Reviews

The Human Mind and the Mind of God: Theological Promise in Brain Research. By JAMES B. ASHBROOK. Lanham, MD: University Press of America, 1984. 383 pages. $17.75 (paper).

"I turned to brain research to discern within it its theological promise. I found that theology presents parallels to the brain's regularities and mind's emergent properties" (p. 314). In these words, James Ashbrook sums up his book. What he finds in brain research is lateralization or functional asymmetry, and he accepts the view that this asymmetry in the brain is reflected in the working of the human mind. The asymmetry of the human mind is in turn reflected in the history and theology of the Christian religion. The fact of brain/mind asymmetry is the source of inadequate responses when the two halves do not work well together. Its functioning is deficient when it allows one half to dominate to the neglect of the other; the functioning is disturbed when the two halves are in competition or conflict. The actual trajectory of Christian history and theology has been marked by these undesirable trends and thus has been subject to self-destructive functioning. Just as the asymmetry of the brain is rooted in one unified physical organ, so also the bifurcations of the human mind find their resolution in a unity which is ultimately rooted in the unity of the mind of God. The book is finally a proclamation of this unity and its availability to the human community within the forms of asymmetry and bifurcation that characterize our concrete existence.

Let me state at the outset my own asymmetrical response to this book: as with the hemispheres of the brain, each response is authentic and essential to the whole assessment. On the one hand, Ashbrook has given us a work that is impressive in its design and in its execution. Beyond that, it is an important book in that it attempts something that is rarely done, but which must be done; and it proposes a hypothesis which is fruitful for further thinking, even if that hypothesis may itself be judged to be inadequate. On the other hand, in both design and execution, the work raises such questions and doubts in the reader's mind that one will at times rephrase the subtitle of the book to read "promise and *disappointment* in brain research." Whether the disappointment is due to the intrinsic slipperiness of the subject matter (as Ashbrook writes, [p. xxi]) or to the author's treatment of it is a judgment each reader has to make. I will take up each of these assessments in turn.

No brief review can do justice to the book; it may be beyond the competence of any single reviewer to comment adequately on its range of discussions. The first one-third of the book (Part I, "Mind as Metaphor: An Analytic Bridge") deals with the empirical details of brain research and Ashbrook's first basic hypothesis, that "the concept 'mind' serves as a bridge between theology and neuropsychology" (p. xviii). This section appeared in briefer form in *Zygon* (19:331-50, "Neurotheology: The Working Brain and the Work of Theology"). Although this thesis is oft-reiterated in the work, in concert with the elaboration that "just as the mind reveals the human meaning of the brain, so God

[*Zygon*, vol. 20, no. 3 (September 1985).]
 ISSN 0044-5614

discloses the religious meaning of the mind" (p. xviii), it is not an easy task to discern exactly what Ashbrook means by the thesis. The ambiguity is due in part to Ashbrook's awareness of the difficulties that attend his task; as a result he seems deliberately to employ opaque elaboration. The hypothesis amounts to this: first, the brain is the neurobiological substratum of the human mind, and the working of the mind is a reliable image of the intentions of God; second, but since one cannot validate either of the moves which this hypothesis entails (i.e., from brain to mind and from mind to God) by direct inference, one must make an interpretive leap which speaks "as if" such inference were possible. The result is that "mind" is not accorded the status of model, but rather of "analytic metaphor," which seems to mean that it is a heuristic category. He proceeds "as if" the thesis were validated without claiming such validation. He draws upon that nuance of the term *metaphor* which suggests that it is both same and different from that which it seeks to describe.

Although the discussion of brain/mind draws upon a wealth of neurobiological data, hemispheric lateralization is what clearly looms largest in Ashbrook's thinking. He focuses on the left/right duality that is now familiar to us (e.g., left = analytic, right = synthetic). The discussion is by no means simplistic, but it is this duality that rivets Ashbrook's attention. Anchored in this brain, the mind is described by a four-fold typology which characterizes mind-input as "naming" (left) and "immersed" (right), mind-output as "analytic" (left) and "imaginative" (right). The discussion is much fuller than my summary can convey. This move from brain to mind is itself an interpretive leap, just as the next move from human mind to divine mind is even more a thrust of faith. In order to consummate the second leap, Ashbrook links the left/right duality to a typology of Paul Ricoeur's: "the phenomenology of manifestation and the hermeneutics of proclamation" (p. 13). Manifestation is right brain/mind, linked to "mystical-priestly-metaphysical-aesthetic" ways of perceiving God, whereas proclamation (left brain/mind) is linked to "prophetic-ethical-historical-doctrinal" ways. Ashbrook calls these types "trajectories of belief" (after David Tracy). "They distinguish what is foreground and background in the gestalt of understanding God's ways of being God. As such they provide contrasts of 'focal meaning' comparable to brain contrasts of cognitive processing. The human mind perceives differences in the divine mind" (p. 13).

Exactly one-half of the book is included in Part II, "Architectures of Mind: Central Images." This part is a stunning commentary on eastern and western Christianity, organized through an analysis of the comparative architectural achievement of the Saint Sophia church in Istanbul and the cathedral of Chartres, incorporating both institutional history and the development of theology. East is correlated to the right brain/mind, while West mirrors the left. In the first part of the book, Ashbrook had suggested a move from *is* to *ought*, in which brain functioning is judged to be "deficient" if one half dominates so as to ignore the other half; the functioning is "disturbed" when it draws upon both left and right without resolving the competition between them. When translated into the historical discussion, this typology of assessment suggests a tragic flaw in both streams of Christianity, the East suffering from right-dominant deficiency ("too much vision, not enough sight"), the West falling to left-dominant disturbance ("too much inquiry, not enough context"). The reader must remember that I have summarized here 185 pages of discussion in the book itself.

In Part III, "Many Minds—Many Meanings," it is clear that the impasse of Christianity East and West is the sad fate all of humanity (both individuals and society) must undergo if it cannot find the unity of the one brain, the one human mind, the one divine mind. The call is to make the move from Babel (total disarray) to Pentecost (festival of diversity-in-oneness). Just as the relation of brain, mind, and God defies strict inference, so the oneness of the human race is a reality that defies "direct description"; yet it exists as a "deep structure" which "we only access . . . through surface structures" (p. 290). The surface structures are constituted by the duality that marks the actual functioning of the brain/mind; these surface structures cannot be avoided, but they must be integrated as we move more deeply and gain accessibility to the deep structure that is the source of promise for humans.

The final twenty pages of the book are essential—and surprising. In that section, "Many Minds, Many Meanings—One Humanity," Ashbrook makes it clear that he is well aware of criticisms that may be raised about his broad-brush technique, his global synthesis, and his interpretive leaps. He closes with a statement of boldness; he is willing to live with the "unscientific" (his term) inferences he has drawn. He insists that it is necessary to correlate mind and theology to empirical scientific evidence, even if that correlation is based on weak inference, and for this reason must be considered to be intrinsically unscientific.

I address several questions directly to the book. First, is it misleading to focus so exclusively on lateralization as *the* lesson we have to learn from current brain research? Could we not lift out other themes for attention, with equally provocative results? For example, one thinks of the significance of the brain's own evolution; the marvelous organ that occupies the human cranium embodies in itself the evolutionary history of the species and its forebears. Or we might wonder that the brain seems to be "wired" to receive data that we ordinarily associate with the ecstatic and the numinous, thereby raising the question of the status and significance of such data. What is the relationship between the brain and such basic forms of patterning as archetype, myth, ritual, and moral systems? Is the brain inherently wired for such patterning? The brain possesses an elaborate set of neurogenetic control processes; consciousness has "causal potency" over neural events. What is the significance of such phenomena? The ecological fit of the brain with its environment and with other brains holds also an important lesson for us. The relationships of our lives (parents-children, men-women, adversaries) would not be what they are if our brains were not formed as they are, in apparent reciprocity with other processes in our ontogenetic development and with other brains. With the emergence of biosocial anthropology, the interaction between brain and behavior is receiving new attention. What will such investigation reveal about the roots of religious behavior and its function and purpose? Since brain research seems so much in its infancy, and with the prospect that alliances with other disciplines will turn up startling new hypotheses (e.g., the alliance with quantum physics), perhaps Ashbrook paints a picture of "current" brain research that is too solid and stable. These and other themes figure substantially in current brain studies, along with lateralization. They could also lead our thinking into realms that are provocative for human existence and theology, even to the point of giving us a glimpse into the Mind of God.

Second, would not a sequel to Ashbrook's work be in order, devoted more directly to the philosophical and theological assumptions on which he is build-

ing, but which he leaves rather unexplored? A cluster of related concepts seems utterly foundational for Ashbrook's enterprise: analogy of being (*analogia entis*), analogy, metaphor, image of God (*imago dei*), and the unity of *is* and *ought*. Although it is too much to expect discussion of these complicated items in a book already so packed with multi-faceted analysis, nevertheless the assumption is that these concepts enable us to make larger, ultimately theological sense of brain research. I agree with the author, but such an assumption is itself of the greatest importance, and it needs at least preliminary examination and elaboration if Ashbrook's contributions are to be widely credible. At stake here is a basic assertion that our ways of knowing (epistemology) are consonant with the way things really are (ontology).

Theological assumptions also surround the unquestioning normativeness that Ashbrook ascribes to Ricoeur's typology of manifestation and proclamation. Notably absent is any serious attention to studies in the phenomenology of religion, particularly those by Rudolf Otto, which would offer different perspectives. When Ashbrook sets creation and redemption in a relationship of duality, one fears a sort of ultra-Protestant theological bias, particularly in his assertion that redemption negates the world and creation (pp. 13, 14, 82) and in his assessment that redemption correlates to the left brain/mind whereas creation correlates with the right. What of the trajectories that conceive of redemption as a fulfillment of creation or the Irenaean position that John Hick has noted? (We note that these motifs are substantial in the Western traditions that Ashbrook subsumes under left brain/mind.)

Third, do the qualifications that Ashbrook acknowledges to his argument prove in the long run to be more significant than he grants? The author is refreshingly sophisticated, especially concerning the reservations that may be held about his basic arguments. However, when he acknowledges that his thesis holds only among the population that is left-brain dominant (p. 57), and then suggests that less than half the population is thoroughly left-brain dominant, one wonders just what the empirical base for his thesis is. What does such diversity among human brains indicate about the mind of God? Such a question requires careful response since it is so relevant to Ashbrook's thesis that there is an analogical unity between brain, human mind, and divine mind.

Fourth, is the attempt to move from one discipline to another, from empirical description to historical, philosophical, ethical, or theological interpretation finally rooted only in intuition and leap of faith? This may be the major issue raised in this book; it is the issue that makes the book most exciting and relevant to the religion/science interface. Ashbrook himself is ambivalent on the question of how firm is the base for such movement from description to interpretation. The ambivalence is articulated early on in the book: "As an analogy, the metaphor crosses neuropsychology and theology without assuming literal correspondence. I juxtapose these disciplines 'as if' they belong together. They may not correspond except through an act of faith or an exercise in imagination. The metaphorical value of the human brain, however, can serve as a 'pathway to God.' The approach is a new form of an empirical-natural theology" (p. 18). With this, Ashbrook meets head-on the fundamental issue that confronts all attempts to relate religion and science, philosophy and science, and ethics and science. Ultimately, he rests the proof of his argument where Alfred North Whitehead insisted it must rest: Ashbrook does not intend to argue the reader into submission with logic but rather to convince the reader by the intrinsic persuasiveness of the hypothesis.

The question is whether the intuitive leap is as naked as Ashbrook paints it in this book. Are there not certain kinds of empirical pointers that suggest that one intuitive interpretation may be preferable to another or which at least rule some possible hypotheses unlikely? For example, do the diversities observed in the hemisphericality of the brain suggest that the near-ideology of the popular right/left analysis that we hear so much these days is not adequate and must be recast? Might not Ashbrook's own hypothesis be subjected to such critique? It may not be the case that the right/left typology as such is either simply true or false (e.g., p. 320), but rather that the diversity of brain asymmetry requires a different hypothesis which will not raise right/left categories to the level of ideology. An alternative interpretation may in itself be an intuitive leap from the empirical descriptions, but it will be monitored by those descriptions in a way that Ashbrook's is not. Ashbrook speaks several times of the "looseness" of fit between evidence and inference, between objective sensory input and subjective experience. That looseness may be inescapable, but it may also be lessened through a more careful attention to what the method of analogy entails.

This critique is not to fault Ashbrook's sensibilities nor his enterprise in empirical-natural theology. Quite the contrary, that effort must be encouraged and intensified. Rather we must embark on a more rigorous pursuit of the very goals he has here enunciated. In this, we see the fruitfulness and importance of his work. Ashbrook has seen with utter correctness one direction in which theology must go, and he is one of the few who have stated that view so emphatically. His effort rests on the assumption (inescapable for the Judeo-Christian tradition) that the way in which humans are made is consonant with their Creator and that Creator's will for them. That being so, our reflection upon God must take into account how we have been made, just as a consideration of the empirical data must include the question of what our larger significance might be. If it be the case that a work's value is finally judged not only by its being more or less "correct," but rather also according to its capacity to stimulate further thinking by virtue of its fruitfulness, then Ashbrook's book must be considered to be of high importance.

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The Post-Darwinian Controversies: A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America 1870-1900. By JAMES R. MOORE. Cambridge: Cambridge University Press, 1979. 502 pages. $37.50.

Immediately upon its publication in 1979 James R. Moore's *Post-Darwinian Controversies* established itself as a major work in the area of Darwin studies and of late-nineteenth-century relations between science and religion. That status has not changed. The volume is divided into three parts. The first, "Historians and Historiography," reviews the rise of and the fundamental historical distortions in the military metaphor which has long supplied the terms in which

[*Zygon*, vol. 20, no. 3 (September 1985).]
 ISSN 0044-5614

scholars have discussed the conflict between science and religion. The second, "Darwinism and Evolutionary Thought," attempts to describe the development and difficulties of Darwinism as a scientific theory in the latter decades of the nineteenth century as well as its rivals among evolutionary philosophies. Of the three parts, these chapters are the least satisfactory today having been superseded to a degree by recent scholarship. The third section, "Theology and Evolution," is the heart of the book and by far the most interesting part.

In part three Moore presents an analysis of Christian theological reaction to Darwinism based on three categorizations. First there were the irreconcilables who rejected Darwinism totally. These Moore calls the Christian anti-Darwinists. Their rejection, he argues, came not from genuine Christian obstacles to acceptance but rather from a philosophy of science which required that real knowledge be certain and from a belief in the fixity of species that derived from Greek metaphysics. The second group were Christian Darwinists who, again for philosophical reasons, were not able to accept natural selection, but who did accept organic evolution. These thinkers were able to become evolutionists only by adapting it to a theology that was progressive and heterodox. Moore argues that only those among the religious controversialists "whose theology was distinctly orthodox" could accept Darwin's theory of natural selection "because the theory itself presupposed a cosmology and a causality which, owing much to orthodox doctrines of creation and providence, could be made consonant *a priori* with orthodox theistic beliefs" (p. ix). The theological liberals, on the other hand, could not accept natural selection because their theological beliefs were threatened by it. This third group Moore calls Christian Darwinians. They alone "understood Darwin's theory and left it substantially intact" (p. 116).

In untangling these separate strains of thought and also in searching for an alternative historiographical approach to the so-called conflict of science and religion, Moore makes use of Leon Festinger's theory of cognitive dissonance. In looking back over the book, one might wonder whether this theory is merely excess baggage. Does a model of "reducing dissonance" improve on more traditional modes of intellectual analysis in explaining the resolution of inner or public intellectual conflicts? Or does it merely give Moore a vocabulary for discussing conflict without using the language of conflict? A related difficulty which Moore, who is apparently an historical relativist, does not discuss is how one transfers a social psychology from one's own time to another without making any adjustments. Is this, perhaps, an instance of fashionable positivism: of using a social science formula to do something that might be accomplished equally well—or better—by the ordinary methods of intellectual history? In any event, its use is anomalous in the work of one who believes that historical circumstances condition and circumscribe all thought.

In part one, Moore shows that the military metaphor of a warfare between religion and science has never been appropriate to historical reality and has infected scholarship for too long with a false polarity which has distorted the perception of Christian responses to evolutionary thought. Few today would question this. Moore's alternative, a "crisis of faith" among scientists and laymen in the nineteenth century, has been a common approach with many scholars. The retirement of the military metaphor from historical writing, then, would be welcome if it is remembered that conflicts did occur; and when they did it would be specious for historians to describe them as being anything else.

In part two of the book Moore shows that Darwinian theory was highly controversial and fluid during the decades after the publication of the *Origin of Species* in 1859. The abbreviated discussion may exaggerate the extent to which Darwin was routed by his critics, but the strategic point, that natural selection was not without scientific critics, is valid and important for Moore's argument. The discussion of Darwin's own work and thought, however, as well as that of his rivals, is not without factual errors and those interested will especially want to consult Peter Bowler's recent *The Eclipse of Darwinism* (Baltimore, Md.: Johns Hopkins Press, 1983) as well as R. W. Burkhardt, Jr.'s earlier *The Spirit of System* (Cambridge, Mass.: Harvard Univ. Press, 1977) for more accurate assessments of the relation of non-Darwinian evolutionary thought to so-called Lamarckism during this era. Generally, however, Moore gives a good overall summary of Darwin's work and of the positions taken by his critics. The essay on Herbert Spencer is particularly outstanding.

Many readers will find part three of the book the most challenging and probably, when all is said and done, the least convincing. Although Moore analyzes Darwinist and Darwinian uses and abuses of the idea of natural selection, he gives relatively little attention to their understanding of it *as science*, which is the way Darwin understood it: how it works and how it *cannot* work in a world of natural causality. It would appear that cognitive dissonance theory has built a bias into Moore's analysis that prevents him from considering theory choice as the result of scientific judgment. That liberal Christians might reject natural selection for scientific reasons (which Moore shows were plentiful enough) is passed over in favor of the assumption that they rejected natural selection and embraced Lamarckism or some other idea because of their theology, that is, in order to reduce "dissonance" between that and evolution.

Similarly, Moore's thesis regarding the orthodox acceptance of natural selection turns on the issue of whether the orthodox really understood it. If they did not, then Moore's paradox—that orthodox Christians were virtually alone in their ability to grasp and accept natural selection because of their theological affinities with Darwin's thought—turns out to be nonexistent. In actuality, the orthodox failed to grasp the necessary assumptions of Darwin's science. They, like the liberals, created an evolutionary theological fantasy that made it possible to reconcile their religious ideas with evolution. We have Darwin's assurance that Asa Gry did not understand why natural selection had to be formulated in purely naturalistic terms, why Gray's theological improvements made nonsense of it. Gray is Moore's star exhibit. Far from being an orthodox Darwinian, it was when Gray was orthodox that he ceased to be a Darwinian. The others understood natural selection no better. That "Darwinism and design are reconciled in the divine superintendance of variation" (p. 296) and that "the ultimate causes of variation are inscrutable and thus, by implication, divine" (p. 289) were views that were scientifically and morally repellent to Darwin. No one who held such views can be said to have understood natural selection as Darwin did. It would be more accurate to say that the orthodox could accept as compatible with their theology what they *thought* was Darwinism. But, in fact, there was simply no possible Christian theological consonance with natural selection conceived as a naturalistic evolutionary mechanism. Moore argues that the theology of the liberal Christians "was unable to receive" Darwinism (p. 353). In a final sense, that of the orthodox Christians was no more able.

One further criticism may be made. In Moore's analysis Darwin's naturalism is seen as little more than the result of his loss of Christian faith. It fails to

emerge as a creative force in his thought. Hence, Moore is able to equate Darwin's unquestionable legacy from William Paley and Thomas Malthus with orthodox theology and Darwin becomes a sort of Calvinist. But this characterization ignores the naturalistic elements in Darwin's intellectual legacy as well as his power to reshape the theological ideas he acquired into very different naturalistic forms. It is as mistaken to see Darwin as having primarily theological antecedents in his significant intellectual background as it would be to see Darwin as a totally secular thinker. True, Moore avoids this last, but he errs in seeing the hidden theodicy in the *Origin of Species* as existing in the good of every creature which is achieved by natural selection (p. 331). The true theodicy was to exculpate the creator from responsibility for the blood-soaked creation that resulted. This was the theological meaning of Darwin's naturalism. It was a meaning to which the orthodox were necessarily unreceptive because of their belief in divine sovereignty.

Moore's book opened up an important field of post-Darwinian study and still provides a splendid introduction and a bibliography of less well-known literature that will keep scholars busy for years. It is truly that rare thing: a genuinely pioneering and path-blazing work. Those who deal with the Darwinian era will have to wrestle with Moore's thought for some time. Even where it is unconvincing, it challenges; it rushes at one from unexpected places and forces the re-examination of comfortable truths. *The Post-Darwinian Controversies* is without doubt one of the more important books in the recent flood of writing on Darwin and Darwinism.

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Theology and Science in Mutual Modification. By HAROLD NEBELSICK. New York: Oxford University Press, 1981. 192 pages.

It is generally accepted that the scientific revolution marks a major turning point in human history. Michael H. Hart, in his book *The One Hundred: A Ranking of the Most Influential Persons in History* (New York: A & W Visual Library, 1978), rates Isaac Newton, who represents the scientific revolution, as more influential than Jesus of Nazareth. Not only has the use of the scientific methodology resulted in a rapid rise of technology which has changed (and continues to change) almost every aspect of human living, but also our values, our self-perception, and our very patterns of thought have been changed. Science has become the accepted authority by which "facts" are established, and the scientific methodology is the universally recognized path to knowledge.

What, then, are the implications for Christianity (and, indeed, any religious faith), whose heritage comes to us from times which predate the scientific revolution? How has the rise of a scientific/technological culture influenced our religious faith? What can Christianity have to say to such a culture? These are the issues which Harold Nebelsick addresses in his book *Theology and Science in Mutual Modification*.

[*Zygon*, vol. 20, no. 3 (September 1985).]
 ISSN 0044-5614

The book consists of five chapters, the first of which ("The Present Perspective") examines the present difficulties facing our society due to the "collective schizophrenia between . . . 'the arts' or 'the humanities' on the one hand and 'the sciences' on the other" (p. 19). Nebelsick gives an excellent overview of the problems deriving from our split into C. P. Snow's "two cultures." One consequence, distasteful to those who take religious faith seriously, is that Western society "now judges the Church as an antiquated institution . . . hardly the place to which the majority now turn for answers to life or strength to meet basic problems" (p. 22). A professional theologian himself, Nebelsick places heavy blame on theologians for ignoring the increasing influence of science on human thinking and values.

Christianity has not, however, remained free from being influenced by the rise of science. In Chapters 2 and 3 ("From Natural Theology to Hegelian Idealism" and "The Idealization of Protestantism") Nebelsick examines the way in which theology was affected by classical science from the time of Newton to the early twentieth century. Treating mainly reformed theology, he shows how Christian thinkers gradually evolved toward a position whereby religion limited itself to concern over mankind's "inner" being while ignoring problems which existed in the "real world." Beginning with the reaction of philosophers (notably Immanuel Kant) to Newtonian mechanics, Nebelsick carefully traces the "idealization and anthropocentricization of the faith" (p. 83). By the late nineteenth century the Christian religion "did not demand radical change, nor could it" (p. 109). The church therefore accommodated itself easily to (and eventually came to endorse) whatever culture surrounded it. This "culture-Christianity" produced particularly disastrous results in Germany in the early twentieth century.

Chapter 4 ("Karl Barth's Break with Enlightenment Theology") is devoted mostly to Barth, whom Nebelsick and others believe to be the most influential theologian of the twentieth century. Barth strongly rejected the compromises which previous theologians had made with secular culture and instead stressed that Christianity must remain true to its own heritage of faith—a heritage which usually placed it in opposition to culture. Barth's positive contribution to Christian theology was immense but, since science and technology are part of secular culture, Barth's theology had the effect of actually reinforcing the separation and isolation of theology from science.

In the final chapter ("Crisis and Dialogue") an account is given of various recent and current attempts to bridge the gap between science and theology. A very important effort was the organization, by mathematician Gunter Howe, of the "Göttingen Conversations." These meetings took place annually from 1948 through 1959. Unfortunately, Howe was not able to persuade Barth, or any other leading theologian, to attend. Nevertheless, a number of other efforts have been made which, directly or indirectly, were inspired by Howe's initiative. Nebelsick is able to close on a note of guarded optimism concerning future interaction between scientists and theologians.

Nebelsick's book is not light reading for the nontheologian and will probably not appeal to one who is only casually interested in the science/theology relationship. For the seriously interested reader, however, the book provides an excellent introduction to understanding how Christian theologians have been influenced by the rise of a science-based culture and how they have met (or failed to meet) the accompanying challenges. The writing is concise, but dense in citations (there are more than 600 in fewer than 150 pages of text).

The book can therefore serve as an excellent reference source. It should definitely be read by anyone with serious interest in establishing a dialogue between theology and science.

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The Phenomenon of Man Revisited: A Biological Viewpoint on Teilhard de Chardin. By EDWARD O. DODSON. New York: Columbia University Press, 1984. 257 pages. $25.00.

The subject of evolution is full of problems and controversies, especially if treated not only on a strictly scientific basis but also extrapolated to philosophy and even theology. The immense variety of living forms—perhaps a sign of dissipation of energy (increase of entropy)—and on the other hand the gradual "perfection" culminating in the human species give ample food for thought not only for physicists, astronomers, and particularly for biologists and paleontologists but also for those who focus their attentions on problems of ultimate concern. It is therefore no wonder that evolutionary treatises, especially if they cover a broad field, come under close scrutiny and often sharp criticism.

Pierre Teilhard de Chardin's work, especially his *Phenomenon of Man* (New York: Harper & Brothers, 1959) is almost ideally suitable as a target for multiple attacks, especially because of its poetic language and visionary inclinations. As the author was both a priest and a scientist, he had the singularly difficult double task to convince religious authorities that his views are not contradicting religious tenets and at the same time show to scientists that what he has written is solid science which can stand up to a systematic scrutiny by his peers. He was not very successful in either of these tasks.

His ecclesiastic superiors did not allow him to publish his work in his lifetime, which is now a fact of church history. More importantly, the question whether his ideas about biological evolution, the mechanism by which living organisms are shaped in geological time, are sound and acceptable by the scientific consensus is still unresolved. Interestingly, the two most prominent authorities, indeed founders of modern evolutionary biology, Julian Huxley and Theodosius Dobzhansky, endorsed Teilhard's synthesis from the beginning, even though they disagreed with some of his biological (or religious) ideas. Yet, other outstanding scientists, among them two Nobel laureates, Peter Medawar and Jacques Monod (not specialists in evolutionary biology) and one outstanding authority of paleontology, George G. Simpson, have severely criticized the *Phenomenon of Man*. (One suspects that a certain anti-religious bias influenced these critics. Both Medawar and Monod attacked not so much the scientific details than the *Weltanschauung* of Teilhard, while Simpson, a personal friend, although his criticism is strictly factual, is known to be a strong opponent of religious concepts: on one occasion he called religion the higher form of superstition.)

Under such circumstances an unbiased and strictly professional scientific re-evaluation by a competent expert was long overdue. Edward O. Dodson's

[*Zygon*, vol. 20, no. 3 (September 1985).]
 ISSN 0044-5614

book certainly meets the demand since his competence is beyond doubt. As author of a highly successful textbook on evolutionary biology, *Evolution: Process and Product* (New York: Van Nostrand, 1976) and another, earlier text, *Genetics: The Modern Science of Heredity* (Philadelphia: W. B. Saunders, 1956), it would be hard to find somebody more competent and suitable to evaluate Teilhard's work from a scientific point of view. It should be added here that Dodson is a practicing Roman Catholic with a Protestant background and upbringing (see J. A. O'Brien, *Where I Found Christ*, New York: Doubleday, 1950) which might be considered a bias in the opposite direction compared with the earlier Teilhard critics. However, considering the excesses of some of these earlier critics this may just help to restore the balance needed for an objective analysis of Teilhard's work. Dodson certainly does not hide his views on religion behind a scientific cloak, for example in Chapter 14 ("The Christian Phenomenon").

There is no doubt that the book is objective and the judgments well balanced. A good deal of it is solid science, and any college student could use the brief outline of the facts of evolution (Chapters 4 through 10) as a text for an introductory course in evolutionary biology. The objectivity is also shown—and perhaps this is the greatest merit of the book—in that it points out in detail and without hesitation what the author considers the shortcomings of Teilhard's biological concepts. It is a fact that Teilhard accepted Lamarckism (including inheritance of acquired characters) and orthogenesis (evolution in definite directions, as if driven by inner forces) and neglected the synthetic theory (today's neo-Darwinism, i.e., the reconciliation of the concept of natural selection with the facts of Mendelian genetics). Dodson considers this unacceptable and "disturbing," and here he is in full agreement with most of the earlier critics. However, in Chapter 10 ("Some Evolutionary Generalizations," especially in the section "Causal Factors in Evolution") he explains that the Teilhardian synthesis is not necessarily linked to Lamarckism and orthogenesis and can be reconciled with neo-Darwinian concepts. This thesis is, in a sense, the central point of the book and its greatest asset because many scientists who may be otherwise sympathetic to Teilhard's views were often "turned off" by his unorthodox biological viewpoint which they were trained to reject.

Here we are touching a sensitive nerve of today's evolutionary biology. When it comes to the question of what is "acceptable" and what is not, one realizes an increasing tension between the protagonists of the synthetic theory (neo-Darwinism) and those who look further and maintain that there are other mechanisms besides those "approved" by neo-Darwinism which may have contributed to the molding of species (see, for example, M. W. Ho and P. Saunders, eds., *Beyond Neo-Darwinism: An Introduction to the New Evolutionary Paradigm* [London: Academic Press, 1984]). Perhaps a good deal of this growing controversy could be resolved by assuming that evolution had its own evolution and nature might have used different tools at different times and places. It was suggested in *The Mechanism of Evolution: A New Look at Old Ideas*, by M. de I. Wolsky and A. Wolsky (Basel: Karger, 1976) that Darwin's idea of selection for "fitness" might have worked most efficiently and exclusively in the prebiotic era, when chance combinations of chemicals were "selected" according to their potentiality for further macromolecular uses. Obviously, once the genetic mechanism, based on the "information content" of nucleotide chains (DNA and RNA) was established, a new method of organic evolution opened up with many additional consequences and derivations. And much later, with the

appearance of the nervous system's computer capacities, a further, entirely new, behavioral evolutionary mechanism emerged in which the organisms play a leading role over the physical environmental factors ("selection in reverse"). These and similar mechanisms might coexist and cooperate in various combinations and exert different effects on evolutionary processes at different places in different situations. These possibilities should be taken into consideration when discussing the merits and "acceptabilities" of established concepts, like Darwinism (in its updated Mendelian-Darwinian form), Lamarckism, orthogenesis, let alone the today fashionable macroevolutionary (punctualistic) concepts. One simply cannot make absolute judgments, universally applicable to all situations.

However, returning to Dodson's book, it should be emphasized once more that by reconciling Teilhard's ideas with neo-Darwinian orthodoxy, and in general reviewing the Teilhardian concepts with an unbiased and indeed sympathetic, yet strictly scientific, attitude the author has done more than anyone else to make *The Phenomenon of Man* acceptable for readers with scientific rather than philosophical-theological background.

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The Miracle of Existence. By HENRY MARGENAU. Woodbridge, Conn.: Ox Bow Press, 1983. 143 pages. $16.00.

Henry Margenau is professor emeritus of physics and natural philosophy at Yale University. He is a distinguished theorist in both molecular and nuclear physics and has written on such diverse topics as ethics and science, mathematics, and the philosophical foundations of modern science. *The Miracle of Existence* is a sequel to his widely read work, *The Nature of Physical Reality* (New York: McGraw-Hill, 1950; reprinted by Woodbridge, Conn.: Ox Bow Press, 1977), and his more recent book on epistemology coauthored with L. LeShan, *Einstein's Space and Van Gogh's Sky* (New York: Macmillan, 1982).

According to Margenau, this book "attempts a synthesis of science, philosophy, and religion" based on the philosophy of idealism found in G. W. Leibniz, George Berkeley, and Immanuel Kant. Margenau rejects reductionism and materialism which seek to explain life and mind in terms of biology and chemistry and these in terms of prequantum physics (p. 8). Instead, he argues for "transcendence with compatibility," the view that more complex theories contain simpler theories as well as new observables which have no meaning in such simpler theories. Hence Margenau believes that radically novel ideas emerge as science grows so that the concepts of physics, for example, will not be sufficient for "the realm of the living."

Margenau believes that Darwinism cannot account for the directedness of evolution. Rejecting vitalism, Margenau examines various "nonphysical principles" such as homology (Arthur Koestler), epigenetics (C. H. Waddington), and entelechy (H. Driesch). In attempting to move beyond the current

[*Zygon*, vol. 20, no. 3 (September 1985).]
 ISSN 0044-5614

mind/matter ontology in science, he draws on quantum physics in proposing a concept of body as "splitting into an increasing variety of essences that are nonmaterial, highly elusive, incomprehensible to 'common sense,' often incapable of visualization and localization . . ." (p. 39).

The book includes a summary of the scientific methodology Margenau developed in *The Nature of Physical Reality*. According to Margenau the repeatability of sense data leads to a process of "reification" in which the mind creates the external world. Still the continued identity, stability, and cohesion of things are "an aspect of the miracle of existence for which no simple scientific reasoning can account" (p. 50). Margenau suggests that sense data are converted into appropriate concepts by "rules of correspondence" similar to Percy Bridgman's "operational definitions." Scientific laws are subject to verification and are sought according to criteria such as "simplicity (Occam's razor), stability, extensibility, causality, and finally elegance of formulation"—criteria which have evolved through the history of science. Thus science is "the human creation of the external world" (p. 62). The book includes several diagrams which clarify Margenau's epistemology and suggest a rough correspondence between his ideas and those of Karl Popper and John Eccles.

Margenau sees the methodology of psychology, sociology, and economics as clearly "set apart" from that of the more quantitative physical science. Hence a new approach is required which will bring new definitions of consciousness, life, mind, and soul. After identifying mind with consciousness and soul with self, he turns to a key issue of this book: the problem of free will. How can one explain the mind both as controlling and being controlled by the body? Margenau's initial move is to critique a variety of what he considers materialist explanations of mind and will. For example, Margenau rejects arguments from quantum physics which account for free will in terms of the collapse of the state vector, hidden variables, or action at a distance. After surveying a number of other arguments his conclusion is that "present day physics seems to contain no agency directly identifiable with the mind" (p. 87).

Nevertheless Margenau does find the concept of a physical field appealing, given its properties of "immateriality, lack of position, or even spatial confinement, unusual and abstract features that require novel methods of investigation" (p. 97). Examples are gravitational, radiational, nuclear, and probability fields especially as they are used in quantum physics. This leads him to his "first conjecture" that "the concept of mind or consciousness resembles most closely what physicists call a field" (p. 93).

He turns to religion as the subject that seeks to "harmonize knowledge of the external world with the more intricate concerns of the mind" (p. 98). Then he raises the question of God's intervention in nature and in human life and with it the problem of evil. According to Margenau, God created both the world and its laws and has "agreed to adhere" to them. Furthermore, "suffering is mistaken for evil. If man were omniscient he might regard it as good in the full context of all events . . ." (p. 102). Margenau suggests that religion could have the "structure of science" if it were open to "empirical verification." He holds that some Christian views on creation are not disallowed by Big Bang physics. Finally, "some of the miracles reported in the Bible become acceptable as instances of psychic healing" (p. 105).

Margenau's last chapter includes a series of speculations on the existence of a "universal mind," drawing from a rich variety of sources including the thought of Erwin Schroedinger and Carl Jung and such fields as gauge theory, relativity, quantum mechanics, evolution, Vedantic vision, and the Upanishads.

Perhaps, Margenau suggests, "each individual mind is part of God or part of the Universal Mind" (p. 120).

Although the issues Margenau raises are terribly important, for this review only some points can be discussed. I will first examine some philosophical issues, then some scientific issues, and finally some religious issues.

Central to Margenau's philosophy is his rejection of reductionism in general and materialism in particular and his adoption of an idealist versus a realist epistemology. Although I agree with Margenau in finding reductionism unsatisfactory, the position he offers in its stead is fraught with ambiguity.

Margenau frequently defines idealism by contrasting it with "realism, a view that takes things to be in essence as they appear . . ." (p. 1). Yet modern realists would agree with Norwood Hanson, for example, that "all data are theory-laden." Surely the literal realism which Margenau describes is only an historical relic whose resuscitation makes an unworthy foil for Margenau's attack. His "rules of correspondence" provide a critique of naive realism, but do not help in deciding between critical realism or idealism, either of which could include this suggestion.

At a deeper level, his discussion of "sense data" and "compatibility" raises familiar problems which, unfortunately, Margenau tends to ignore. In their move from logical positivism to neopositivism, Bridgman and others found that basing science on something as transient, unrepeatable, and private as sense data led to a blind alley. Instead science should be formulated in terms of statements about repeatable procedures and publicly observable operations. Moreover, Margenau repeatedly characterizes scientific method in terms of "verification" as the prediction of new facts and suggests that "metaphysical principles both precede and are verified by every full-fledged science" (p. 21). One wonders what happened to the thought of Popper, Carl Hempel, Stephen Toulmin, and so many others in this regard. Finally the insistence of Thomas Kuhn and Paul Feyerabend that successive paradigms in science are incommensurable and thus that continuity is in question challenges Margenau's notion that specific theories are subsumed into more general ones by such relationships as compatibility.

Margenau's idealist philosophy is initially attractive, but his repeated rejection of a reality apart from consciousness is unsettling. Without some acknowledgement of an independent physical reality how can one account for the stunning success of empirical, intersubjective science? Though I would want to agree with him in rejecting strict reductionism by underscoring the subjective dimensions of all knowledge, Margenau's thesis would be clearer if he placed it more carefully in the context of the work already underway for decades by philosophers of science.

This book is dotted with statements about science in general, and physics in particular, which raise some significant scientific issues. For example, the relationship between determinism, materialism, and reductionism deserves more attention than Margenau gives it. The definition of terms here is critical. At one point "materialism" is defined as the contention that "all reality consists of matter." This view, he claims, has been discredited. In its stead, radiation was discovered to be "nonmaterial, and when it was later shown to consist of so-called photons, which under many physical conditions are discrete, nobody was allowed to regard them as particles of matter" (p. 22). What does the term *nonmaterial* mean here? Surely not nonphysical, since physics as such still studies the phenomenon of light. Surely not nonmechanical, since electromagnetism, the theory of light, is in several senses a mechanical theory. What about

massless? Granted that light is massless in the sense of having zero rest mass, still the concepts of mass and matter are crucially distinct in physics. And why not "particles of matter"? Given the change in meaning of matter since Isaac Newton and René Descartes, in quantum field theory light comes in packets and is treated on the equal footing with electrons, and with second quantization a wave interpretation is given to particles.

Elsewhere Margenau writes that such things as gravitational fields "are not attached to matter and could never be called material" (p. 87). Yet Albert Einstein's fundamental insight was to tie the gravitational fields to their material sources via the field equations of general relativity, in analogy with Maxwell's coupling of the electromagnetic fields to electric charges.

Margenau favors a probabilistic interpretation of quantum physics: "For electrons . . . there exists at present no theory that could possibly succeed in eliminating the use of probabilities. . . . Probabilities are the ultimate concepts in the theory of electron behavior" (p. 90). Although the standard interpretation of quantum physics is probabilistic, it is for instrumentalist more than for idealist reasons. Furthermore, there do in fact exist alternative interpretations. Here one wishes that Margenau had entered into dialog with the thought of David Bohm and others, whose (admittedly controversial) work on "hidden variables" *does* offer a deterministic approach to quantum phenomena.

Margenau tries to attack reductionism with the notion of "transcendence with compatibility." Aside from its philosophical problems, his examples raise innumerable technical problems. For example, Margenau claims that James Clerk Maxwell's equations are compatible with, but cannot be reduced to, Coulomb's law. Although this is certainly true if one assumes Galilean relativity, Coulomb's law *will* give Maxwell's equations under a Lorentz transformation (i.e., in the context of special relativity). Elsewhere Margenau argues that the Pauli exclusion principle embodies new forms of order at the quantum mechanical level which are only manifest in multibody problems—hence another example of transcendence with compatibility. Yet Pauli's principle, and spin-statistics in general, emerge directly from relativistic quantum mechanics. One could argue that in relativistic quantum mechanics we simply have a more correct theory of the electron.

Margenau's primary theme in this book might be that the mind can be thought of as a nonmaterial field, whose interactions with the brain involve minimal or zero exchange in energy. Yet in physics one expects that all interactions which involve exchange of information require at least a quantum of action (involving energy and time). (Multiparticle configurations described by the Pauli exclusion principle involve neither an exchange of energy nor information.) Hence I do not understand how the mind could causally affect the body (however conceived) without either one gaining or losing energy.

Given Margenau's commitment to overturning a materialistic explanation of mind, I find it highly unsettling that, after searching through an enormous breadth of subjects in the natural sciences for the best analog for the mind, Margenau returns to the notion of a field in physics. Although Margenau tries to talk about this analogy as nonmaterial one might argue that this is a symptom of the very reductionism he wishes to avoid, since field is, after all, a *physical* notion.

Finally, some religious issues must be raised. Margenau's identification of mind and soul renders most of what follows practically undecipherable. For example, by characterizing divine inspiration in terms of ethical values that "prove true in an empirical sense" he seems to reduce religion to a set of ethical

rules. Elsewhere, although Margenau's notion of a "universal mind" is intriguing, he describes it in terms of "Tao, Logos, Brahman, Atman, the Absolute, Mana, Holy Ghost, Weltgeist, or simply God" (p. 106). This formulation conflates too many notions to be really useful given the concrete differences among world religions. For example, is there not more commonality between Taoism and Buddhism, with their naturalistic and psychological dimensions, than between Taoism and Judaism or Taoism and Christianity, where theism is central? In Hinduism Brahman in the final analysis is understood as beyond concepts and images whereas for Christianity the Holy Ghost is the immanent giver of life, the teacher, and the comforter.

In conclusion, *The Miracle of Existence* is significant for the breadth of its topics, spanning many specialized domains of thought and including numerous authors and ideas (in one chapter alone Margenau cites almost two dozen authors!); for the foundational character of the questions it raises and wrestles with; and for the boldness, excitement, and enthusiasm Margenau brings to his work. Its mood shifts from an intense to a playful character; its style varies from an objective report of competing opinions to an energetic defense of the author's views. It proposes to challenge the prevailing materialistic, reductionistic, and deterministic interpretations of science, and it seeks a new synthesis in which science, philosophy, and religion share a vision of reality.

Margenau's distinguished career has produced a number of impressive and widely read works. In this book Margenau attempts something much more speculative and controversial. I applaud such an effort at synthetic work. Although some of Margenau's ideas seem promising, whether the book succeeds in its ambitious purpose is another question. Still to reflect on Margenau's attempt and to argue with it is a worthwhile enterprise.

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The Liberation of Life. By CHARLES BIRCH and JOHN B. COBB. Cambridge and New York: Cambridge University Press, 1985. 353 pages. $17.95 (paper).

It is good news that this book, originally published in 1981 in a very expensive hardcover edition, is now available as a paperback. A scientist and a theologian have collaborated to produce a comprehensive, coherent, and readable volume bringing together ideas from biology and process philosophy. Their basic thesis is that mechanistic models of life are inadequate and that the forms of life at various levels—from cell to community—are more adequately represented by an "ecological" model.

At first sight one might take this to be really two books, six chapters on biology and metaphysics and four chapters on environmental, medical, and social ethics; these sets of topics are usually treated separately. But in fact the book is united by the use of an ecological model throughout. The ethical judgments of the second half are informed by two themes developed in the first half: every being is constituted by its interaction with a larger environment, and all beings are subjects of experience, though there is a very wide range in the richness of their experience.

[*Zygon*, vol. 20, no. 3 (September 1985).]
 ISSN 0044-5614

The early chapters give a fine summary of the current state of molecular biology and evolutionary theory and indicate how these scientific discoveries can be viewed in the perspective of the process philosophy of Alfred North Whitehead. Charles Birch and John B. Cobb agree with Whitehead that even the simplest entities are to be understood as *subjects of experience*. They discuss the ways in which a cell takes account of and responds to its environment. They emphasize that the purposive behavior of birds and animals plays an important role in evolution; the writings of C. H. Waddington and Alister Hardy are cited in describing how new forms of behavior can influence the direction of genetic change. But in the case of lower life forms the scientific evidence for subjectivity is less convincing. Whitehead defended the subjectivity of lower-level entities because he held that basic metaphysical categories must be applicable throughout the range of entities in the world; a similar dedication to intellectual coherence undoubtedly motivates these authors.

The term *ecological* effectively captures many features of process thought. Every being is inseparable from its wider environment. Reality consists of dynamic and interdependent events. Humanity is fully a part of the natural world, both in its evolutionary history and in its present web of relationships. This analysis of evolutionary history allows for both continuity and novelty. Thus subjectivity is said to be present in rudimentary form at all levels of reality, while consciousness represents the emergence of the genuinely new. I would like to have seen further discussion of the relation between continuity and novelty in evolution, as well as some reference to recent work in hierarchy theory which deals with the relations between levels of organization in a living organism. The book gives a running critique of reductionism and mechanism in biology but does not directly consider epistemological issues.

In Chapter 6 the authors suggest that *the principle of Life* (with a capital "L") should be taken as the central religious symbol. They tell us to trust Life as a cosmic power and to see Life as God. Life is the creator, bringing order out of chaos and creating value and freedom. Life, we are told, aims at the realization of value in the richness of experience. It provides a specific purpose for each entity in each moment. Life can be considered personal and even loving because these gifts are tailored to particular needs, even though it appears impersonal in subordinating the individual to the species. Even though suffering and death seem to have the last word, we can look to the future with confidence that Life will achieve some end other than extinction. It can even be trusted to overcome evil, suffering, and death; therefore it can be worshipped unreservedly.

Birch and Cobb include a summary of Whitehead's dipolar concept of God. The reader has been well prepared for what Whitehead calls the Primordial Nature of God, but the Consequent Nature of God has little connection with earlier or subsequent chapters. Both Whitehead's God and an individual organism are capable of having aims, but what does it mean to say that Life as a cosmic principle has aims? The discussion of Life's purposes and aims is not tied in to the earlier discussion of the purposes and aims of individual organisms. Whitehead's God is clearly both immanent and transcendent, as William Christian and much of Cobb's earlier writing have shown; but in what sense is Life transcendent? How does trusting Life differ from trusting the evolutionary process, which Julian Huxley recommends? What are the grounds for confidence that Life can overcome evil, suffering, and death? Is there a leap of faith in asserting that it is a redemptive as well as a creative power?

In more general terms, should we take this part of the book as a form of natural theology built on evolutionary biology and ecology? Or is it a theology of nature arising from a dialogue between science and religion? One thinks of Teilhard de Chardin's Preface to *The Phenomenon of Man*, in which he claims that he deals only with the phenomena and not with metaphysics or theology; yet surely we have to say that Teilhard's religious commitments inform many sections of his book. Is this true also of *The Liberation of Life*? There is little explicit attention given to specifically theological or methodoligical questions. This cannot be attributed to the fact that Birch is professionally a scientist rather than a theologian, since it is clear from his other writings that like Cobb he is a person of unusual religious sensitivity and theological sophistication. Perhaps, as with some of Teilhard's writings, there was an effort here to avoid theological language in order to communicate with scientists and secular readers. Would it be more helpful to view the book as an attempt to elaborate a coherent synthesis of ideas derived from distinct scientific and religious sources, while recognizing that religious ideas can be modified and reinterpreted in the light of scientific ideas, and vice versa?

In the chapters on ethics, the authors show that the goal of enhancing *richness of experience* provides a criterion of judgment which is applicable to a wide variety of ethical choices. In the past, most forms of ethics have taken only human welfare and human rights into account. Albert Schweitzer went to the opposite extreme and ascribed equal value to all forms of life in accordance with the principle of "reverence for life." Some holistic philosophers have followed Aldo Leopold in making the ecosystem the locus of value. For them, human and nonhuman beings are valued in terms of their contribution to the community of life, with no distinctive value attached to human life as such. Birch and Cobb provide a significant alternative to all these positions. The criterion of richness of experience provides grounds for asserting the intrinsic value and the instrumental value of all living things, while at the same time it allows us to make relative judgments when there are conflicts between human and nonhuman interests. Every creature enjoys its own experience and contributes to the experience of others, but in diverse ways. There is no mention here of a theme in Whitehead's writing and in Cobb's other writings: every creature also contributes to God's experience, which provides a perspective on the whole.

The authors apply the same criterion of richness of experience to several issues in medical ethics. It provides justification for removal of life support from a comatose patient who has no prospect for distinctively human experience. It allows for abortion if the mother's future experience is significantly at stake. But are there dangers in concluding that there are differences in the worth of individual human beings because they differ in their intrinsic capacity for rich experience and in their instrumental contribution to the experience of others?

Is this a form of utilitarianism in which the goal is to maximize the total richness of experience rather than total happiness or satisfaction? Such a criterion has the advantage of encouraging respect for present and future life, both human and nonhuman. But it seems to face problems similar to those of classical utilitarianism, including the difficulty in comparing and aggregating diverse kinds of experience, and the need to introduce and justify a separate principle of distributive justice in addition to the principle of maximizing aggregate experiential richness. Do Birch and Cobb provide adequate grounds for the protection of human rights? They do establish clearly that killing a

person is ethically far more serious than killing an animal. But does their willingness to compare the value of differing human lives open the door to abuses? We may judge that a Down's syndrome baby will never have the capacity for real freedom and diversity of experience, and therefore withhold critical surgery. But what about choosing on these comparative grounds which patients should have access to scarce medical resources (such as renal dialysis a few years ago)? Does one then abandon the criterion and rely on a lottery in order to maintain equal opportunity? Are there equal human rights which are more fundamental than differences in capacity for richness of experience?

These authors do in practice express a strong commitment to social justice, even if its theoretical basis is not altogether clear. It leads them to favor preventive medicine rather than costly transplant surgery or expensive high-tech procedures. It leads them to urge the redirection of medical research toward the chronic diseases of poverty and malnutrition which affect the vast majority of the world's population. Concern for justice toward future generations along with an understanding of humanity as part of nature are reflected in their detailed discussions of sustainable agriculture, renewable energy sources, and appropriate rather than large-scale technologies. In all of these areas the ecological model provides many illuminating insights concerning policies in technology, resource planning, and rural and urban development. By the end of the book the authors have presented a powerful vision of a just and sustainable society in an interdependent community of life. It is recommended reading for anyone interested in the intellectual foundations of new attitudes and policies which will contribute to the survival of our threatened planet.

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