

FIVE STEPS IN THE EVOLUTION OF MAN'S KNOWLEDGE OF GOOD AND EVIL

by Ralph Wendell Burhoe

At our Star Island conferences of the Institute on Religion in an Age of Science, for more than a decade we have been wrestling off and on with a scientific approach to understanding right and wrong or good and evil. For the most part we have been asking scientists of various kinds to say what they think their understanding of the scientific pictures of things may imply for human values and religion. At the close of this year's conference, on how man can know right from wrong, I shall try to draw together elements from a number of our papers this year and from past years, as well as from other sources in the sciences, to make what seems to me a coherent picture of man's long history of learning to distinguish good from evil.

First, I wish to assert that the pictures of man and the world, on which we are basing our analysis, are the pictures currently widespread among leaders in various fields of science. These conferences on religion in an age of science have not been based on esoteric fringes of the scientific community but have involved scientists near what might be described as the top center of recent scientific development in several fields. I cite a sampling of publications to designate what I mean by top center of recent scientific mappings of man and his world relevant to our problem of the relation of science to values, a sample which, perhaps, exaggerates a little the frequency of IRAS conference participants.¹

Also, I should note that scientists here have used the terms "good and evil" and "right and wrong" loosely. We have not always reflected the special meaning of these terms in religion and theology, nor have we even been consistent among ourselves. I don't think this makes too much difference in our initial essays to apply the sciences to the prob-

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ZYGON

lems of religion, a task that is so unconventional and difficult that I think we shall be forgiven for some present inconsistencies.

A SCIENTIFIC REVELATION OF PRIMARY OR INTRINSIC VALUE

By and large, I would say that we have all been referring to a single, common, primary value, life, and this in the context of an evolutionary picture on which there is great consensus among us. From this primary value of evolving life, all our other values are derived as means or ways to this end. We all seem agreed that the sciences are a fertile source of revelation of the nature of these secondary values serving viability. Some of us go further to argue that we can not help ourselves in adopting "life" as the primary, or, as the philosophers would say, the "intrinsic," value relative to which other values are "instrumental."

In this evolutionary scheme of life, some of us have limited our notions of human values to those values that emerge only after man emerges from the animal to the human societal and cultural level. But others of us would rather stress the continuity of values through all levels of emerging life, from the events preceding nature's first selection of certain patterns of self-replicating complex molecules to man and beyond to man's successors. Either definition is proper so long as the speaker makes clear the different semantic limits or bounds within which he is using the term. It is perfectly proper to limit the denotation of "human" and "human values" to those aspects of man that emerged only after the date we find for the emergence of *Homo sapiens*. But, as everyone knows, man still has in his genotype a vast heritage whose origins contemporary comparative biochemistry traces back in some cases to the time when yeasts emerged and even beyond.² These genotypic patterns encode and specify basic values of the human being to which, so long as they remain, all subsequently evolved refinements and restructuring of values must conform. Hence such ancient values are still a determinative ground for all contemporary values, even of the highest human cultures. Therefore, I wish to make it clear that I am describing human values in the wider framework of time and events of the cosmos as they are manifest in scientific revelations concerning the total evolution of life on earth. I take this larger frame of reference in order to embrace the scientific revelations that bring us as close as I think we can come to understanding the cosmic source of our "ultimate," "intrinsic," "most sacred," or "religious" values.

I shall describe this revelation of the sciences concerning man's ultimate or intrinsic values simply by pointing to a notion that has

been established only in the past two or three decades since A. I. Oparin³ first suggested the billions of years of molecular evolution leading up to what we now call living forms, and the notion set forth by Erwin Schrödinger⁴ and Norbert Wiener⁵ that this whole process can be distinguished from the world very nicely by the fact that it is a program that runs exactly counter to the general or most probable program of the surrounding environment. That is, evolving life is the growth of organization or order which represents a decrease in entropy in a world that in general operates under the second law of thermodynamics in the direction of increasing entropy or increasing disorder. One must quickly add that life does not violate the second law, but, as Schrödinger pointed out, a living organism has the "astounding gift of concentrating a 'stream of order' on itself and thus escaping the decay into atomic chaos—of 'drinking orderliness' from a suitable environment."⁶

One must also point out that this character of living organisms is the product of a "natural selection" by the environment. As Oparin states, in describing the dynamics of directed chemical evolution of molecular aggregations (including colloidal gels or coazervates), "Of course, the mere gain in dynamic force and the acceleration of chemical reactions within the coazervate could not determine the further evolution of such formations, but the increasing rate of chemical transformation was all the time regulated by a 'natural selection' of newly arising formations. If the increase in the rate of a given reaction so affected the coördination between assimilation and degradation as to promote the latter, such an imperfect system would become mechanically unfitting for further evolution and would perish prematurely."⁷

I would summarize this revelation of the sciences as saying that life is a system of order maintained in an environment that ordinarily decreases order and that the primary direction, goal, or value of life, which was established by the natural selection that is an inherent characteristic of the general environment, is to continue that order or, in the history of evolutionary development, to increase that order. Here I think we have a definition of the primary, intrinsic, or ultimate goal or value of any living system, a definition established by the nature of the cosmos itself in creating living systems. Any act of a living system that violates this primary value simply weeds out that living system. Hence all living systems possess this cardinal or inherent value. One could say that life was created by, and its primary goal or value is forever established by, the nature of the cosmos. The various subsidiary goals or routes to this intrinsic value are legion, but not

ZYGON

infinite. It is the task of all evolving systems of life to explore further routes to this primary goal as challenged by the ever changing circumstances set forth by the environment. To do otherwise is to lose all value as a living system.

The question of how long this primary value of life will be maintained by the cosmos is not clearly settled by the scientific pictures. Some, such as Bertrand Russell or Wiener,⁸ who believe that the total cosmos is forever operating according to the second law of thermodynamics, find themselves compelled to predict the eventual end of life in the heat death of such a cosmos. But these people give no account of the origin of the available energy of the cosmos, and there are related problems that the sciences cannot now or perhaps ever definitively answer. In any case, man finds himself in the midst of this order-building program in a system that appears capable of sustaining itself billions of years into the future, and it seems to me quite enough for our worries and hopes that we live in the confident faith that this is our goal for much farther in the future than we can reasonably see. No doubt at some time, perhaps in a year, perhaps in a million, we will find some better resolution of our role in the distant future of billions of years hence. Meanwhile entropy remains a problem for theodicy.

Anthropologist Anthony F. C. Wallace pointed out at our IRAS conference in 1961, in summarizing the essence of an estimated one hundred thousand varieties of religions in human cultural evolution, that "this dialectic, the 'struggle' (to use an easy metaphor) between entropy and organization, is what religion is all about."⁹ A wide scientific community seems to see this negentropic or order-building goal as the primary good or value of life, running as a common thread from the primitive organic chemicals to the highest religions.

In this paper I wish to bring together in review, for the better understanding of our problem, "how man can know right from wrong," some of the subsidiary mechanisms that operate under this ultimate value of any living system to inform man concerning what is good or right.

FIVE STEPS IN LEARNING RIGHT FROM WRONG

As I see it, the sciences reveal five steps in man's history of learning to know right from wrong and good from evil. These steps represent what in the language of evolutionary theory are called emergent levels of novel systems of life. At these Star Island conferences we have heard many scientists, such as Hudson Hoagland,¹⁰ Harlow Shapley,¹¹ and Oscar Riddle,¹² talk about these emergent forms or new structures

of reality that appear when the lower forms are organized in special ways. I shall outline in brief five major steps in a series of evolutionary emergents, that is, five successive and important ways by which man is able to distinguish right from wrong.

1. *Genotypic knowledge* The first step is genetic learning. Oparin, and Hoagland among others at this conference, have told us about the more than a billion years of genetic learning about what is right if we are to have life. More than three decades ago Walter B. Cannon¹³ wrote of "the wisdom of the body"—describing some of the wonderful bodily mechanisms that carry on billions of operations in each of us in such a complex and elaborate way that no one could consciously operate the system. Present biology strongly suggests that these mechanisms develop as our bodies grow under the guidance of patterns "learned" or "selected" in the phylogeny or development of the human genotype over millions of years. Many scientists at these IRAS conferences—Theodosius Dobzhansky,¹⁴ Alfred Emerson,¹⁵ R. W. Gerard,¹⁶ Hudson Hoagland,¹⁷ A. G. Huntsman,¹⁸ Ashley Montagu,¹⁹ H. A. Murray,²⁰ George Wald,²¹ and others—have told us how our loves, hates, and basic values, are grounded in our genetic heritage. In prehuman animals it is known that the genotype is the primary code that directs sometimes complex co-operative social behavior;²² in man the genotype is only a necessary foundation for moral and social behavior. Robert Morison has pointed out one way that this genetic code for knowing what is good still operates at the human level: "individual self-sacrifice for the good of the community . . . is built into the material roots of his biological system."²³ Cultural anthropologists have joined the biologists in recognizing the genetic code of values as undergirding all human values. Ward Goodenough told us that in goal- or value-directed behavior "the genes provide the foundation."²⁴ Since there are perhaps ten billion "words" in the human genotype, a truly huge encyclopedia of information about what is right and wrong, I have sometimes called this the ten billion commandments in contrast to Moses' ten.

2. *The brain's knowledge* The second great step for discerning good and bad emerged when multicellular animal organisms began to elaborate special cells and organs of cells that we call the central nervous system. Dr. Hoagland also outlined how this new (emerging especially rapidly in the past million years) instrument of knowing good and evil operates.²⁵ While its basic structure is patterned by the genotype, the brain operates at a new level of learning and keeps in its memory not only the wisdom of racial history incorporated in the genotype but also many new pieces of information about what is good and bad,

learned in the development of the individual from birth till death. He pointed out how the RNA molecules, so similar to the DNA letters of the genetic code, may be the alphabet in which the brain's memory is written. And he noted how this instrument of life, of survival—the brain—functions to provide values, to integrate the information fed to it into a hierarchy of values, relating this information to genetically established centers of “pain and pleasure” in the lower brain, which direct our choices so as to maximize the possibilities for life.

This organ in man, with its great freedom to make investigations and choices, brings upon man the terrible burden of the conscious knowledge of good and evil. Some of our IRAS scientists, such as Dobzhansky, have told us how akin this is to the story in Genesis about man's eating from the tree of knowledge and becoming aware of good and evil.²⁶ The social life of the insects is directed almost completely by the genotypic code of right and wrong, their brains being too small to provide for the complex mechanisms of consciousness and culture; and hence insects do not have, nor do they require for their level of life, the knowledge that weighs on the minds of men with the uncertainties and anxieties about the future.²⁷

3. *Culturally transmitted knowledge* The third step in emergent evolution of mechanisms for distinguishing between good and evil appeared only in the past few million years when there evolved a central nervous system complex enough to communicate information or knowledge from one organism to another for many generations without sending it through the genetic language. This occurs to some degree in many—perhaps most—animal species but does not become very significant until we reach the hominids and man. In us the development of the brain and related organs of communication makes possible the transmission of a symbolic code of information not only from parent to child but from maiden aunt to child and from dead men to strangers of another culture and century.

Ward Goodenough has told us how, with the development of social specialization and interdependence, codes of right and wrong developed which, though requiring that the individual give and take on his immediately sensed, genetically structured values of good and bad, tended to optimize both individual and social opportunities for life. The human brain's new ways of learning and new ways of storing information now become part of the machinery for the evolution and storage of social information—information that can be transmitted to the community in seconds instead of centuries. The knowledge of good and bad to be transmitted may be said to have been selected (and

sacralized) by its capacity to promote survival, whether or not the mechanism of selection is consciously perceived. Such knowledge becomes embedded in the "culturetype" (the myths, language, technology, and characteristic social behavior) of the society largely, it may be presumed, because it was sacred for the viability of the society. The culturetype is, then, a joint product of the genotype and the environment, which is fed back to each new generation of the society. The culturetype thus becomes a new source of information, a relatively stable and transmittable "heritage" in addition to the genotype, but with considerable independence from the genotype. Living organisms are the sites where responses to the environment are organized under the heritage of more or less stable information, which has been provided jointly by genotype and culturetype. The waxing and waning of populations with particular characteristics is the "natural selection" of the information heritages which they incarnate. Related notions will be found set forth, not yet in fully harmonious fashion, by scientists whose works I have cited.²⁸

Co-operating with natural selection, cultures also consciously developed new ways of motivating their behavioral codes through socially imposed sanctions, although, as Ward Goodenough pointed out, no cultural code can violate the internal codes of good and evil in each organism established by the genotype. The religious traditions that evolved in different primitive cultures were, like languages, semiconsciously accrued bodies of wisdom with various functions to provide man with courage, hope, fear, and other adaptive attitudes or feelings toward the often invisible forces in his environment, which, like weather, disease, and animals, represented hopes or threats to his felt needs.²⁹

Proper or responsible behavior for the welfare of the more discernible fellowmen seems to have been a later development of religions to facilitate or sanction the individual's acceptance of the established moral codes and to some extent to help formulate or reform the moral code itself for greater viability of the group. (The genetic code of values took care of this earlier.) In most societies most of the moral code is not enforceable to any great extent by police or socially enforced power but is primarily maintained by internalizing the social values in the central nervous system as a conscience or superego, reinforced by religious beliefs and social sanctions.³⁰ As Ward Goodenough indicated, the superpersonal forces, superior to men and called gods, became the source of the sanctions, the hopes and fears, that enforce the moral code.

ZYGON

4. *Rational knowledge* The fourth step in the emergent evolution of new mechanisms for knowing good from evil and right from wrong is a cultural development that is intermediate between the primitive cultural mechanisms of step 3 and the modern sciences which I am calling step 5. This fourth step has been dominant in the higher human civilizations of the past three thousand years. An understanding of the mechanism underlying this fourth step will help us understand some of the virtues and weaknesses of traditional theology and philosophy as guides to knowledge of right and wrong and will also help us to understand the nature of the fifth step, science.

The fourth step may be called logic, reason, or rationality. This arose in large measure by the discovery of the logical powers of language as a means of finding truth and for helping to resolve life's perplexing ambiguities. The Greeks, in our cultural tradition, discovered how the predicting or projecting processes of the brain could, by using as an input the partial model of the events of the world and their relations found symbolically represented in language, compute new truth, test it, and to a remarkable degree "prove" whether it is right or wrong, whether the problem was one of geometry or ethics.

These powers of language originally evolved by a largely unconscious selection in human behavioral patterns. But, when linguistic symbols and rules of usage (grammar, etc.) are used, they provide a newly emergent mechanism for what we call the process of conscious reasoning or rationality. The unconsciously evolved structure of language provides a highly abstracted and useful model of the world evolved in the selection of phenotypic behavior patterns encoded in the memory machinery of the brain. Its structure provides some capacity to deduce new knowledge by operating under its rules. We call this logical deduction. According to some philosophers of science, this is the ground on which modern science is built.

Most of us today are familiar with the grounds of logic. We know that if you can say two things you may have the power to be convinced of the truth of a third and new thing as a consequence. (1) All men are mortal; (2) Socrates is a man; (3) hence Socrates is mortal.

To illustrate the connection between a logically operated symbolic system or language and what we now call science, we can look at that ancient but still largely valid special language we call geometry. The Euclidean geometry was a system of symbols representative of the space of experience and the rules for manipulating them to produce new information. For instance, every high-school graduate knows that the Euclidean language about triangles tells us that, if we can measure

only three parts of a triangle, we can logically deduce the correct or true lengths or angles of three other hitherto unknown parts.

Especially in this area of geometry, the Greeks may be said to have discovered the basic elements of our fifth step, science. From their symbolic models of triangles the Greeks knew how to deduce accurately the width of a river without ever crossing the river. They needed only to measure a length between two points on one side of the river and the angles formed as they made a line of sight from each end of that line to a single point on the other side of the river. A high point in the power of geometric language was the Greek measurement of the circumference of the earth with only a small error, nearly two thousand years before Magellan sailed around it. This they did by measuring the length of the shadows of two sticks at two points along the Nile River in Egypt.

This same logical power of language was used in the development of religious, theological, and moral ideas. The Greek philosophers used the same power of language to develop their ethics, and at the same time the writers and editors of the Old and New Testaments were using it (some say with less rigor of internal coherence than the Greeks but with more effort to test against history or empirical experience) in their development of religious ideas. The early Christian theologians took upon themselves the task of making logical and rational interpretations about the Judaic pictures of God, man, and his salvation to the best of their ability under the canons of logic established by the Greeks. This resulted in a beautiful culmination of rational interpretation of Christian doctrine, such as that by Thomas Aquinas.

5. *Scientific knowledge* Wonderful as were the geometries, philosophies, and theologies growing out of the fourth step, which discovered and refined the logical power of language to understand and anticipate the world of experience, the full power of modern science for vastly increasing man's expansion of knowledge did not emerge until a few centuries ago. The secret of the new sciences, from the time of Copernicus and Galileo, was the discovery that neither the traditional nor intuited premises, implicit or explicit, in a symbolic model of the real world are necessarily true. They are at best rough approximations, and there needs to be, first, some way of testing their validity and, second, some way of inventing a cleaner, purer formulation of the conceptual or symbolic system so that it may better accord with the facts of experience.

The first of these needs is the system of empirical testing. This means careful observation of what actually happens and noting how well it

conforms to the linguistic or other symbolic model or theory. The second of these needs is illustrated by what happened to the Greek or Ptolemaic model of the solar system, which worked very well within the limits of astronomical observation for a long time. But by the time of Copernicus the empirical observations required more and more minor repairs in order to get a good correlation between the theoretical model and the actual events observed. Copernicus imagined (thanks to the brain's capacity to project variant patterns of symbols for summing up the contents of its memory bank of experience) a different model, with the sun instead of the earth as a center for heavenly motions. This is a sort of artistic invention, a new perspective, a new frame of reference, a novel hypothesis about some imaginary, not directly observable machinery or model of the way things are, which then is found to fit the observed facts better.

In summary I should like to emphasize that in each of these five successive ways in which man has come to know right from wrong there is a common feature. At each level in the process of establishing patterns of right behavior, from the variety of relatively random behaviors a few and only a few are selected because they are right or viable. B. F. Skinner brought this to our attention here on Star Island about ten years ago when he told us about the "operant reinforcement"—a "natural selection" of more or less random behavioral responses. Present notions of evolution and development suggest that this process is going on in the "natural selection" of randomly produced inputs into molecular aggregations, of randomly produced inputs or mutations of genotypes, of randomly produced inputs into bisexual recombinations of genetic patterns, of randomly produced inputs of environmental factors impinging on the surface of a living cell, of randomly produced inputs into the patterns in a central nervous system or brain, of randomly produced inputs into the behavioral patterns in primitive cultures, of randomly produced inputs into the logical computers possessed by brains informed or structured by culturally transmitted languages, and of randomly produced inputs (from the scanning of memory banks and sensory inputs) into the structured forebrain of an artist or scientist. This recurrent theme of random trials followed by selection, which I ascribe to all levels of emergence of stable and viable patterns of life, is perhaps not a very clearly documented or accepted scientific generalization, at least not in the sweeping form in which I have presented it. Nevertheless it is to me a very reasonable one, and one that has tremendous value for a theology grounded in the sciences,

for it reveals a common generator and determiner of human and all destiny. (Subsequent to the preparation of this paper, B. F. Skinner has published a paper which shows beautifully the essential functional identity between "natural selection" in the long-term learning of organic species and the "operant conditioning or reinforcement" of short-term learning that goes on as an organism develops from birth to death. This reinforces my generalization by thus linking these two major categories of "learning."³¹)

SCIENCE AND KNOWLEDGE OF GOOD AND EVIL

Today, scientists generally recognize that there is no perfect and final knowledge in the possession of man, and that ultimate truth in a finite knower is an impossibility. What they assert instead is that there are no limits to man's improving his models, his images, his language about the world of reality. For scientists there is the possibility of ever more adequate truth, even if not ultimate truth.

I do not need to labor the fact that the scientific way of learning new truth is the fastest and most effective yet evolved. On this account we can say it is the highest of the five steps of learning or knowing that I have named. It has been doubling the amount of our information in something like every ten or fifteen years. If it keeps on at this rate, in another century we may know one hundred to one thousand times as much as we know now.

I perhaps do need to labor a bit the fact that the scientific kind of increase in knowledge can and must apply to our knowledge of morals, of right and wrong, of good and evil.

As I indicated at the beginning, science suggests that for living systems life is the supreme or intrinsic value for which all other values are instrumental. That life and the instrumental values productive of life are established as values by the cosmos is implicit in the extension of the hypothesis of natural selection back to chemical evolution. The reasonable hypothesis is that the cosmos produced life on earth, and probably on many other earths in a cosmos of billions of galaxies. We have heard Shapley tell this story here: the evolution of life is a natural product of the way things are in the cosmos, from hydrogen and the laws of its behavior.³² And for each living species, from the most primitive, the value of life is established in its genotype by the selective forces of the physics and chemistry of the molecules of the genotype operating in the physics or chemistry of the local environment provided by the cosmos, including, of course, the physics of the other molecules of the

ZYGON

cell, the neighboring cells, and the environing milieu, inanimate and animate.

All species, which have by some error valued something else more than what this nature requires for their continuation, simply have not continued in being. In terms of recent scientific views of life, it is almost tautological to say that if any of these metastable systems of order, living in a disordering environment, fail to integrate all their parts and behaviors to support the maintenance of this order, then they are automatically swallowed up by the surrounding disordering, entropic world, and become void and without form or life. The moment you do not prefer life to death, you die. Here, of course, I am not referring to superficial and sometimes misleading verbal expressions of preference but to the organized activity of the many billions of cells that constitute a living man, even though he inanely declares he prefers death to life. Nor do I refer merely to the life of those billions of cells that constitute the temporary bodily or organic expression of a combined genetic and cultural code of life; for Wald and others here have made clear to us that the higher living systems require the death of the body in order that the genotype may grow to new and higher levels. This germ plasm or genotype is a sort of inner soul of organic life that does not necessarily die as the body or organism does; but in man and other living species it has been in continuous existence and growth for billions of years.

I repeat the fact that most religions have recognized life as the supreme value or good, not excepting the Judaeo-Christian tradition. One of the great commands of the Lord to man in the biblical Genesis is to choose life rather than death. I call your attention also to a religious sect, the Shakers, which held that mortal life for descendants was not sacred, that marriage, sexual intercourse, and children were wrong rather than right. All that remains of any such religion, after one generation of faithful followers passes away, are "fossils" to remind us that they are no more. I once lived in a town where there remained the empty farmhouses and barns of these Shakers whose rules of right and wrong were wrong. I do not mean to say that the dinosaurs and Shakers did not in some way contribute to and perhaps enhance our life. I mean simply that they did not embody the ultimate value of living systems: life. There is only one judge of what is sacred for living beings and that is survival, according to both the scientific and most religious pictures.

Science does more than tell us what is our most sacred value, it tells us how to recognize as yet undiscovered elements of the instrumental

value hierarchy, which reaches its apex in maintaining and increasing life's order, much more acutely than was possible by earlier religions and philosophies. Schrödinger's notion that life is a process that feeds on the entropic or decaying-order process is a definition of the nature of life that will surely prove to be a guide to our intellectual quest for understanding and evaluating the hierarchy of our values. Once there is opened to man the insight that life is his supreme value and that it is defined in the basic laws and events of the universe, then he has indefinite facilities for approaching human values through the sciences.

One of the interesting sidelights provided by this scientific picture of man and his values is that a value is essentially the same thing as information or knowledge. Schrödinger³³ and Wiener³⁴ both pointed out that this anti-entropic evolutionary direction of life or increasing order was mathematically identical with what we call information. It is common today to speak, as Hoagland did, of the information cumulated in the gene pool as defining life. This accumulation of information, from our most primitive ancestors of many million years ago to the present moment, is the incarnation of the basic values of our system of life. Now the dominantly unself-conscious nature of this information should not cause misunderstanding. This scientific use of "information" does not require that information be self-conscious. The higher nervous systems of the most evolved animals and man, which provide a limited self-consciousness, are simply a special case of a general program of increasing information. Consciousness is an emergent phenomenon, as is life itself, in this long evolutionary history of new and better ways to accumulate information or life.

KNOWLEDGE OF GOOD VERSUS GOOD BEHAVIOR

I have suggested that the sciences have emerged as the latest and best way of accumulating information and that information is negentropic like life and the cardinal defining value of life. I, and others at this conference, have shown something of how the sciences reveal or make conscious the values and the value-producing mechanisms of preconscious life. But we have had questions that still bother many of us. Granted that we can have knowledge about values, does this help us in behaving according to these values? St. Paul was not the first or the last to complain that he did that which he knew he should not do and did not do that which he knew he should. It has been suggested that religion is not a matter of knowledge or understanding or information but of feeling. The ethically minded might suggest it is not even

ZYGON

sufficient to say religion is feeling: it must be right or moral behavior or deeds. What do I think the sciences can answer to this problem?

First, let it be noted that in the accumulation of information or wisdom about life in the genotype one cannot separate the information from behavior. The ten billion commandments in the genotype are ordinarily executed to the letter of the law or wisdom for living thus laid down, to every last jot and tittle. The love and mutual concern often sacrificial of life, of the members of the ant colony, who devote themselves, their lives to the various chores of mutual support and duty in the community, are genotypically informed, and values thus informed are so enacted. One could properly say that moral behavior and moral information for ants are the same thing, if one is willing to allow the terms "moral" and "information" to apply to the underlying unconscious mechanisms. And the problem that St. Paul complained of does not exist at this level.

The problem of the distinction between information and behavior is introduced at the level of the central nervous system, as Riddle has told us. The problem is that of having to make choices in situations where it is not always immediately clear which choice is higher in the hierarchy of values impressed upon the brain by the genotype in combination with its learning experience in a human culture. Hoagland and Ward Goodenough have made it clear that in human beings there are hierarchies of values. It is the function of the brain or central nervous system to seek, in the midst of the tremendous amount of complex information and complex value hierarchies present in the patterns of the nervous tissue, the optimum path, the path of most significant value for life. As Wallace told us in 1961, this brain and the religious systems it harbors seek to maximize the good or life and minimize the threats thereto.³⁵

The seeming conflict of values between one particular conscious desire or intent and a different direction in the actual behavior is the result of the fact that we are not conscious of most of the tremendously difficult and complex operations by which we make the choices of optimum value. We are not conscious of all the information involved in the decision process that leads to our actions. The religious problem of evil is revealed in new clarity by this scientific picture of the problems of getting a right answer by means of this machinery we call the brain.

Although the genotypic "moral code," the genotypic code for good behavior, is always followed to the letter of the law, the law in the genotype is not perfect. It is full of errors. As Hoagland pointed out,

about a third of all biological conceptions are not viable. In the genotypic codes, as in human social codes of right and wrong, there is no perfect code. We have heard much about "moral relativism" at this conference. It begins in the genetic stage, and it continues in the stage of the central nervous system, because the input from both genotype and culture contains error. Living systems simply are not fully pre-adapted to all future contingencies. It would seem that we can epitomize the program of life as the unending search for the right code without our ever fully reaching it. This is parallel to our earlier note that scientific knowledge may ever improve without reaching any ultimate or absolute truth. If the failures and inadequacies of the codes of right behavior of any time and place are always with us, to that extent we are always wrong, bad, and evil. And since in evolutionary pictures of life this is the case, we may say that man in this sense is inherently wrong, bad, and evil. One finds this parallel to religious doctrines of original sin.

However, it should be noted that this same process in another perspective is good. If life is the supreme value, it is clear that in this universe it can be obtained only by this unending program of trial and error, which continues to build up higher and higher systems of order or life. In this wider perspective evil becomes the agent of the good, wrong or error the means to the right, and death the source of greater life.³⁶ Hence the sciences may here be providing the basis for a resolution of an ancient religious paradox.

The third and fourth steps of collecting information, including sacred and moral information, were cultural. The third was accumulation of wisdom, which our ancestors came across largely by accident but which, when it provided better adaptation to the conditions of life, was selected to be remembered and transmitted by the symbolic systems of behavior, including language. The fourth step was the more conscious utilization of the logical powers of language.

The transmission systems for these two ways of cultural accumulation of moral wisdom were, by their nature, pretty closely tied to the pain and pleasure mechanisms of the brain. The social conditioning or educating process had been largely successful in tying or conditioning socially transmitted duties, hopes, and fears to the basic motivational system as these were internalized in the brain or, as some might say, in the conscience or in the superego.³⁷

Moreover, the cultural rules for right and wrong seldom conflicted greatly with the less sacred or less moral input of the culture into the brain. As Ward Goodenough pointed out, the transition from the hunt-

ZYGON

ing and gathering stages of life to the agricultural and then to the early urban were accompanied by corresponding changes in the patterns and methods of enforcing right and wrong behavior.

DISINTEGRATION OF VALUE STRUCTURES OF HIGHER CULTURAL LEVELS MEANS DEATH

But since the rise of the extremely rapid methods of gaining new knowledge and creating entirely new circumstances of life, which began with the modern sciences a few centuries ago, there has not been a correspondingly rapid evolution in our value structures and the sanctions therefor. This lag of the moral and religious aspects of culture relative to the general explosion of knowledge and the corresponding explosion of technology, with its radical alterations of the conditions of life, leaves mankind in its most vulnerable condition in perhaps millions of years. Hoagland has pointed this up in the context of the atom bomb, and Ward Goodenough in terms of the conflict of cultures in a suddenly small world which technology has produced.

We are all aware of the fact that the old religious beliefs have evaporated, leaving us with rather feeble religious sanctions for morality. I, and increasing millions of others, cannot accept the revelations of the fourth step of knowledge where they conflict with those of the fifth step. There are many here and elsewhere who have questioned the adequacy of secular sanctions, by government, law, police, or armies. Many have wondered whether there are any objective sanctions or criteria for the validity of any of the plurality of ethical systems of right and wrong.

Relativism or subjective morality carried to the extreme is a defeat of the whole idea of a social code or right and wrong that Ward Goodenough has said is essential for social life; and he is backed by considerable social-science opinion in this.³⁸ Many who have left the churches of the West suppose that there is no problem. Their assumption is often like that of some of the religious liberals who suppose that man is somehow natively endowed with adequate values, and by this they can hardly mean anything other than that the genotype alone, apart from religious beliefs, is a sufficient basis for goodness.

But I think the cultural anthropologists and some other social scientists are backing the convictions of more conservative leaders of religion: that a human society cannot long endure in a state of anomie, in the absence of a more or less coherent culturally transmitted norm or hierarchical system of values. The genotypically transmitted hierarchy of values was not sufficient even for primitive human cultures.

Already then, religious systems provided the cultural supplementations of genetic values necessary to their particular societies. As Ward Goodenough pointed out, the different cultural and religious traditions are variant adaptations, representing different cultural species. They are no more identical or alike than the different species of fish are; but like the fish adaptations they all have to meet certain common problems, such as sex, death, property rights, etc., and each culture or religion represents a viable adaptation under the particular circumstances of the time and place where it has flourished. The cultural anthropologists and sociologists and psychologists have found that, when the central value beliefs represented in religions of a primitive or an advanced society begin to break up, the people at the same time experience an increase in mental and social breakdown until there is a religious revitalization or a conversion to a more adequate religious and moral system.³⁹

But if it be true, as is suggested by many analysts, that the cultures of the various higher religious traditions of the world today are dissolving in the face of the new information revealed by the sciences, and if it also be true that genotypic wisdom is by itself insufficient to generate adequate motivation or structure for human social life in an age of science, where shall we find our authority for values?

I conclude by saying that the sciences as sources of valid information and new revelations are our best hope. They contain the most complete and validated information about the nature of man and about the nature of the realities that created him, sustain him, and determine his destiny. The sciences led me to discard the still widespread twentieth-century supposition that it is not possible to have objective truth about values, about either the cultural moral codes of right and wrong or the organic values produced in the genotype. I have been greatly impressed by the finding of the evolutionary theory of adaptation that there is an external reality with which all creatures must come to terms, an objective reality that imposes our values upon us. In my opinion such a non-human source of values, a superhuman source in that it determines what men shall do rather than vice versa, is equivalent to what the religions have called a god, a god that is now revealed by the sciences as the system of reality upon which our lives are dependent, a reality that is involved in judging by selection, not only our genetic wisdom, but our cultural wisdom. The present scientific picture as I read it says that all life, including human psychological and cultural patterns, is selected by a single system of reality that operates eternally to define what is good or evil for all patterns of life. Today the sciences are our best sources of revelation as to its

nature and its requirements for either genetic or cultural adaptation, and hence for the necessary revisions of our knowledge of right and wrong.

Furthermore, information, whether in the genotype, the primitive brain, primitive religion, rational religion, or the sciences, is tied hand and glove with human feelings and behavior; and we therefore need not fear what many mistakenly believe: that such information is unable to influence our deepest emotions and behavior.

As I said in the beginning, I do not intend to present specific codes of right and wrong or good and evil, only a generalized picture as to where we have gotten them in the past and where I think we are going to get them in the future. I have been trying to answer the general question: how does and how can man know right from wrong?

NOTES

1. (a) Sol Tax (ed.), *Evolution after Darwin* (3 vols.; Chicago: University of Chicago Press, 1960). These volumes contain papers ranging in topic from cosmic and chemical evolution through biological to cultural evolution. (b) Anne Roe and George Gaylord Simpson (eds.), *Behavior and Evolution* (New Haven, Conn.: Yale University Press, 1958). (c) John R. Platt (ed.), *New Views of the Nature of Man* (Chicago: University of Chicago Press, 1965). (d) Harlow Shapley (ed.), *Science Ponders Religion* (New York: Appleton-Century-Crofts, 1960). (e) Hudson Hoagland and Ralph W. Burhoe (eds.), *Evolution and Man's Progress* (New York: Columbia University Press, 1962). (f) Theodosius Dobzhansky, *Mankind Evolving* (New Haven, Conn.: Yale University Press, 1962). (g) Bentley Glass, *Science and Ethical Values* (Chapel Hill: University of North Carolina Press, 1965). (h) D. O. Hebb, *Organization of Behavior* (New York: John Wiley & Sons, 1949). (i) M. F. Ashley Montagu, *The Direction of Human Development* (New York: Harper & Row, 1955). (j) C. H. Waddington, *The Ethical Animal* (New York: Atheneum Publishers, 1961).

2. Cf., e.g., George Wald's statement in *Zygon*, I, No. 1 (March, 1966), 46.

3. Cf. A. I. Oparin, *The Origin of Life* (New York: Macmillan Co., 1938; 2d ed., Dover Publications, 1953). Molecular evolution leading to life and the pioneering work of Oparin were first brought to the attention of this conference in 1954, when George Wald gave a version of a paper, "The Origin of Life," which was published in the *Scientific American* of August, 1954. In the decade following that paper, remarkable progress has been made in clarifying our understanding of the physical forces molding the evolution of molecular structures into living systems and molding the subsequent evolution of life. This will be found reflected in Wald's "The Origins of Life" published in the *Proceedings of the National Academy of Sciences* for August, 1964.

4. Erwin Schrödinger, *What Is Life?* (New York: Doubleday & Co., 1956).

5. Norbert Wiener, *The Human Use of Human Beings* (Boston: Houghton Mifflin, 1950; paperback, New York: Doubleday & Co., 1954).

6. Schrödinger, *op. cit.* (n. 4), p. 75.

7. Oparin, *op. cit.* (n. 3), p. 192; also Hans Gaffron, "The Origin of Life," in Tax (ed.), *op. cit.* (n. 1a), I, 40. I might point out that this broad conception of "natural selection" as the inherent character or law, being revealed by the sciences, of the way things happen in this cosmos, provides for me a rational and consoling attitude toward some of the perplexing problems of man's future. No matter what wild cultural schemes we may devise, no matter even if we establish cybernetic machines that can

exceed all that human societies now can perform, no matter what competing patterns of life may be found elsewhere in the cosmos, we can hypothesize or have faith that, so long as variant or competing trials keep the program open, natural selection will continue to select ever more stable and higher patterns of order or life. We have here the grounds for a scientifically credible concept of a god, or ultimate ground of life, determining all destiny (and hence good), including man's. I am developing such a cosmic theology in other papers.

8. See, e.g., Wiener, *op. cit.* (n. 5), p. 40.
9. Anthony F. C. Wallace, *Religion: An Anthropological View* (New York: Random House, 1966), p. 38.
10. See, e.g., Hudson Hoagland's "Ethology and Ethics—The Biology of Right and Wrong" in this issue, which was also given at this 1965 IRAS conference, and his "The Brain and Crises in Human Values," *Zygon*, I, No. 2 (June, 1966), 140–57.
11. Harlow Shapley, "Life, Hope, and Cosmic Evolution," *Zygon*, I, No. 3 (September, 1966), 275–85.
12. Oscar Riddle, "The Emergence of Good and Evil," in this issue.
13. Walter B. Cannon, *The Wisdom of the Body* (New York: W. W. Norton & Co., 1932).
14. Th. Dobzhansky, "Mankind Consorting with Things Eternal," in Shapley (ed.), *op. cit.* (n. 1d), pp. 117–35.
15. A. E. Emerson, "Dynamic Homeostasis: A Unifying Principle in Organic, Social, and Ethical Evolution," *Scientific Monthly*, LXXVIII, No. 2 (February, 1954), 67–85; his "Human Cultural Evolution and Its Relation to Organic Evolution of Termites," *Termites in the Humid Tropics, Proceedings of the New Delhi Symposium* (Humid Tropics Research) (Paris: UNESCO, 1962); or the briefer treatment on pp. 319–21 of his paper "The Evolution of Adaptation in Population Systems," in Tax (ed.), *op. cit.* (n. 1a), I, 307–48.
16. R. W. Gerard, "Comments on Religion in an Age of Science," in Shapley (ed.), *op. cit.* (n. 1d), p. 89.
17. Hudson Hoagland, "Some Reflections on Science and Religion," in Shapley (ed.), *op. cit.* (n. 1d), p. 27.
18. A. G. Huntsman, "Poised between the Dictates of Nature and a Peculiar Freedom," in Shapley (ed.), *op. cit.* (n. 1d), p. 191.
19. A. Montagu (see n. 1i).
20. H. A. Murray, "Two Versions of Man," in Shapley (ed.), *op. cit.* (n. 1d), p. 159.
21. Wald, *loc. cit.* (n. 2).
22. Emerson, "Human Cultural Evolution and Its Relation to Organic Evolution of Termites" (n. 15), pp. 2–3.
23. R. S. Morison, "Darwinism: Foundation for an Ethical System?" *Zygon*, I, No. 4 (December, 1966), 348.
24. W. Goodenough, "Human Purpose in Life," *Zygon*, I, No. 3 (September, 1966), 218; and also his "Right and Wrong in Human Evolution," in this issue.
25. Hoagland, *op. cit.* (n. 10).
26. Dobzhansky, "Mankind Consorting with Things Eternal" (n. 14), p. 128.
27. Emerson, "Dynamic Homeostasis . . ." (n. 15), p. 70.
28. See the following notes: 1a, b, e, f, g, i, j: 10: 15: 24: see also Julian S. Huxley, "Evolution, Cultural and Biological," in W. Thomas (ed.), *Yearbook of Anthropology* (New York: Wenner-Gren Foundation for Anthropological Research, 1955); Clifford Geertz, "The Impact of the Concept of Culture on the Concept of Man," in Platt (ed.), *op. cit.* (n. 1c), pp. 93–118; Clyde Kluckhohn, "The Scientific Study of Values and Contemporary Civilization," *Zygon*, I, No. 3 (September, 1966), 230–43; Robert S. Morison, "Where is Biology Taking Us?" *Science*, CLV (January 27, 1967), 429–33; this and the paper by Th. Dobzhansky, "Changing Man," *Science*, CLV (January 27, 1967), 409–15, are stimulating papers on this theme that come to my attention as this

ZYGON

issue of *Zygon* goes to press; B. F. Skinner, "The Phylogeny and Ontogeny of Behavior," *Science*, CLIII (September 9, 1966), 1205-13.

29. Emerson, "Dynamic Homeostasis . . ." (n. 15), p. 71.

30. William Ernest Hocking, *The Coming World Civilization* (New York: Harper & Row, 1956), p. 17.

31. Skinner, *op. cit.* (n. 28). This paper also reinforces my next point, about the lack of perfection inherent in man, at the level of behavioral ontogeny or development. The impossibility of perfection at the genetic and phylogenetic level has been clearly made by the geneticists and evolutionary theorists.

32. Harlow Shapley, *Of Stars and Men* (Boston: Beacon Press, 1958).

33. Schrödinger, *op. cit.* (n. 4).

34. Wiener, *op. cit.* (n. 5), pp. 21, 32.

35. Wallace, *op. cit.* (n. 9), p. 38.

36. See, e.g., the following papers in *Zygon*, I, No. 4 (December, 1966): Theodosius Dobzhansky, "An Essay on Religion, Death, and Evolutionary Adaptation," pp. 317-31; Morison, "Darwinism: Foundation for an Ethical System?" pp. 347-53; J. P. Warbasse, "On Life and Death and Immortality," pp. 366-72.

37. B. F. Skinner, "The Design of Cultures," in Hoagland and Burhoe (eds.), *op. cit.* (n. 16), pp. 124-36; Emerson, "Dynamic Homeostasis . . ." (n. 15), p. 67; see also n. 10.

38. See, e.g., the following papers in *Zygon*: Anthony F. C. Wallace, "Rituals: Sacred and Profane," I, No. 1 (March, 1966), 60-81; L. K. Frank, "Man's Changing Image of Himself," I, No. 2 (June, 1966), 158-80; and Kluckhohn, *op. cit.* (n. 28).

39. See Wallace, *Religion: An Anthropological View* (n. 9); Murray, *op. cit.* (n. 20); and Skinner, "The Phylogeny and Ontogeny of Behavior" (n. 28).