick acceptance of relativity as an example of the "boundless self-conceit of the times which seeks to destroy respect for the past." He noted that the new relativity "has many parallels with the insidious effects of evolution on Christian faith and society."[22] N.G. Augustus saw in relativity "an attempt to have nature conform to our senses rather than educate our senses to the apprehension of the reality about us."[23] Anglican Bishop Archibald Robertson expressed doubt about some of the correlations that were being drawn, noting that "the values of Christian thought and experience are qualitative not quantitative."[24]

Later Views

Authors of the late 1920's and early 1930's were often critical of the responses of their earlier counterparts. F.L. Cross, Librarian of Pusey House, Oxford warned against the "precipitant use of Einstein or Planck for apologetic purposes," and commented that physicists such as Whitehead, Eddington and Jeans have "received little assent from the learned world" for their attempts to relate physics to faith.[25] Philosopher Herbert Dingle, writing in the *Hibbert Journal*, asserted that "whatever spiritual reality may underlie the events of nature is eternally inaccessible to science."[26] Joseph Dudley, sounded a similar note in *The Bible Champion*, by suggesting that relativity was another case of "extending theoretical speculation far beyond the data."[27]

Some writers, however, continued to maintain the earlier enthusiasm. The Rev. M. Green found that "the new science offers new fields for faith to triumph."[28] Jesuit C. W. O'Hara, writing in *Science and Religion: A Symposium* (1931), found that the work of Einstein and Planck had "closed the gap between religion and science."[29] Burnett Streeter, Fellow of Queens College, Oxford saw relativity as offering "new apologetic possibilities."[30] Theodore Graebner observed "the most up-to-date scientific speculation is proceeding along lines of spiritualism, idealism, the recognition of the supernatural and the divine."[31]

Specific Correlations

Science is Not All

Both scientists and theologians saw a new sense of humility emerging in the physical sciences. Physicist Robert A. Millikan noted: "We have learned not to take ourselves as seriously as the 19th century physicists took themselves. We have learned to work with new satisfaction, new hope, and new enthusiasm because there is so much that we do not understand."[32] Oxford Bishop Archibald Robertson welcomed the new role of physics in checking "the self-confidence of science."[24] The limitations imposed on scientific measurement by the new physics were seen by some commentators as allowing a window for other (religious) ways of thinking.

Materialism on Trial

One prominent theme was found in the view that relativity did away with the ancient Christian adversary of materialism. Philosopher H. Wildon Carr championed this position in early interpretation of relativity in the *Times Educational Supplement*, and a pair of controversial articles in *Nature*. Carr asserted that "rejection of the Newtonian concept of absolute space and time and the substitution of Einstein's space-time is the death-knell of materialism."[12b] For Carr:

> . . . the principle of relativity IS the rejection of materialism. Materialism is a causal theory of scientific reality. It is the argument that when we pronounce anything in our sense-experience to be real we imply an independent cause for it. According to the principle of relativity, the inference is entirely unnecessary and to insist on it unscientific. Instead of this causal theory relativity offers a simple correspondence theory.[12d]

F.R. Tennant, Lecturer and Fellow of Trinity College, Cambridge crystallized the thought of many writers in observing that relativity is a "potent tool in the case against anti-theistic naturalism implicit in the closed-system thinking of the Newtonian world."[33] M. Green wrote: "the old determinism is dead both in physics and theology."[34]

Creation

Correlations with the theme of creation were a common feature. L. Franklin Gruber concluded that "a finite and temporal and therefore created, universe issues from this scientific world-view."[35] For Patterson, "relativity provides an additional endorsement that space belongs to the finite and physical order."[36] J. Arthur Thompson found the new physics to provide a picture of "impressive grandeur" whose "unification is congruent with the religious concept of a creator."[37] C.W. O'Hara asserted, "the Creator is seen to be the origin of the whole universe—the gap between religion and science has been closed."[38]

Immanence vs. Transcendence

The Newtonian model had been traditionally interpreted in deistic terms, with God far removed from the self-functioning natural order. H. Wildon Carr found a new role for relativity in his suggestion that "while drawing us away from the idea of a separate or transcendent God, it interprets the idea of an immanent God."[15] For J.J.B. Coles, "Relativity can only be interpreted in terms of an Immanent God, a Reality which in its very nature is Life and consciousness."[39] On the other hand, Bishop McConnell warned that "some of the present day theorizing about the immanence of God seems to be intended to shut God into the present system."[40] Patterson emphasized the fact that time had been shown to be part of the finite and physical order and was not to be confused with the eternity of God as found in Newton and Clarke.[41] Many writers emphasized the new "unification of nature" stemming from relativity.

Various Levels of Knowledge

McConnell, in viewing space in divine perspective, asked: "may there . . . be . . . in the Divine Will and

Mind possibilities of other spaces independent of us, but to which we might be conceivably introduced?"[40] Hopkinson found room for "fleeting glimpses" of divinity at higher levels. He concluded: "the mind is led to the conception of a still higher order of intelligence, and thence to an infinite series of yet higher orders, of which each is God to the order immediately below it."[42] Robertson, however, was skeptical about this notion.

> I welcome Mr. Hopkinson's step from space to the Divine Intelligence which is above space, without feeling at all compelled to take a step from outside space to an infinite series of Gods, one over the other. When the mind has reached God it finds Him, One and self-sufficient.[43]

The Victorian observer could not find God in his world because religious experience had not been taken into account in its construction. In the new world of relativity, the religious man no less than the scientist has the right to find the experience that he seeks.

F.R. Tennant felt that the new physics offered a place for religion not available in nineteenth-century thought: "The attempt to picture and model with exactness has given way to satisfaction with being able mathematically to conceive." "Nature so neatly ordered by number for exact quantitative relationships can at the same time be characterized by an indefinite number of other relations and qualities." He saw the physicist as "interested in the one sort of quality or relation that is relevant to physical science while he leaves abundant opening for the philosopher [and theologian] to posit such additional elements as he may find necessary for the explanation of the world of experience as a whole."[44]

Ontology

The ontological status of the universe is important since some sort of "realism" is required if the notion of God as creator and sustainer is to make sense. Philosopher Ray H. Dotterer found that relativity implied that the world is "objectively real and independent of the cognitive relation," and warned his readers against "all too hastily inferring that the world of relativity must be a world of caprice and subjectivity. . . . Indeed, the relativity theory is, precisely, an attempt to give a description of the world which shall transcend the view of any particular observer, or even, if that be possible, of all observers."[45] Robertson reminded his readers that "the admission of the general relativity of knowledge does not carry with it the admission of the relativity of truth."[46] This point has often been missed by Einstein's interpreters. Indeed, Einstein would have preferred that his theory be called "The Theory of Invariance" rather than Relativity Theory.[47]

Implications for the "Afterlife"

Orrock Colloque speculated that the Einstein theory might help us to better understand the life of those who are in the place of departed spirits.

> What do space and time mean to them? They enjoy motion at a velocity greater than light and may go everywhere in God's great universe. It is in their travels and in their studies of God and His creation that they grow in the knowledge and love of God. They learn to think in terms of mathematics, the universal language of God, and so enter into the mysteries of the laws of grace and of the laws of nature both. Whatever of truth they learned from past efforts is of use to themselves and to others but now they see, not from within the box of three dimensions, limited by time, but from without, from timeless eternity.[48]

Morrison notes with approval the assertion of Bishop Barnes that in unifying space and time "we have no right to postulate that in the world to come part of this complex will be destroyed while the other part remains intact." Morrison felt that he "now had the support of physics" in firmly repudiating the notion that "God's wonderful world of nature . . . would be scrapped in the afterlife."[49]

Colloque felt that the Catholic notion of time "has something in common with Einstein's relativity."[50] In his words:

> Time fades for us into the relative eternal and will fade for creation into eternity itself. . . . just as time is embraced within eternity, as one circle is included within another, so our life and thought is included within the consciousness of those who dwell with Christ in the other world. We are fellow-citizens with the saints.[51]

Chance vs. Necessity

The perennial issue of chance vs. necessity in accounting for physical causation was extrapolated to the domain of theology. One writer rejoiced that "the new physics allows man a greater place to mold his destiny and transform his personality as over against an oppressive Calvinism, stern and inexorable."[52] The tightly determined universe of the nineteenth century, evolving along a predetermined path, left little room for freedom and responsibility. It seemed congenial only to deistic indifference or the iron grip of Calvinistic predestination. William B. Smith thought otherwise:

> The vigorous and uncompromising doctrine of universal relativity leaves no escape from the conclusion that the subjects of its treatment are themselves the creatures of the intelligence that so boldly, so audaciously manipulates them in whose hands they are more plastic than wax, being fused and compounded and contorted at will.[53]

A Skeptical Note

H.E. Barnes' anti-Christian polemic, *The Twilight of Christianity*, included a scathing denunciation of religious apologists who used scientific theories to support religious views. He was particularly vexed by the assertions of the typical prominent scientist "whose scientific views are in the adult phase, while in the religious field he is intellectually a youth in short pants." Barnes stated: "Whitehead's conception of God was a highly obtruse physical notion, yet he frequently lapsed into attributing to his obtruse God many orthodox, theistic qualities, thus affording a loophole for the satisfaction of the faithful."[54] Barnes accused astronomer Eddington of reading his Quaker leanings into relativity. J.H. Randall, Jr. echoed this view in lamenting the fact that "many physicists have blossomed forth as liberal theologians. . . . Aware that modern physics has abandoned doctrines that were once hostile to religious claims they imagine that there is no further conflict between religion and science and are ignorant of the way that anthropology, psychology and higher criticism have changed the nature of modern religion."[55]

British Philosopher Herbert Dingle sharply criticised Arthur Eddington's understanding of the implications of relativity for religion. In Dingle's eyes, Eddington had closely examined the external world and found nothing whose behavior is not mechanically determinable, and thus nothing worthy of worship that we can call "God." In using this approach, Eddington sought to hold onto the Victorian world view that the external world existed independent of the observer, whose task lay in taking measurements of various kinds to find out what was already there. The new perspective of relativity recognized physics to be a description of the relations between the results of operations chosen and performed by the investigator. They are the results of his definitions, not the magnitudes of objective features of the external world. The world is thus inferred from experience. The Victorian observer could not find God in his world because religious experience had not been taken into account in its construction. In the new world of relativity, the religious man no less than the scientist has the right to find the experience that he seeks.

Eddington knew all this, but betrayed himself to the pre-Einstein approach in seeking to find something "real" in the external world which could be understandable in a spiritual sense. Quaker Eddington was viewed as "leaving his mystical outlook on nature and looking for the fossilized remains of a real Victorian Great First Cause." Dingle went on to say that Eddington confused himself and his readers because of "his inherent predispositions which forced him to look for more behind when the essence of the matter was not behind, but up front and led him to banish the roots of religion to the world of the physically unknowable instead of recognizing them where he really knew they were—in that which is known more immediately than any external or physical world, in experience itself."[56]

We should remember that the ideas of a previous generation should be first judged in terms of the theological and religious concerns of that day.

Process Theology

The process theologies of realist metaphysicians, such as mathematician-philosopher Alfred North Whitehead, stand as the most enduring positions to find roots in relativity. Whitehead felt that the time was ripe for a new synthesis of knowledge—one free from materialism, but still in touch with science. He saw the religious vision as one element in the human experience which shows an upward trend—man's one ground for optimism. His estimate of religion was based on a dynamic "philosophy of organism":

> Whitehead wants us not to think of an elemental 'substance' underlying the world or dualistically of 'mind and matter', but rather of process in an interconnected conception of reality in which all aspects of experience are interjoined—aesthetic, moral and religious interests of the world as well those ideas which have their origin in natural science.[57]

Some Generalizations

The reader may well regard many of the quotations of the previous pages as meaningless in the light of current interpretative fashions. The pressure to "come up with something" may have caused the pundits of the day to offer half-baked notions that do not stand up to the test of time. We should remember that the ideas of a previous generation should be first judged in terms of the theological and religious concerns of that day. The cherished notions that we so passionately argue today may be viewed with the same unsympathetic eye in the

twenty-first century. These writers felt that a revolutionary scientific development should have major significance for a variety of areas of religious thought. Nonetheless, by the early 1930's it seemed that "relativity" had raised no new religious problems nor settled any old ones. The optimism of the early period had been dulled by a failure to establish new correlations between science and religion; indeed, there was a rather strong reaction against the contribution of scientists who were often viewed as being out of their depth when they attempted to apply science to philosophy or theology.

Science was able to provide for the properly motivated viewer "glimpses of the divine," and "metaphors of great power" for gaining new insights into the categories of faith. It offered the potential for a new sense of unity between God and nature and, when properly understood, an ontology which supported orthodox Christian views of creation and providence. Unfortunately, other observers thought differently and little consensus was achieved. If the old mechanistic materialism appeared to be discredited by relativity, it was not replaced with theism. However, not all of the earlier discussion has been relegated to history. The next section will note some of the themes of the earlier period which have emerged in current discussion with new vigor and direction.

While Einstein was to remain in the public eye throughout his life, for one observer "the year 1919 represents the culmination of his career."[58] Unfortunately, he chose to leave the mainstream of physical thought by rejecting the quantum theory that he had done so much to establish. He spent his remaining years in a fruitless effort to unify electromagnetism and gravity within the framework of a "unified field theory." As physicists turned increasingly to quantum theory, "Einstein's views became for his peers a source of puzzlement, sorrow, and finally indifference."[58] This bypassing of Einstein by the scientific mainstream may have contributed to the loss of interest at the philosophical-religious level evidenced by the mid-1930's.

The current theological concern with Einstein has been paralleled by a renewed scientific and popular interest in relativity, starting in the 1960's with the discovery of quasars, cosmic fireball radiation, pulsars, black holes and gravitational lenses. Theorists such as Stephen Hawking, Igor Novikov, James Bardeen, John Wheeler and others began to make discoveries in general relativity that had been missed for four decades. They have written widely in the scientific and popular press, and brought back to the general public some of the flavor of the field which had been lost after 1919. Today, Einstein is back in fashion in scientific and theological circles alike!

Enduring Themes

A number of areas of correlation in early discussions may be found in the work of today's writers. Theologian Thomas Torrance, a key figure in current integrative thought, emphasizes the new unity in science brought about by Einstein's thinking as "not inconsistent with the Christian faith . . . "[59] Torrance more recently reflects earlier thinkers in his assessment of the significance of Einstein's work "as reaching down to the very foundations of our understanding of the universe, affecting everything we know far beyond the limits of physics . . . [which] . . . imports a radical alteration in the regulative basis of knowledge, transforming not only the structure of science but our basic ways of knowing." For Torrance, "the liberation of the human spirit from a closed determinist continuum of cause and effect, which is now taking place, makes for the resuscitation of belief in divine providence and divine response to human prayer. . . . "[60] Other early themes captured by Torrance include the idea that nature is characterized by "a unitary rational order," and that "the universe is found to comprise interrelated levels of being, each of which is far from being closed in upon itself, but is open to and explicable in terms of its immediately higher level and indeed of the whole multi-levelled structure of the universe."[61] A further theme emphasizes the relational perspective of nature over and against the container perspective of pre-Einstein physics.

Arthur R. Peacocke, writing in a book commemorating the 100th anniversary of Einstein's birth, mentioned other ideas which parallel the thinking of the 1920's. He recognized "a skepticism within and towards science itself . . . [and] . . . a much more humble view of physical law," an emphasis that "science arises from interaction between the world of nature and ourselves . . . ", a realist ontology, and finds that time as part of time-space owes its existence to God and supports the traditional Judeo-Christian doctrine of creation.[62] Barrie Britton has recently commented on the transcendence of God: "If it is accepted that both time and space are actually dependent on the existence of the physical universe for their very meaning, then it is but a small step to realize that the Creator of such a universe must, by logical necessity, be *outside* and *independent* of the time and space perceived within his creation."[63]

Conclusion

In this historical study we have shown that theologians, philosophers and scientists found a broad range of religious implications stemming from Albert Einstein's work on relativity. These early correlations were often strained, inconclusive and conflicting, yet some themes have shown enduring significance.

The current crop of thinkers has developed the religious and philosophical implications of relativity at a level of sophistication and application far beyond the expressions of earlier writers, in a context of theological and philosophical perspectives not present in the 1920's. It remains to be seen if these expressions will provide a lasting framework for an integrative approach, or suffer the same fate as the vision of those who wrote so enthusiastically six decades ago.

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REFERENCES

[1](a) A.R. Peacocke, "The Theory of Relativity and Our World View," in Maurice Goldsmith, Allen MacKay and James Woudhusen, eds. *Einstein: The First Hundred Years* (New York: Pergamon Press, 1980) pp. 73–91. (b) Thomas F. Torrance, *Transformance & Convergence in the Frame of Knowledge* (Grand Rapids: Wm. B. Eerdmans Publishing Co., 1984). (c) Ian Paul, *Science and Theology in Einstein's Perspective* (Edinburgh: Scottish Academic Press, 1986). (d) Harold P. Nebelsick, "Theological Clues From the Scientific World," *Journal of the American Scientific Affiliation 38* (1986), pp. 110–121. (e) Ralph G. Mitchell, *Einstein and Christ: A New Approach to the Defense of the Christian Religion* (Edinburgh: Scottish Academic Press, 1987).

[2]Abraham Pais, *'Subtle is the Lord . . .': The Science and Life of Albert Einstein* (New York: Oxford University Press, 1982), p. 307.

[3]*Ibid.*, p. 306.

[4]Lewis Elton, "Einstein, General Relativity, and the German Press: 1919–1920," *Isis 77* (1986), pp. 95–102.

[5]Pais, *op. cit.*, p. 315.

[6]Ronald W. Clark, *Einstein: The Life and Times* (New York: The World Publishing Co., 1971), p. 245.

[7]Arthur Eddington, *Space, Time and Gravitation: An Outline of General Relativity Theory* (Cambridge: Cambridge University Press, 1920), p. 200.

[8]Robert A. Handy, *A History of Churches in the United States and Canada* (Oxford: Oxford University Press, 1976), p. 286.

[9]Bernard Ramm, *The Christian View of Science and Scripture* (Grand Rapids: Wm. B. Eerdmans Publishing Co., 1955), p. 27.

[10]*Ibid.*, p. 26.

[11]John Macquarrie, *Twentieth-Century Religious Thought: The Frontiers of Philosophy and Theology, 1900–1960* (New York: Harper & Row, 1963), p. 226.

[12](a) H. Wildon Carr, "The Metaphysical Aspects of Relativity," *Nature 106* (1921), pp. 809–811. (b) H. Wildon Carr, "Metaphysics and Materialism," *Nature 108* (1921), pp. 247–248. (c) Norman R. Campbell, "A Response to Carr," *Nature 108* (1921), pp. 399–400. (d) H. Wildon Carr, "A Response to Campbell," *Nature 108* (1921), p. 400. (e) Hugh Elliot, "A Response to Carr," *Nature 108* (1921), p. 432. (f) H. Wildon Carr, "A Response to Elliot," *Nature 108* (1921), p. 467. (g) Edmund McClure, "A Response to Campbell," *Nature 108* (1921), p. 467. (h) Harold Jeffreys, "A Response to Campbell and Elliot," *Nature 108* (1921), p. 568. (i) S.V. Ramamurty, "A Response to Carr, et. al.," *Nature 108* (1921), p. 569. (j) Norman R. Campbell, "A Response to McClure," *Nature 108* (1921), p. 569.

[13]Orrock Colloque, "Einstein and Catholic Theology," *American Church Monthly 6* (1920), p. 525.

[14]Leslie Walker, "Concerning Einstein," *Dublin Review 171* (1920), p. 275.

[15][anon.], "Relativity in Religion," *Homiletic Review 83* (1922), p. 27.

[16]J. O. Patterson, "Relativity: Some Metaphysico-Theological Considerations," *The Ecclestical Review 66* (1922), pp. 263, 256.

[17]Austin Hopkinson, "Relativity and Revelation," *Hibbert Journal 21* (1922–23), pp. 54, 55.

[18]Albert Clarke Wyckoff, "The Downfall of the Mechanistic Dynasty," *Biblical Review 16* (1931), pp. 331, 343.

[19]F.J. McConnell, "Relativity and Theism," *Methodist Review 107* (1924), p. 17.

[20]C. Bruehl, "Theory of Einstein and Scholastic Epistemology," *Ecclestical Review 64* (1921), p. 305.

[21]C. Dawes Hicks, "Recent Philosophical Literature," *Hibbert Journal 19* (1920–21), p. 158.

[22]N.G. Augustus, "Re Einstein," *Methodist Quarterly Review 73* (1924), pp. 477, 485.

[23]*Ibid.*, p. 477.

[24]Archibald Robertson, "Revelation and Relativity: How it Strikes a Bishop," *Hibbert Journal 21* (1922–23), p. 534.

[25]F.L. Cross, *Religion and The Reign of Science* (London: Longmans, Green and Company, 1930), p. 36.

[26]Herbert Dingle, "Physics and God," *Hibbert Journal 27* (1928), p. 46.

[27]Joseph Whitney Dudley, "A Revolution in Astronomy," *The Bible Champion 35* (1929), p. 209.

[28]M. Green, "The New Revolution in Science and Its Implications for Religious Faith," *Homiletic Review 99* (1930), p. 3.

[29]C.W. O'Hara, in *Science and Religion: A Symposium* (London: Gerald Howe Ltd., 1931), p. 111.

[30]Burnett Hillman Streeter, *Reality: A New Correlation of Science and Religion* (New York: MacMillan Co., 1926), p. 31.

[31]Theodore Grabner, "Is the New Science Hostile to Religion?" *Concordia Theological Monthly 3* (1932), p. 921.

[32]Robert A. Millikan, *Evolution in Science and Religion* (New Haven: Yale University Press, 1927), p. 28.

[33]F.R. Tennant, "The Present Relation of Science and Theology," *Constructive Quarterly 10* (1922), p. 284.

[34]Green, *op. cit.*, p. 5.

[35]L. Franklin Gruber, "The Einstein Theory," *Bibliotheca Sacra 79* (1922), p. 88.

[36]Patterson, *op. cit.*, p. 259.

[37]J. Arthur Thompson, *Science and Religion* (New York: Scribners and Sons, 1925), p. 104.

[38]O'Hara, *op. cit.*, p. 113.

[39]Coles, *op. cit.*, p. 123.

[40]McConnell, *op. cit.*, p. 18.

[41]Patterson, *op. cit.*, p. 261.

[42]Hopkinson, *op. cit.*, p. 58.

[43]Robertson, *op. cit.*, p. 530.

[44]Tennant, *op. cit.*, pp. 287–289.

[45]Ray H. Dotterer, "The Einstein Theory From the Standpoint of Philosophy," *Reformed Church Review 2* (1923), pp. 234, 235.

[46]Robertson, *op. cit.*, p. 529.

[47]Gerald Holton, in *Some Strangeness in the Proportion*, Harry Woolf, ed. (Reading, MA: Addison-Wesley Pub. Co., Inc., 1980), p. 57; and Note 21, p. 63.

[48]Colloque, *op. cit.*, p. 529.

[49]J.H. Morrison, "The New Physics and Religious Thought," *The Expository Times 40* (1928–29), p. 380.

[50]Colloque, *op. cit.*, p. 526.

[51]*Ibid.*, p. 530.

[52]Green, *op. cit.*, p. 6.

[53]William B. Smith, "Relativity," *Mind 31* (1921), p. 510.

[54]Harry Elmer Barnes, *The Twilight of Christianity* (New York: The Vangard Press, 1929), pp. 357, 358.

[55]J.H. Randall, Jr., "The Effects of Science and Industry on Religion, I. The Forces That Are Destroying Traditional Belief," *Current History 30* (1929), pp. 360–361.

[56]Herbert Dingle, *The Sources of Eddington's Philosophy* (Cambridge, England: Cambridge University Press, 1954), pp. 28, 29.

[57]Macquarrie, *op. cit.*, p. 264.

[58]Robert P. Crease and Charles C. Mann, *The Second Creation: Makers of the Revolution in 20th-Century Physics* (New York: Macmillan Pub. Co., 1986), p. 40.

[59]Thomas F. Torrance, *Theology in Reconciliation* (London: Geoffrey Chapman, 1975), p. 270.

[60]Thomas F. Torrance, *Christian Theology and Scientific Culture* (New York: Oxford University Press, 1981), pp. 12, 18.

[61]*Ibid.*, pp. 31, 39.

[62]Peacocke, *op. cit.*, pp. 75, 77, 83, 86.

[63]Barrie Britton, "Evolution by Blind Chance," *Scottish Journal of Theology 39* (1986), p. 351.

A History and Analysis of the 15.7 Light Year Universe

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In 1953, Moon and Spencer proposed that radiation from very distant parts of the universe would reach the earth in no more than 15.7 years. Their proposal was based on an earlier theory of Walter Ritz (1908) who argued that the speed of light relative to an observer was dependent upon the motion of the source, and not constant as claimed by Special Relativity. Moon and Spencer's results were well received among young-earth creationists as a way of circumventing the great age of the cosmos implied by the travel time of light from various objects in the universe. This paper discusses the history of the Ritz hypothesis and its impact on the discussion of the speed of light. It is shown that both the Ritz hypothesis and the resulting proposal by Moon and Spencer were in error. Nevertheless, Moon and Spencer's proposal continued to be promulgated by some young-earth creationists even after crucial experiments had proved it false.

Introduction

Objects in the universe are observed by virtue of the radiation they emit. On the basis of strongly supported theories dealing with the formation and propagation of radiation, astronomers have been able to determine distances from Earth to extremely remote segments of the universe.[1] If one assumes that the radiation received from a distant object was generated by the object itself, and that the radiation traversed the distance between the object and Earth at a constant velocity, then the universe is at least as old as the radiation's travel time. Since radiation from some objects has taken billions of years to arrive, the universe is at least billions of years old.

A common young-earth retort to the above astronomical argument for an extremely old universe is to claim that objects were created with their radiation *en route* to Earth. That is, both the object and the radiation appearing to emanate from it were created simultaneously. Although distance measurements may be accurate, *no* correlation exists between distance and age. Hence, the universe may seem billions of years old, but its actual age is only a few thousand years.

In a continuing effort by young-earth creationists to show the youth of the universe, another explanation has been promoted which allows material bodies to be located at great distances while the light-travel time from them remains quite short, on the order of 15.7 years. The ensuing discussion deals with the history and validity of this latter explanation.

Historical Background

Ever since the formulation of Einstein's second postulate of Special Relativity—that the velocity of light in a vacuum is independent of the motion of either the source or of the observer—many have attempted to give an alternate theory which retains so-called Galilean relativity.[2] The difference between Einsteinian and Galilean relativity can be seen in the following example.

Suppose an airplane is moving with a speed of 1000 ft/sec and that it fires its machine guns in the forward direction. Suppose further that the bullets leave the gun with a speed of 2000 ft/sec. To an observer on the ground who is being attacked by the plane, the bullets would move at a speed of 2000 + 1000 = 3000 ft/sec. (Needless to say, we have a very dedicated physicist on the ground who is more interested in the results of the experiment than in saving his or her life!)

Now suppose that the plane is moving away from the observer and that its aft guns are firing bullets at the same speed as before. In this case, the bullets pass the observer with a speed of only 2000 − 1000 = 1000 ft/sec. In short, Galilean relativity states that the relative velocity between moving objects is found by the algebraic addition of the velocity vectors of these objects. In the above example, all velocities are parallel, so the simple addition and subtraction of the speeds of the plane and of the bullets is permitted.

Einsteinian relativity, on the other hand, operates quite differently. Suppose now that the plane is moving at a very great speed, say one-half the speed of light, and that it shoots laser beams which travel at the speed of light in a vacuum (henceforth called the "normal speed of light"). As the plane attacks the observer on the ground, one would think that the laser beams would dash by the observer with a speed of one and one-half times the normal speed of light. On the contrary, ground measurements would show that the laser beams pass with a speed no more than the normal speed of light. The same situation holds as the plane moves away from the observer. Again, the speed of the laser beams does not change. In fact, regardless of the motion of the plane, the laser beam speed would continue to be that of the normal speed of light, no more and no less. Simple addition in the Galilean sense does not work. This observed constancy of the velocity of light, regardless of the motion of the source or of the observer, is a cornerstone of Einstein's Theory of Special Relativity.

Other intriguing predictions in Einsteinian relativity are: no material object can travel faster than the normal speed of light; material objects gain mass as they gain momentum; moving clocks run slower compared to non-moving clocks; and a stick moving parallel to its length becomes shorter. All of these effects, except the last one, have been experimentally verified; hence, in spite of strange effects, Einstein's theory has long been held as the proper formulation for explaining kinematic and electromagnetic phenomena. Nevertheless, since the consequences of his theory contradict everyday human experience, various efforts have been made to explain high speed physical phenomena without abolishing ordinary (i.e., Galilean) ideas of space and time.

The most serious contender to Einstein was Walter Ritz. In 1908, he argued for the constancy of the velocity of light with respect to the emitting source.[3] An observer would then find that the velocity of light depends upon the relative velocity between his or herself and the source. Although Ritz's hypothesis was in keeping with Michelson and Morley's classic result[4], later experiments raised serious questions about his proposal. In 1913, Willem de Sitter argued that Ritz's assumption would introduce spurious eccentricities in the observed orbits of binary stars.[5] Visually, the system would appear more eccentric than allowed by the laws of mechanics. De Sitter's effect would arise because the light from the component of the binary system moving towards Earth would travel faster than light from the same component moving away from Earth. In effect,

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circular orbits would appear elliptical. But de Sitter noticed no such effects to an experimental accuracy of one part in five hundred.

In 1942, Peter Bergmann argued that the Ritz hypothesis would produce multiple star images in visual binaries.[6] Again, no such effects were detected, and the negative results of the above observations were used as evidence against the Ritz hypothesis.

Astronomers, however, do not use meter sticks to measure distances; they use the radiation emitted by the objects.

In 1953, however, Parry Moon and Domina Spencer analyzed a number of visual binaries to see whether the phenomenon predicted by Bergmann would even be visible in the first place.[7] They assumed the Ritz hypothesis[8], but their computations showed that Bergmann's predicted multiple images for binaries would not, in fact, be observed. (They do not elaborate on de Sitter's prediction of spurious eccentricities, and they do not mention whether they reexamined his data or not.) Hence, they concluded that visual binaries proved absolutely nothing about the constancy of the velocity of light. In the same article, Moon and Spencer performed a similar analysis of spectroscopic binaries and of Cepheid variables.[9] They concluded that the Ritz hypothesis *would* produce spurious spectral lines, but no such phenomenon was observed.

Moon and Spencer gave two possible explanations for the negative spectroscopic results: (a) the velocity of light is constant after all, in favor of Einstein, and the Ritz hypothesis is wrong; or (b) the velocity of light is constant with respect to the source, in favor of Ritz, but space is curved. In the latter case, although astronomical space is unchanged, the time for light to reach the earth is greatly reduced, thereby eliminating the time differential necessary to observe multiple spectral images. In their own words:

> Assume that light travels in a Riemannian [i.e., curved] space. The usual distance . . . employed by astronomers is unchanged as regards material bodies; but for light, it is replaced by the corresponding Riemannian distance. . . . In essence, therefore, the method of this paper leaves astronomical space unchanged but reduces the time required for light to travel from a star to the earth.[10]

By appealing to their data, these authors fixed the radius of curvature of the universe at five light years. In such a universe, light from the most distant objects would reach the Earth in only 15.7 years (one-half of the circumference of a five light year circle), thereby ensuring that the predicted effects of Bergmann (and de Sitter?) would not be seen.

Subsequent to Moon and Spencer, new life was breathed into the Ritz hypothesis by J.G. Fox (ref. 2). Fox argued as follows: The velocity of the radiation emitted by a source is not the critical factor. What really matters is its velocity after passing through a medium. If this medium is stationary, or moving very slowly with respect to the observer, then the velocity of the radiation is slowed down to the normal velocity of light. That is, even though the velocity of the radiation emitted by an object may initially differ, even greatly, from the normal velocity of light, passage of this radiation through a stationary medium of sufficient optical depth will destroy any evidence of the radiation's initial speed. (This is known as the Ewald and Oseen extinction effect.) Radiation will appear to travel at its normal speed regardless of its initial speed. And since binary stars and Cepheid variables are enveloped in gas which can "extinguish" the initial speed of the emitted radiation, *no* evidence can be deduced from the observations of de Sitter and Bergmann to disprove the Ritz hypothesis. Hence, even as late as the early 1960's, we were left with no direct proof, astronomical or otherwise, for the validity of Einstein's postulate on the constancy of the velocity of light.

Does this imply that Moon and Spencer were correct? Is the universe so small that light from its most distant parts takes only 15.7 years to arrive to earth?

Discussion

Let us look at the difficulties with Moon and Spencer's formulation. First, Moon and Spencer, in effect, want to place the material bodies of the universe at a different location than what is inferred from the radiation they emit. Pay careful attention to their statement that "the usual distance . . . employed by astronomers is unchanged as regards material bodies; but for light, it is replaced by the corresponding Riemannian distance. . . . "[11] They would have a point if astronomers measured distances by laying meter sticks end-to-end from Earth to the object whose distance they are measuring, and then compared this result to that obtained by analyzing the radiation emitted by the object. A variation in these distance measurements could then be attributed to a difference in the path used by the radiation compared to the one in which the meter sticks were laid. Astronomers, however, do not use meter sticks to measure distances; they use the radiation emitted by the objects (ref. 1). Hence, the distance inferred by astronomers is precisely the light-travel distance, or

Moon and Spencer's so-called "Riemannian distance." One cannot speak of a "usual distance" as being different from a "Riemannian distance."[12]

Second, while the Moon and Spencer hypothesis explains the lack of multiple images in spectroscopic binaries and Cepheid variables, it introduces its own multiple images. A universe as small as they propose would be full of images resulting from the bending of radiation emitted from nearby sources. In effect, their hypothesis implies that objects which we observe are composed of nothing more than the overlapping reflections of a few nearby sources. Are we really to believe that the great Andromeda Galaxy, whose millions of individual stars can be resolved, is only a composite of multiple reflections of a few stars near Earth which happen to appear in the form of a spiral galaxy? The situation would be analogous to sitting in a barber's chair between two parallel mirrors that produce a series of images which fade into an apparent distance.

Observations of both terrestrial and extra-terrestrial phenomena have shown once and for all that Ritz's hypothesis is invalid. . . . Since Moon and Spencer based their hypothesis on Ritz, their proposal should have been abandoned as early as 1964 and not used in discussions on the age of the universe.

Third, with a Riemannian curvature of only five light years, objects farther than about 7.8 light years (circumference divided by four) would exhibit an increase in apparent size with distance.[13] This means that a diffuse object, like a nebula, situated close to 15.7 light years away from Earth would fill almost the entire sky. It would be like looking at a curved mirror from its focal point: the reflection of one's eye would be seen covering the entire surface of the mirror!

Fourth, Akridge (ref. 5) has pointed out that a universe as small as the one proposed by Moon and Spencer, which contains the universe's present mass, would require a density which is totally unacceptable.

For all the above reasons, Moon and Spencer's solution should have been abandoned from its inception rather than touted as an answer to the astronomical age problem.

But is Fox's criticism—that the observations of de Sitter and Bergmann did not take the Ewald and Oseen extinction effect into account—still valid? Definitely not, for by 1964 direct evidence for the validity of Einstein's postulate on the velocity of light was provided by a number of experimenters: D. Sadeh; T.A. Filippas and J.G. Fox; and T. Alvager et al.[14] All of these experimenters measured the velocity of gamma rays which had been emitted by decaying subatomic particles moving at nearly the speed of light. In every case, the velocity of the gamma rays equalled that of the normal velocity of light in free space. In no case did the velocity of the gamma rays behave as proposed by Ritz.

In addition to the above Earth-based experiments, in 1977 K. Brecher used radiation from pulsars (rotating neutron stars which emit radiation in a periodic manner) to show that the speed of light was independent of the motion of the source.[15] Neither Brecher's experiment nor the ones mentioned in the preceding paragraph were subject to Fox's criticism. Hence, observations of both terrestrial and extra-terrestrial phenomena have shown once and for all that Ritz's hypothesis is invalid. Similarly, since Moon and Spencer based their hypothesis on Ritz (ref. 8), their proposal should have been abandoned as early as 1964 and not used in discussions on the age of the universe. In the same manner, one must also reject any attempt to fix the universe's radius of curvature at the ridiculously low value proposed by Moon and Spencer.[16]

Young-Earth Reaction to Moon and Spencer

In spite of the inherent difficulties and contrary experimental evidence, numerous young-earth creationists seized upon the proposal of Moon and Spencer as an answer to the problem of light-travel time from distant objects in the universe. In 1961, Whitcomb and Morris commented that "the very fact that such a theory can be developed and seriously considered demonstrates that astronomy has nothing really *definite* [their emphasis] as yet to say about the age of the universe."[17] It is true that in 1961 there was no conclusive experimental evidence for the validity of the constancy of the speed of light; but it is unfortunate that these authors did not realize the intrinsic weaknesses of Moon and Spencer's proposal and reject it outright. In 1971, Harold Slusher accepted Moon and Spencer's results as being "in line with a number of physical indicators that the universe is quite young."[18] George Mulfinger, in his 1973 review article on astronomy, declared that "to the best of my knowledge this

original paper [Moon and Spencer] has never been refuted."[19] Ten years later, in 1983, Richard Niessen accepted the Moon and Spencer hypothesis as a possible harmonization of a young universe with the "allegedly great distances of the outer galaxies."[20] Unfortunately, Niessen's proclamation was repeated by later authors.[21] And as late as 1985, A.J. Monty White asserted that Moon and Spencer's view was the scientific explanation "most favoured by creationists."[22]

And so it has gone. A proposal of dubious scientific value, later discredited by experiment, was uncritically accepted and promoted by numerous young-earth creationists as an answer to the problem of light-travel time from distant regions of the universe.

Ideas have always been debated in scientific circles. Some ideas remain and others are rejected when appropriate evidence is uncovered. It is a matter of integrity, however, that those who engage in the battle of ideas will have done a thorough literature search and that they will be knowledgeable in their evaluation of the evidence. But we find that the material written by some young-earth creationists concerning Moon and Spencer failed in thoroughness—crucial experiments were unknown or neglected—and in knowledge, as Moon and Spencer's idea was accepted in spite of its bad astronomy. On both counts, a trust that exists among scientists was violated. This not only affects the way in which non-Christians view "creation science," it also adversely affects the way they view the Gospel. If Christians cannot be trusted to be truthful and/or competent in the area of science, why should they be trusted when speaking about the validity of Christianity?

It is most unfortunate that the non-Christian world has been provided with yet another example of questionable scientific investigation by some young-earth creationists.[23]

NOTES

[1]Any elementary astronomy text will discuss how astronomers measure distances by utilizing the radiation emitted by the objects whose distance is being measured. Also see David J. Krause's summary in "Astronomical Distances, the Speed of Light, and the Age of the Universe," *Journal of the American Scientific Affiliation 33*, (1981), pp. 235–9. A detailed explanation appears in Michael Rowen-Robinson, *The Cosmological Distance Ladder: Distance and Time in the Universe* (New York: Freeman, 1985).

[2]Histories of these attempts are found in W. Panofsky and M. Phillips, *Classical Electricity and Magnetism* (Reading, MA: Addison-Wesley, 1962), pp. 272–84; W. Pauli, *Theory of Relativity*, trans. by G. Field (Oxford: Pergamon Press, 1958), pp. 1–9; J.G. Fox, "Evidence Against Emission Theories," *American Journal Physics 33*, (1965), pp. 1–17.

[3]See ref. 2. Ritz's original article appeared in *Annales de Chimie et Physique 13*, (1908), p. 145.

[4]As an aside, D.C. Miller's apparent contradictory evidence to Michelson and Morley has been reanalyzed by R.S. Shankland and found to be consistent with other observations which have reproduced Michelson and Morley's result. See D.C. Miller, "Observations with Sunlight on July 8–9, 1924," *Proceedings of the National Academy of Sciences 11*, (1925), p. 311; and R.S. Shankland et al., *Reviews of Modern Physics 27*, (1955), p. 167.

[5]Helpful explanations of effects caused by differing speeds of light emitted by the same source are given by Krause, ref. 1, p. 237, and by G. Russell Akridge, "The Universe is Bigger than 15.71 Light Years," *Creation Research Society Quarterly 21*, (1984), pp. 18–22. De Sitter's work appeared in *Physikalische Zeitschrift 14*, (1913), pp. 429, 1267.

[6]Peter G. Bergmann, *Introduction to the Theory of Relativity* (New York: Prentice Hall, 1942). Also see the explanation by Akridge, ref. 5, p. 18.

[7]Parry Moon and Domina E. Spencer, "Binary Stars and the Velocity of Light," *Journal of the Optical Society of America 43*, (1953), pp. 635–41.

[8]The Moon and Spencer hypothesis is intimately connected to Ritz's idea. On page 639 of their article, they refer favorably to Ritz three times. These authors support the Ritz idea because they see their view as "a simple and reasonable world picture that allows all of our ordinary ideas of local space and time to remain unchanged." (p. 641)

[9]Spectroscopic binaries are binary stars which are too far away and/or in which the component stars are too close together to be seen visually. Spectroscopic binaries are detected by observing periodic Doppler shifts in the position of spectral lines as a result of the motion of each component. Cepheid variables are bright stars which vibrate (expand and contract) at a fixed rate that correlates with their intrinsic brightness. The vibration is inferred from the periodic change in the star's intensity, thereby allowing astronomers to find the distance to Cepheids by comparing their observed brightness to their intrinsic brightness.

[10]Moon and Spencer, ref. 7, p. 639.

[11]*Ibid.*

[12]How unfortunate that this fact was not grasped by Paul Steidl, who discusses Moon and Spencer in such a manner as to leave his readers believing the their proposal is viable, albeit "exotic." See *The Earth, the Stars, and the Bible* (Philadelphia: Presbyterian and Reformed Pub. Co., 1979), p. 224. Any explanation which places objects of the universe in "flat space" while having light travel in "Riemannian space" is completely untenable!

[13]Martin Harwit, *Astrophysical Concepts* (New York: Wiley, 1973), p. 441; Steven Weinberg, *Principles and Applications of the General Theory of Relativity* (New York: Wiley, 1972), pp. 418–27.

[14]D. Sadeh, "Experimental Evidence for Constancy of the Velocity of Gamma Rays, Using Annihilation in Flight," *Physical Review Letters 10*, (1963), pp. 271–73; T.A. Filippas and J.G. Fox, "Velocity of Gamma Rays from a Moving Source," *Physical Review 135*, (1964), pp. B1071–75; T. Alvager, F.J.M. Farley, J. Kjellman, and I. Wallin, "Test of the Second Postulate of Special Relativity in the GeV Region," *Physics Letters 12*, (1964), pp. 260–62.

[15]Kenneth Brecher, "Is the Speed of Light Independent of the Velocity of the Source?", *Physical Review Letters 39*, (1978), pp. 1051–54.

[16]Numerically, the present radius of curvature of the universe, in light years, is on the order of its age, in years.

[17]John C. Whitcomb and Henry M. Morris, *The Genesis Flood* (Philadelphia: Presbyterian and Reformed Pub. Co., 1961), p. 370.

[18]Harold Slusher, "A Scientist Explains," *Science and Scripture* (Mar/Apr, 1971), pp. 369–70.

[19]George Mulfinger, Jr., "Reviews of Creationist Astronomy," *Creation Research Society Quarterly 10*, (1973), p. 174.

[20]Richard Niessen, "Starlight and the Age of the Universe," *Impact 121* (July, 1983). *Impact* is a monthly publication of the Institute for Creation Research.

[21]Frederic R. Howe, "The Age of the Earth: An Appraisal of Some Current Evangelical Positions (Part 2)," *Bibliotheca Sacra* (April/June, 1985), p. 119; Stephen R. Schrader, "Was the Earth Created a Few Thousand Years Ago?" in *The Genesis Debate: Persistent Questions about Creation and the Flood*, ed. by Ronald Youngblood (Nashville: Thomas Nelson, 1986), p. 67.

[22]A.J. Monty White, *How Old is the Earth?* (Welwyn, Herts., England: Evangelical Press, 1985), pp. 103–5.

[23]For other examples of using outdated astronomical evidence to support a young universe, see my "Meteoritic Influx and the Age of the Earth," *Journal of the American Scientific Affiliation 28*, (1976), pp. 14–16. Reprinted in *Origins and Change: Selected Readings from the Journal of the American Scientific Affiliation*, ed. by David Willis (Elgin, IL: American Scientific Affiliation, 1978). Also see Howard J. Van Till, "The Legend of the Shrinking Sun: A Case Study Comparing Professional Science and 'Creation-Science' in Action," *Journal of the American Scientific Affiliation 38*, (1986), pp. 164–174.

Self-Reproducing Automata and the Origin of Life

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The minimal complexity needed for life is examined by assuming that the simplest living thing is a self-reproducing automaton. The work of von Neumann, Codd and Langton in designing mathematical models for such automata is briefly reviewed, and Langton's very simple self-reproducing automaton is described in detail. The complexity of Langton's automaton strongly suggests that life is designed rather than accidental.

In recent decades a number of scientists have been active in seeking to demonstrate that life arose from inanimate matter by purely natural processes.[1] Most of their work has consisted of studying the biochemistry of simple life forms to propose steps by which the necessary level of complexity could be reached by chemical reactions, whether of greater or lesser likelihood.

To facilitate such proposals, various assumptions have been made about the nature of the earth's early atmosphere, about energy sources necessary to drive the needed reactions, and about specialized environments in which inorganic chemicals might be converted to simple organics such as sugars, amino acids and nucleotides. Some work has also been done in seeking to polymerize such simple organics to produce the very complex biopolymers such as proteins and the nucleic acids DNA and RNA which are the crucial biochemicals of living cells. The results to date have not been particularly persuasive.[2]

The great complexity of biopolymers such as DNA and proteins has made it difficult to understand how present-day life chemistry could have been produced by purely natural processes. The jump in complexity from simple organics to such biopolymers is much too large to be explained by a series of purely random processes. In response to this difficulty, those who envision a strictly naturalistic origin of life claim that some much smaller molecular arrangements may have existed which were capable of self-reproduction, and which were formed by prebiological selection processes. Such molecules then evolved by mutation and natural selection—a process viewed as a powerful way of producing order in an otherwise random situation—to the large, complex proteins and nucleic acids used today. These smaller molecules were eventually rendered obsolete by their more complex descendants, and so passed off the scene.

In this paper, we do not intend to examine this claim directly by a discussion of biochemistry. Instead we wish to investigate the mathematical complexity of self-reproduction. For those who propose a naturalistic origin of life, a definition of a living thing as a self-reproducing machine should be satisfactory, even if others regard such a definition as too simple. What, then, can we find out mathematically about the simplest structure that can reproduce itself? How complex is such a structure? What is the likelihood that such a

structure might have formed randomly in the available time and space our universe provides? Such questions lead us to the mathematical theory of self-reproducing automata.

Von Neumann's Self-Reproducing Automaton

A survey of the literature indicates that the first person to design a mathematically feasible machine that reproduces itself was John von Neumann (1903–1957). A native of Hungary, von Neumann came to the U.S. in 1930 after earning his doctorate in mathematics at the University of Budapest. In 1931 he became a professor at Princeton University, and two years later a member of the Institute for Advanced Study there. Von Neumann was unusual among mathematicians, being interested in applications of all sorts and in being able to communicate easily with scientists and engineers. During World War II he was active in military applications of mathematics, and later served on the U.S. Atomic Energy Commission.

Although von Neumann invented the mathematical theory of games and made important contributions to both ergodic theory and the mathematical foundations of quantum mechanics, we are here interested in his pioneering work in computers, which eventually led to his mathematical theory of self-reproducing automata. Von Neumann entered the field of computers through the problem of solving non-linear partial differential equations. Here, he came to realize that mathematics had reached a stalemate in trying to obtain general solutions to such equations, but that specific cases could be solved numerically. These solutions could then be used as a guide to theorizing about general solutions.

Since numerical solutions to such equations are quite time consuming when done by hand, von Neumann did some of the earliest work on electronic computers. He was a consultant on several early models (ENIAC, EDVAC and JONIAC), suggesting improvements in physical design and memory. He also invented the idea of using flow charts for program design, and pioneered the concept of using one language for the computer and another for the programmer. In working out a theory for automatic control of computers by internal programs, he was led to a mathematical theory of automata.

In all, von Neumann produced five works on automata: (1) "General and Logical Theory of Automata," written in 1948 and published in 1951; (2) "Theory and Organization of Complicated Automata," five lectures given in 1949; (3) "Probabilistic Logics and the Synthesis of Reliable Organisms from Unreliable Parts," 1952; (4) "Theory of Automata: Construction, Reproduction, Homogeneity," 1952–53; and, (5) *The Computer and the Brain*, written 1955–56 and published in 1958. Items one and three are included in volume 5 of von Neumann's collected works[3]; item five was published as a separate book[4]; items two and four, in which we are particularly interested, were published posthumously as *The Theory of Self-Reproducing Automata*.[5]

Though von Neumann intended to eventually design a mathematical model of reproduction that would realistically simulate a simple living organism, he only lived long enough to sketch out details for a much more abstract automaton that would make a copy of itself. This automaton was completed (with a few minor corrections) by Arthur Berks. Let us look briefly at von Neumann's automaton as a preparation for our further discussion of a much simpler automaton.

Von Neumann imagined his self-reproducing automaton as an organized collection of small automata which can be represented as individual computer chips filling a large two-dimensional plane. These chips are rectangular and linked to each of their four nearest neighbors. Each chip can be in any one of 29 different states, which include a quiescent or "turned-off" state, several "warm-up" states for converting the quiescent state into functional states, and finally several functional states which would transmit information in various directions or serve as junctions for information transmission.

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Von Neumann's self-reproducing automaton consisted of imposing certain initial state-values on a set of chips at time t = 0, in such a way that this set of chips would subsequently send out a construction arm and convert a quiescent set of chips nearby into a copy of itself. This automaton was rather complex, requiring an array of some 300 × 500 chips for the memory control unit, something similar for the construction unit, and a "tail" of some 150,000 chips to store information on the details of the automaton to be built.[6]

Von Neumann's self-reproducing automaton is notable, like early computers, mainly for showing that such a machine is feasible. Its enormous complexity, however, hardly gives encouragement to those who hope that a self-reproducing machine might happen by itself.

Langton's Simple Self-Reproducing Automaton

In the years since von Neumann's proposal, various attempts have been made to simplify his automaton. E.F. Codd, for instance, was able to design an automaton in which each of the constituent computer chips needed only eight states instead of von Neumann's 29.[7] Yet Codd's automaton was still as complex as a typical electronic computer, and thus hardly likely to happen by chance.

Von Neumann's self-reproducing automaton is notable, like early computers, mainly for showing that such a machine is feasible. Its enormous complexity, however, hardly gives encouragement to those who hope that a self-reproducing machine might happen by itself.

Recently, Christopher Langton has proposed a drastic simplification of von Neumann's automaton, following up on some ideas suggested by Codd.[8] Langton notes that the automata of von Neumann and Codd were unnecessarily complex because each was designed to be able to make any kind of automaton (depending on the information stored in the machine's long tail). Thus, each made copies of themselves as a special case of their capabilities as universal constructors. Langton notes that nothing so complicated as this is necessary, since the living things we are trying to mimic only make copies of themselves, not of some drastically different life forms. Langton thus abandons the idea that the automaton must be able to make other kinds of automata, and seeks the simplest machine that will make only a copy of itself. In what follows, let us go into some detail in order to appreciate Langton's simple self-reproducing automaton.

Following Codd, Langton represents the array of computer chips mathematically as a two-dimensional array of numbers, one for each chip, which specify the state in which each chip is presently functioning. Zero is used to represent the chip in its quiescent state, and the numbers 1 through 7 represent the other functional states. The automaton can thus be represented mathematically as a two-dimensional matrix of numbers which change with each unit of time as the machine functions.

The state of a particular chip at time t is calculated from its own state at the previous time-step t − 1 as well as the states of its neighbors at t − 1. What the seven functional states of the chip actually do in the machine can be chosen by the designer as he or she selects the set of "transition rules" which govern how each state changes with time. Following Codd, Langton defines state 1 as an element of a datapath. State 2 is used for elements of sheath material which protect the datapath. States 1 and 2 work somewhat like a nerve cell, which has a central core transmitting its signal protected by a sheath to keep the signal from straying, or like an insulated electric wire, as in Figure 1.

```
2 2 2 2 2 2
1 1 1 1 1 1
2 2 2 2 2 2
```

Figure 1

The remaining numbers, now just 3 through 7, give us five signals which can be defined to tell the automaton to carry out various functions. Typically these signals will move along a datapath of 1's. The direction of movement of a signal is specified by making each signal a pair of digits, the leading digit being one of the numbers 3 through 7, the following digit a zero. Figure 2 shows a 7 signal which will move to the right one step for each unit of time.

```
2 2 2 2 2 2
1 0 7 1 1 1
2 2 2 2 2 2
```

Figure 2

Datapaths form junctions where a path splits in two, as in Figure 3.

```
  2 1 2
  2 1 2
2 2 2 1 2 2 2
1 1 1 1 1 1 1
2 2 2 2 2 2 2
```

Figure 3

When a signal approaches such a junction coming, for example, from the left, it will split into two copies of the signal, one following each of the other datapaths, as in Figure 4.

Given these features, we can design a simple device which will send a periodically repeating signal along a datapath. We simply make a closed loop with an open "tail" in one corner, as in Figure 5.

```
2 2 2 2 2 2 2
2 1 1 1 1 1 2
2 1 2 2 2 1 2
2 1 2   2 1 2
2 1 2 2 2 1 2 2 2
2 1 1 0 7 1 1 1 1
2 2 2 2 2 2 2 2 2
```

Figure 5

The device shown will continually circulate its 7 – 0 signal counterclockwise around the small loop (or square, if you prefer), sending a 7 – 0 signal down the path to the right once every time the signal in the loop comes around to the junction at the lower right corner.

All this was noticed by Codd. It took the genius of Langton to observe that in this one simple device we already have the makings of a self-reproducing machine, without adding a lot of additional complexity.

Suppose the 7 – 0 signal is so defined that, when it strikes the end of a datapath, it lengthens the datapath by one unit, as in Figure 6.

Now, suppose the 4 – 0 signal is so defined that a *pair* of such signals striking the end of a datapath causes the path to make a lefthand corner. It turns out that we need to use another state, 3 for example, as an intermediate step in this maneuver, leaving us with just two states, 5 and 6, for anything else we want to do.

At this point, we have the machinery necessary to send a repeating signal around a loop of the proper size such that the signal can extend the loop's arm (or tail) **n** units, and then make the arm turn left. If we have the signal go around the loop four times, it will make the arm fold itself around into another loop, and we can design this new loop to be the same size as the original loop.

With some judicious choices for the transition rules, remembering that these rules govern how a chip changes state at the next time-step on the basis of its previous state and the state of its four neighbors, we can design the two remaining signals, 5 and 6, to arise when a signal going around the new loop collides with a signal coming from the old loop. The 5 and 6 move away from the collision area in opposite directions. The 5 disconnects the "daughter" loop from the "mother," and causes the mother to form a new arm at the next corner counterclockwise from the original arm, where it will then begin the process of forming another daughter loop. The 6 makes a new arm on the daughter loop, so that it can begin to form a "grand-daughter."

Doubtless it took Langton a lot of experimenting to find the simplest such machine that worked, but he eventually came up with a loop ten units on a side, possessing a five-unit arm and storing its construction information in a sequence of six 7 – 0 signals followed by two 4 – 0 signals. This machine, with the signals properly located at time t = 0 (as in Figure 7), will first extend its arm six units and then make a left corner. By then, the information will have cycled around the loop once and come back again, extending the arm in the new direction six units and turning left again. In 35 time units the arm turns its first corner, in 70 its second, and in 105 its third corner. The new loop closes back on itself at **t** = 124, separates into two loops at **t** = 128, sets up the mother loop to start making another daughter at **t** = 147, and has the first daughter in the same state as the mother originally was (**t** = 0) at **t** = 151.

Having programmed my small personal computer in Basic to apply Langton's transition rules to his initial

```
  2 1 2          2 1 2          2 1 2
  2 1 2          2 1 2          2 1 2
2 2 2 1 2 2 2  2 2 2 1 2 2 2  2 2 2 7 2 2 2
1 0 7 1 1 1 1  1 1 0 7 1 1 1  1 1 1 0 7 1 1
2 2 2 2 2 2 2  2 2 2 2 2 2 2  2 2 2 2 2 2 2
```

time t t + 1 t + 2

Figure 4

Figure 6

loop, I can testify that it works! Due to limited memory space and a slower computer, I did not run the program past **t** = 153 to see the birth of third and fourth generation loops as Langton did. He provides an interesting discussion of how the loops "die" when they run out of space to make further daughters, for which I refer you to his original paper. A copy of my program with transition rules and a starting loop is provided in the appendix to this paper, should you wish to adapt it to your computer and experiment with it yourself. It is much more sophisticated than the public-domain computer game called "Life."

The Complexity of Langton's Automaton

So, Langton has brilliantly demonstrated that something mimicking life can be designed. Does this indicate that life arose by chance or by design? To get some feel for the answer to this question, we need to analyze the complexity of his automaton.

Clearly, Langton's device is at or near the minimum complexity for self-reproduction of any meaningful sort. The information stored in the datatrain is very small because of the loop's four-sided symmetry. Even so, to specify the particular initial state of the automaton, we must indicate the state of **n** chips at **t** = 0. Thinking of the automaton as a rectangular array of 10 by 15 chips, **n** = 150. Or, we can ignore chips outside the structure itself, and make **n** = 110. Ignoring the chips inside the "doughnut hole" of the loop, **n** = 94. Finally, ignoring all the zero-state chips, we can get **n** down to 86. For each case but the last, each chip specified could be in any one of eight states, giving 8 to the nth power combinations. For the last, each could be in any one of seven, or 7 to the nth power combinations. Table 1, in its middle column, gives the number **N** of possible combinations by which the chips could be specified in each case.

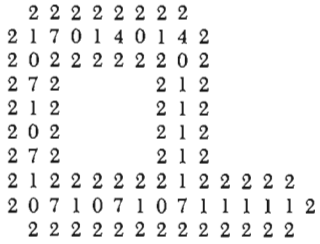

Figure 7

Thus, to produce the complexity of the initial state of the Langton automaton, we must search through some 5×10^{72} combinations for the one which works. Or, allowing for the four rotations through 90 degrees, about 10^{72} combinations.

However, before we attempt to estimate how likely the random formation of such a functional automaton is, we should note that most of the complexity of this device has been hidden under the rug, so to speak, in the details of the transition rules. These rules can be simplified slightly from those listed in Langton's Table 1, by eliminating all rules which put the chip in state zero and specifying instead that all rules not listed give a zero result. Even doing this, there are 190 rules producing the other seven states. To produce these randomly, we would need to search 7 to the 190th combinations, about 2 times 10 to the 160th. Combining this with the complexity of the initial state calculated above, we obtain the results **N′** in the right-hand column of our Table 1. Again, allowing for rotations, we have about 5×10^{232} combinations.

The number of combinations listed for the easiest case (**n** = 86) corresponds to the number of 276-letter words (276 = 86 + 190) one can make with a seven-letter alphabet. How likely is it that such a number of combinations would be successfully searched in the history of the universe? To make such a calculation, we have to make some assumptions concerning how many objects are being searched and how rapidly.

Since it is the biochemical situation to which we will want to eventually apply our result, let us try to mimic this in a very rough way. Let us suppose that the seven letters correspond to seven common elements occurring in life chemicals, and the words correspond to strange "molecules" formed of their combinations. (Please be advised that we are not doing any real chemistry here.) Let us take hydrogen as state zero and leave it out of the calculation. Let us ignore helium as unreactive and call the seven elements carbon, nitrogen, oxygen, sulfur, phosphorus, potassium and sodium. This calculation is going to be very sloppy, so let's give each element the same abundance, namely that of carbon—the most

common of the seven—which has a cosmic abundance about .0003 that of hydrogen.[9]

Suppose all these elements within a given volume of the universe are forming only 276-atom chains, and are forming new combinations as rapidly as a carbon atom can move to a new chain; say, a distance of 10 Angstroms at standard temperature, 300 degrees Kelvin. (Need I point out that all these assumptions are fantastically favorable?)

Then, using Boltzmann's equation to calculate the speed of carbon atoms at 300 degrees Kelvin (8×10^4 cm/sec), new chains will form at the rate of $R = 8 \times 10^{11}$ per second per chain. In the visible universe (actually the universe out to the Hubble radius), there are about 2×10^{12} galaxies averaging 10^{11} stars each.[10] Taking our sun as an average star, it has a mass of 2×10^{33} grams. This amounts to about 4×10^{56} grams of hydrogen within the Hubble radius. Assuming each of the seven elements being used is as common as carbon, the mass of elements reacting is about 8×10^{53} grams. Using Avogadro's number and an average gram atomic weight for our elements of 24, this will give about 2×10^{76} atoms reacting in our chains or, dividing the number of atoms per chain (276), about 7×10^{73} chains. The time to form the total number of possible combinations is then:

$$\text{time} = \frac{\text{Number of combinations } N'}{\text{Number of chains} \times \text{rate}}$$

$$\text{time} = \frac{5 \times 10^{232}}{(7 \times 10^{73})(8 \times 10^{11})}$$

$$\text{time} = 10^{147} \text{ seconds}$$

$$\text{time} = 3 \times 10^{139} \text{ years}$$

That is a long time! We can easily convert this into a probability that this will happen in our universe, in its twenty billion year history, merely by dividing the age of the universe by the time given above. The result is:

$$\text{probability} = 10^{-129}$$

Conclusions

Such a probability is astronomically small. There are estimated to be only about 10^{81} elementary particles in the universe.[11] Suppose one of these particles were marked and we were set the task of randomly selecting this particle from all the others in the universe with no way of telling it from the others. The chance of successfully locating such a particle would be 10^{48} times larger than the chance formation of a molecule with the organized complexity of the Langton automaton.

Table 1

n *Number of Chips*	*N* *Number of Combinations*	*N'* *Combinations with Transition Rules*
150	3×10^{135}	5×10^{295}
110	2×10^{99}	5×10^{259}
94	8×10^{84}	1×10^{245}
86	5×10^{72}	2×10^{233}

Unless there is some flaw in these calculations, I see only two possible responses: (1) Maybe life is designed after all. Recently, this has been the response of several formerly agnostic scientists.[12] (2) Perhaps the simplest self-replicating machine is really much simpler than the one we have analyzed. To which I respond, "Please design some such machine so that we can take your answer seriously."

Zoologist Richard Dawkins, author of *The Selfish Gene*, believes scientists should choose a naturalistic model for the origin of life, even if the model predicts it is very unlikely to happen. He suggests that since there may be as many as 10^{20} earth-like planets in the universe, and since it took about one billion years for life to show up on earth, we should admit any model in which the formation of life on a given earth-like planet has a probability of only 1 in 10 to the 20th.[13] According to our calculations here, the probability of forming a simple self-replicating molecule is more than 10^{100} *less* than Dawkin's threshold. It seems to me that we are looking at very strong evidence that life is designed.

REFERENCES

[1]See, e.g., Cyril Ponnamperuma, *The Origins of Life* (New York: Dutton, 1972); Stanley L. Miller and Leslie E. Orgel, *The Origins of Life on Earth* (Englewood Cliffs, NJ: Prentice-Hall, 1974); John Farley, *The Spontaneous Generation Controversy from Descartes to Oparin* (Baltimore: Johns Hopkins, 1977); Sidney W. Fox and Klaus Dose, *Molecular Evolution and the Origins of Life* (New York: Marcel Dekker, 1977).

[2]See, e.g., Charles B. Thaxton, Walter L. Bradley and Roger L. Olsen, *The Mystery of Life's Origin: Reassessing Current Theories* (New York: Philosphical Library, 1984); Robert Shapiro, *Origins: A Skeptic's Guide to the Creation of Life on Earth* (New York: Summit Books, 1986).

[3]John von Neumann, *Collected Works*, A.W. Taub, ed. (New York: Pergamon Press, 1961–63, 6 vols.).

[4]John von Neumann, *The Computer and the Brain* (New Haven, CT: Yale University Press, 1958).

[5]John von Neumann, *Theory of Self-Reproducing Automata*, ed. and completed by Arthur W. Berks (Urbana, IL: University of Illinois Press, 1966). The biographical data on von Neumann comes from this source.

[6]*Theory of Self-Reproducing Automata* gives no size information for the whole machine. Berks gives 337 x 547 for the Memory Control Unit on p. 261 and notes (p. 280) that von Neumann never finished the Construction Unit. An earlier popular discussion of von Neumann's machine is given in John Kemeny, "Man Viewed as a Machine," *Scientific American 192* (April 1955):18, 58–67; reprinted in *Mathematics in the Modern World* (San Francisco: W.H. Freeman and Co., 1968), chap. 50. Kemeny's size estimate, 80 x 400 chips with a 150,000 chip tail, is certainly too small for the final functional version.

[7]E.F. Codd, *Cellular Automata* (New York: Academic Press, 1968).
[8]Christopher G. Langton, "Self-Reproduction in Cellular Automata," *Physica 10D* (1984):135–144.
[9]See, e.g., the relative cosmic abundances in *The McGraw-Hill Encyclopedia of Astronomy* (1983), p. 108.
[10]Calculations based on information from Martin Harwit, *Astrophysical Concepts* (New York: Wiley, 1973), pp. 42, 61.
[11]Give or take a few orders of magnitude. See our number above for the total amount of hydrogen and multiply by Avogadro's number, times two to count the electrons—this is a few orders of magnitude larger if the neutrinos and photons are included.
[12]See, e.g., Fred Hoyle and Chandra Wickramasinghe, *Evolution from Space* (New York: Simon and Schuster, 1981); Dean H. Kenyon, in Foreword to Thaxton, Bradley and Olsen, *The Mystery of Life's Origin*.
[13]Richard Dawkins, *The Blind Watchmaker* (New York: Norton, 1986), pp. 143–146.

APPENDIX: A Basic Program for Langton's Automaton

PROGRAM "REPRO"

COMMENT

Program in S-Basic to emulate Langton's self-reproducing automaton as described in Christopher G. Langton, "Self-Reproduction in Cellular Automata," *Physica 10D* (1984), pp. 135–144. Mutations may be simulated by modification of the initial array A (X,Y) (external file "AUTO") or by changing transition rules (external file "TRULES").

```
END
VAR A,B,C,I,J,L,M,N1,N2,N3,N4,R,T,TIME,TR,TRBL,X,Y,Z = INTEGER
DIM INTEGER A(40,40) TR(8,77) TRBL (8,77) Z(40,40)
FILES D, D, SA(1)
CREATE "TRULES"
CREATE "AUTO"
REM Read in Transition Rules TRBL(I,J), TR(I,J)
OPEN #2; "TRULES"
FOR I=0 TO 7
  J=1
100             INPUT3 #2; TRBL(I,J), TR(I,J), TRBL(I,J+1), TR(I,J+1),
    TRBL (I,J+2), TR(I,J+2), TRBL(I,J+3), TR(I,J+3), TRBL(I,J+4),
    TR(I,J+4), TRBL(I,J+5), TR(I,J+5), TRBL(I,J+6), TR(I,J+6)
                IF TRBL(I,J+6)=7777 THEN 130 ELSE 120
120             J=J+7
                GOTO 100
130         NEXT I
            CLOSE #2
            REM Read in array A(X,Y)
            OPEN #2; "AUTO"
            FOR Y=0 TO 39
                INPUT3 #2; A(0,Y), A(1,Y), A(2,Y), A(3,Y), A(4,Y),
    A(5,Y), A(6,Y), A(7,Y), A(8,Y), A(9,Y), A(10,Y), A(11,Y),
    A(12,Y), A(13,Y), A(14,Y), A(15,Y), A(16,Y), A(17,Y), A(18,Y),
    A(19,Y), A(20,Y), A(21,Y), A(22,Y), A(23,Y), A(24,Y), A(25,Y),
    A(26,Y), A(27,Y), (A28,Y), A(29,Y), A(30,Y), A(31,Y), A(32,Y),
    A(33,Y), A(34,Y), A(35,Y), A(36,Y), A(37,Y), A(38,Y), A(39,Y)
            NEXT Y
            TIME=0
            REM Print array A(X,Y)
500         TEXT 1   ,&
                                    COMPUTER SIMULATION OF
                                LANGTON SELF-REPRODUCING AUTOMATON
```

```
        &
        PRINT #1;  ,  ,  "TIME = "; TIME
        PRINT #1
        PRINT #1
        FOR Y=0 TO 39
            FOR X=0 TO 39
                IF A(X,Y)=0 THEN 510 ELSE 520
510             PRINT #1;  "  ";
                GOTO 530
520             PRINT #1; A(X,Y);
530         NEXT X
            PRINT #1; CHR$(13); CHR$(10);
        NEXT Y
        PRINT #1; CHR$(12);
        REM Given array A(X,Y), calculate successor Z(X,Y)
        REM Main X,Y Loop
750     FOR Y=1 TO 38
            FOR X=1 TO 38
            REM Assign center and neighbors
            C=A(X,Y)
            T=A(X,Y-1)
            R=A(X+1,Y)
            B=A(X,Y+1)
            L=A(X-1,Y)
            REM Four cyclic combinations of T,R,B,L
            N1=T*1000+R*100+B*10+L
            N2=R*1000+B*100+L*10+T
            N3=B*1000+L*100+T*10+R
            N4=L*1000+T*100+R*10+B
            REM Selecting N with lowest value
            IF N1<=N2 THEN 1000 ELSE 1030
1000        IF N1<=N3 THEN 1010 ELSE 1060
1010        IF N1<=N4 THEN 1020 ELSE 1080
1020        M=N1
            GOTO 1100
1030        IF N2<=N3 THEN 1040 ELSE 1060
1040        IF N2<=N4 THEN 1050 ELSE 1080
1050        M=N2
            GOTO 1100
1060        IF N3<=N4 THEN 1070 ELSE 1080
1070        M=N3
            GOTO 1100
1080        M=N4
            REM Look up transition value
1100        CASE C OF
                    0:  I=0
                    1:  I=1
                    2:  I=2
                    3:  I=3
                    4:  I=4
                    5:  I=5
                    6:  I=6
                    7:  I=7
            END
            J=1
1200        IF TRBL(I,J)=M THEN 1210 ELSE 1220
1210        Z(X,Y)=TR(I,J)
            GOTO 1250
1220        IF TRBL(I,J)>M THEN 1230 ELSE 1240
1230        Z(X,Y)=0
            GOTO 1250
1240        J=J+1
            GOTO 1200
1250        NEXT X
        NEXT Y
        REM End main X,Y loop
        REM Replace old A(X,Y) by new
1300    FOR Y=1 TO 39
            FOR X=1 TO 39
            A(X,Y)=Z(X,Y)
            NEXT X
        NEXT Y
        TIME=TIME+1
        GOTO 500
```

FILE "AUTO"

[Forty lines of forty numbers each, separated by commas; somewhere in the middle, with room to grow, locate the original automaton; the rest of the numbers are zeros.]

```
. . . 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 . . .
. . . 0,0,0,0,0,0,0,0,2,2,2,2,2,2,2,2,0,0,0,0,0,0 . . .
. . . 0,0,0,0,0,0,0,2,1,7,0,1,4,0,1,4,2,0,0,0,0,0 . . .
. . . 0,0,0,0,0,0,0,2,0,2,2,2,2,2,2,2,0,2,0,0,0,0 . . .
. . . 0,0,0,0,0,0,0,2,7,2,0,0,0,0,2,1,2,0,0,0,0,0 . . .
. . . 0,0,0,0,0,0,0,2,1,2,0,0,0,0,2,1,2,0,0,0,0,0 . . .
. . . 0,0,0,0,0,0,0,2,0,2,0,0,0,0,2,1,2,0,0,0,0,0 . . .
. . . 0,0,0,0,0,0,0,2,7,2,0,0,0,0,2,1,2,0,0,0,0,0 . . .
. . . 0,0,0,0,0,0,0,2,1,2,2,2,2,2,2,1,2,2,2,2,2,0 . . .
. . . 0,0,0,0,0,0,0,2,0,7,1,0,7,1,0,7,1,1,1,1,1,2,0 . . .
. . . 0,0,0,0,0,0,0,0,2,2,2,2,2,2,2,2,2,2,2,2,0,0 . . .
. . . 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 . . .
```

FILE "TRULES"

```
1,2,6,3,7,1,11,2,12,2,13,2,21,2,
26,2,27,2,52,5,62,2,72,2,102,2,212,5,
232,2,522,2,1232,1,1242,1,1252,5,1262,1,1272,1,
1275,1,1422,1,1432,1,1442,1,1472,1,1625,1,1722,1,
1725,5,1752,1,1762,1,1772,1,2527,1,6666,0,7777,0,
1,1,6,1,7,7,11,1,12,1,21,1,24,4,
27,7,51,1,101,1,111,1,124,4,127,7,202,6,
212,1,221,1,224,4,226,3,227,7,232,7,242,4,
262,6,264,4,267,7,272,7,542,7,1112,1,1122,1,
1124,4,1125,1,1126,1,1127,7,1152,2,1212,1,1222,1,
1224,4,1225,1,1227,7,1232,1,1242,4,1262,1,1272,7,
1322,1,2224,4,2227,7,2243,4,2254,7,2324,4,2327,7,
2425,5,2426,7,2527,5,4444,0,5555,0,6666,0,7777,0,
1,2,2,2,4,2,7,1,12,2,15,2,21,2,
22,2,23,2,24,2,26,2,27,2,32,6,42,3,
51,7,52,2,57,5,72,2,102,2,112,2,122,2,
142,2,172,2,202,2,203,2,205,2,207,3,212,2,
215,2,221,2,222,2,227,2,232,1,242,2,245,2,
255,2,262,2,272,2,312,2,321,6,322,6,342,2,
422,2,512,2,521,2,522,2,552,1,572,5,622,2,
672,2,712,2,722,2,742,2,772,2,1122,2,1126,1,
1222,2,1224,2,1226,2,1227,2,1422,2,1522,2,1622,2,
1722,2,2227,2,2244,2,2246,2,2276,2,2277,2,7777,0,
1,3,2,2,4,1,7,6,12,3,42,1,62,2,
102,1,251,1,3333,0,4444,0,5555,0,6666,0,7777,0,
222,1,232,6,322,1,4444,0,5555,0,6666,0,7777,0,
2,2,21,5,22,5,23,2,27,2,202,2,212,2,
215,2,224,4,272,2,1212,2,1242,2,1272,2,7777,0,
1,1,2,1,1212,5,1213,1,1222,5,6666,0,7777,0,
7,7,222,1,225,1,232,1,252,5,6666,0,7777,0,
7777,0,7777,0,7777,0,7777,0,7777,0,7777,0,7777,0,
```

Coping With Controversy: Conflict, Censorship and Freedom Within Evangelicalism

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Although we are surrounded by controversies within the Christian community, little attempt appears to have been made to ask how Christians cope with disagreements. In this paper, attention is drawn to a number of relevant biblical principles, including the significance of unity in the Body of Christ and of humility, how to act when disagreement arises, and the place of judgement. These principles are then worked out in relation to evangelicalism, including its scope, the role of public polemic and serious debate, the dangers of dogmatism and of censorship, and the importance of freedom of expression and of mutual interdependence within evangelicalism.

Introduction

Controversy is inescapable; it is a *sine qua non* of human existence. To attempt to shield ourselves from it is to flee from one of the most basic realities of our world. On the other hand, to revel in it is to walk a path of destruction and divisiveness with grievous consequences for individuals and even whole communities. Remarkably, however, we are amazingly ill-equipped to cope with it, both at the individual and group levels. My emphasis in this article is on controversy at the group level, in particular on the way in which we cope with a divergence in beliefs and attitudes within Christianity and especially evangelicalism. This is one of the most difficult areas of conflict for Christians, because it calls into question the nature and extent of our commitment to Christ.

Such controversies surround us, and yet all too often we attempt either to ignore their existence and back away from them, or we confront them with a relish difficult to reconcile with being followers of Christ. Either way, one of the tragic results is a desire to isolate ourselves by becoming aligned with like-minded people in homogeneous groups. This, in turn, may lead to censorious attitudes as the group battles for existence against competing groups perceived to be a threat to the purity of *our* group. Controversy is then inevitable since it has become part-and-parcel of the group mentality.

Controversy—One Illustration

Everyone is capable of quoting some controversy or another. I shall quote one, in which I was intimately involved. I do this, not because it was worse than many others, but simply because it is I who have had to come to terms with it. The focus of my interest in the present

SEARCH Scientists Who Serve God

TEXAS PROFESSOR PROBES LIFE'S MYSTERY

Walter Bradley is an energetic young engineer whose academic career has not stood in the way of his Christian witness. It has even thrust him into a scientific squabble that may affect the way we read the Bible.

As a professor of mechanical engineering at Texas A & M University, Bradley studies various materials to find out why they sometimes fail. His work helps make sure that huge rotors will not fly apart at high speeds. He has done "failure assessment" studies of plastic connectors in San Antonio's municipal water system – which uses 70,000 of them.

Bradley was born in Dallas, grew up in Corpus Christi, and majored in engineering science at the U. of Texas in Austin. Born into a Christian home, Walt made a youthful commitment to Christ. His faith "stayed on the shelf," he says, until as a student he came in contact with "serious Christians" of his own generation through Campus Crusade for Christ. On graduation, Walt married his sweetheart, Ann.

Awarded a three-year graduate traineeship from the National Science Foundation, Walt stayed on at Texas to do basic research in the College of Engineering. With his new Ph.D. in 1968, he joined the metallurgical engineering faculty of the Colorado School of Mines. At Golden he studied metals and taught engineering until his move to Texas A & M in 1976 with Ann and their two children, Sharon and Steven.

His Energy Calculations Pose a Problem

In the early 1970s Christian groups began inviting Walt to lecture on faith and science. In 1974 he connected with other Christian scholars through the American Scientific Affiliation and through Probe Ministries. In Probe-sponsored visits to university campuses, Walt presented the Christian message and fielded student questions.

Tough questions about evolution and creation forced him to broaden his own background. A discipleship group in his home brought him into contact with a Ph.D. student in geochemistry, Roger Olsen. They began writing a book about the origin of life, eventually collaborating with chemist Charles Thaxton, a Probe staffer at the time. In 1984 it was published by Philosophical Library, titled *The Mystery of Life's Origin.*

What could an engineer and "materials scientist" contribute to such a book? "Well," says Professor Bradley, "if life began on its own from nonliving stuff, those materials had to obey the same laws as the materials I study." Many "scenarios" have been invented to explain how life began on the early earth or in its atmosphere. Some have been tested in "simulation experiments." Bradley's contribution was to analyze the energy required for any such scenario to "work."

His conclusions? "At the very least," he says, "the origin of life has to be considered an extremely improbable event. I think Christians would call it a miraculous event, even if we knew how God did it. But the fact is that no scenario proposed so far comes even close to satisfying the energy requirements of my calculations. The origin of life is still a mystery."

Publication of *The Mystery of Life's Origins* has led to many speaking engagements in an already busy life. But Walter Bradley thinks Christian faculty should have greater visibility and influence on university campuses. He wants students to see that a vibrant Christian faith and an active Christian witness are fully compatible with serious intellectual pursuits.

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Scientific Investigation

SCIENTISTS CONTINUE TO EXPLORE LIFE'S ORIGIN

Until the middle of the 19th century it was easy to believe in "spontaneous generation." People saw mold begin to grow on old bread and mice suddenly appear in grain bins. Then a French scientist, Louis Pasteur, showed that life *never* appeared when already living organisms (or their microscopic spores) had been totally excluded.

But how did life ever get started in the first place? That problem grew when 20th-century "molecular biology" showed that even a bacterial cell contains thousands of intricately arranged chemical structures. Reasoning that the first stages of life may have been much simpler, in the 1950s some scientists tried setting up experiments to simulate the chemistry of the early earth.

Those first experiments were quite exciting. They produced some of the amino acid building blocks of proteins and some small components of nucleic acids. Many scientists expected to keep going, hoping to produce some form of "proto-life" in the test tube. They formed an International Society for the Study of the Origin of Life (ISSOL) to exchange fast-breaking information.

But when ISSOL investigators met in Berkeley in 1986, they were still unable to report such a breakthrough. Some think life began with RNA, a simpler form of nucleic acid than the DNA now carrying the "genetic code" in living cells. Others bet on protein molecules called enzymes, folded into shapes that could speed up chemical reactions.

ISSOL Scientists Have a Problem

Today all life depends on *both* nucleic acids and proteins. It's a cyclic "chicken vs. egg" situation. Nucleic acids carry the coded information to make the right proteins, but enzyme proteins are necessary for nucleic acids to replicate. The chemistry of RNA makes it a good "information carrier" but not a very good enzyme molecule; protein chemistry is just the other way around.

Now the "thermodynamic approach" is making the origin-of-life problem seem even more difficult. Walter Bradley has calculated the amount of "configurational entropy work" required to select the right amino acids out of a "prebiotic soup" and line them up in the correct order before zipping them into a simple protein. Even if plenty of thermal zip-up energy is available, he argues, no one has any idea of how energy could be harnessed to do the necessary organizing work.

Is it possible to use ordinary heat energy, seen in the random motion of molecules, to produce a stable molecular arrangement? That depends. Bradley illustrates it this way: Suppose you want all the balls on a pool table to group together and stay that way. Easy. Make a shallow depression in the center of the table, put the balls on the table anywhere and gently jiggle it. The balls move naturally from their positions and organize themselves into a low-energy, stable formation. But what if your shallow depression is in a "hill" in the center of the table? Now, to get each ball up that high-energy hill you have to jiggle the table somewhat harder. But as you try to get the next one in, your high-energy jiggling will make some of the others roll out again.

To Bradley, that's the kind of problem facing investigators of the origin of life (or *abiogenesis*). At present, there's no theoretical way around it. Of course, some new discovery may bring a fresh perspective. For example, the newly discovered "smoke holes" (*fumaroles*) of undersea volcanoes provide a new environmental model for the origin of life, a place where "primitive" gases, high thermal energy, and a watery environment all exist together.

ISSOL '86 participants were eager to study the chemistry now going on around such fumaroles. But Walter Bradley, who gave two papers at the meeting, sees nothing in that new environment to solve the "configurational entropy" problem. Scientists *still* do not know how life on earth began.

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MORE ON THE ORIGIN OF LIFE

1. Teaching Science in a Climate of Controversy (American Scientific Affiliation, 1986). A readable 48-page booklet with a good section on the origin of life, produced by evangelical Christians in science to help teachers cope with the creation/evolution controversy. Order from your Christian bookstore or from ASA, P.O. Box 668, Ipswich, MA 01938. $4.00, postpaid. Quantity discounts.

2. The Mystery of Life's Origin: Reassessing Current Theories (Philosphical Library, New York, 1984) by Charles B. Thaxton, Walter L. Bradley, and Roger L. Olsen. This is a technical discussion of origin-of-life studies, with a challenging philosophical conclusion. By three evangelical Christians who are scientists.

3. Origins: A Skeptic's Guide to the Creation of Life on Earth (Bantam Books, New York, 1987) by Robert Shapiro. If you think only Christians are skeptical about claims that we know how life began, read this amusing (but serious) nontechnical book by an agnostic chemist who works in the field himself.

After three decades of theoretical and experimental work, scientists cannot agree on the chemical steps that brought life into existence. Most scientists, some of them Christians, think this gap in our knowledge will eventually be bridged with a plausible series of steps obeying laws of physics and chemistry. Many Christians, including some scientists like Walter Bradley, doubt that scientists will ever bridge that gap.

Some scientists are convinced that the origin of life was a divine *miracle* beyond the power of science to explain. Their theological stance is referred to (by those who object to it) as a "God-of-the-gaps" position. To many devout believers in the Bible, it is a risky kind of theology. They warn that some gaps once claimed as evidence of a "special creation" were later filled by a scientific explanation. When that happens, science comes off looking very powerful but God's creative power seems diminished.

Papering Over the Cracks

Rushing in to glorify God by posing creation as an alternative to natural processes is like trying to "paper over the cracks" with a *supernaturalistic* assumption. Some Christians have tried to set up a *creationist* alternative to regular science. In the 1980s courts in Arkansas and Louisiana, and now the U.S. Supreme Court, have ruled that "creation science" is really a religious position merely masquerading as science.

But Christians are not the only "believers" tempted to claim too much. Atheists and humanists often claim support from science for their own "secular religiosity." (If that phrase seems odd, substitute *ideology*, a term that can include both religious and nonreligious "faith positions." *Their* "scientisms masquerading as science" go under such names as positivism, materialism, naturalism, and evolution*ism*. Anyone insisting that life *must* have arisen by natural processes (but unable to specify them) is also a believer in papering over a crack—with a *naturalistic* assumption.

Creation's Deeper Meaning

For most Christians, the biblical doctrine of *creation* states the overall terms of God's relationship to everything in the natural world, including all living things. The Bible asserts that God has brought everything into being and sustains it moment by moment. The doctrine of creation is not based on Genesis 1 and 2 alone. It is emphasized in many of the Psalms (such as Psalms 19, 102, and 104) and elsewhere in the Old Testament. Three New Testament passages (in John 1, Colossians 1, and Hebrews 1) extol the Creator, extending praise to Jesus Christ as "the living Word" at the center of God's creative activity.

All Christians praise God as the creator of physical life. Some believe he did it in an instantaneous supernatural miracle, which science can never "break down" into a sequence of steps. Others think of all events as natural processes with a supernatural (or "trans-empirical") aspect, since everything ultimately belongs to God and "proceeds according to his Word." They would say that even the highly compressed story in Genesis 1 pictures God doing things in sequential steps. To believe that God has the power to create life instantaneously does not mean that he did it that way. The Bible calls some events miracles but seems unashamed to implicate natural processes in God's purposeful activity.

At present the origin of life is one gap in human knowledge. Christians can surely assert that God created life, while humbly admitting that neither the Bible nor modern science tells us exactly how it was done.

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Theological Reflection

WAS THE CREATION OF LIFE A MIRACLE?

SOME EVANGELICAL EVALUATIONS OF CREATION

1. God Did It, But How? (Zondervan, Grand Rapids. 1981) by Robert B. Fischer. A small paperback showing how a chemist distinguished as a Christian educator puts science and the Bible together.

2. In the Beginning: The Opening Chapters of Genesis (InterVarsity Press, Downers Grove. 1984) by Henri Blocher. A thoughtful reader's guide to the Genesis creation narratives, with an appendix on what science has to say, translated into English by David G. Preston. Blocher is professor of systematic theology at the Faculté Libre de Théologie Evangélique, Vaux-sur-Seine, France.

3. The Fourth Day: What the Bible and the Heavens Are Telling Us About the Creation (Eerdmans, Grand Rapids. 1986) by Howard J. Van Till. An astronomer and physicist at Calvin College in Michigan argues that neither the biblical nor the scientific view of the cosmos is complete in itself. Van Till is currently on the executive council of the American Scientific Affiliation.

In the beginning God created the heavens and the earth" (Gen 1:1). After some time had passed, God said, "Let the earth put forth vegetation... " (1:11), and later, "Let the waters bring forth swarms of living creatures... " (1:20), then, "Let the earth bring forth living creatures... " (1:24).

To some Christians the creation narrative in Genesis 1 reads much like an outline of the current scientific picture of progressive development of life on earth. To others the narrative is a more-or-less literal account of a series of discrete, instantaneous formative acts. Some think our present inability to solve the riddle of life's origin points to the latter interpretation. Theologians still argue about views of the Bible represented by the two interpretations.

Honoring Life's Creator

Christians are united when we focus on *Who* rather than *How* or *When*. It is ultimately God who created life, those Genesis passages proclaim—not Nature or Chance or Evolution or Science. After he created life, "God saw that it was good." We praise God for *all* his mighty works, whether we can understand them or not, whether we can imitate them or not.

"In the beginning was the Word, and the Word was with God, and the Word was God. He was in the beginning with God; all things were made through him, and without him was not anything made that was made. In him was life, and the life was the light of men... " (John 1:1-5) "And the Word became flesh and dwelt among us, full of grace and truth; we have beheld his glory, glory as of the only Son from the Father" (John 1:14).

To Christians, a concept even greater than God's gift of physical life is his gift of spiritual life—the kind not quenchable by death. In the Old Testament, the Creator calls physical life into existence—perhaps by designing the universe to produce it. Throughout the Old Testament he is also creating his own people, both by declaring his intent and by patiently molding the raw material into what he wants them to become. In the New Testament God is seen as a heavenly Father who, like a human parent, is a "giver of life" in a more personal sense.

Some Christians rejoice in being "born again." Others cherish the image of being "adopted into the Lord's family." Some emphasize the moment or day or year in which they first experienced the newness of spiritual life. Others tell how patiently God worked, first to draw them to himself, then to mold their lives after they learned to love him as their heavenly Father.

We meet God as Father by following Jesus as Lord. That enables us to pray joyfully, to experience forgiveness, and to find guidance and strength for our daily work—including scientific work. We can be grateful that we don't have to settle all the scientific or theological problems first. We can be thankful right now for the gift of eternal life.

It is worthwhile to study life. It's even better to live it, abundantly.

Ω

Thoughtful Worship

LIFE IS GOD'S GOOD GIFT

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context is the nature of controversy—what it is, what it leads to, and how we respond to it.

Wednesday, 6 June 1984 marked the beginning of the furore over my book *Brave New People*, a book principally devoted to a consideration of the new reproductive technologies.[1] It was in the chapter on therapeutic abortion that I had apparently transgressed all the principles of evangelicalism, by allowing for abortion under certain circumstances. According to my critics I was the arch-proponent of abortion on demand, and a leader of the pro-abortion forces within evangelicalism. No justification, it seemed, was required to support this assignation, in spite of the fact that *Brave New People* only incidentally dealt with therapeutic abortion and hardly dealt at all with abortion in general terms.

I found that my "heretical" views had earned me notoriety within evangelical circles. Not only this but, in the eyes of some, my views were so dangerous they had to be censored. And they were, since *Brave New People* was withdrawn from the American market. The censorship was carried out by a few self-appointed guardians of evangelical morality, who conducted a vociferous and concerted campaign against the book, myself, and the publishers. I shall not spell out the details of the accusations, since I have already done so in my article: "The View From a Censored Corner."[2]

The crucial point is this: the criticisms and condemnations were all made in the name of Christ and were, I imagine, intended to bring honour to Him and His church. By its very nature, however, controversy of this nature becomes polarized. The critics are right, the condemned are wrong. Even stronger than this is the claim that the critics are God's true representatives, whereas the condemned are unworthy of Him and are probably not Christians at all. What we need to note is the certainty implicit within this polarization—or rather a set of certainties: regarding the validity of one's own set of beliefs, the purity of one's own attitudes, and the authority to act as sole judge of the standing and integrity of other Christians. It is these certainties that I wish to question, since they lie at the heart of so much conflict within Christian circles.

Biblical Principles

In order to explore this matter further I shall turn to a number of principles found in the New Testament.

1. Unity in the Body of Christ

This is the bedrock principle to be affirmed by Christians when confronted by individual and group interrelationships within the church. This was attested by Jesus in His high priestly prayer (John 17:20–23) and by the repeated emphases made by the writers of the New Testament letters (Ephesians 4:1–6). Paul, in writing to the Ephesians, urged them to make every effort to keep the unity of the Spirit through the bond of peace (Ephesians 4:3).

The picture presented by this concept is of a body: all the parts of which are essential for its normal functioning. In exactly the same way we all need each other within the Body of Christ. It is in these terms that we are to view the gifts of the Spirit, since the various gifts given by Christ to His church are to be used for the strengthening of the Christian community. To keep them to ourselves is to deny them to other Christians and weaken the Body of Christ. Similarly, Christ's Body is weakened when we prevent a Christian from ministering to other Christians, and much more so when we deny that this other Christian is even a member of Christ's Body.

The unity of the Body of Christ implies that we are to be open to having fellowship with all others who acknowledge the saving work of Christ on the cross and who demonstrate that work in the quality of their lives. These other Christians will undoubtedly include those with whom we have profound disagreements on a

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whole range of matters apart from those central to Christian belief. Nevertheless, if we have a high view of the unity of the Body of Christ, we can neither downgrade nor ostracize other Christians on the ground that we differ from them over political, ethical, or even certain theological questions.[3]

The unity of Christ's Body should constitute the prime impetus to a resolution of conflict between Christians. This is because nothing is of sufficient importance to cause schism within the church, as long as the essential integrity of the gospel concerning the person and work of Christ is maintained. Everything else should be regarded as peripheral in nature and open to honest debate.

Nothing is of sufficient importance to cause schism within the church, as long as the essential integrity of the gospel concerning the person and work of Christ is maintained.

It is only when the unity of Christ's Body is accepted that we are in a position to learn how to live with one another, and such living in turn entails learning how to disagree with one another in love. Disagreeing "in love" involves entering into dialogue with one another, while retaining respect for the integrity and spirituality of the other. It involves praying for those Christians with whom we disagree, speaking with them, reading their books, and sincerely seeking to learn from them. It involves being prepared to test all our views on social and spiritual matters against the general principles found in Scripture. Sometimes, we will be wrong and then we must admit that we have been wrong. But even if convinced that we are correct, we may still have a great deal to learn from our adversaries, and we always need each other within the Body of Christ.

One of the foremost obstacles to an outworking of these principles is the existence of factions (Galatians 5:20); groups of people who narrow down what they have in common to one issue or one area of agreement. The motive for this may be exemplary, and yet all too easily this move becomes associated with a party spirit, with selfish ambition, with dissension, and with envy. Very readily, what becomes important is allegiance to the group, and outward impressions become crucial (Galatians 6:12). It is in this spirit that secondary matters are elevated so that they become issues of primary concern. This occurred in the early church with regard to circumcision, and it can happen today with any secondary issue. If, for instance, we are prepared to be separated from fellow believers on questions such as those of nuclear warfare, feminism, apartheid, or abortion, we are claiming that these questions are more important than the work of Christ on the cross. We are making a peripheral issue, no matter how important it is in its own right, into a central one, and in doing this are displacing Christ from the centre of Christianity.

2. *Humility*

Few themes are as dominant in the New Testament as that of humility (Luke 14:7–14; Romans 12:3,4; Philippians 2:3,4). We are not to think of ourselves more highly than we ought (Romans 12:3). We are to be realistic, and remember that what we are comes from God. Whatever we have in the way of abilities, gifts (both natural and spiritual), and position in society comes from God. To think highly of ourselves is, therefore, a contradiction in terms for Christians, who are to realize their dependence upon God's mercy. Consequently, it is entirely inappropriate to strive to advance our own interests; rather, we are to live for others—acknowledging their interests and seeking to advance them.

In a conflict situation, therefore, we are to put the interests of our antagonist first. This does not mean we are to demean ourselves and our arguments, as though our arguments are worthless and our antagonist's valuable. It is, rather, a matter of seriously considering the stance and attitudes of the other person, and seeking to understand why he/she holds that particular position. It is an attempt to put ourselves in the shoes of our antagonist, so that we can begin to appreciate the essence of this alternative perspective.

We are no longer living for ourselves but for Christ (2 Corinthians 5:17), and therefore, for His people—including those of His people with whom we disagree in certain areas. Even more generally, we are to love our neighbour as ourselves. Such principles lead inevitably to the concept of servanthood, a concept demonstrated by Christ who came to serve and not laud it over His fellow beings. (John 13:4–17). His supremacy lay in the quality of His self-giving, in the extent to which He put the claims of others above the claims that were rightfully His. He lived, not for His own satisfaction, but in order to bring fulfillment and wholeness to others.

The life of Christ was the essence of humility, and it is to be clearly expressed in the arena of conflict and disagreement. As we find ourselves in opposition to others, our chief concern is not to win an argument but

to see that truth prevails and that the welfare of those opposing us is upheld. These were the points stressed by Paul as he instructed the Ephesian Christians to speak truthfully to their neighbours, to be kind and compassionate to one another, and to forgive one another, because God had forgiven them in Christ. (Ephesians 4:25,32). Moreover, Paul warned against any talk that would destroy others and that failed to build them up (Ephesians 4:29). James warned us, in considerable detail, against envy and selfish ambition and diagnosed the cause of fights and quarrels as self-centred desire (James 3:9–4:3). A poignant illustration of self-centred ambition is provided by Diotrephes, who sought leadership in the church at all costs (3 John 9,10). His ambition led to malicious gossip and lies, and an unwillingness to welcome and accept fellow Christians. Diotrephes loved to be first, and inevitably this desire led him to ostracize other leaders in the church. The end result of such desires is the institutionalization of unresolved conflict.

3. *When Disagreement Comes*

Whatever our ideals may be, we rarely live up to them. We fail; we fall into sin, and sometimes we are wrong. Inevitably, therefore, there will be disagreements among the followers of Christ. When we fail to understand each other, or resolutely adhere to our own position, difficulties ensue.

Christ was well aware of this possibility (Matthew 18:15–17). According to His advice, if you consider that your brother has offended, speak to him quietly and point out where you consider he has erred. In our society this may simply be a matter of phoning him, writing to him, or sending him a carefully written critical review of what he has said or written. There are numerous expressions of this first step at reconciliation, depending entirely on the circumstances, and this informal, one-to-one approach may prove adequate. He may listen to you, agree with you, and determine to change his ways or modify his views. Of course, the person in the wrong may be *us*, and it may be we who are approached to change *our* lifestyle or attitudes.

Failing a response, the second step is to approach the erring person accompanied by one or two others, who also consider than an error has been committed, More specifically, these others should be leaders in the Christian community or, at least, people who are respected by those within the community. If such leaders are not prepared to back you up, the matter should be laid to rest, since there are never to be personal vendettas within the body of Christ and the only reason for approaching fellow Christians whom you think have erred is to attempt to assist them. Bringing in other responsible and respected Christians is what we might refer to as group consultation, and is the next level at which debate is to take place. When Paul was confronted by the warring Euodia and Syntyche, he pleaded with them to agree with each other in the Lord, and he asked one of the church leaders to help heal the rift between them (Philippians 4:2,3).

If the supposedly erring Christian is still adamant, the matter should then be brought before the church at large. This is when the debate becomes public, and occurs out in the open. Even at this level though, there is to be discussion. If the general opinion of the church is that the brother is at fault, and if he refuses to repent or change his views, he may then be considered as having placed himself outside the fellowship. In a similar vein, when there are issues of disagreement within evangelicalism, major church leaders should be brought together to discuss matters and to engage in serious dialogue. There needs to be considerable agreement at this level before a person or viewpoint is condemned as lying outside evangelicalism.

Group dialogue was the function of the Church Councils in the early years of the church, as with the council in Jerusalem in Acts 15. In that instance, Paul and Barnabas disagreed sharply with some others in the church on the role of circumcision. As a result they, with some other Christians, went to Jerusalem to discuss the matter with the apostles and elders. There was dialogue and ardent debate, as a result of which agreement was reached. Subsequently, a course of action was adopted to let other churches know the decisions that had been reached.

As we find ourselves in opposition to others, our chief concern is not to win an argument but to see that truth prevails and that the welfare of those opposing us is upheld.

These ways of dealing with disagreements all involve discussion and dialogue, commencing at the personal level and working up to public discussion. All are characterized by a desire to find the mind of Christ, and all treat the erring party as a responsible participant. There is never autocratic condemnation. If agreement appears to be impossible, the parties may have to go their separate ways, as happened when Paul and Barnabas disagreed (Acts 15:36–41). Even when this occurs, however, respect for the other party is essential,

with an acknowledgement that, as far as one is aware, the other party is seeking to be faithful to the Lord.

4. Judgement

Implicit within the previous principles is a refusal to judge others. Even if we consider other Christians to be in error, guilty of sin, or promulgating heresy, it is not our prerogative to judge them by ourselves. The reason for this is two-fold: God alone is judge, and we are sinners (Matthew 7:1–5). Whatever errors we may detect in others are likely to be small compared with the errors that characterize us, even if these errors are in a totally different area from the one in dispute. In other words, we, too, may be wrong. Under no circumstances, therefore, are we to set ourselves up as judges of others within the Body of Christ. This does not mean we can do nothing about sin or error within the Church; rather, we have to adopt the appropriate procedures, namely, employ consultation rather than indulge in judgementalism.[4]

There are never to be personal vendettas within the body of Christ and the only reason for approaching fellow Christians whom you think have erred is to attempt to assist them.

A fascinating approach to rivalry was provided by Paul when dealing with those Christians who were preaching Christ, and yet in doing so were attempting to embarrass Paul himself. Even though he considered their motives suspect, he still rejoiced because Christ was being preached (Philippians 1:15–18). He could well have condemned those people, judged their motives, and entered into public conflict with them. However, because they were making Christ known, he acknowledged the positive rather than negative aspects of their preaching. In doing this, he recognized a major difference between those particular people and the many false teachers, who were distorting the essence of the gospel and preaching a false Christ. In a similar vein, it behooves us to distinguish between differences that strike at the heart of the gospel and those that are not central to it.

A major obstacle to moving in this direction is that we readily erect rigid rules encompassing details of beliefs, attitudes and practices. Those who obey these rules are accepted; those who reject them or disobey them are judged and rejected. Quite apart from the fact that rules can readily detract from the freedom and responsibility found in Christ, they all too easily lead to judgementalism, since they are the basis on which judgements are made. It is no wonder, then, that Paul instructed the Colossian Christians not to "let anyone judge you by what you eat or drink, or with regard to a religious festival, a new moon celebration or a Sabbath day" (Colossians 2:16). All these rules are based on human commands and teachings, and will disappear. They appear to be wise, but in the end are valueless (Colossians 2:21–23). Tragically, they enable people to judge one another. Not only is it unjust, since it implies higher standards for others than we accept for ourselves, but it also demeans all that Christ has bestowed upon us, replacing His wisdom by sinful human standards. For Christians, judgement is to be replaced by accountability; we are accountable to each other, just as we are all accountable to God. It is in accountability, rather than in judgement, that we learn to discern the mind of Christ.

Coping With Conflict

In this section, I shall explore ways in which these biblical principles might be applied in current controversies.

1. Scope of Evangelicalism

Classic evangelical affirmations centre on the nature of the biblical revelation, the person and work of Christ, and justification by faith alone.[5] Other affirmations, no matter how important in their own right, have been excluded as central ones. And so it is that beliefs about church government, God's sovereignty in election, baptism, and the gifts of the Spirit, are not central to evangelicalism, in that differences of opinion and conduct in these areas can be accomodated within its framework.

Nevertheless, we are having difficulty in accommodating differences on many social questions, since certain stances are regarded by some as the only acceptable expressions of evangelical thought and action. These stances have, therefore, been incorporated by them within the core of doctrines they consider essential to evangelicalism. Examples of such stances within contemporary debate are particular conservative views of the status of the embryo and fetus, and of many economic, defense, and evolutionary matters. To deviate from them is, we are informed, to court spiritual and moral disaster; such deviations being as serious as deviations on doctrines concerning the person and work of Christ.

For those who hold views such as these, a person can only be considered an evangelical if he/she is a strident anti-abortionist, is opposed to most forms of biomedical technology, believes in a free market economy, and is an advocate of the nuclear deterrent. The question confronting us is whether we have adequate grounds for making issues such as these *theological* watersheds. These areas tend to be ones where there is a great deal of uncertainty and unease within evangelicalism. Consequently, if they are allowed to assume theological significance, evangelicals will have allowed their uncertainty on these matters and their lack of theological expertise in them to control their thinking. What is required is serious theological reflection, not short-term criticism of individual items of concern or the perceived short-comings of other evangelicals.

This raises a broader question, namely, whether there is a legitimate place within evangelicalism for those who are professionally trained in areas other than theology, and capable of honestly and openly exploring these other realms—whether science, medicine, economics or politics. Without such interdisciplinary exploration, the response of evangelicals will owe far more to conservative attitudes (including conservative *theological* attitudes) than to serious biblically informed assessment. As evangelicals, we should be sketching out the common ground there is between those of us in different disciplines. With this as our basis, we can begin the task of serious dialogue on those issues that divide us.[6]

2. *Public Polemic and Serious Debate*

Issues of public concern have long posed difficulties for evangelicals. After many years of neglect, they have recently realized the importance of a Christian voice in political and social matters. This is all to the good, signifying as it does a return to the realization that we are to exercise our ministry as salt and light within society (Matthew 5:13–16). Nevertheless, social involvement has its dangers, and one that is evident at present is the drive for a "unified evangelical voice" on a range of issues within society, including biomedical ones such as abortion, homosexuality, the status of the embryo and fetus, and also various economic and political issues.

Regardless of the merits of these evangelical concerns, it has led to a pressure group mentality, according to which there is only one stance on these issues acceptable to evangelicalism. Any deviation from this rigid position is considered a betrayal of the evangelical cause. The result is that no distinction is made between public polemic and serious ethical debate, and evangelicals are not allowed to discuss in the public arena controversial topics that have public implications. Once such a distinction is made, practically all forums for debate have been removed. Public speaking, writing, and publishing are all—to some extent—public activities. The desire for a unified evangelical voice implies that what is spoken, written and published must express only one viewpoint—the authorized one.

Certain stances are regarded by some as the only acceptable expressions of evangelical thought and action. These stances have, therefore, been incorporated by them within the core of doctrines they consider essential to evangelicalism.

Debate on many complex ethical questions involves unresolved ethical quandaries. As a result, serious debate does not take the form of a political pamphlet aimed at advocating one particular viewpoint, since contending viewpoints need to be examined on their own merits. It is my contention that a serious Christian assessment of issues cannot, and indeed must not, conform to a precise political platform. The dilemmas of life and death rarely conform to the niceties of black-and-white political debate, and Christians should be the first to realize this.

Evangelicals need to beware of forming pressure groups to advocate the rights and wrongs of single ethical (or other) causes. Even should they succeed in wielding some political power in this way, it will be at the expense of oversimplifying issues and of becoming identified with a particular cause as much as with Christ. The trouble with pressure groups is that while they readily identify one's "friends," they also convert non-supporters into "enemies," even when those non-supporters are fellow Christians who may agree in large part (if not entirely) with the cause in question. Pressure groups, therefore, lend themselves to becoming schismatic, dividing the body of Christ for the sake of individual causes.[7] The question confronting us is whether any cause (however worthy in itself) is of such importance that it is justifiable, in attempting to forward it, to destroy the unity of the body of Christ.

3. *The Dangers of Dogmatism*

Dogmatic pronouncements on complex issues assert the infallibility of those making the pronouncements, and stem from their certainty about the correctness of their interpretations and conclusions. Dogmatism is the

antithesis of humility, since it allows no room for error. And yet, as finite and fallen creatures, all our understandings are subject to error. For instance, we can never be absolutely certain we have not misunderstood God's word. Kenneth Kantzer, in drawing a distinction between scriptural infallibility and human fallibility, has written: "Holy Scripture is, indeed, infallible; but our interpretations and our applications are not. To confuse scriptural infallibility with human fallibility robs Christians of their ability to work effectively both with other believers for the kingdom of God and with unbelievers for the good of humankind."[8] James Sire has expressed a similar viewpoint in rather different terms: "As we read Scripture, practice it, live in community with other believers and involve ourselves in worship, we grow, change our minds, modify our theology. Even what we learned yesterday needs to be subject to change as we check it out on the nerve endings of our life and as we hear our friends comment on our insights."[9]

This is not an argument for indecisiveness or for a subjective, ever-changing theology. But it is an acknowledgement that we may be wrong on many complex matters we have to face in modern society, and we may have to modify our opinions. Our authority is still Scripture, but where Scripture does not point unequivocally in one direction, we have to take seriously Christian tradition, the contributions of contemporary Christian thinkers, and even debate within society. Moreover, all these insights need to be informed by the Spirit of the Living Lord.

Some disagree. For them Christian tradition alone is correct, and our culture—when it disagrees—is inevitably incorrect. For example, one writer has argued that there is a danger in allowing debate on abortion in Christian publications.[10] This is based on the view that abortion is seriously wrong by biblical standards, that it is a departure from "the accepted views," that "new" positions ought not to be promoted as guidance for other people to follow, and that "new moral positions" are accommodations to cultural change. The outcome of such criticism is that it is only "traditional moral principles" that are worthy of consideration. By definition, no discussion of abortion is allowable. In these terms, traditional moral principles are, without question or debate, regarded as being totally true to Scripture.

Such a stance as this is an assured one. The true way is known since Christian tradition is correct. Unfortunately, it overlooks one possibility, and this is that Christian tradition may be wrong. What is then required is a change in the direction of evangelical culture. It is only when this possibility is accepted that we are in a position to learn from Christians with whom we may disagree on theological matters, and even to learn from non-Christians.

Dogmatism elevates individualism and downgrades the community. It refuses to accept the pluralism of the evangelical world, let alone the pluralism of society. It insists that agreement on the basic tenets of the faith is not enough. Agreement is also required on complex contemporary issues, whether these be the use of force in keeping peace, economic matters, divorce and remarriage, the role of women in the church, homosexuality, abortion, euthanasia, and many other issues. Faithful followers of Christ do not agree on any of these applied issues, and to insist otherwise is to impose upon evangelicalism the sort of dogmatism and authoritarianism totally foreign to the life and example of Jesus. The result is that arbitrary cultural norms are imposed on evangelical groups, norms that rapidly come to assume more authority than Scripture, since they are neither derived from Scripture nor subject to it.

4. Freedom of Expression

The argument I have just set forth has an inevitable concomitant; this is that differences of opinion are to be expected within evangelicalism, and that we have to learn to cope with such differences. This, in turn, is based upon another fundamental assertion, an acceptance of the necessity of freedom of thought within Christian circles. In these terms, it is imperative that we learn to distinguish between criticism of ideas and criticism of the people holding those ideas. Strong disagreement with the views of a fellow Christian does not give us the "right" to question that person's motives or assault his or her character and reputation. This is character-assassination, an activity that always emanates from the supposed superiority of one person over another. It is the opposite of the Christian virtues of servanthood and humility, denigrating as it does all that the other person stands for.

Dogmatism is the antithesis of humility, since it allows no room for error.

It is imperative that we learn how to disagree with one another in a positive and supportive way. This attitude is essential for the emergence of genuine tolerance, by which we are enabled to take seriously the sharply conflicting views of another. We need to beware of turning friends into enemies because we cannot agree on everything, and of fragmenting the

Body of Christ because we cannot agree on some matter peripheral to the essentials of our faith in Christ. This is schism, no matter how important the matter may be in its own right.

Within Christian circles, the principle of dialogue based on respect for each other's position and integrity is crucial. When this is lost, it is replaced by an unyielding harsh legalism that is prepared to destroy people and institutions in order to win a political battle. Even when confronted by notoriously difficult dilemmas, constructive ways forward are possible for those who have been redeemed and made new in Christ. This is one of the outcomes of the new life in Christ, and hence should characterize the life in the community of the redeemed. Constructive ways forward are based on debate and serious dialogue. The only alternatives are piously packaged solutions that have the appearance of providing assured answers, and yet will be ignored by ordinary Christians when confronted by difficult choices.

Debate over complex ethical issues, therefore, not only has a place within evangelicalism, but is essential for the health of the evangelical community. There is no other way of tackling issues over which no evangelical consensus has been reached. The presentation of representative evangelical viewpoints is the essence of any community based upon a belief in the priesthood of all believers. If this right of presentation is not safeguarded in the Christian community, we have chosen dictatorship and have lost any semblance of the freedom and responsibility that are found in Christ alone. Intellectual honesty and spiritual integrity are basic ingredients of a Christian community, and are integral to the moral burden placed upon us as Christ's representatives.

Difficult as it may be to allow and even encourage freedom of expression, it is made possible by the Christian's ultimate belief in the triumph of truth over error. This, again, should be one of the characteristics of the redeemed community. It is integral to the hope of the church, stemming as it does from Christ's triumph over death. We are made free in Christ, and we are to express this freedom in our relationship with others, and supremely with other Christians. Inevitably, there are dangers: we may misuse this freedom and exploit it, or we may impose rules as a means of ensuring safety. Despite these dangers, either in the direction of libertarianism or of legalism, we cannot ignore it. To do so is to turn our backs on one of God's richest blessings.

5. *Censorship*

Censorship is the converse of freedom of expression. It is an unwillingness to allow ideas contrary to one's own to stand the test of public opinion, and is an attempt to protect those holding one's own viewpoint from exposure to conflicting ideas. The motives of the censor may be exemplary, but the result is likely to be a narrow, bigoted constituency.

In Christian terms, the need to screen out material with which one disagrees, including material emanating from fellow believers, is a denial that evangelical faith is consistent either with intellectual freedom or intellectual creativity. It asserts that we are unable to contend for the faith, and that we lack the resources for distinguishing good from evil. In contrast to this, Christians are to believe in intellectual freedom because the person redeemed by Christ has been set free and liberated by the gospel, and can trust in God's sovereignty and direction. Christians should realize that nothing is beyond the scope of God's concern and that all human endeavour is under the providence of God.[11] Since it is our minds that have been liberated, we need never fear the truth because the framework of our thinking is now God's truth. As a result, we are enabled to face head-on the confusing array of contemporary beliefs, analyze them and their associated presuppositions, and respond with compassion and understanding.[12]

We have been created as thinking creatures. It behooves us, therefore, to indulge in serious thinking, and to decide in a responsible manner what to read and view. This, in turn, is not a matter of simply reading and viewing that which we know we will agree with, but that which is a worthy indicator of the thinking and attitudes of the society in which God has placed us—even if we strongly disagree with some of the contents. Our responsibility as Christians is to be faithful representatives of God within society, but this is impossible if we are uninformed about that society. We need to be, in the words of the Christian librarian Donald Davis, "open persons who are constructively grappling with the issues of real life as they are reflected broadly in the publishing world."[13] We are to be challenged by all facets of society and its ideas, never isolated from them.

If we acknowledge that all truth is God's truth, we should be confident in the ultimate victory of that truth. As God's people, we are to be agents for intellectual freedom. We should be life-affirming people, able to live with a wide range of ideas and concepts, even with those with which we disagree. This demands responsibility and judgement; it also demands a willingness to live with controversy, inside and outside the Christian community.

With a carefully thought-out world view, conflicting thought-forms can be approached with integrity. This

is possible, because the intellectual freedom that Christians enjoy seeks to bring all ideas under the scrutiny of God, and all thoughts under the Lordship of Christ. These are not new ideas. They were expressed in 1644 by John Milton when he reacted to an ordinance passed by Parliament in 1643 calling for the licensing of the press. The basis of his opposition to censorship was the nature of truth. He wrote: "Truth is strong, next to the Almighty. She needs no policies, nor strategies, nor licensings to make her victorious—those are the shifts and the defences that error uses against her power. Give her but room, and do not bind her when she sleeps, for then she speaks not true."[14]

Our responsibility as Christians is to be faithful representatives of God within society, but this is impossible if we are uninformed about that society.

In the end truth will triumph over error, even if error appears to be victorious in the short-term. But how can we recognize truth, since it is so often mixed with error? James Sire has commented: "In a fallen world the possibility of error is the necessary condition for the entrance and triumph of truth."[15] The two have to be seen together; they have to be compared, and to stand up to criticism. Again, as Milton wrote: "Assuredly we bring not innocence into the world, we bring impurity much rather: that which purifies us is trial, and trial is by what is contrary. That virtue therefore which . . . knows not the utmost that vice promises to her followers, and rejects it, is but a blank virtue, not a pure."[16]

There is no room for censorship within Christian circles, where access to all kinds of thinking is essential.[17] Otherwise, we shall foster a community in which people are unable to encounter opposition of any kind. In the long-term, censorship fosters weakness and not strength, and that is not the way of Christ's kingdom.[18]

6. *Mutual Interdependence*

Polemical writing, hot rhetoric, censorship, a pressure group mentality, individualism, authoritarianism, and loyalty to a political slogan work together to break up the Body of Christ. Each of these in its own way is a call for independence, and each of these places an ideal, a goal, or a person above loyalty to Christ. Independence is fostered rather than interdependence, and the health of the Body of Christ is sacrificed at the expense of achieving some specific goal—no matter how worthy that goal is as an end in itself.

The concept of the Body of Christ leads inevitably to one indispensable practical application, and that is mutual interdependence. We need each other, and we are therefore to support each other. Not only this, but we have inescapable obligations to each other, namely, to talk to each other, to uphold each other, and to respect each other.[19] As we begin to treat each other like this, we will be in a position to cope with dissenting views within the community of the Lord's people. How, though, do we do this?

(A.) We are to realize that our brothers and sisters in Christ are indeed precisely that, whatever there may be that divides us. They are, in Donald MacKay's words, "front-line comrades," whose chief end in life is to glorify God and enjoy him forever.[20] If this is true of us, it is also true of a fellow believer for whom Christ died and who is earnestly seeking to be faithful as a Christian, even if there are issues that separate us.

(B.) Implicit in what I have just said is another set of obligations: we are to listen to each other, seeking to understand and appreciate what it is that the other is stressing. We are to seek that which is genuinely Christ-affirming in that position, however much we may disagree with its interpretation or practical outcome. Under no circumstances are we to caricature the views of a fellow believer, or insist that a fellow Christian is lying, is a hypocrite, or is guilty of foul motives. We are to be faithful to each other by expressing accurately and fairly those viewpoints with which we disagree. And of course, we are to talk to one another, discuss frankly our differences and the reasons for them, and assess our own faithfulness and the nature of our views. Together, we are to seek that which is true in each other's position, and then to affirm these truths.

(C.) We are to help and encourage each other, even when we differ on issues we consider to be of considerable importance. Help and encouragement are necessary because we are engaged in a common enterprise,

Under no circumstances are we to caricature the views of a fellow believer, or insist that a fellow Christian is lying, is a hypocrite, or is guilty of foul motives.

that of forwarding the cause of Christ and of being His faithful representatives in a pluralistic society. We act in this way by providing feedback for the other person, through carefully thought-out criticism of the other's position. Such feedback includes raising serious questions which the other person may not have asked, and which may help to throw additional light on the validity or otherwise of that position. In the same way, we are to be prepared to have our own position questioned and challenged in a similar manner. We must cultivate an atmosphere of mutual support in which we seek the other's good, and together with them seek the mind of Christ. Such a framework is an edifying and learning one, in which we submit ourselves to one another in the fear of God.

(D.) We are to meet each other face to face. This is the ideal, even if it is not always possible. When impossible, we should write to each other rather than harangue each other in public. We should let each other know informally what we think, and not immediately criticize and condemn each other publicly. To meet one another, or at least correspond, is to begin to see each other as real people and especially as fellow believers. We can begin to appreciate what the other person is like as a human being, and not simply as a public face. We begin to see them as they are before God, and not as representatives of a rival evangelical constituency. They are people for whom we are to pray, and for whose well-being we are to strive. As we love them as human beings, we become concerned for them. Even if we think they are on the verge of heresy, we are to commit ourselves to support and aid them, not score points off them in a debate or heresy trial. The other person may be wrong and may need my assistance; but I also may be wrong and may need the assistance of my sincere opponent. Mutual interdependence is crucial, and informally and quietly meeting with one another face to face is a vital prerequisite.

(E.) The assistance of other Christians is frequently of enormous help when differences separate us. When we think someone is guilty of a serious error, we should solicit the advice of others, especially those who are knowledgeable in the area of concern, before acting or reacting publicly.[21] Key Christians should be brought together to determine the seriousness of the position taken and wide-ranging dialogue needs to take place with evangelicals holding a variety of views. Dialogue of this nature is essential and is "a major vehicle for determining truth in a world where truth is so entwined with error. . . . This side of glory, we evangelicals do not possess the final truth."[22] This is a provocative point, and yet it is also a fundamental theological premise. Mutual interdependence is not an optional extra for a Christian community; it is fundamental to its integrity.

NOTES

[1]This was initially published by Inter-Varsity Press, UK, and is still available on the British market. A follow-up book, *Manufacturing Humans: The Challenge of the New Reproductive Technologies* (Leicester: Inter-Varsity Press, 1987) is available on the British market.

[2]Jones, D. Gareth, "The View From a Censored Corner," *Journal of the American Scientific Affiliation* 37, 169–177, 1985.

[3]I realize this discussion has implications for denominational matters, and for consequent ecumenical considerations. While these are of considerable importance, perceived difficulties in handling such considerations should not be used as an argument against the points being made in this section. Conversely, if denominational differences are used to justify the existence of divisive disagreements between Christians, I would suggest that crucial biblical principles are being disregarded.

[4]In this paper I am not dealing with church discipline. Nevertheless, this principle would appear to be relevant in that context as well as in the present one.

[5]I am not suggesting that these affirmations are the *only* essential ones. It is not my purpose in this paper to argue for what is the minimal theological context of the gospel. I am suggesting, however, that there are certain critical principles and certain peripheral matters. Disagreement over the precise details of each category does not affect the force of my argument.

[6]See my article: "Bioethics—Meeting Ground Between Theologians and Non-theologians," *Christian Arena 39* (3), 8–11, 1986.

[7]It has to be asked whether pressure groups, by their nature, are incompatible with the attitudes of Christ. This is undoubtedly an extremely contentious suggestion, and all pressure groups do not manifest the same characteristics. It is, nonetheless, a serious query.

[8]Kantzer, Kenneth S., "Problems Inerrancy Doesn't Solve," *Christianity Today 31* (3), 14–15, 20 February 1987.

[9]Sire, James W., "Brave New Publishers: Should They Be Censored?" In *Evangelicalism: Surviving its Success* (David A. Fraser, ed.) (St. Davids, PA: The Evangelical Round Table, vol. 2, Eastern College and Eastern Baptist Theological Seminary, 1987), pp. 128–147.

[10]Perrota, K., "Differences of Opinion?", *Eternity* 37 (1), 56–59, 70–71, 1986.

[11]Stott, J.R.W., *Your Mind Matters* (Downers Grove, IL: InterVarsity Press, 1973).

[12]Barcus, N., *Developing a Christian Mind* (Downers Grove, IL: InterVarsity Press, 1977).

[13]Davis, D.G., an unpublished paper entitled: "Intellectual Freedom and Evangelical Faith," 1985.

[14]Milton, John, *Areopagitica* in *Complete Poems and Major Prose* (M.Y. Hughes, ed.) (New York: Odyssey Press, 1957), p. 747.

[15]Sire, *op. cit.*, p. 16.

[16]Milton, *op. cit.*, p. 728.

[17]Thomas, Cal, *Book Burning* (Westchester, IL: Crossway, 1983), pp. 34–35.

[18]These views are put forward as a general principle. Considerable discussion is required to ascertain whether censorship is ever allowable, e.g. to protect minors. If it is, it would be an exception to the general rule opposed to censorship.

[19]MacKay, Donald M., "The Health of the Evangelical Body," *Journal of the American Scientific Affiliation* 38, 258–265, 1986.

[20]*Ibid.*

[21]Sire, *op. cit.*, p. 13

[22]*Ibid.*, p. 23.

Communications

THE CONTEMPORARY RELEVANCE OF AUGUSTINE'S VIEW OF CREATION

A common impression exists among lay Christians and many non-Christians that the church interpreted Genesis 1–3 literally until the last two centuries. This allegedly traditional rendering includes the idea that God created the cosmos over a span of six ordinary 24-hour days, that there was no death in the world until the fall of Adam, and that at the time of the fall God introduced many other unpleasantries into the world-order as a punishment for sin. Included is the notion that thorns and thistles were not part of the original creation. Moreover, one encounters the suggestion that the church firmly held to these traditional ideas until the early 19th century, when geology proposed the concepts of an old earth and death before the appearance of man. The conclusion for many evangelicals is that these traditional ideas are the plain teaching of Scripture, and that attempts to avoid these plain teachings arose because of an unholy desire to accommodate biblical teaching to the dictates of an anti-Christian modern science.

That such a reading of church history is simplistic becomes clear when we consider the views of Augustine, the church's greatest theologian between Paul and Aquinas, on Genesis 1–3. Although we can gain an inkling of Augustine's approach to Genesis 1–3 from scattered comments in *Confessions* and *The City of God*, deeper insight is now possible for a wide audience with the recent publication of a fresh English translation of his great work, *On the Literal Meaning of Genesis*.[1] The few studies of Augustine's view of creation that are based on the Latin text are not widely accessible. It is my judgment that anyone seriously interested in the Genesis–science discussion should take the time to study this new translation. It is full of surprises. I wish to make a few observations about Augustine's general approach and his specific interpretations of the text of Genesis 1–3.

General Comments About Interpretation

Intriguing as Augustine's interpretations of specific texts may be, let's first look at some general attitudes that Augustine displays towards the text and its interpretation.

1. ***Augustine stresses that his interpretation of Genesis 1–3 is literal and not metaphorical or allegorical.***

Augustine had tried his hand earlier at interpretation of Genesis (*A Commentary on Genesis: Two Books against the Manichees*) and adopted a more allegorical method. He later came to reject that method and in this more mature work, written in his late fifties just before *The City of God*, he is concerned "to discuss Sacred Scriptures according to the plain meaning of the historical facts, not according to future events which they foreshadow" (p. 39). Given his strong commitment to literal interpretation, it is fascinating to recognize that the outcome bears absolutely no resemblance to modern literal interpretations. For example, he concludes that in Genesis 1 the terms "light," "day," and "morning" bear a spiritual, rather than physical, meaning. Yet for Augustine, spiritual light is just as literal as physical light, and the creation of spiritual light is just as much a historical event or fact as the creation of physical light. What is literal for one person may not be literal for others.

2. ***Augustine claims that the interpretation of Genesis 1 is not at all obvious and is fraught with difficulties.***

Commitment to a literal interpretation does not solve all problems, nor does it lock the exegete into only one reading of the text. Perhaps more than any other interpreter, Augustine was painfully aware of the difficulties of the text. On point after point he lays out the various possibilities and often does not know how to commit himself. He freely acknowledges the many problems and options. He says that he has

> worked out and presented the statements of the book of Genesis in a variety of ways according to my ability; and, in *interpreting words that have been written obscurely for the purpose of stimulating our thought*, I have not rashly taken my stand on one side against a rival interpretation which might possibly be better. I have thought that each one, in keeping with his powers of understanding, should choose the interpretation that he can grasp. Where he cannot understand Holy Scripture, let him glorify God and fear for himself. (pp. 43–44, emphasis mine)

He further observes that "It is a laborious and difficult task for the powers of our human understanding to see clearly the meaning of the sacred writer in the matter of these six days" (p. 103). How different is his attitude than those who, disregarding the labors of many of the church's greatest minds over the past two millennia, have convinced themselves that the fundamental interpretation of Genesis 1–3 is perfectly obvious. If we follow Augustine's lead, we will be very careful before using the words "the clear teaching of Scripture" in connection with these chapters.

3. ***Augustine claims that we ought to be willing to change our minds about the interpretation of Genesis 1–3, particularly as new information comes to light.***

Consistent with the claim that Genesis 1–3 is difficult and obscure, Augustine repeatedly urges restraint, flexibility, openness to new interpretations, and openness to new knowledge that may provide insight into the text. He says that "in matters that are obscure and far beyond our vision . . . we should not rush in headlong and so firmly take our stand on one side that, if further progress in the search of truth justly undermines this position, we too fall with it. That would be to battle not for the teaching of Holy Scripture but for our own, wishing its teaching to conform to ours, whereas we ought to wish ours to conform to that of Sacred Scripture" (p. 41).

4. ***Augustine is particularly emphatic that we ought not to make absurd statements about what the Bible says when such statements flatly contradict what people already know from other reliable sources. We ought not to rigidly and dogmatically commit Scripture to interpretations that can easily be shown to be false on the basis of physical evidence.***

It seems to me that the following lengthy quotation cannot be heard enough because it is so terribly relevant to the present discussion about Genesis and earth history. Augustine says:

> Usually, even a non-Christian knows something about the earth, the heavens, and the other elements of this world, about the motion and orbit of the stars and even their size and relative positions, about the predictable eclipses of the sun and moon, the cycles of the years and seasons, about the kinds of animals, shrubs, stones, and so forth, and this knowledge he holds to as being certain from reason and experience. Now, it is a disgraceful and dangerous thing for an infidel to hear a Christian, presumably giving the meaning of Holy Scripture, talking nonsense on these topics; and we should take all means to prevent such an embarrassing situation, in which people show up vast ignorance in a Christian and laugh it to scorn. The shame is not so much that an ignorant individual is derided, but that people outside the household of the faith think our sacred writers held such opinions, and, to the great loss of those for whose salvation we toil, the writers of our Scripture are criticized and rejected as unlearned men. . . . Reckless and incompetent expounders of Holy Scripture bring untold trouble and sorrow on their wiser brethren when they are caught in one of their mischievous false opinions and are taken to task by those who are not bound by the authority of our sacred books. For then, to defend their utterly foolish and obviously untrue statements, they will try to call upon Holy Scripture for proof and even recite from memory many passages which they think support their position, although *they understand neither what they say nor the things about which they make assertion.* (pp. 42–43)

It seems to me that some of the young-earth, flood geology proponents of this century exemplify those whom Augustine had in mind. One can only guess at the damage done to evangelistic efforts among scientists by the persistent claims of Christians that the Bible teaches a young earth and a global deluge.

Augustine sees only trouble in committing Scripture to interpretations that supposedly provide information about the physical structure of the earth or the cosmos. Consider these two examples:

> Let no one think that, because the Psalmist says, *He established the earth above the water*, we must use this testimony of Holy Scripture against these people who engage in learned discussions about the weight of the elements. They are not bound by the authority of our Bible; and, ignorant of the sense of these words, they will more readily scorn our sacred books than disavow the knowledge they have acquired by unassailable arguments or proved by the evidence of experience. (pp. 47–48)

And:

> But someone may ask: 'Is not Scripture opposed to those who hold that heaven is spherical, when it says, *who stretches out heaven like a skin?*' Let it be opposed indeed if their statement is false. . . . But if they are able to establish their doctrine with proofs that cannot be denied, we must show that this statement of Scripture about the skin is not opposed to the truth of their conclusions. (p. 59)

Augustine shows respect for scientific activity, and does not want to put Scripture in a situation of conflict with it.

5. ***Augustine is obviously interested in the science of his own day and interacts with it. He takes extra-biblical knowledge seriously.***

For example, it is clear that he accepts spontaneous generation of organisms and the four elements of Greek thought. He expends considerable effort in relating Genesis 1 to the four elements and to the Greek theory of natural places: "One must surely not think that in this passage of Holy Scripture there has been an omission of any one of the four elements that are generally supposed to make up the world just because there seems to be no mention of air in the account of sky, water, and earth"(p. 76).

From his general approach to this text, it would appear that Augustine, the great theologian, a man saturated in Holy Scripture, actually encourages the church not to cling dogmatically to specific renderings of the text but to rethink its interpretations in the light of genuine extra-biblical knowledge. Perhaps we should pay him serious attention.

Specific Interpretations

Now let's look at some of Augustine's specific interpretations of the first chapters of Genesis.

1. ***Augustine says that God created all things simultaneously.***

There can be no mistaking that Augustine teaches that God created everything simultaneously in the beginning. Some things were made in fully developed form as we see them today, and other things were made in a potential form, so that in time they might become the way we see them now. Augustine went far beyond any superficial reading of the text by claiming that neither the creation nor the subsequent unfolding took place in six ordinary days. He is explicit that God did not create the world over the course of six temporal days. "The sacred writer was able to separate in the time of his narrative what God did not separate in time in His creative act" (p. 36).

2. ***Augustine says that the six-day creation structure has nothing to do with the passage of time during creation but is a logical framework.***

Augustine repeatedly stresses that the six days are not six successive ordinary days. They have nothing to do with time. For him, this is unequivocally the case for the first three days before the making of the sun, but he is equally inclined to say the same of the last three days. The days are repeatedly claimed to be arranged according to causes, order, and logic. For example: "These seven days of our time, although like the same days of creation in name and in numbering, follow one another in succession and mark off the division of time, but those first six days occurred in a form unfamiliar to us as intrinsic principles within things created" (p. 125). The days of creation "are beyond the experience and knowledge of us mortal earthbound men . . . we must bear in mind that these days indeed recall the days of creation but without in any way being really similar to them" (p. 135). Further, "we should not think of those days as solar days. . . . He made that which gave time its beginning, as He made all things together, disposing them in an order based not on intervals of time but on causal connections" (p. 154). And finally, "But in the beginning He created all things together and completed the whole in six days, when six times he brought the 'day' which he made before the things which He made, not in a succession of periods of time but in a plan made known according to causes" (pp. 175–176). Why does the narrative employ the device of the six days? "The reason is that those who cannot understand the meaning of the text, *He created all things together,* cannot arrive at the meaning of Scripture unless the narrative proceeds slowly step by step" (p. 142).

As the six days have nothing to do with the passage of time, Augustine relates them to the knowledge that intellectual creatures—that is, angels—have of created things, both as they exist in the Word of God and as they exist in themselves. This knowledge was made known to the angels in the six ordering steps: "That day, which God has made, recurs in connection with His works not by a material passage of time but by a spiritual knowledge, when the blessed company of angels contemplate from the beginning in the Word of God the divine decree to create" (p. 134). Or, "The seven days . . . with which we are familiar . . . are like a shadow and a sign reminding us to seek those days wherein created spiritual light was able to be made present to all the works of God by the perfection of the number six" (p. 145). There is no doubt that Augustine's view is strange and difficult to absorb, but he has a ready comment for us: "And when you hear that all things were made after day was made, you may possibly understand this sixfold or sevenfold repetition which took place without lapse of time. If you cannot yet understand it, you should leave the matter for the consideration of those who can" (p. 150).

3. ***Augustine does not envision the fall resulting in fundamental structural changes in the cosmos, or even the introduction of death into the animal realm.***

For many Christians, Genesis teaches that substantial changes occurred in the structure of creation at the time of Adam's fall. There is widespread belief that thorns and thistles were specifically introduced into the world to be an annoyance to sinful human beings. Such plants, it is thought, did not exist in the original creation. That was certainly not Augustine's view. He says:

> We should not jump to the conclusion that it was only then that these plants came forth from the earth. For it could be that, in view of the many advantages found in different kinds of seeds, these plants had a place on earth without afflicting man in any way. But since they were growing in the fields in which man was now laboring in punishment for his sin, it is reasonable to suppose that they became one of the means of punishing him. For they might have grown elsewhere, for the nourishment of birds and beasts, or even for the use of man. Now this interpretation does not contradict what is said in the words, *Thorns and thistles shall it bring forth to you,* if we understand that earth in producing them before the fall did not do so to afflict man but rather to provide proper nourishment for certain animals, since some animals find soft dry thistles a pleasant and nourishing food. . . . I do not mean that these plants once grew in other places and only afterwards in the fields where man planted and harvested his crops. They were in the same place before and after; formerly not for man, afterwards for man. And this is what is meant by the words *to you.* (p. 94)

It is a further surprise to note that Augustine does not even see animal death and corruption as a direct result of the fall. In answer to the question as to why animals eat each other, he claims that it is because that is the way they were made. Human sin is not considered as the cause. Moreover, it is because we are fallen that we *perceive* animal death and corruption as an evil.

> One might ask why brute beasts inflict injury on one another, for there is no sin in them for which they could be a punishment, and they cannot acquire any virtue by such a trial. The answer, of course, is that one animal is the nourishment of another. To wish that it were otherwise would not be reasonable. For all creatures, as long as they exist, have their own measure, number, and order. (p. 92)

He also speaks of death as follows: "For He has wrought them all in His wisdom, which, reaching from end to end, governs all graciously; and he leaves not in an unformed state the very least of His creatures that are *by their nature* subject to corruption, whose dissolution is loathsome to us in our fallen state by reason of our own mortality" (p. 90, emphasis mine).

4. ***Augustine suggests that the bodies of Adam and Eve were created mortal.***

Augustine raises the interesting question: why would Adam and Eve have to eat if they were created immortal? "It is difficult to explain how man was created immortal and at the same time in company with the other living creatures was given for food the seed-bearing plant, the fruit tree, and the green crops. If it was by sin that he was made mortal, surely before sinning he did not need such food since his body could not corrupt for lack of it" (p. 97). His solution is that Adam and Eve were created with mortal bodies. Their death was the result of their sin, but Augustine suggests that, had they not sinned, they would have been given the spiritual bodies with which we will be endowed at the resurrection.

> He was mortal . . . by the constitution of his natural body, and he was immortal by the gift of his Creator. For if it was a natural body he had, it was certainly mortal because it was able to die,

> although at the same time immortal by reason of the fact that it was able not to die. Only a spiritual being is immortal by virtue of the fact that it cannot possibly die; and this condition is promised to us in the resurrection. Consequently, Adam's body, a natural and therefore mortal body, which by justification would become spiritual and therefore truly immortal, in reality by sin was made not mortal (because it was that already) but rather a dead thing, which it would have been able not to be if Adam had not sinned. (pp. 204–205)

Those interested in the issue of human origins should take a closer look at Augustine's views.

Conclusions

1. It is historically inaccurate to maintain that modern science alone forced the church to come up with ideas about Genesis 1–3 that differ from the allegedly traditional views. Many of Augustine's interpretations are plainly at variance with what are commonly perceived in evangelicalism as traditional views of Genesis. And, I might add, he was never accused of heresy for his views. It is plain that we cannot accuse Augustine of departing from the plain meaning of Scripture in order to make peace with science as we know it. Obviously, Augustine was not looking over his shoulder at scientific geology or paleontology. It is therefore all the more remarkable and significant that he adopts positions generally not perceived as the traditional church positions.

2. Given that a theological thinker of Augustine's genius arrived at the views he did after years of careful study of the text, it is incumbent upon us to approach the early chapters of Genesis with far less dogmatism and far more humility and caution than we often do. Augustine's interpretations should help us guard against facile claims about the obvious meaning of these texts. The point here is not that we should adopt Augustine's specific interpretations (I've got problems with some of them myself), but that we should recognize what Augustine recognized: namely, the early chapters of Genesis are in fact complex and do not render easy, pat answers. Once the entire evangelical world comes to grips with that simple conclusion, we will have made some progress.

REFERENCES

1. St. Augustine, *The Literal Meaning of Genesis*, translated and annotated by John Hammond Taylor, S.J., 2 vols. (New York: Newman Press, 1982). All page references in the text of this paper are to pages in volume 1.

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WHAT IS SCIENCE?

Whereas the 19 June 1987 voiding of a 1981 Louisiana law by the Supreme Court (7–2) in the case of Edwards vs. Aquillard 685 centered primarily on the question "What is religion?", the rejection of the 1981 Arkansas Act 590 by a Federal Court in 1982 also involved the question "What is science?" One of the ACLU principal witnesses for the plaintiffs in the earlier case was the philosopher-theologian Langdon Gilkey, a professor at the liberal Divinity School of the University of Chicago. In his interesting 1985 report, "Creationism on Trial: Evolution and God at Little Rock", he notes parenthetically, "Many scientists . . . don't really know too much about what science is or is not." If he included philosophers and theologians in his indictment, I would agree; better instruction is needed about the nature of science, particularly its self-imposed limitations. For example, the Washington Post recently published two letters: "What do creationists know about science?" (11 July 1987) and "Social scientists are not 'real' scientists" (18 July 1987).

Gilkey notes that creation scientists claim that science is essentially "a body or collection of facts."[1] He faults them in that "they center science in the facts it explains, they, therefore, fail to center science in its theories explanatory of the facts." As a theoretical physicist, I disagree with his dictum that "science is located in its theories, in its theoretical structure not in its facts. . . . It is the theories, not the facts involved in scientific inquiry that makes it science." He finds support in the opinion of another witness, Professor Michael Reese, a philosopher of science at Guelph University in Canada, who claims that "the essence of science lays in its theoretical structure." He agrees with the latter's regard of evolution as a fact—a promotional dogma of many biologists.[2] The facts of evolution, I believe, are the observed data—not the theory that explains a carefully arranged sequence. My own view of the scientific method is not so simplistic. It is a complex process which involves at least four sequential ingredients: communal experiential (observed) facts, analyzed related factors, synthesized factitious theory, and experimental (observed) facts—with imagination as a common thread.[3] I would hardly designate any as generally central, although the observed facts might be regarded as so-called boundary conditions of partial differential equations.

In his own testimony, Gilkey claims that "the basic forces or factors referred to in a scientific explanation are quantitative"—a common fallacy, presumably because of their common use. The philosopher Rudolf Carnap emphasized that there are three kinds of concepts in science: classificatory, comparative, quantitative.[4] Unfortunately, mathematics for the qualitative has not yet been as highly developed as for the easier quantitative. Noteworthy also is Gilkey's careless identification of scientism with positivism.[5] I agree, however, with his regard of evolutionism as having a religious aura about the scientific theory of evolution. On the other hand,

his statement that "this factual account represented the 'science' of the eighth- to sixth-century Hebrew world (B.C.E.)" suggests a modern connotation of the word "science," which is misleading.

Gilkey deplores that "the wider public, both those who attend church and those who do not, remain apparently unaware that there is no longer any conflict between science and religion." This is narcisstic, or at best, wishful thinking. The philosophy of science and the philosophy of religion are always bound to conflict, inasmuch as they both regard the same culture from different viewpoints. The overlapping views involve the same basic questions: What is true? What is real? What is of value? Hopefully, the apparent conflicts will change as each new view and insight becomes more complete, pointing to an ideal and necessary reconciliation. At present, however, I cannot accept his dictum that "there is essentially no threat of religion to science or of science to religion"—a fool's paradise in a greedy, competitive technological world. I do, however, agree that by definition science is agnostic, not atheistic.

Gilkey raises two interesting questions: How is it possible for creation science, particularly the earlier deistic form, to arise in an admittedly scientific culture? And why are some reputable scientists attracted to creation science? I agree wholeheartedly with his own conclusions that so-called creation science is not strictly a science inasmuch as it lacks testable prediction, but that it is religiously related as it primarily deals with ultimate concerns. I also agree with his observation that "today in the Church there is little understanding of creation. The doctrine of providence is not often discussed."

NOTES

[1]See, for example, the argument from design of William Paley, et. al.
[2]*Encyclopedia Britannica*, 15th edition.
[3]From the same linguistic root as "theater": a view.
[4]"Philosophical Foundations of Physics," 1966.
[5]cf., Richard von Mises, "Positivism: A Study in Human Understanding," 1951.

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The love of God, as it is the sovereign remedy of all miseries, so in particular it effectually prevents all the bodily disorders the passions introduce, by keeping the passions themselves within due bounds. And by the unspeakable joy, and perfect calm, serenity, and tranquillity it gives the mind, it becomes the most powerful of all the means of health and long life.

John Wesley, *The Works of John Wesley*, Vol. XIV (Grand Rapids: Zondervan, 1872).

Book Reviews

Blessed are the Peacemakers: Rewriting the History of Christianity and Science

An essay review of three works:

THE GALILEO CONNECTION: Resolving Conflicts Between Science and the Bible by Charles E. Hummel. Downers Grove, IL: InterVarsity Press, 1986. 293 pages, index. Paperback; $8.95. (Reviewed in *Journal ASA*, September 1986)

CROSS-CURRENTS: Interactions Between Science and Faith by Colin A. Russell. Grand Rapids, MI: Eerdmans, 1985. 272 pages, index. Paperback; $10.95. (Reviewed in *Journal ASA*, December 1986)

GOD AND NATURE: Historical Essays on the Encounter Between Christianity and Science by David C. Lindberg and Ronald L. Numbers (eds.). Berkeley, CA: University of California Press, 1986. xi + 516 pages, annotated bibliography, index. Hardcover, $50.00/ Paperback, $17.95. (Reviewed in *Perspectives*, June 1987)

> In this nineteenth century, as at the dawn of modern physical science, the cosmogony of the semi-barbarous Hebrew is the incubus of the philosopher and the opprobrium of the orthodox. Who shall number the patient and earnest seekers after truth, from the days of Galileo until now, whose lives have been embittered and their good name blasted by the mistaken zeal of Bibliolaters? Who shall count the host of weaker men whose sense of truth has been destroyed in the effort to harmonize impossibilities—whose life has been wasted in the attempt to force the generous new wine of Science into the old bottles of Judaism, compelled by the outcry of the same strong party?
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> It is true that if philosophers have suffered, their cause has been amply avenged. Extinguished theologians lie about the cradle of every science as the strangled snakes beside that of Hercules; and history records that whenever science and orthodoxy have been fairly opposed, the latter has been forced to retire from the lists, bleeding and crushed, if not annihilated; scotched, if not slain. But orthodoxy is the Bourbon of the world of thought. It learns not, neither can it forget; and though, at present, bewildered and afraid to move, it is as willing as ever to insist that the first chapter of Genesis contains the beginning and the end of sound science; and to visit, with such petty thunderbolts as its half-paralyzed hands can hurl, those who refuse to degrade Nature to the level of primitive Judaism.[1]

The ideologue who penned these famous words, Thomas Henry Huxley, was almost incapable of discussing biblical religion without lapsing into vitriolic polemics that could, at least in this case, degenerate into vulgar anti-Semitism. As a high priest in the new religion of secularism, Huxley had his own orthodoxy to defend, and he never missed an opportunity to win converts through rhetorical conquest. He was not without allies. In an age that was remarkable for its positivistic fervor, two others stood out no less than Huxley for their commitment to the cause: Andrew Dickson White, a historian who was the first president of Cornell University, and John William Draper, a chemist turned historian who had shared the dias with Huxley and Samuel Wilburforce at a now legendary session of the 1860 meeting of the British Association for the Advancement of Science at Oxford.[2] Determined to establish forever the autonomy of science from religious thought, each chose the landscape of history on which to fight his battle. White's *History of the Warfare of Science with Theology in Christendom*[3], whose title accurately conveys its content, and Draper's mainly anti-Catholic *History of the Conflict between Religion and Science*[4] set the tone for the historiography of science and Christianity for about a century. It was not until the appearance in 1979 of James R. Moore's revisionist treatment of *The Post-Darwinian Controversies* that historians were confronted with an open challenge to abandon military metaphors when discussing science and religion.[5] Moore's book, I am pleased to state, has altered significantly the way in which historians of science treat science/religion issues. I can only hope that it eventually has a similar impact on the scientists and journalists whose audiences are usually much larger.[6]

The subtitles of the three books reviewed here reflect the influence of Moore's call for a new historiography of Christianity and science; they also reflect the very different purposes of their authors. Hummel's focus on "*resolving* conflicts between science and the *Bible*" emphasizes peacemaking, and targets not the scholar but the Christian student who is troubled by challenges to the Bible arising from the claims of science. Russell goes well beyond conflict resolution, finding a host of "*interactions* between science and *faith*" in an effort to show students that Christianity, far from being in conflict with science, has in fact been closely intertwined with scientific progress. Both Hummel and Russell can be understood to have written apologetical works, though one is considerably more defensive than the other. Lindberg and Numbers, on the other hand, have deliberately tried to avoid apologetics, whether in defense of Christianity *or* science, in putting together a collection of historical studies of "the *encounter* between *Christianity* and science," both of which are treated critically. Their volume, although intended for a

wider audience than just professional historians of science and religion, will probably fail to reach that audience owing to the depth of historical sophistication presupposed by several of the essays it contains—and this would be unfortunate, given the overall quality of the collection.

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Charles Hummel, an ASA member who directs faculty ministries for Inter-Varsity Christian Fellowship, has advanced degrees in chemical engineering and biblical literature. In other words, he is neither strictly a scientist nor a historian of science. Yet he has done his homework diligently, using in his research not only classic monographs but also a fair amount of recent specialty literature, including portions of *God and Nature* that he was able to see in proofs. Thus, his book goes well beyond popular treatments of science/religion themes. At the same time it remains popular in its style, level of discussion, and choice of topics.

InterVarsity Press targets Christian college students, many of whom feel their faith threatened by the ideas and attitudes of their science professors. Hummel tries to overcome those fears as fully as possible by showing that Christianity and science are "allies rather than enemies" (p. 20) in the lives of Christian scientists. To that end, the first two-thirds of Hummel's book contains sensitive biographical studies of four scientists who considered themselves Christians: Copernicus, Kepler, Galileo, and Newton. This approach works well to humanize science—indeed, to "demythologize" the commonly held view of science as completely objective, absolute knowledge divorced from more subjective knowledge such as philosophy and theology. Galileo and Newton are often put forth as prototypes of what scientists should be: dispassionate students of nature who know how to separate hard science from mere metaphysics. Hummel paints very different pictures of both men. Galileo was far from dispassionate. As Hummel notes with charitable understatement, he "had a knack for antagonizing people" (p. 86) that got him into serious trouble with his university colleagues and some factions in the Church. Nor did he avoid significant metaphysical commitment. In an excellent discussion of an often misunderstood subject, Hummel argues correctly that Galileo's notion of science was essentially Aristotelian: only those propositions derived deductively from first principles were worthy of being called "science." Isaac Newton is also "demythologized" by Hummel. Instead of the usual—and woefully inaccurate—Enlightenment view of Newton as the embodiment of scientific rationalism, whose God was just a poor clockmaker, we find rather the intense student of biblical prophecy whose God was ever active in a universe that was not completely mechanical.[7]

On the whole, Hummel's fluent, well-researched biographical essays are an asset to his book. But I am troubled by two points. First, Hummel skirts past Newton's Arianism with no more than a passing acknowledgement. In a book about the partnership between science and orthodox Christianity, this simply will not do—how does an Arian fit in with Trinitarians? Second, I cannot fail to note that none of Hummel's sketches deal with a *modern* scientist. The youngest studied (Newton) has been dead for two hundred and sixty years, during which time the sense of separation between science and religion has steadily increased. I am left wondering whether Hummel could have found four modern scientists of comparable stature to illustrate the partnership of science and faith.

The last third of *The Galileo Connection* moves in another direction. Instead of exploring 16th and 17th century examples of the harmony between Christianity and scientific excellence, Hummel turns his attention to resolving what many contemporary Christians perceive as conflicts between science and the Bible. He begins at the right place, with an examination of the basic principles of biblical interpretation. Hummel observes that the purpose of Scripture is religious rather than scientific, and he laments that "biblical authority and reliability are often mistakenly extended to the realm of scientific explanation" (p. 170). Hummel proceeds to develop what he understands to be the biblical view of nature, balancing the immanence and the transcendence of God. Nature, he stresses, is the moment-by-moment work of a free and sovereign Lord. "Biblical theism," Hummel argues,

> opposes both pantheism and deism; God is neither just a part of the world nor is he locked out of its activity. He is constantly working within nature as well as human history to achieve his purposes. The biblical writers attribute *all* events in nature—both the recurring and the miraculous, the predictable and the unexpected—to the power of God. (p. 178)

Hummel rejects Aquinas' distinction between the natural and the supernatural, noting that this led historically to the gradual removal of God from His creation: whatever could be understood in terms of natural law, by definition, could not be assigned to divine activity. This is hardly a novel theme—the radical dependence of nature on God is deeply embedded in the Reformed and Augustinian traditions, to say nothing of early modern science—but it will be very new indeed to most readers.[8] Hummel is to be commended for taking the time to develop this theme at length, and at a level comprehensible to his audience. Given this theology of nature, it is not surprising to find Hummel explaining that natural laws are descriptive of an observed order rather than prescriptive of a necessary order.[9] This makes it possible for him to argue that miracles are not violations of natural laws. Thus, the occurrence of miracles becomes a question not for science but for history to address.

Hummel again appeals to hermeneutics to resolve the inevitable issue of cosmogony: once the reader understands how to interpret Genesis 1 properly, he hopes, most of the difficulties will be dissolved. Ever since the early 19th century, the "concordist" approach to the first chapter of the Bible has been favored by conservative Protestant writers.[10] Concordists typically endorse either the "gap" theory or the "day-age" theory as a means of harmonizing the biblical account with the great antiquity of the earth required by modern geology. However, in assuming that Genesis and geology are telling substantially the same story, concordists are assuming that the purpose of Genesis 1 is at least partly scientific. And this Hummel does not accept. The original purpose of this passage, he argues, the only purpose that was evident to the Hebrews, was to proclaim a radical monotheism that de-deifies nature. Any attempt to derive scientific information (such as the fixity of species or the age of the earth) from this theological polemic is unwarranted.

For Hummel, then, concordism is a house built upon sand, lacking a solid hermeneutical foundation and too strongly attached to the shifting ground of scientific theories. He likewise rejects the "two-realm" model, that confines theology and science to separate spheres. The approach that Hummel endorses views theology and science as "complementary perspectives—different kinds of maps for the same terrain" (p. 261), neither one exclusive of the other or complete in itself.[11] Many readers may have difficulty in appreciating this subtlety, but the fault will not be Hummel's. Throughout the book he has tried to present a thoughtful account of complex matters, without oversimplifying or distorting either the issues or their history.[12] In my judgment, he has succeeded very well.

The history of science—is it science or history? This question, which is often asked in one form or another, can betray a lack of understanding of an interdisciplinary academic field that has come into its own only in the last quarter century. The puzzled reader, who had expected to learn more about *science*, has had to wade through a morass of apparently irrelevant historical trivia in order to find "the good parts" pertaining to the development of scientific thought. In fact, most historians of science would contend, the reader has indeed learned more *about* science by negotiating the morass. But is this true? Does one really learn more about science by studying the general historical context in which it is embedded? One's answer—and one's approach to the history of science—depends on one's view of science itself. The "internalist" approach follows the conceptual development of a particular scientific theory or discipline, with little or no regard for influences that come from "outside" science. The "externalist" approach emphasizes the importance of just those external influences that are ignored or downplayed by the internalist approach. To put it succinctly, "internal" history of science looks a lot like science and "external" history of science looks a lot like history. As always when dealing with labels, one must be careful not to simplify too much. In reality, most historians of science combine elements of both approaches, at least in their teaching and writing if not also in their research.

Colin Russell, a distinguished historian of chemistry at England's Open University and currently president of the British Society for the History of Science, makes it very clear in his book, *Cross-Currents*, just where he stands on the proper approach to the history of science. He also spells out the relevance of historiography to science/faith issues:

> The approach taken to history of science in the present book is essentially pragmatic, and open to all kinds of evidence. Unlike the old-fashioned Victorian approach to science that was full of 'heroes' and triumphalism, it does not envisage the historic relations between science and religion in terms of conflict. Ironically, in this respect, it differs from certain modern 'creationist' critiques of science. Indeed, in seeing continuity between science and religion, it agrees with some Marxist interpretations, sharing with them a holistic view of life and history. We shall, however, disagree in recognizing the complex nature of the human drama, regarding its reduction to the mere status of 'class struggle' as arbitrary and artificial. Within recent history of science this approach has found numerous supporters, most notably Professor R. Hooykaas of Utrecht. Its analysis would acknowledge elements of genuine controversy but would explore them in precise theological terms, would avoid simplistic conflict models and would take fully into account nuances of belief across the ideological spectrum. Scholars in this tradition would accept that much scientific thought is socially conditioned, though that is not at all to deny the 'givenness' of natural phenomena and the uniqueness of science and the possibility of genuinely objective scientific knowledge. (p. 19)

Thus, Russell charts a middle course between the Scylla of internalist "triumphalism," which deifies science, and the Charybdis of purely external analysis, which reduces science

Books Received and Available for Review

(Please contact the book review editor if you would like to review one of these books.)

W. Anderson, *To Govern Evolution*, Harcourt, Brace, Jovanovich

B. Barron, *The Health and Wealth Gospel*, InterVarsity

A. Clark, *Understanding Science Through Evolution*, Thomas

R. Ericksen, *Theologians Under Hitler*, Yale

W. Fore, *Television and Religion: The Shaping of Faith, Values, and Culture*, Augsburg

P. Gay, *A Godless Jew: Freud, Atheism, and the Making of Psychoanalysis*, Yale

P. Giurlanda, *Faith and Knowledge*, University Press of America

B. Groeschel, *Stumbling Blocks or Stepping Stones: Spiritual Answers to Psychological Questions*, Paulist

P. Gundry, *Neither Slave Nor Free: Helping Women Answer the Call to Church Leadership*, Harper and Row

C. Hyers, *And God Created Laughter: The Bible As Divine Comedy*, John Knox

A. Iannone, *Contemporary Moral Controversies in Technology*, Oxford

C. Kreider, *The Rich and the Poor: A Christian Perspective on Global Economics*, Herald Press

P. Langley, *Scientific Discovery: Computational Explorations of the Creative Processes*, MIT Press

D. Lyon, *The Steeple's Shadow: On the Myths and Realities of Secularization*, Eerdmans

H. Maturana and F. Varela, *The Tree of Knowledge: The Biological Roots of Human Understanding*, New Science Library

M. Mayers, *Christianity Confronts Culture*, Zondervan

P. McCorduck, *The Universal Machine: Confessions of a Technological Optimist*, Harcourt, Brace, Jovanovich

T. Miethe, *A Christian's Guide to Faith and Reason*, Bethany

T. Morris, *Francis Schaeffer's Apologetics: A Critique*, Baker

L. Noble, *Sociotheology*, BookCrafters

R. Oden, *The Bible Without Theology*, Harper and Row

R. Perkins, *Looking Both Ways: Exploring the Interface Between Christianity and Sociology*, Baker

R. Philipchalk, *Psychology and Christianity*, University Press of America

M. Poole and G. Wenham, *Creation or Evolution: A False Antithesis?*, Latimer

V. Poythress, *Symphonic Theology: The Validity of Multiple Perspectives in Theology*, Zondervan

A. Rudin and M. Wilson (eds.), *A Time to Speak: The Evangelical-Jewish Encounter*, Eerdmans

O. Segerberg, Jr., *The Riddles of Jesus and Answers of Science*, Reges Books

R. Sherlock, *Preserving Life: Public Policy and the Life Not Worth Living*, Loyola University Press

A. Simon, *Christian Faith and Public Policy: No Grounds for Divorce*, Eerdmans

M. Stafleu, *Theories at Work: On the Structure and Functioning of Theories in Science*, University Press of America

J. White, *Honesty, Morality, and Conscience*, NavPress

to a mere figment of the imagination. In sailing that course, he has followed in the wake of two superb sets of materials on science and belief already produced by Russell and his colleagues at the Open University.[13] It was not Russell's intention to condense those materials into a single volume (I suspect that would have been impossible!), although he has obviously benefitted from the extensive research that went into producing them. His goal rather is to address, in a synthetic way, some major themes in the history of science and Christianity, aiming his comments at the same audience Hummel has chosen: the college student who happens to be a Christian. *Cross-Currents* was written at the request of the British branch of Inter-Varsity Christian Fellowship, and in Britain it is available from IVP. American InterVarsity Press chose to publish Hummel's book instead, so Eerdmans carries the American rights to Russell's.

Among the themes that Russell includes are several that will be familiar to readers with a modest knowledge of science/faith issues: the reception of Copernican astronomy, the Puritan influence on science, tensions between mechanistic science and divine providence, the rise of natural theology, geology and the flood, and the debates surrounding Darwinian evolution. One of the strong points of *Cross-Currents*, however, is the attention given to less widely known themes. Among these are the significant role of Nonconformists as entrepreneurs in the early Industrial Revolution, interactions between Romanticism and 19th century science, theological issues in modern physics, and the alleged connection between Christianity and a lack of respect for the environment. All of these issues are drawn from the history of science since the 16th century. Almost nothing is said about the first 1500 years of interaction between science and the church. Recognizing Russell's need to be selective, I nevertheless find this a serious flaw.

It is necessary in synthetic works to use a broad brush, as Russell does in *Cross-Currents*. But zeal for the larger picture can lead to carelessness in painting details. In a few places there are plain errors of fact,[14] but I am bothered more by several loose points in his arguments, most of all by his handling of Robert Boyle, Isaac Newton, and Samuel Clarke with respect to their notions of miracles. Russell identifies five positions on the relationship between God and the world, among them: deism, in which God ignores the world after creating it; "semi-deism" (a term Russell borrows from Reijer Hooykaas[15]), which allows occasional divine intervention, suggesting that ordinarily the world is not under direct divine control; and radical Christian theism, which holds God to be the active cause of all natural phenomena. Boyle, Newton, and Clarke all fit Russell's description of a radical theist. Each held that God is constantly working in the world, sometimes in extraordinary ways perceived as miracles, but usually in ordinary ways that can be described in terms of natural law. This belief was the source of Boyle's opposition to Aristotelianism, which had endowed nature with powers of its own. It also lay behind the Leibniz-Clarke correspondence, in which Clarke acted as Newton's second in defending the latter's insistence on unmitigated divine freedom and sovereignty over nature.[16] But Russell leaves the reader very confused about this—indeed, the confusion may reveal a misunderstanding of his own. Although he admits that radical theism "seems at times to be present in the writings of Boyle, Clarke and others," he adds that it "is overshadowed by the prevalent notion of a rule of law which does, indeed, make God redundant *as a scientific hypothesis*" (p. 96, emphasis Russell's). For this reason, I gather, Russell discusses Boyle in the section devoted to semi-deism. I fail to see the point. For both Boyle and Clarke, natural laws were the rules by which God freely chose to govern His own actions. Thus, they both could appeal to natural law without directly invoking God, but also without in any sense diminishing His sovereignty or implying His lack of providential care. I see nothing here to suggest semi-deism. The mere fact that Boyle and Clarke speak of divine "interpositions" or "alterations" in the course of nature does not make them semi-deists. I am further confused when, in the same section, Newton and Clarke come under fire for *not* making God redundant as a scientific hypothesis—now and then, they thought, the solar system required divine adjustments. Russell sees this, too, as semi-deism. Elsewhere (p. 91) he concedes that Newton's God was "so much more than" just a divine mechanic, but the point is never developed and the ambiguity remains.

Russell's treatment of Ernest Rutherford is equally ambiguous. Russell observes that Rutherford "appeared to eliminate theology from his thinking," and quotes A.S. Eve's comment that he could not find in Rutherford's papers "any line of writing connected with" religion (p. 213). Suddenly, on the next page, we are confronted with the statement that, if only he had known it, Rutherford was "heir to the Christian rationale for science" by virtue of his association with the Cavendish Laboratory. The same chapter on modern physics contains equally weak suggestions, amounting to no more than pure coincidences, of the significance of Judeo-Christian views for other physicists: Max Born, Max Planck, and Neils Bohr. Somehow Russell avoids the temptation to associate Albert Einstein with orthodoxy as well. The discussions of James Prescott Joule and James Clerk Maxwell provide a few details about their religious views, but never rise above the level of implication when trying to relate those views to their scientific achievements. A similar vagueness dogs Russell almost everywhere. With the exception of the epilogue on Faraday and an excellent chapter on biblical themes in the scientific revolution, Russell fails to clearly delineate the influence of Christianity on science, leaving the reader with an unsubstantiated impression of the nature of that influence. He seems more concerned with showing that historic Christian faith is left intact by modern science—a conclusion that many readers will be able to accept, regardless of their religious convictions, but hardly an interesting historical thesis.

Ironically, the lack of a clearly demonstrated historical thesis is probably the result of an admirable ambition: to write a concise yet comprehensive history of science and Christianity at a level suitable to nonspecialists. The fact that a historian of Russell's standing has fallen short suggests just how difficult that task may be. Two other distinguished historians of science, David C. Lindberg and Ronald L. Numbers, have also met with mixed results in their attempt to produce a comprehensive, if not concise, history of Christianity and science that will be intelligible to nonspecialists. Their volume, *God and Nature*, containing eighteen essays by different scholars, grew out of a conference they hosted in April 1981 at the University of Wisconsin. For three days, a

sizeable group of scholars, representing church history as well as history of science, dissected papers by several participants that had been circulated prior to the conference. Most of these papers, often after extensive revision, were included in *God and Nature*. Some papers were never revised to the satisfaction of the editors and thus were left out, one was deleted by the publisher,[17] a few more were added to the collection after the conference, and two had already been published elsewhere.[18] The result is a first rate set of essays, but not, as had been hoped, a book that both nonspecialists and undergraduates could appreciate in its entirety. While several of the essays are simple, direct expositions of well-known historical ground, others present original research or attempt clever reinterpretations of old ground. If the former are well suited for typical undergraduate classes, the latter for the most part are better reserved for advanced seminars, perhaps even for graduate students in history or history of science. Some months ago I participated in a workshop for college faculty, devoted to Christianity and the history of science, at which *God and Nature* was the principal text. A number of participants, most of them natural scientists, had considerable difficulty in coming to terms with a few of the essays. The root of the difficulty lies in the fact that *God and Nature* explores a vast intellectual territory from a very wide variety of approaches. A few essays (e.g., those by Westfall and Roger) follow the classic "great man" style of internalist history of science, though of course the focus is broad enough to embrace theology. These are readily accessible to all readers. Others (e.g., Jacob, Moore, Webster) exemplify a commitment to externalism, and can be very hard for nonspecialists to appreciate fully. Others (e.g., Lindberg, Ashworth, Gregory) are general overviews that defy classification in simple terms.

The unifying theme of the volume is the historical bankruptcy of the warfare thesis, though this is largely taken for granted rather than repeatedly demonstrated. Unlike Hummel and Russell, who seek to counter warfare thinking by promoting instead the harmony of Christianity and science, the authors of these essays seek to establish a historiography that ignores such ideological goals. They have certainly pointed the way. Perhaps the best example of this balanced approach is Gary Deason's excellent essay, "Reformation Theology and the Mechanistic Conception of Nature." Deason argues that the Reformation emphasis on the radical sovereignty of God was closely related to the mechanical philosophers' belief in the passivity of matter. This has been said many times before, but almost always as part of a larger argument intended to prove that modern science is the offspring of Christianity—the very antithesis of the warfare thesis. In Deason's capable hands, however, the differences between the Reformers and the mechanists loom just as large as the similarities. The mechanists' God, he reminds us, "only faintly resembled the Reformers' God, despite their common understanding of the notion of sovereignty." The doctrine of creation was emphasized almost to the exclusion of the doctrine of redemption, which for the Reformers was at the heart of Christianity.[19] Altogether, a book like *God and Nature* is sorely needed, even if some parts will be out of reach for many readers. Its existence is solid evidence that historians are beginning to take seriously Jim Moore's call for a nonviolent historiography of Christianity and science.

None of the three works reviewed here would serve well as a textbook for the average undergraduate course. Having been written specifically for Christian students, neither *The Galileo Connection* nor *Cross-Currents* would be appropriate for classes at secular institutions. And, if either were to be used at a Christian college (Hummel would probably be the better choice), the instructor should make students aware of the apologetic stance of the author. The Open University series mentioned above remains the best student-oriented material on science and belief; unfortunately, however, the set covering the period from Copernicus through Darwin is no longer available. Cambridge University Press is now preparing a new set of textbooks on science and religion that might fill the void. In the meantime, it would be pointless to ignore those parts of *God and Nature* that undergraduates can readily understand, and it would be a mistake not to order copies of all three for a college library.

NOTES

[1]From Huxley's 1860 review of Darwin's *On the Origin of Species*, in T.H. Huxley, *Collected Essays*, 9 vols. (London: Macmillan, 1893–4), II, 52f, in the volume devoted to Darwiniana.

[2]See J.R. Lucas, "Wilberforce and Huxley: A Legendary Encounter," *The Historical Journal* 22 (1979), 313–330. Ironically, Draper did not mention this incident in *Religion and Science*—indeed, his failure to do so in itself argues that the usual version of the story is not reliable.

[3]This was the title of the final, two-volume work published by Appleton in 1896. Shorter versions of the argument had appeared in 1869 and 1876. For the history of White's *History*, see pp. 29–40 in James R. Moore, *The Post-Darwinian Controversies: A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America, 1870–1900* (Cambridge University Press, 1979); the introduction to David C. Lindberg and Ronald L. Numbers, *God and Nature*, a book that is reviewed here; and the works cited in both of these places.

[4]New York: Appleton, 1874. On Draper, see Moore, *op. cit.*, pp. 20–29, and Donald Fleming, *John William Draper and the Religion of Science* (University of Pennsylvania Press, 1950).

[5]See note 3.

[6]I am thinking here of several recent books or television series, each probably more widely known than Moore's book, that perpetuate elements of the warfare approach: Horace Freeland Judson, *The Eighth Day of Creation: Makers of the Revolution in Biology* (Simon and Schuster, 1979), emphasizes that atheists have made scientific advances because of their atheism; pages 307–309 of Ernst Mayr's *The Growth of Biological Thought: Diversity, Evolution, and Inheritance* (The Belknap Press, 1982); Carl Sagan's series, *Cosmos*, which lies solidly in the unfortunate Cornell tradition established by White; some episodes in Jacob Bronowski's famous series, *The Ascent of Man*; and a few places in two very new series, James Burke's *The Day the Universe Changed* and the Annenberg/CPB physics series, *The Mechanical Universe*.

[7]Hummel's knowledge of recent scholarship is evident in all four biographical studies, but is nowhere more obvious than in the Newton material.

[8]I cannot cite here a significant fraction of the pertinent literature. I will mention just two articles that clearly relate how Reformation theologians and certain early modern scientists blurred the nature/supernature distinction. See Gary B. Deason, "Reformation Theology and the Mechanistic Conception of Nature," pp. 167–191 in *God and Nature* (reviewed here); and Keith Hutchinson, "Supernaturalism and the Mechanical Philosophy," *Hist. Sci.* 21 (1983), 297–333.

[9]Here he follows the late Donald Mackay, whose work is well known among ASA members. See, e.g., *The Clockwork Image* (InterVarsity Press, 1974).

[10]In recent years, the endorsement of Bernard Ramm has been influential. See *The Christian View of Science and Scripture* (Eerdmans, 1954), pp. 144–156. Contemporary creationists reject concordism, however, on the grounds that it concedes too much to science. For a vigorous attack on concordism, see "The Origin of the Solar System," a pamphlet by John C. Whitcomb, Jr. (Presbyterian and Reformed, 1964). The roots of concordism are bound up in the long history of the metaphor of two books (Nature and Scripture). For an outline of that history, see "The Two Books of God," Roland Mushat Frye's essay in the collection he edited, *Is God a Creationist?* (Scribner's, 1983), pp. 199–205.

[11]Once again, Hummel follows Mackay.

[12]I have found only one place in which Hummel errs in stating a matter of fact. On page 225 he says that James Hutton advocated uniformitarianism, "inspired by his recognition of divine design in nature." I am not aware of any evidence to suggest that Hutton believed in design—he was a classic Enlightenment pagan who probably thought the world was eternal. Hummel does not document his statement.

[13]I refer to the six units, "Science and Belief: From Copernicus to Darwin," published in 1973 but now sadly out of print, and the seven additional units, "Science and Belief: From Darwin to Einstein," published in 1981–2 and still available. In my judgment, these booklets remain unequalled for their fairness, clarity, and comprehensiveness.

[14]There is an apparent error in the opening sentence of the second chapter: "It is generally agreed that what may be recognized as modern science came into being during the century following 1543, when Copernicus proclaimed a sun-centered universe and Harvey discovered the circulation of the blood." I say "apparent error" because the problem could be one of syntax. Copernicus did indeed publish his famous book in 1543, as the sentence implies, but Harvey's work dates from well past 1600 (his book on circulation from 1628). Both occurred within a century of 1543. This may be what Russell means to say, but if so, he is quite obscure about it. An actual error is found on page 39, where Russell states that "an 8-minute discrepancy between the observed orbit of Jupiter and the best prediction based on circular motion" led Kepler to propose elliptical planetary orbits. The planet was Mars, not Jupiter. On page 42, Russell refers to Andreas Osiander as Copernicus' "Protestant friend," yet the two men never met. And on the next page, Russell retells the famous story of Father Thomas Caccini's sermon against Galileo, in which "It is reported that Caccini echoed biblical words when he said, 'Ye man of *Galilee*, why stand ye gazing up into heaven?' " The story is almost certainly apocryphal—the earliest known version dates from 1773, well over a century later. See Olaf Pedersen, "Galileo and the Council of Trent: The Galileo Affair Revisited," *J. Hist. Astr.* 14 (1983), 1–29, at note 21.

[15]Hooykaas introduced this term in *Natural Law and Divine Miracle* (E.J. Brill, 1959), which was reprinted in 1963 with a new title suggested by Martin Rudwick: *The Principle of Uniformity in Geology, Biology, and Theology.*

[16]For a full discussion, see my doctoral dissertation, "Creation, Contingency, and Early Modern Science: The Impact of Voluntaristic Theology on Seventeenth-Century Natural Philosophy," Indiana University (1984); J.E. McGuire, "Boyle's Conception of Nature," *J. Hist. Ideas* 33 (1972), 523–42; and Alexandre Koyre, *From the Closed World to the Infinite Universe* (Johns Hopkins University Press, 1957), pp. 235–72.

[17]John C. Burnham's paper, "The Encounter of Theology with Deterministic Psychology and Psychiatry," which has been published in *Bulletin of the Menninger Clinic* 49 (1985), 321–52, takes an openly confrontational approach that is out of step with the rest of the essays.

[18]These are the papers by Lindberg, "Science and the Early Christian Church," *Isis* 74 (1983), 509–30, and an abridged version of the paper by Numbers, "Creationism in 20th Century America," *Science* 218 (1982), 538–44.

[19]Here Deason echoes Richard S. Westfall's argument in *Science and Religion in Seventeenth-Century England* (Yale University Press, 1958). Westfall's essay in *God and Nature*, "The Rise of Science and the Decline of Orthodox Christianity," moves in the same direction.

Reviewed by Edward B. Davis, Assistant Professor of Science and History, Messiah College, Grantham, PA 17027.

THE ORIGINS OF AGNOSTICISM: Victorian Unbelief and the Limits of Knowledge

by Bernard Lightman. Baltimore, MD: Johns Hopkins University Press, 1987. x + 249 pages, illus., notes, biblio., index. Hardcover; $29.50.

> *Agnosticism* either admits the existence of God . . . but denies that we can know Him or know about Him; or else it declares man incapable of determining whether such a being (or Being) exists or not. Its one argument can be put into a nutshell—the finite cannot possibly comprehend the infinite. This confuses *com*prehension with *ap*prehension. There is a very wide difference between imperfect knowledge and perfect ignorance. A real agnosticism, however, is untenable; is forsaken even by its professors—e.g. Herbert Spencer. Directly it ceases to be content with blank and barren denial, and attempts to construct a philosophical system, it begins to work out its suicide. It cannot avoid affirmations, *ipso facto* the opposite of agnostic. (J. Robinson Gregory, *The Theological Student: A Handbook of Elementary Theology*, rev. and enl. ed. London: Charles H. Kelly, 1913 [1st ed. 1892], p. 24.)

Lightman is a young Canadian scholar at Toronto's York University and co-author with Sydney Eisen of the massive secondary bibliography, *Victorian Science and Religion.* In his *Origins of Agnosticism*, he has made an original and permanently important contribution to the history of theological and scientific ideas.

All of us who are interested in the nineteenth-century religion and science debates after Darwin are familiar with the work of the evolutionary naturalists Herbert Spencer, John Tyndall, and Thomas Henry Huxley, and have at least heard of the lesser-known mathematician William Kingdon Clifford and Leslie Stephen, who was the major literary ally of the "scientific naturalists." These infamous unbelievers were the architects of what was known as the "New Reformation" and together produced a distinctive kind of belief that came to be called, in the years after 1869, "agnosticism." In his clearly written discussion of this small circle of friends and colleagues, Lightman provides a revisionist map that not only opens up new scholarly territory, but at the same time substantially alters our understanding of familiar terrain. Agnosticism lay at the heart of Victorian scientific naturalism, and "scientific agnosticism," it turns out, was profoundly religious.

This apparent paradox is sharpened by Lightman's demonstration of the debt the original agnostics had to Christian theism and metaphysics. Although the agnostic scientists were notoriously anti-clerical and shared a deep antipathy for traditional theological dogma, they also shared evangelical upbringings and a desire to "purify" the faith of their fathers and mothers. Too, they shared a pantheistic sense of the holiness of the world and of the holiness of science as a secular vocation. In sacralising nature and sanctifying a certain social order, the agnostics revealed themselves as "new natural theologians" whose work stood as the culmination of the Protestant Reformation. Indeed, some of the forgotten "minor" figures in the Victorian movement envisioned an agnostic "church," with its own creed, catechism, and hymnary to aid in the worship of the Unknown God.

In his first chapter, Lightman discusses the provenance of the Huxleyan terms "agnostic" and "agnosticism." It's the clearest account of this issue to date, although I'm still inclined to think Huxley was being misleading when he later denied deriving the words from Paul's *agnosto theo* (Acts 17:23) via his early reading of the Edinburgh philosopher William Hamilton. Initially, Lightman stresses the epistemological, rather than anti-orthodox or ideological character of agnosticism. (Since gnosticism was itself judged heretical by the early church, orthodox Christianity was originally "agnostic.") Lightman distinguishes agnosticism from atheism, skepticism, positivism, materialism and empiricism, and indicates the relation of the movement to scientific naturalism, a

wider program, but one whose leading lights happened to be the apostles of agnosticism at the time.

On page five of his *Idealistic Reaction Against Science* (1914), Antonio Aliotta noted that Spencer's agnosticism used "as its weapons the transcendentalism of Kant, which Hamilton and Mansel had pressed into the service of faith. . . . " The suggestion that the roots of nineteenth-century agnosticism are to be found in Victorian theology has not been properly explored. Lightman remedies this situation in his second chapter, which examines the Victorian divine Henry Longueville Mansel—author of *The Limits of Religious Thought* (1858)—as the "missing link" in agnosticism's evolution. This is a convincing and informed tour through the philosophy of knowledge and religion in Kant, Hamilton, and Mansel; thinkers who supplied the agnostics, especially Spencer, with much of their intellectual ammunition. The Kantian strain in "Christian agnosticism" (and its more naturalistic recensions) is not only identified, but is analysed in a manner that even the philosophically inept can appreciate.

The unknowability of the infinite, transcendent deity by finite human minds was a thoroughly orthodox feature of classical western theism and mysticism. The tradition of *theologia negativa* is mentioned by Lightman (p. 54) without further comment. He is aware of its agnostic implications, and it is worth making the point explicit. The *via negativa*, or "apophatic way" (as embodied, for instance, in the late-patristic writings of Pseudo-Dionysius that were known in Britain by the High Middle Ages), asserts the utter transcendence and sovereignty of God. In this tradition, God is ineffable; human language is unable to describe or reveal God's real being. All human attempts to know or speak of God fail, and indeed are blasphemous and sacrilegious. In this reverent agnosticism, attempts to deal with the nature of God from a finite standpoint were not only inadequate and empty, they themselves evoked the transcendent majesty and glory of God.

Lightman unpacks the ironically religious nature of Victorian agnosticism in his third chapter, "Herbert Spencer and the Worship of the Unknowable." Spencer's *First Principles* (1862), the first volume of his multi-volume "Synthetic Philosophy," served in many ways as the Bible of agnosticism; it depended heavily upon Mansel's apologetics, and the philosophy of Mansel's Scottish mentor Hamilton. In *First Principles* Spencer offered a reconciliation of science and religion based upon his version of cosmic evolutionism, and an agnosticism with a definite devotional air. Like Mansel, Spencer believed that the very limitation of human knowledge directly implied the existence of a Power beyond all knowing. Spencer's deity was "the Unknowable," though—happily enough for his publishers—this did not prevent him from writing a good many pages on the attributes (infinite, impersonal, eternal, all-powerful . . .) of a God who by nature and definition could not be known.

The fourth chapter explores the career of agnosticism in the 1870's. Agnosticism arose in the context of the social relations among Spencer, Huxley, Tyndall, Clifford, and Stephen, and was refined in the crucible of controversy. Following the work of both Robert Young and Frank Turner, Lightman explains the scientific naturalists' attack on orthodoxy as part of their strategy of "professionalisation," in which the younger scientists vied against the established educational and political interests of the Anglican Church and the Tory party. The circle of scientific agnostics constituted a kind of "new priesthood" (as Francis Galton, the father of eugenics, called it) dedicated to justifying an emerging liberal, industrial, middle-class order. In their struggle for livelihoods, for social power and prestige, they created a cultural role for themselves that in some ways conflicted, and in other ways was continuous with the role fulfilled by the priests of the old order.

In an especially good fifth chapter, Lightman continues the story of the religious and theological dimensions of the "Church agnostic" under the nominal polemical guidance of "Pope Huxley." The popular image of naturalist opposition to all things ecclesiastical, theological, and spiritual still persists in the late twentieth century, but in fact Spencer, Tyndall, and Huxley (along with Darwin, the fourth Evangelist of scientific agnosticism) understood their critical blasts against Christianity as helping to purify a faith gone corrupt. Personally, emotionally, aesthetically, and morally the agnostics were deeply religious beings. Their quarrel was with outmoded theology, not with pure religious sensibilities.

Neither the religion nor the theology of the agnostic scientific naturalists has yet been completely explicated. The God of Victorian science after Darwin was still, for many, the sublime Author of nature and Designer of nature's laws. As a measure of the intricacies of post-Darwinian natural theology, the Lord of evolutionary deism had strong affinities with the God both of Spinoza and of Calvin. "Nature" could be both God's body and the created "theatre of God's glory." In any case, the agnostic naturalists believed that their God was more exalted than the Jehovah of the misguided bibliolaters.

Along with the major figures of the "New Reformation" (a term that seems to appear in the 1850's, and used throughout the rest of the century), Lightman introduces some of the key minor players in the agnostic movement. His material on Frederick James Gould, Richard Bithell, and Samuel Laing is new and most interesting. I, for one, hope that Lightman's next book will be devoted to these characters; they deserve more attention.

The sixth chapter, on "the new natural theology," is a fitting climax to this book (a prejudiced view, I admit, as the argument fits so nicely with my own research). There is a good section on the worship of nature, especially of the Alps, where "muscular agnostics" were wont to sojourn much like pilgrims of old. The connection with the "muscular Christianity" of the clergyman-novelist (and Darwinian camp-follower) Charles Kingsley—first wryly noted by Huxley—is suggested by Lightman, but not developed. One place to start tracing this further link between robustly evangelical agnosticism and Christianity is in Norman Vance's fine study, *The Sinews of the Spirit: The Ideal of Christian Manliness in Victorian Literature and Religious Thought* (Cambridge University Press, 1985).

The Victorian agnostics were not only nature worshippers, but "new" natural theologians, whose work was based upon their scientific rendering of what Huxley called the "new Nature" (the laws of which manifested the will of an unknowable, immanent God). "The heart of the new natural theolo-

gy," writes Lightman, "was an emphasis on the ability of science to uncover the order in nature through an empirical study of the physical world" (p. 153). Or, as Huxley said, paraphrasing a line from that favourite Victorian hymn "All Hail the Power of Jesus' Name": "Order is lord of all."

The latter-day scientific saints preserved the earlier natural theologians' concepts of order, purpose, and teleology in the world by reinterpreting them in evolutionary terms, within a naturalistic world view. I disagree with the implication (p. 159) that the post-Darwinian natural theologians who integrated Christian theism and evolutionary theory "came around to the agnostic way of thinking" by updating Paley with nomothetic notions of design. The defenders of what Jim Moore has called "Christian Darwinism" (a term that dates from the 1860's) could find all the necessary resources for their beliefs in what passed for orthodox theology at the time. Lightman presents no detailed evidence that these believers depended on "the agnostic way of thinking" (though there is evidence that the Christian Darwinians read and criticised the agnostics). In any event, there were not only "pre-Darwinian" but "pre-agnostic" natural theologians *cum* theistic evolutionists. And long before Paley there was a tradition in British natural theology that emphasized not particular, individual contrivances, but the grand apprehension of law and order in nature as a whole.

Chapter six finishes with an account of the "holy trinity" of agnostic doctrines; i.e., belief in nature's lawful uniformity, causal determinism, and the objective existence of a real world. Clifford's radical dissent from strict agnostic orthodoxy on epistemological and methodological grounds is also discussed.

The seventh and concluding chapter is aptly titled "The Tragedy of Agnosticism." By the end of the nineteenth century, the scientific agnostics were either dead or in various stages of decline and despair. The demise of the acolytes saw the demise of the deity: "The death of the agnostic god of science transformed the robust faith of agnosticism into a frustrated and despairing doubt longing for faith" (p. 182).

"Doubt longing for faith" is one good way of summing up the religious predicament of twentieth-century humankind. But all is not lost. Lightman calls for the reappropriation of a Kantian agnosticism that, in offering a "true defense of science," must also represent a defense of religion as well. This is not an uncritical back-to-Kant plea, but rather the expression of hope in the possibility of a legitimate synthesis of knowledge and faith (Kant's "pure" and "practical" reason). Here, Lightman would seem to be in unconscious sympathy with certain trends in German theology since the 1970's, especially in the work of Hans Küng. Though the somewhat self-deceiving creed of Victorian agnosticism was long ago discredited, he concludes: "An authentic agnostic view of the limits of [human] knowledge is a necessary component of a sound theism" (p. 182).

Notwithstanding Robert Flint's still-valuable 600-page treatise, *Agnosticism* (1903), Lightman's *Origins* is the most interesting and best documented interpretation of Victorian agnostic thought in this century. This is not a naive hyperbole; I'm aware—as the author himself is aware—that more work remains to be done. The story of agnosticism can be told in greater detail, and with wider scope. There is room for a more finely textured account of the "denominational" sources and sectarian varieties of agnosticism. Lightman's work should be read alongside recent studies of that self-styled agnostic Charles Darwin for a fuller portrait of the faith. It's too bad Frank Burch Brown's monograph, *The Evolution of Darwin's Religious Views* (Mercer University Press, 1986) appeared too late to be incorporated. On page 161, Lightman names Darwin's disciple George John Romanes in passing as a critic of scientific naturalism and agnosticism. And yet, at times, Romanes was a strong and articulate advocate for these positions; his role in the history of agnosticism needs further study in the wake of Frank Turner's interpretation (*Between Science and Religion*, Yale University Press, 1974, chap. 6).

The complete neglect of the Princeton theologian James McCosh's critiques of agnosticism is a weakness that I hope will be overcome in later articles and books on the Victorian movement. I am eager to hear what Lightman might make of such works as *Criteria of Diverse Kinds of Truth as Opposed to Agnosticism* . . . (1882), *Certitude, Providence, and Prayer* (1883), *Agnosticism of Hume and Huxley* (1884), and *Herbert Spencer's Philosophy* . . . (1885). But any quibbles with the present treatment do not affect my judgment that Lightman's reading of the published and unpublished sources supersedes all previous examinations of agnosticism, and will be the touchstone for future research.

James Turner's study of "the origins of unbelief in America" was titled *Without God, Without Creed* (Johns Hopkins University Press, 1985). It is clear from Lightman's work that the original Victorian agnostic "unbelievers" had both a God *and* a creed. The unbelief of the scientific naturalists depended, in fact, upon a certain kind of believing—one with ideological affinities and social-intellectual continuities with previous Christian tradition, including natural theologizing and the production of theodicies.

If the social history of natural and religious knowledge teaches us one thing (apart from the importance of material contexts and social relations), it is that the history of science is the history of belief.

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THE SCIENCES AND THEOLOGY IN THE TWENTIETH CENTURY by Arthur Peacocke (ed.). South Bend, IN: University of Notre Dame Press, 1986. 309 pages. Paperback; $12.95.

This book contains 14 papers given in 1979 at an international symposium, representing six countries, in Oxford, England. The group was evidently composed of seven theologians, three philosophers of science, three sociologists, and one physicist—hardly a representative group. Also, there is an introduction by Arthur Peacocke from Oxford University, and a retrospective by Mary Hesse from Cambridge University. No academic or religious background is given of the

participants at the symposium. In the index, ten of the participants are listed along with five philosophers, four scientists, and such past thinkers as Augustine and Marx.

The primary scientific field discussed was cosmology—not representative of experimental science. The editor states that the question underlying this volume is "whether or not, and to what extent, the common intention to seek intelligibility in human life and its surroundings gives to any mutual modification of the one enterprise by the other." There is no question in my mind that the same creation regarded from different viewpoints will present overlapping views with different peaks, since theology and science are both imperfect. The editor identifies eight possible interactions.

Part one deals primarily with creation; part two with themes such as order in nature; part three with truth and the evidential value of religious experience; part four with the theological function of Western science. Part four classifies different types of scientists: fundamentalists, orthodox, liberals, modernists, agnostics, and atheists. It also presents the preliminary report of a study done with a 36-page questionnaire for the Unification Church.

It is surprising to find no attempt at defining science. While the title seeks to differentiate science from theology, throughout the book they overlap. There is theological science, scientific theology, theologies of science, scientific Marxism, Marxist science, exact science, relativistic science, French science, social scientific reasoning, scientificity, and sociobiology as paradigm science. The conclusion: "the term science is highly problematic . . . science will cover what the members of society variously take to be science." Some other confusing terms include physics and mechanics, pantheism, dualistic basis of Newtonian science, quasi-finalistic, methodological atheism, relevance-of-theology-to-cosmology-principle, principle of credulity, and conservation of finite reality.

Some statements I find faulty, such as comments on the principle of inertia, the anthropic principle, the history of science, and miracles. Many other statements could be debated throughout the book, such as: "Truth is not to be found in contemplation of the given but in one's commitment to the possible," and "The only truth to which man is after, the truth which is at the service of happiness."

For those interested in how a few contemporary scholars view some of science and theology in the twentieth century, this book may provide some stimulation. It would not be intelligible for the layman, but is intended for professionals.

Reviewed by Raymond J. Seeger, retired from the National Science Foundation, Bethesda, MD 20816.

SCIENCE AND THEOLOGY IN EINSTEIN'S PERSPECTIVE by Rev. Dr. Iain Paul. Edinburgh: Scottish Academic Press, 1986. 107 pages. Hardcover; $17.00

In this book, Iain Paul, who holds doctorates in both physical science and systematic theology, explores the epistemological interrelations between science and theology. He published an earlier book, *Science, Theology and Einstein*, in 1982, and in this sequel attempts to show that modern science and Christian theology are not radically opposed to one another. Outlines of the similarities between scientific and Christian faith, scientific and theological knowledge, scientific and theological communication, the universe and God, universal and divine unity, universal and divine authority, the rationality of the universe and Jesus Christ, and the intuitive relation and the Holy Spirit are drawn from an Einsteinian perspective. A brief discussion of motivation and community concludes the essay.

This is not an apologetic text, but a philosophical text intended to contribute to the dialogue between science and theology. It is one of the monographs in *Theology and Science at the Frontiers of Knowledge Series*, edited by Thomas F. Torrance.

The writings of Athanasius and Einstein serve as guides along the way of similarity. The similarity between scientific enterprise and theological activity is stressed, as can be seen in this excerpt taken from the book's introduction:

> Modern science and systematic theology have a common concern with all that lies between the birth of the universe and the end of the world. . . . Scientific research stretches from the nature of the subatomic particle to the structure of the universe, while systematic theology reaches from the jot and tittle of scripture to the Alpha and Omega of the creation. In neither case are the problems arbitrary. Always they arise within a living context, and therefore, they exhibit a dynamic continuity. Each discipline displays a vibrant form and a creative content developed through the centuries by the coordinative tension between experience and reflection. This tension characterizes both activities that have more in common than is generally appreciated.

This text sparkles with parallels, and does indeed provide a framework for dialogue between scientists and theologians. The typical reader will be a philosophical scientist or scientist philosopher who is concerned about the interrelationship between science and theology.

Reviewed by Fred H. Walters, Department of Chemistry, University of Southwestern Louisiana, Lafayette, LA 70504.

GOD AND THE NEW BIOLOGY by Arthur Peacocke. San Francisco: Harper and Row Publishers, 1986. 197 pages, index. Hardcover; $19.95.

Arthur Peacocke, biochemist and Anglican priest, has published this collection of essays, reflecting his perception of the latest findings in the "new biology" which he defines as the synthesis of traditional evolutionary theory with modern biochemistry and molecular biology. He attempts to deal with this area of biological thought as it relates to the themes of man, God, and nature.

In the first half of the book, the author discusses reductionism in science, especially biology. This is a clear and understandable presentation of the reasons behind reductionist thought, and the limitations and problems associated with it. The author then turns to the area of evolution and religious thought. He surveys various views of individuals, such as Teilhard and others, with special emphasis given to the position of the Church of England. The remainder of the book is primarily a collection of Peacocke's thoughts on creation, evolution, man, God, and the Church. This is followed with a rather long appendix on the subject of thermodynamics and the origin of life.

The author provides extensive footnotes (about 27 pages in all), and also a complete index. There is no bibliography; however, the footnotes do provide references for further reading.

As far as the content of the book is concerned, the author does not provide any new insights into the findings of molecular biology. Further, his discussion of the creation is not likely to be welcomed by conservative Christians. He freely embraces a "materialistic" view of the universe including cosmic evolution, spontaneous generation of life, and the emergence of humans from lower forms. He does not appear to accept any traditional view of God as Creator. Rather, he explains that God's role has been that of transcendence and immanence. He asserts on several occasions that matter is capable of organizing itself into more complex forms, and that humans are the end result of this process. Any doctrine of the Fall as an historical event, as well as any historical significance to Adam and Eve, are clearly rejected by the author. Self-consciousness and any spiritual aspect of humans is attributed to the same natural processes that organized the first life. Thus, the book is most likely to appeal only to those who share the author's theological viewpoint.

Reviewed by Philip Eichman, Biology Department, Harding University, Searcy, AR 72143.

THE CREATION by Don Stewart. San Bernadino, CA: Here's Life Publishers, 1984. 178 pages, index. Hardcover; $18.95.

The Creation is the second of five "Family Handbooks of Christian Knowledge" edited by Josh McDowell for Campus Crusade for Christ. It was adapted from a book originally written by Willem J.J. Glashouwer and Willem J. Ouweneel, published in Dutch under the title *Het ontstaan van de Wereld* in 1980. Stewart and McDowell are seminary graduates who have written several theological books. This appears to be their first attempt in the field of science.

Stewart begins with the historical development of science/reason and a world view that no longer included God. Chapter two, on the origin of the universe, includes some ancient religious cosmologies, but consists mostly of a good discussion on astrology and its failings in biblical and scientific cosmologies. Stewart considers Genesis to be "an accurate, historical summary of the original creation of this universe and all that is in it." Chapters three and four focus on God's role as designer of the universe and in the origin of life. Chapter five, "Evolution or Creation," is rather balanced and objective, with a section that clarifies the definitions of evolution, microevolution, macroevolution, species, and other terms often poorly understood. Objectivity and balance fade as chapters six through nine (the fossil record, man, natural disasters, Noah's universal flood) present a one-sided, "scientific creationist" view. Stewart concludes with a chapter that reviews the main messages of previous chapters and presents many quotations from the Bible (Job and Psalms), Morris, Ramm, Rehwinkel, Laird Harris, and others.

Stewart presents some very sound principles and insights throughout the book, but they are often dwarfed, especially in the last half, by frequent inferences and statements strongly favoring a young earth. He states that "reasonable interpretations of relevant Scripture passages can argue either for a very ancient creation or a more recent one." Yet, except for one reference each to the Bible and an encyclopedia, all citations in chapter eight are from *Scientific Creationism* by Henry Morris, or John Whitcomb ("Flood"). Davis Young's book, *Christianity and the Age of the Earth*, or other common, differing viewpoints would greatly increase Stewart's perspective.

Several captions under illustrations seemed questionable. The statement "Mutations cannot account for evolution," appearing under a picture of a bull with a fifth leg dangling from its shoulder hump, ignores microevolutionary mechanisms and developmental anomalies. The caption under a picture of a crowd of people states that "careful research in population statistics seems to indicate that if man has really been on earth for more than one million years, the earth's population would actually be many times larger than it is." This implies that population numbers are merely a function of time, and ignores ecological carrying capacity, technological development, and other important influences. The source of this "careful research" was not cited.

Most (55%) of the books in Stewart's list of recommended reading were published in the 1970's, and the rest in the 60's and 50's. Of the three books written in the 1980's, the two most recent were written by the author (1982). Although the list included several key references, some very good ones—such as Dan Wonderly's or Davis Young's books about Christian views on the age of the earth—would have added more balance on some key issues.

At least two quotes were attributed to an author who quoted another's work, and not to the original author. For example, Stewart's quote of Thurman (p. 82) was actually a passage from G.A. Kerkut's *Implications of Evolution*, quoted by Thurman. A similar instance also occurred on page 86, where Thurman was misspelled as Thurmond. The use of absolute words such as "all," "totally," and "completely" seemed inappropriate to a discussion of scientific matters.

The book's strengths lie in its attractive appearance and rather balanced approach during the first five chapters. It is

equivalent to the Time-Life series of slick-page books for general family use. Its 234 illustrations are mostly photographs, nearly all in color, of excellent quality, and often helpful for readers without a science background. *The Creation* is an excellent book for readers interested in the "scientific creationist" view of creation.

Reviewed by Duane Thurman, Professor of Biology, Oral Roberts University, Tulsa, OK 74171.

MAN AND MIND by Thomas J. Burke (ed.). Hillsdale, MI: Hillsdale College Press, 1987. 222 pages, index. Paperback.

Dr. Burke is a faculty member of Hillsdale College, teaching in the area of philosophy of religion. Six authors contribute to this book of readings, which presents special problems for the reader if one is looking for a unified point of view. No matter how the papers are shared for revision and comment, the effect is similar to reading several articles in a specific journal.

However, when the topic selected is such that each author brings a different face to the subject, the book can be like a gem—with each author presenting a facet, reflecting a somewhat different aspect of the underlying truths. This is the case here. Each author is a committed Christian, mainly of the reformed tradition, each presenting a somewhat different perspective.

One disturbing element is that the general position seems to be defensive. One gets the impression that each author is tilting at windmills of his own making; a position similar to most of us who are defenders of the faith! Dr. Burke starts out with the statement that we all need structure in order to have meaning and purpose in our lives. One might say that this is a reflection of the way our nervous system has been constructed. He then goes on to say that every psychological system makes assumptions about human nature, which, though masqueraded as if scientifically determined, actually are not. Answers are distorted and relate to philosophical and theological concepts, even though the originators may be unaware of this and would deny it, especially the theological aspects.

One interesting sidelight is that Dr. Burke suggests that a complete view of humanity necessitates contributions from every field, including psychology and its social science "sisters," a comment which could create some criticism in our sexist society—perhaps "siblings" would be a better choice!

In his assertion that a "Christian Psychology" is a necessary part of our armamentarium, I would differ in definition. I believe it is as unnecessary to call psychology "Christian" as it is for physics, biology or chemistry to be called "Christian," as he notes. If we are all discovering "God's Truth," to call the method by which that truth is uncovered, psychology in this sense, would be to identify with technologies that may be shortly out of date, and thus create backlash. This occurred when the early church accepted scientific ideas as the ultimate truth and incorporated them as dogma, only to later discover that science disproved those assertions.

A distinction about integration bears comment. The authors generally take the position that the integration of psychology is with theology, not revelation. Integration assumes equality, and science and revelation are not equal. This distinction must be kept clear in our attempts to understand the relevancy of scientific truth with our faith, but it is often confused.

Dr. Burke makes a plea for that kind of integration in all of our efforts. Dr. Stephen Briggs, from the University of Tulsa, suggests that a Christian theory of personality is necessary even though it is based on assumptions, because other theories are constructed likewise. Dr. Mary Vander Goot of Calvin College and Dr. Paul Vitz of New York University take to task the assumptions of psychology and psychoanalysis for presenting an inadequate view of personality. Dr. Ransburg of Hillsdale College reviews psychological theories, while Dr. Merold Westphal of Hope College does the same for philosophy, as those theories apply to personality. Following this discussion, Dr. William Kilpatrick of Boston College reemphasizes the point that secular psychology cannot adequately explain human personality, because the significant dimension of life is left out.

The Rev. Dr. John Reist, also of Hillsdale College, supplies some biblical background as an underpinning for all of the above-mentioned ideas. Dr. Mary Stewart Van Leeuwen of Calvin College uses Dr. Maddi's metatheory as a framework for analysis and the core characteristics for a world view of personality theory. The theory in the final chapter, by Dr. Vitz, attempts to tie these ideas together with a covenant theory, based on the concepts of personhood developed in Judaism and Christianity.

I am impressed with the ideas of the book. The purposes outlined in the introduction have been addressed, but I wish that other views had been included. The impression given is that a group of like-minded people got together and pooled ideas. Perhaps a follow-up book, introducing other theological concepts and psychological models, could do this. This book, however, will be useful for persons who are struggling with the relevance of Christian faith as related to personality theory.

Reviewed by Stanley E. Lindquist, Professor of Psychology, California State University, Fresno, and President of the Link Care Foundation, Fresno, CA 93710.

OBJECTIVE KNOWLEDGE: A Christian Perspective by Paul Helm (ed.). Downers Grove, IL: InterVarsity Press, 1987. 192 pages. Hardcover; $10.95.

Since all human knowledge is perceived by subjective human beings, does it then follow that objective knowledge does not exist? If that is so, have we not then discovered objective knowledge in the statement itself, and thus disproved the idea that objective knowledge is nonexistent? So argue the nine contributors to this slim, provocative volume. Mark Ross, for example, asks in "Who Is Telling the Myth?" if we have "objective reason for thinking that objective knowledge is a myth?" If so, then objective knowledge has been found and, if not, then it must also exist.

These British scientists, including a professor of theoretical chemistry and the secretary of the Research Scientists Christian Fellowship, admit that scientific description is never perfectly accurate, but the objective reality being observed by the subjective scholar is still there in absolute terms. Perspectives are different, but the objective reality is the same. The accuracy of observation is not determined by the observer's values or background, but by the precision, honesty, and "objectivity" of his analysis.

Objective knowledge exists in absolute terms (both in the Hebrew and Greek concepts of truth), but our perception of it is always relative. That is immensely different than saying that objective knowledge does not exist at all. One suspects that part of the problem is the modern tendency to ignore God as omniscient, and thus to limit the existence of knowledge only to human mental perceptions. One cannot demand that finite people have infinite knowledge, even collectively. But neither should it be assumed that finite knowledge is necessarily inadequate or insufficient for life or civilization. Achievements in technology, the arts, communication and transportation, and even in romance and cuisine indicate the vitality of limited knowledge.

Confusion persists partly because of the use of the term *objectivity* to describe the detached, disinterested observer. (Which is not to say that the same observer is also uninterested and uninvolved in his quest for truth.) The two meanings of the term *objective* must be clearly distinguished, and the Christian must affirm both. Such is a central thesis of this book. It is not enough to realize the existence of objective knowledge outside of oneself. One must also be as honestly "objective" as he is subjectively capable in his use and analysis of the external world he observes. A person with an objective attitude is willing to listen and learn, and does not attempt to force data into rigid molds. One should approach data with a sense of discovery. One will then be open to "surprises," and creative enough to "see" things not previously noticed from new perspectives.

One may well accept both concepts of objectivity as central in life, yet many problems remain in the quest for knowledge and truth. *Objective Knowledge: A Christian Perspective* defends objectivity and seeks to apply it in science, ethics, and in the social sciences.

Reviewed by William H. Burnside, Professor of History, John Brown University, Siloam Springs, AR 72761.

INNOVATIVE APPROACHES TO COUNSELING by Gary Collins. Waco, TX: Word Books, 1986. 218 pages, index. Hardcover.

Gary Collins begins this book with the confession that he doesn't like counseling, although he has majored in it, has taught it, and has written many books about it! This view has led him to consider other aspects of "counseling," and that is what this book is all about—variations in bringing about changes through other means than being in an office in a one-to-one relationship.

The chapter titles are illustrative of his choice of reviewing methods of working with people: Community, Public, Mutual Aid and Self-Counseling; Lay, Preventive, Environmental, Brief, Cross-Cultural, Planning, and Future Counseling. He follows the chapters with a number of pages of notes, explaining and amplifying some aspects of the text, as well as suggestions for further reading.

Dr. Collins is Professor of Psychology at the Trinity Evangelical Divinity School in Deerfield, Illinois. He has been chairman of the department and has written several other books in the field.

This book is the introductory volume for a series on differing aspects of counseling; some books have been written, and others are forthcoming. This compendium is designed to give a survey of several approaches to counseling which may not be as well known as the more common ones, although most of them have been around for a long time.

As the majority of the book is a rehash of many other books and approaches, it is of special value to the beginner in the field—to give some insight into counseling approaches other than the usual ones. The books carries with it the weakness of all such books in superfluous treatment, necessary in order to give structure to the project. Were it not so, the book would be many times the size.

In the final chapter on future counseling, the author attempts to prognosticate and evaluate some of the trends now apparent in the field. He suggests some extrapolations and extensions of current methods for more general use. This chapter, in many ways, might be considered the most provocative one in the book, and may interest the casual lay-observer in the potentialities available within his own spheres of influence.

The book is designed for the beginner, or for the person desiring a broader view about counseling than is usually found in a book on the subject. Because the treatment is superficial, its value for the professional counselor is minimal.

Reviewed by Stanley E. Lindquist, Professor of Psychology, California State University, Fresno, and President of the Link Care Foundation, Fresno, CA 93710.

IMAGINATION: Embracing the Theology of Wonder by Cheryl Forbes. Portland, OR: Multnomah Press, 1986. 199 pages, index. Hardcover; $12.95.

The name Cheryl Forbes will be recognized by regular readers of *Christianity Today*, a magazine for which she served as an editor and feature writer for many years. Now she serves as executive director for Zondervan Publishing House.

This book, the author's second, is one in the series of Critical Concern Books published by Multnomah Press and intended to address important contemporary issues. It is about the imagination, "the ability God gave you to fill your life with meaning."

What is imagination? Forbes quotes another writer who defines imagination as "a power in the human mind which is at work in our everyday perception of the world, and is also at work in our thoughts about what is absent; which enables us to see the world, whether present or absent, as significant, and also to present this vision to others, for them to share or reject."

Forbes looks at imagination from many different angles. She stocks this volume with fictional stories, historical references, religious images, biblical symbols and common metaphors, all in an attempt to describe, define and understand imagination. She distinguishes imagination, which all of us possess, from creativity, which some of us possess.

According to Forbes, Jesus used parables to expand the imagination of his followers. Today God uses many models to stretch our imaginations, including non-Christians. Forbes refers to writers who are gifted in stretching the imagination, such as Madeleine L'Engle and Chaim Potok. She also includes scientists as imagination stretchers.

Up until the closing days of the nineteenth century, the arts dominated the life of imagination, writes Forbes. Today, however, the sciences inform the imaginations of artists and ordinary people. However, even science today is an art. It advances ideas that captivate the imagination, such as evolution which transformed the way people looked at humanity even in the absence of evidence, and computers, an irresistible and controlling metaphor for how the brain works.

Written in nontechnical and nonscientific language, this book is easy reading. The literary language may aggravate the scientist who prefers more written precision. Forbes' use of perception, instinct and creativity shows no knowledge of the psychological literature on these topics. On the other hand, the naiveté of Forbes' approach has its own charm and may provide inspiration and motivation to the Christian who seeks to use imagination for the glory of God. The book closes with an eclectic annotated reading list.

Reviewd by Richard Ruble, John Brown University, Siloam Springs, AR 72761.

GLOSSOLALIA: Behavioral Science Perspectives on Speaking in Tongues by H. Newton Malony and A. Adams Lovekin. New York: Oxford University Press, 1985. ix + 292 pages, index. Hardcover; $29.95.

This work has an advantage that so many of its genre do not: it is authored by individuals who have understanding and empathy with the subject. Malony is not a practitioner of glossolalia ("speaking in tongues"), but he "has a deep appreciation for those who do," and he brings 12 years of programmatic study to the task. Lovekin is an Episcopal priest who does speak in tongues, and has been active in the field both as a scientific researcher and as one teaching and leading others into the Baptism of the Holy Spirit.

At the same time, the authors caution that "this is a treatise on social/behavioral science—not theology," although they "tried to respect the self-reports and testimonia," and hope that others "will find these ideas presented clearly and provocatively." While this goal has been fulfilled, the psychological jargon can get to be a little heavy for someone who has very little knowledge of psychology.

The first eight chapters are divided into three sections that present the history of the research and evaluate it according to three models: 1.) glossolalia as anomalous behavior ("that which is distinct or different from something not only in degree but in kind"), 2.) aberrant behavior (abnormal), and 3.) extraordinary behavior ("that which is atypical or unusual for either the individual or for the society at large"). Five chapters are required to discuss the effects of glossolalia in producing or failing to produce physical, personality, cognitive, attitudinal, behavioral, and value changes. In the final chapter, Malony and Lovekin draw their many lines of investigation together into an "integrative interpretation." There is an extensive bibliography of the works discussed in the text, plus good subject and author indices.

The book is good for those who are interested in the psychological approach, and it "fills the need for an exhaustive and up-to-date interpretation of these endeavors in the social/behavioral sciences." Chapter 6 is especially welcome to this reviewer, because it reports and discusses extensive research that neatly eliminates the widely held canard that glossolalics are in a state of ecstasy while speaking. However, a striking paradox is also presented by this materialistic study of a phenomenon that is essentially spiritual in origin—something like measuring electricity with a yardstick. The problem is that it is a sterile dissection, much like studying love by dissecting and describing the human reproductive organs. The research and the discussion of that research generally excludes God or the Holy Spirit as an active agent. Perhaps most would say that this is inevitable in a scientific study; therefore, the question must be raised, "Is it possible to have a 'scientific' explanation of a spiritual experience, as opposed to merely describing and classifying the external manifestations of some of the results of this experience?" Malony and Lovekin do deal with this question in their final chapter, but the results are not too satisfying.

The authors also do an excellent job of making clear the non-Christian nature of the subjects and researchers involved

in the pioneering work, and the occult and/or mental aberration of the original subjects. For this very reason, it is all the more disappointing that there is a systematic failure to make the very fundamental and essential distinction between "true" glossolalia (i.e., from the Holy Spirit) from "false" or "counterfeit" glossolalia (i.e., from the "other side" through mental illness and direct demonic activity). This may be a natural result of the totally psychological orientation of most of the researchers, and the goal of the authors to study and report this phenomenon "scientifically." However, is it not rather basic scientific practice to isolate and define the object of study so that two different things are not being mixed? In all fairness, it must be pointed out that Malony and Lovekin provide us with an excellent and very thought-provoking discussion of Christian glossolalia in the final chapter.

This book is recommended for those who want a comprehensive, systematic, and fair presentation of the important scientific research on glossolalia, combined with a balanced evaluation. Those who are looking for a work that combines sound theological observations along with psychological insights will have to look elsewhere.

Reviewed by Eugene O. Bowser, University of Northern Colorado, Greeley, CO 80639.

ABORTION: Toward an Evangelical Consensus by Paul B. Fowler. Portland, OR: Multnomah Press, 1987. 225 pages. Hardcover.

The title and content of Paul Fowler's book express his desire to put biblical Christianity on the spot. As with so many ethical issues, the church has demonstrated too little practical unity with regard to abortion. Some would see this simply as a result of our cultural diversity. Others, like Fowler, consider this evangelical division a disaster; as much a contributor to the present flood of abortion on demand as any other societal factor. The author believes that we, as the church, should together be able to take a strong moral stand by "examining the underlying concepts and assumptions of the basic prochoice arguments and in comparing them with Scripture" (from the preface).

Fowler is ordained in the Presbyterian Church of America, and presently serves as professor of New Testament at Columbia Graduate School of Bible and Missions. He is also on the boards of Voice of Calvary Ministries and the Christian Action Council. Fowler presents his prolife convictions with carefully chosen illustrations and without resort to polemics. His self-stated approach is confrontation tempered with love. Reference material is adequate and particularly well chosen for a popular book.

The initial chapter, "Why Can't We Agree?", is a brief historical analysis covering ancient Greece, Rome, and finally Christendom. No confusion here: "the early church stood united against abortion" (p. 17). Add to this the continuous opposition to abortion by Judaism and both Catholic and Protestant streams of post-Reformation Christianity. It is only the past couple of decades that have seen a rift in the prevailing stance. Fowler describes the changing mood that swept abortion, along with many other moral monsters, into acceptance in our culture. Evangelicals were generally unconcerned or uninformed about the move to liberalize abortion laws in the 1960's and early 1970's. Less biblically oriented denominations and various Jewish groups joined the proabortion activists before and after the 1973 Supreme Court decision that destroyed existing state regulations. The American public, and some evangelicals, were increasingly deceived by immersion in the rhetoric of rights of choice, coat hangers, and exaggerated hardship cases. Why didn't evangelicals join Catholics in opposition?

The church's lack of outrage (chapter three) may show to some extent how it had become assimilated into society. Much of the evangelical opinion just prior to the Roe vs. Wade decision (pp. 65–72) was tacitly, if not explicitly, prochoice. Only after 1973 did prolife attitudes become refined and widespread among non-Catholic believers. Even so, there are those who continue to cloud the issue. Chapters four and five are Fowler's salve to smooth over differences, and create a prolife consensus through Scripture. A sincere examination of biblical standards, both implicit as well as explicit, must lead us to reject the prochoice justification for abortion.

Fowler's main point being made, he backtracks to dispel remaining "barriers to consensus" in chapter six. Many of these barriers are also rooted in deceptive prochoice rhetoric. Lest we be unconvinced, the reader is strategically presented in chapter seven with the stark reality of abortion as violence, including violent killing through violent methods in the abortuary, with violent effects on the mother as well as the child.

Especially in the past few years, several good and informative books have dealt with the many aspects of abortion. Some Christians may feel sufficiently educated in the details; however, Fowler makes it clear that much knowledge can be a burden when the appropriate action does not follow. This book on abortion is a significant attempt to produce unity of mission among evangelicals in reversing one of society's great evils.

Reviewed by Jeffrey K. Greenberg, Dept. of Geology, Wheaton College, Wheaton, IL 60187.

FORESIGHT: Ten Major Trends That Will Dramatically Affect the Future of Christians and the Church by Howard A. Snyder and Daniel V. Runyon. Nashville, TN: Thomas Nelson, 1986. 190 pages. Hardcover; $12.95.

The authors of this book conducted two surveys of "over fifty knowledgeable people" (who were not specified either individually or positionally) for the identification of important trends, and elaboration upon their significance for the Church. They then "determined by research and interviews whether the trends were based on solid evidence."

Howard Snyder has a doctorate in historical theology, serves as coordinator of the pastoral team of the Irving Park Free Methodist Church, and teaches in Chicago area seminaries. Daniel Runyon is a writer and free-lance editor.

Among the trends discussed in this book are: from Regional Churches to World Church, from Communist China to Christian China, from Male Leadership to Male/Female Partnership, and from Secularization to Religious Relativism.

This book is light-weight. It is written very much like a newspaper article, and at about that level of intellectual substance. It contains little that has not been presented repeatedly in the secular or religious press on many occasions over the past few years. However, it does collect these items together in a single volume and may be helpful for those who may wish to use information about these trends as allusions in messages or talks.

The perspective of the book is primarily of trends for Protestant Christianity in North America. Furthermore, the trends focus on "religious" themes and do not address some technological trends—such as the increased capability for governmental surveillance of a person's activities, or the growing financial interrelationships within our nation and internationally—that may radically affect everyone's future, including that of the Church.

Reviewed by D.K. Pace, The Johns Hopkins University Applied Physics Laboratory, Baltimore, MD 21200.

DEATH: Confronting the Reality by William E. Phipps. Atlanta: John Knox Press, 1987. 219 pages, index. Paperback.

Phipps is Professor and Chair of Religion at Davis and Elkins College, author of several books, and an active member of the American Academy of Religion. He discusses the situation leading up to death, as well as causes of death and reactions of friends and family of the deceased. He relates several ideas on death that have been held by different religions and eminent authors, but relates his own conclusions in plain statements.

Beginning with an account of his confronting death more than 50 years ago with his grandmother's passing, he concludes that the "multigenerational family structure has virtually disappeared in this century and the role of funeral homes has also changed." The present generation is "death insulated . . . we now reveal the facts of life but conceal the facts of death."

In a chapter defining death as more than the cessation of breathing and heartbeat, and near-death experiences, he defines organic life as beginning at conception. He distinguishes it from the beginning of human life, and concludes that "it would be tragic if one political faction attained the power to impose its definition [of life] on all citizens and thereby remove our present freedom to act on the dictates of conscience."

Fascinating details about life expectancy and aging are supplemented by an appendix which will help predict an individual life expectancy. Other appendices give questions for reflection and discussion, death preplanning and ancient views of death, as well as Jesus and Paul's views of the afterlife.

Although Phipps appreciates Kübler-Ross' research on dying patients, he summarizes critiques of her ideas, and informs us of the hospice movement and hospitals' attitudes toward dying patients. Options in terminal situations, such as ending life by painless means or withholding treatments, are evaluated.

Following statistical data on suicides, the psychological and social causes are given, and what can be done in counseling suicides is presented. "There may well be situations in which suicide can be a conscientious act resulting from a careful weighing of alternatives."

"The homicide rate in this nation has doubled in the past generation"—so the author reasons about the appropriateness of the death penalty, gun control, and war. The author approves of reasonable laws on gun control, and affirms that "we are currently faced with the realistic possibility of the complete destruction of organic life on earth."

A comprehensive account of historical burial methods, cremation, and embalming, with some criticisms of elaborate and costly funeral practices is given. Donating one's body to a medical school and permitting organ transplants are also discussed.

A comprehensive chapter on life-after-death treats conditional theories: "if something is done by you or for you, then you will attain life after death," and whether "life after death can be proven to exist." Is there a soul and spirit, or is "psychic activity . . . the rapid movement in the skull of atomic particles too small to be seen?" "Children and Death" and "Coping with Bereavement" conclude the chapters in *Death: Confronting the Reality.*

If you are as old as I am, you will be intrigued with this stimulating book.

Reviewed by Russell Mixter, Professor of Zoology, Emeritus, Wheaton College, Wheaton, IL 60187.

LOVE FOR A LIFETIME by James Dobson. Portland, OR: Multnomah Press, 1987. 125 pages. Hardcover.

James Dobson is known to most evangelical Christians through his daily radio broadcast on over 1000 stations, his widely distributed films, and his many popular books. The subject of this book is making marriage last, and Dobson is

qualified by training and experience to write about it. He is trained in psychology, is experienced as a teacher and counselor, and is the founder of Focus on the Family, an organization which seeks to strengthen marriage and the family. Dobson, married 27 years, is the father of two children.

Dobson discusses topics you might expect to find in a book about marriage such as money, sex, and communication. Because of its many white spaces, the book is relatively short, but one that contains many, pithy maxims: "The key to a healthy marriage is to keep your eyes wide open before you wed and half closed after"; and, "Perfection doesn't exist. You have to approach marriage with a learner's permit to work out your incompatibilities. It is a continual effort."

This book, printed on quality paper, has a colorful jacket outside and many beautiful pictures inside. Its clarity, succinctness and wisdom qualify it as a wonderful gift to newlyweds, or better yet, to newly engaged. For those who have been married for many years, this book could provide a good refresher course and perhaps put some fire back into a marriage that has gone cold. For those who have the opportunity to strengthen Christian marriages through preaching, teaching or counseling, this book can provide needed help.

Reviewed by Richard Ruble, John Brown University, Siloam Springs, AR 72761.

THE STORY OF THE CHRISTIAN CHURCH (revised ed.) by Jesse Lyman Hurlbut. Grand Rapids, MI: Zondervan, 1970. 192 pages, index. Hardcover.

The Christian Church suffers because many of its members have little sense of its history. That lack of perspective means that there is less understanding than there might be, both among different Christian traditions and in the interaction between Christianity and other religions. Hurlbut's book is an attempt to provide a brief survey of church history for nonexperts. The author's name will be familiar to many from *Hurlbut's Story of the Bible.*

The two millennia of the church's history are divided into six periods: the "Apostolic" (A.D. 30–100), the "Persecuted" (100–313), the "Imperial" (313–476), the "Medieval" (476–1453), the "Reformed" (1453–1648), and the "Modern" (1648–present) churches. Extensive outlines and marginal notes assist in the organization, and review questions at the end make possible a thorough reprise of the book's contents. The book is fairly well balanced in its treatment of the various Protestant traditions. The view of the Roman Catholic tradition is somewhat negative, and the Eastern Orthodox receives almost no attention after the formal split between East and West in 1054 A.D.

In Hurlbut's discussion of church structures, the relationship between church, society, prominent personalities, and "controversies over abstruse doctrines" are deliberately given little attention. Of course, a book this size could not enter in detail into all theological issues. But it is disconcerting to find, for example, that the council of Chalcedon—important both as a doctrinal watershed and as a significant factor in the development of papal influence—is completely ignored. Islam is praised for "its simplicity of doctrine" and for bringing "every soul face to face with God." We are told that the Reformation established the principle "that religion should be rational and intelligent," as if the scholastics had never lived. All in all, the treatment of doctrine and its history is rather naive.

The fact that the current edition is a revision of one which originally appeared in 1918 shows through rather clearly. Such important topics as the church in the Third World and under communism, modern ecumenical dialogues, and the encounter of Christianity with world religions (other than Islam) get little notice. Closing chapters on the churches in the United States and Canada do provide a little updating.

Readers of this journal will be aware of the importance of the interactions between Christianity, science, and technology. Except for a passing reference to the Scopes trial, this subject receives no attention.

The Story of the Christian Church can provide those who have no knowledge of church history with a very basic framework (from a clearly Protestant standpoint) for study of the subject. But one needs to take doctrine much more seriously in order to really understand the dynamics of church history. Today's students need a survey written from the standpoint of an observer near the end of the twentieth century, rather than from one near its beginning.

Reviewed by George L. Murphy, Pastor, St. Mark Lutheran Church, Tallmadge, OH 44278.

MEDICINE, MIRACLE AND MAGIC IN NEW TESTAMENT TIMES by Howard Clark Kee. New York: Cambridge University Press, 1986. 170 pages. Hardcover.

This is monograph number 55 in the Society for New Testament Studies Monograph Series. Dr. Kee is William Goodwin Aurelio Professor of Biblical Studies at Boston University, and sees this monograph as a continuation of his book, *Miracle in the Early Christian World*, published by Yale University Press in 1983.

This scholarly text has five chapters dealing with healing medicine in the Greek and Roman tradition, miracles, and magic. An appendix containing notes by Professor James H. Charlesworth of Princeton Theological Seminary on a medical manuscript from Qumram, chapter notes, a three-page bibliography, and subject, author, ancient author, and scriptural passage indices add to the value of this brief text.

In his introduction, Kee states that his aim is to clarify the relationship between these three approaches to healing—medicine, magic and miracle—rather than to trace the

history of any one of them in detail. In the process, he successfully examines evidence from the centuries before and after the birth of Jesus in the context of the various socio-cultural settings in which the phenomena appear. The author, on the basis of these historical observations, concludes that the phenomenon of healing in the gospels and elsewhere in the New Testament is a central factor in primitive Christianity, and Jesus as healer is a direct continuation of the Old Testament prophetic understanding of what God was going to do in the New Age.

This text would be of interest to biblical scholars as well as to laymen who need a perspective of Greco-Roman, New Testament perspectives on medicine, miracle and magic.

Reviewed by Fred H. Walters, Associate Professor of Chemistry, University of Southwestern Louisiana, Lafayette, LA 70504.

EVANGELICAL THEOLOGY: A Survey and Review
by Robert P. Lightner. Grand Rapids, MI: Baker Book House, 1986. 303 pages, indices. Paperback.

Lightner, a professor of systematic theology at Dallas Seminary and author of several other theological books, makes clear his intention to provide "a survey and review" of evangelical theology rather than a complete text of dogmatics. His book is intended primarily for college use and for review. The author begins by presenting a brief definition of the term "evangelical," which makes clear the conservative character of his book.

The order of topics is largely traditional: the Bible, God and Incarnation, Creation (beginning with angels), Salvation, the Church, and Eschatology. Lightner achieves his intention of integrating the various areas of Christian doctrine, so that they are seen as parts of a whole. This effort toward unity is aided by use of the old principle that "the external works of the Trinity are undivided." It is also helpful that there are sketches of the historical development of various doctrinal areas. (But these *are* sketches, with some unevenness of description and some inaccuracies. Note, for example, the confusion of Clement of Rome with Clement of Alexandria on page 66, and the omission of "And in the Holy Spirit" from the text of the original Nicene Creed on page 69.)

Consistent with the book's purpose, "Questions for Discussion" and "Suggestions for Further Reading" are included at the end of each chapter. In general, the structure and level of the book seem appropriate for the audience which is envisioned.

One useful feature of the presentation is the discussion of "Major Areas of Difference among Evangelicals" in each chapter. Lightner presents his own position on some of these controversial issues, and with others, he leaves the question open.

As one would expect, this conservative treatment of evangelical theology stresses authority, inspiration, and inerrancy of the Bible. However, no real consideration is given to the question of the *character* of biblical material. It seems simply to be assumed, for instance, that the gospel writers intended to present straightforward historical accounts of the life and teachings of Jesus. No consideration is given to what many biblical scholars would see as a process of development within the Old Testament on such topics as Satan, because a uniformity of viewpoint among the biblical writers is tacitly assumed.

The question here is not whether or not the Bible is *true*. Having accepted the truth of Scripture, one must still discern the different means—historical account, story, liturgy, prophetic oracle and others—which the biblical writers used to convey the truth. One who has been exposed to modern critical study of Scripture, even without accepting negative conclusions about the authority of the Bible, will probably feel that some of Lightner's uses of biblical texts are naive. (The plurality of *Elohim* as an argument for the Trinity is an example.)

Sometimes the horizon of theological options is too narrow. Christ's death as a substitute for sinners is certainly a major biblical theme, but there are other scriptural ways of describing Christ's saving work. The table of "Theories of the Atonement" on page 71 is interesting, but it is surprising to find no reference to Aulén's arguments for a *Christus Victor* model of the atonement.

Lightner's discussions of Baptism and the Lord's Supper are quite scanty. After his strong emphasis on original sin, one expects that there will be some discussion of the salvation of infants and infant baptism, but those questions are not addressed. It is simply assumed that water baptism is for adults ("believer's baptism"). Again, after an extremely brief presentation of the understandings of the Lord's Table by Lutherans, "the Reformed," and Zwingli, Lightner states that the latter's "memorial" view "finds the greatest support in the Scriptures." However, no scriptural support is given for this assertion. It seems that the sacraments are not very important for Lightner's understanding of evangelical theology.

There has been, of course, considerable controversy about eschatology. Here the presentation of "areas of difference," with accompanying figures, is especially welcome. It should be helpful for those confused by debates about pre-, a-, and post-millennialism, rapture, tribulation, and other issues.

In summary, there are some issues which one wishes had received more attention. But the book does provide a helpful introduction to the theological tradition which the author presents, both for those within that tradition and for the larger Christian community.

Reviewed by George L. Murphy, Pastor, St. Mark Lutheran Church, Tallmadge, OH 44278.

CHRISTIAN COUNTERMOVES IN A DECADENT CULTURE: A Critical Concern Book by Carl F.H. Henry. Portland, OR: Multnomah Press, 1986. 144 pages. Hardcover.

Carl F.H. Henry is an imposing figure among evangelical thinkers of our time. His reputation has reached the point that even his more routine productions are of background interest to his substantive contributions to evangelical thought. The present volume makes a number of Henry's various compositions available to the general public. This collection consists of sermons and other special addresses, and is organized under three headings: "The Problem," "The Prescription," and "Where Are the Physicians?"

Part one defines the moral and spiritual emptiness of modern western culture, and relates this emptiness to the loss of its ideological base. Chapter one, "The God of the Bible and Moral Foundations," effectively reiterates the biblical basis of traditional western values. In the next chapter, "Twenty Fantasies of a Secular Society," Henry lists twenty current, erroneous beliefs found in contemporary American society. This list provides an impressive criticism of contemporary society from a biblical perspective. The next two chapters, "Nothing to Worry About" and "On Being Beside Yourself," give samples of Henry's thought but make only limited contributions to the course of the argument. Chapter five gives a right-to-life statement based upon the full humanity of the fetus from the moment of conception.

"The Prescription" consists of four sermons dealing with topics important for the Christian solution to "the Problem": Christian freedom, liberation, Christ-centeredness, and the resurrection.

Part three seems to be a challenge for Christians to act in four areas: 1.) Christians should use biblical truths to deal with the problems of secular society; 2.) Christians should act in the political arena; 3.) Chapter 12 is a challenging statement of what Christian journalism could and should be from an undisputed authority; and, 4.) Christians should be more than "tin soldiers" in this conflict.

The selections in this book are of varying significance and challenge. They range from more or less routine exhortations to genuinely profound insights. This is to be expected, but as noted above, Henry is of such stature that everything he says is of some importance.

However, there is one respect in which the book is a distinct disappointment. The title of the book, and of the series to which it belongs, seemed to the present reviewer to promise Henry's definitive proposal for the important issues addressed by the book. Instead, the book delivers an opportunistic collection of discrete items loosely related to the book's title. These selections were worth publishing, but under a less pretentious, more modest title. For those individuals and libraries who wish a complete collection of Henry's works, this book is a useful acquisition. But those who purchase the book on the promise held out by its title may be disappointed.

Reviewed by Andrew Bowling, John Brown University, Siloam Springs, AR 72761.

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I certify that the statements made by me above are correct and complete.

Robert L. Herrmann, Executive Director
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What is the **American Scientific Affiliation?**

We are a world-wide organization of scientists who share a common commitment to the Christian faith (as expressed in our statement of faith, found on the application form inside the back cover). Since 1941, we've been exploring any area relating Christian faith and science, and making the results known to the Christian and scientific communities.

For subscribers, *Perspectives on Science & Christian Faith* is an exciting introduction to controversial issues . . .

For members, *Perspectives* is just the beginning:

1. Our bi-monthly *Newsletter* highlights the work and witness of ASA members, reports of ASA activities, employment notices, and much more.

2. Our *Source Book* offers key books on science/faith at special member discounts, audio and videotape programs, and a Speakers Bureau.

3. Our *National Annual Meeting,* as well as many regional meetings, offers unparalleled opportunities for personal interaction with Christian colleagues. Our *Member Directory* puts you in touch with other Christians in your field and/or geographic area.

4. Our national *ASA Commissions* are addressing issues in problem areas from Bioethics to Science Education.

5. Our vision for the future includes a proposed PBS TV series, further distribution of our publication "Teaching Science in a Climate of Controversy," which has already been sent to over 50,000 high school biology teachers, and a lay-language Science-Faith publication.

INTERESTED? *Let us tell you more . . .*

MEMBERSHIP INFORMATION

WHO MAY JOIN THE ASA?

Anyone interested in the objectives of the Affiliation may have a part in the ASA.

Full, voting membership is open to all persons with at least a bachelor's degree in science who can give assent to our statement of faith. Science is interpreted broadly to include mathematics, engineering, medicine, psychology, sociology, economics, history, etc., as well as physics, astronomy, geology, etc. Full member dues are $35/year.

Associate membership is available to anyone who can give assent to our statement of faith. Associates receive all member benefits and publications and take part in all the affairs of the ASA except voting and holding office. Associate member dues are $26/year.

Full-time students may join as Student members (science majors) or Student associates (non-science majors) for discounted dues of $14/year. Retired individuals, parachurch staff, and spouses may also qualify for a reduced rate. Missionaries are entitled to a complimentary Associate membership in the ASA.

An individual wishing to participate in the ASA without joining as a member or giving assent to our statement of faith may become a Friend of the ASA. Payment of a yearly fee of $26 entitles "Friends" to receive all ASA publications and to be informed about ASA activities.

Subscriptions to *Perspectives on Science and Christian Faith* only are available at $20/year (individuals), $30/year (institutions) and $14/year (students).

An ASA Membership Application can be found inside the back cover of this issue.

Especially for Canadians:

The Canadian Scientific and Christian Affiliation was incorporated in 1973 as a direct affiliate of the American Scientific Affiliation with a distinctively Canadian orientation. For more information contact:

Canadian Scientific and
Christian Affiliation
P.O. Box 386, Fergus, Ontario, NIM 3E2

MEMBERSHIP/FRIEND OF ASA APPLICATION/SUBSCRIPTION FORM

(Subscribers complete items 1–3 only)

American Scientific Affiliation, P.O. Box 668, Ipswich, MA 01938

1. Name (Please print) _____ Date _____

2. Home Address _____ Office Address _____

_____ _____

3. _____ Zip _____ _____ Zip _____

Telephone: _____ Telephone: _____

Permanent Home Address (if applicable): I would prefer ASA mailings sent to:

_____ _____ home _____ office

_____ Zip _____ I give the ASA permission to publish my phone number in the Member Directory _____ Yes _____ No

Place of birth _____ Date of birth _____

Marital Status _____ Sex _____ Citizenship _____

If married, spouse's name _____ Is spouse a member of ASA? _____ Eligible _____

ACADEMIC PREPARATION

Institution	Degree	Year	Major

Field of Study _____

Area of Interest _____

Recent Publications _____

_____

Church Affiliation _____

What was your initial contact with the ASA? _____

If you are an active missionary on the field or on furlough or a parachurch staff member please give the name and address of your mission board or organization.

Name _____

Street _____

City _____ State _____ Zip _____

I am interested in the aims of the American Scientific Affiliation. Upon the basis of the data herewith submitted and my signature affixed to the ASA Statement below, please consider my application for membership. I understand that I may become an *Associate* if I do not qualify as a *Member* at present.

Statement of Faith

I hereby subscribe to the Doctrinal Statement as required by the Constitution:

1. The Holy Scriptures are the inspired Word of God, the only unerring guide of faith and conduct.
2. Jesus Christ is the Son of God and through His atonement is the one and only Mediator between God and man.
3. God is the Creator of the physical universe. Certain laws are discernible in the manner in which God upholds the universe. The scientific approach is capable of giving reliable information about the natural world.

Signature _____ Date _____

(required for Member, Associate Member, Student Member status)

Amount Enclosed _____ Category _____

Comments _____

_____

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OTHER RESOURCES AVAILABLE FROM ASA

"Teaching Science in a Climate of Controversy"—the 48 page booklet that is putting ASA on the map is available from the Ipswich office for:

$4/single copy; $3.00/2-9 copies (same address); $2.00/10 or more copies (same address).

Psalm 111:2 Notecards and Envelopes—these are high quality, designed exclusively for ASA by Karen Herrmann Donahue—featuring a black & brown duotone of the Great Door of the Cavendish Laboratory (Cambridge, England)—with the English translation of the Latin inscription, "The works of the Lord are great, sought out of all them that have pleasure therein." (Psalm 111:2).

$5.50/pkt of 10; plus postage (1 pkt-$1; 2-8, $2.50; 9-15, $5.50).

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Founded in 1941 out of a concern for the relationship between science and Christian faith, the **American Scientific Affiliation** is an association of men and women who have made a personal commitment of themselves and their lives to Jesus Christ as Lord and Savior, and who have made a personal commitment of themselves and their lives to a scientific description of the world. The purpose of the Affiliation is to explore any and every area relating Christian faith and science. *Perspectives* is one of the means by which the results of such exploration are made known for the benefit and criticism of the Christian community and of the scientific community.

INDICES to back issues of *Perspectives* are published as follows: Vol. 1–15 (1949–1963), *Journal ASA* 15, 126–132 (1963); Vol. 16–19 (1964–1967), *Journal ASA* 19, 126–128 (1967); Vol. 20–22 (1968–1970), *Journal ASA* 22, 157–160 (1970); Vol. 23–25 (1971–1973), *Journal ASA* 25, 173–176 (1973); Vol. 26–28 (1974–1976), *Journal ASA* 28, 189–192 (1976); Vol. 29–32 (1977–1980), *Journal ASA* 32, 250–255 (1980); Vol. 33–35 (1981–1983), *Journal ASA* 35, 252–255 (1983); Vol. 36–38 (1984–1986), *Journal ASA* 38, 284–288 (1986). Articles appearing in *Perspectives* are abstracted and indexed in the CHRISTIAN PERIODICAL INDEX, RELIGION INDEX ONE: PERIODICALS, RELIGIOUS AND THEOLOGICAL ABSTRACTS, and in GUIDE TO SOCIAL SCIENCE AND RELIGION IN PERIODICAL LITERATURE. Book Reviews are indexed in INDEX TO BOOK REVIEWS IN RELIGION. Present and past issues of *Perspectives* are available in microfilm at nominal cost. For information write University Microfilms, Int., 300 North Zeeb Road, Ann Arbor, Michigan 48106.

CANADIAN SCIENTIFIC AND CHRISTIAN AFFILIATION

A closely affiliated organization, the **Canadian Scientific and Christian Affiliation,** was formed in 1973 with a distinctively Canadian orientation. The **CSCA** and the **ASA** share sponsorship of the publication. **CSCA** subscribes to the same statement of faith as the **ASA** and has the same general structure. However, it has its own governing body with a separate annual meeting in Canada.

LOCAL SECTIONS of the American Scientific Affiliation and the Canadian Scientific and Christian Affiliation have been organized to hold meetings and provide an interchange of ideas at the regional level. Membership application forms, publications and other information may be obtained by writing to: AMERICAN SCIENTIFIC AFFILIATION, P.O. Box 668, Ipswich, Massachusetts 01938, or CANADIAN SCIENTIFIC AND CHRISTIAN AFFILIATION, P.O. Box 386, Fergus, Ontario, N1M 3E2.

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