

WHAT SPECIFIES THE VALUES OF THE MAN-MADE MAN?

by Ralph Wendell Burhoe

Several factors in twentieth-century thought have tended to break up the established patterns of human values, and it seems that neither tradition, nor theology, nor philosophy, nor all the king's men can put human psyche and society back together again. In the explosive growth and revolutions of the twentieth century it would seem that all the traditional foundations and structures of human life were being broken up.

In no century among the past thousand centuries have conditions of man's life been so radically altered as during the present one. The consequences of these changes for human psyche and society are equally radical. The new ways of viewing man and his world are making many of the cultural sources and traditional formulations of values incredible. The new technologies made possible by the sciences in this century are even converting some of the traditional values into wholly irrelevant and sometimes lethal disvalues. Sex mores and procreation morals are drastically affected by pills and population explosions. Man's ancient value, to labor by the sweat of his brow in collaboration with his fellowmen in order to earn his daily bread, seems increasingly less important as machines and automation take over. But an even greater threat to man's ultimate values looms, sooner or later, in the advance of computer-operated automation. How fast a new cybernated automation will bring it about, in twenty or in two hundred years, is less important than our need to examine and reconstruct our value system. Man must find meaning and sense in a world where, relative to a computer network, man may have as much relevance for providing his daily food as a dog had in the life of a nineteenth-century farm family. If

Ralph Wendell Burhoe, professor of theology and the sciences and director of the Center for Advanced Study in Theology and the Sciences, Meadville/Lombard Theological School, Chicago, presented this paper at the Fifth Conference on Value Inquiry at the State University of New York at Geneseo, April 23-24, 1971: "Values of the Man-made Man." This paper will also appear in a book of the Conference papers published by Gordon & Breach Science Publishers, New York.

computer systems should gradually take over and rapidly evolve to surpass man in the realms of higher levels of thinking and feeling as well as of doing—so as to surpass us as poets, philosophers, statesmen, judges, scientists, or economic planners as well as pilots, bombers, printers, and accountants—what then will be our purposes and our values? There are some computer scientists who foresee this potentiality.¹

At a time when science and scientifically informed technologists are able to provide man with miracles to satisfy his more immediate needs beyond the range even of his highest hopes of a few decades ago, man's sense of his more general or higher values—his sense of ultimate meaning, direction, and duty—has become so fouled up that he has lost the more or less coherent visions of values that for thousands of years enabled him to live within the rather straight and narrow ranges required for the reasonable, satisfactory life of his soul, his society, and his local ecosystem. Just at the time when man is arriving at the point where his scientifically informed technology gives him the miraculous power to change the very nature of the basic genetic and cultural structures of individual or social life, he—or at least an increasing number of sensitive and percipient men—has arrived at a point of anomie, a point of confusion about his goals or values, of what should be, of what life is for. Is it absurd?

Technically, man has recently come into information about how to change or transform himself and his society, his whole way of fulfilling his traditional values. He knows how to make over his world, but the ways in which he refashions it threaten his longer-range welfare in it, and he finds himself with at least as much starving and suffering as ever. Man also knows how to change his own behavior patterns, even the very structures of his being and feeling. But suddenly he finds that he does not know what new designs would make any sense. Exemplifying this anomie, and demonstrating the fact that our traditional values do not very well fit with the transformations we have already brought about by our often unwise use of our scientific technology, is the so-called youth revolution. However, not only today's youth, but also nineteenth-century men like Dostoevsky, Kierkegaard, and Nietzsche were already warning us, perhaps more clearly, about the same general problems.

Any attempts consciously to revise our values to fit with contemporary and future conditions of man will require some understanding of what values are and what in fact specifies and establishes

them. Therefore, this paper will seek to elucidate what it is that specifies or determines the values of man before and after the point in history where, by means of scientific technology, he begins consciously to reshape radically not only his cultural life-style but even his basic biological nature: the man-made man of this conference.

I should indicate that the grounds of my attempt at elucidation are those of the contemporary scientific pictures. I affiliate myself with those philosophers who have called for a greater inclusion of scientifically established information in philosophizing. Ervin Laszlo has charged that "the majority of English and American contemporary philosophers . . . [place] an almost exclusive reliance on direct, everyday information and on the language in which this information is stated. . . . But these assumptions have come to be rejected in the sciences as insufficient and reliance on them as obsolete."² The solution, he suggests, is that the independently accumulated pertinent information can be distilled from the technical superstructure of scientific theories and related to the problems which form the core of philosophical thought. I also share the impatience of those scientists who correspondingly have asserted, like Aharon Kat-chalsky, that, while "on a priori grounds it would seem reasonable to direct our questions regarding foundations for a moral system in a scientific society to the philosophers . . . , experience has, however, discouraged this approach and during the last century there has been a growing tendency to regard science itself as a philosophical foundation for human behavior, a foundation which could provide the dictum for a meaningful, satisfying, and decent life."³

If my *method* to provide answers in axiology from the sciences may be aggravatingly threatening as radically *leftist* from one perspective of many contemporary philosophers and humanists, my *conclusions* may appear to be equally aggravatingly threatening as radically *rightist* from another perspective, for some will suspect that I am attempting to resurrect the God that Nietzsche a century ago declared we had killed, or that I am naïvely accepting a long-since abandoned pre-Kantian and pre-Humean faith in the power of reason and science to reveal human values. You will have to judge how relevant my scientific pictures are for the understanding of human values and how adequately these pictures support my conclusion that it is the eternal and almighty creator and sustainer of life (now revealed more fully by the sciences) that everlastingly determines or specifies man's values at all stages of man's history from times prior to his being a conscious animal until whatever times in the future when our heirs may not only be "post civilized," as

Kenneth Boulding has suggested,⁴ but even “post biological,” as I have suggested.⁵

VALUES DEFINED IN THE CONTEXT OF THE SCIENTIFIC
WORLD VIEW

While the term “values” has many meanings, I shall follow the scientific method of attempting to reduce the ambiguity and confusion by specifying a meaning I intend to utilize. I shall also follow the scientific custom of providing a nonverbal or “objective” referent to which I can point and to which any other man can point and correlate with his nonverbal or “real” or “objective” world of experience. I ask a temporary withholding of their fire from those who will respond: “But values are *subjective*, and hence can’t be discussed objectively.” Words may have many legitimate meanings, and I shall refer to various meanings of the term, but for clarity I shall try to adhere primarily to the following. By “values” I shall mean the ends or goals toward which men tend to move. This you can also discuss or experience privately or subjectively. In all living things we can observe such values, ends, or goals. In plants, biologists often refer to them as tropisms (such as the heliotrope that turns to follow the sun), and in primitive animal forms they are called taxes (e.g., heliotaxis). In more complex living systems, they may be called the norms or values or limits within which the system’s negative feedback or steering mechanisms are established to maintain the system. These are the *norms, ends, goals, or targets* of homeostatic processes or cybernetic mechanisms. In more complex living systems such as human brains and human social systems, we find similar homeostatic or cybernetic functions that maintain the systems within the limits or norms required for their continued life.⁶

I accept the findings of biologists that the goals sought by living organisms are, on the average, goals that fulfill the requirements for the maintenance or enhancement of life; and I accept also the findings that these goals are embodied in the normative settings of the homeostatic or cybernetic mechanisms of the organism, and that these homeostatic mechanisms in general derive from a remembered wisdom or body of information commonly encoded in the DNA which informs or shapes life’s interacting with the particular world found in its habitat.⁷ This habitat, or environment, especially in the human case, includes the cultivated or cultural elements that serve as information that is nongenetically transmitted. This includes the characteristic patterns of the campsite or village, the architecture, tools, gadgets, behavior patterns, noises, music, stories, literatures,

religions, philosophies, technologies, and sciences of the human community. These culturally transmitted patterns, which supplement the genetic information of the DNA, provide templates or guides that shape the formation of human behavior patterns. These cultural patterns are also the selection of a long experience—a selection that has proved itself to be life sustaining.

In short, this definition of values boils down to a set of directions, norms, goals, or specifications for living or life. Life, in this picture, becomes what is sometimes called the ultimate or intrinsic value, or the peak in the hierarchy of a multitude of various subordinate values necessary to accomplish this end.

It should immediately be pointed out that, from the scientific picture, it is not the life of the individual phenotype or organism which is the supreme value, because the biological picture of life is not that simple or “egocentric.” The individual body, extracted from its gene pool of wisdom accumulated in a history of billions of years, or from its pool of cultural wisdom accumulated in a history of millions of years, or from the ecological niche of the world on which it is dependent and to which it is adapted, simply would not exist. The supreme value is obviously not any individual part but the total or ultimate living system.

Moreover, it is easy to show that every individual organism is, statistically speaking, thoroughly imbued with this supreme value of the species over the individual. Each organism is programmed to die within a finite period, and each organism is programmed to procreate new generations and in that procreation to experiment with new variations of the genotypes in the gene pool, that is, to experiment in the creation of new or revised values. In this view, it is shown that our primal, seemingly selfish lusts of the Freudian id are by-products of biological functionings that in reality are primarily altruistic and in the end force us to sacrifice our own bodily welfare and comforts for the far distant welfare of the species in the future. Thus, men, like other animals, are programmed with a value hierarchy, the peak of which we may formulate as the potential advancement of the larger horizon of living systems to higher levels in the future. It is in this larger sense of adaptive potentiality of a total system to life in some longer or ultimate time that the term “life” might be said to represent “ultimate or intrinsic value.” The temporary flourishing of an individual or even a species is known to have values both objectively and internally only because the larger life system has already provided them.

This final or intrinsic human value is one which was not invented

by philosophers nor by any elements of the human community. It is a value which has been given to us by the nature of the ultimate reality which created life and which selects or judges what is good and what is not good for living systems. It is an objectively real, or scientifically verifiable value system, which we may accept and live. If we reject it we simply cease to *be*—whether we be philosophers, scientists, theologians, or whatever kind of men.

All other values of living creatures (men included) are relative to this ultimate value of the evolving system of life. Within each individual man there exist interconnecting nets of values that link his "lower" nature to this ultimate value. In his organism there are millions of simultaneous goals or homeostat settings that are continuously being fulfilled by mechanisms of which we are, for the most part, unconscious, and of which we are only beginning to be conscious through the multifaceted scientific revelations of the nature of man and life. As has already been mentioned, some of these goals or values—encoded in our genotypes and necessarily reflected and elaborated sooner or later in our culturetypes because they are sanctioned or decreed by the same "objective" forces or realities—are altruistic and give us goals that are primarily of service to the total human community even though they often cause us some personal loss and discomfort.

We should mention briefly the relation between "objective" values and "subjective" or "personally felt" values. Here again the new sciences are beginning to clarify the problems that have for centuries properly perplexed philosophers. If, "objectively," life is the primary value, and the life of the individual is an important element in the larger living system of which he is a part, then it is clear that, insofar as his life activities are motivated by his consciously felt or "subjective" desires, to that extent one would expect his "subjective" desires to move him toward those goals or values which are "objectively" or in reality good for his life. That is, he should consciously feel a liking for what his life requires, such as eating and drinking. He should also consciously and naturally feel a dislike or fear for whatever elements in his own nature or his environment might destroy his life, such as getting too tired, too hot, too cool, poisoned, devoured, or otherwise getting into a situation that would be hurtful, disadvantageous, or lethal for him or for the larger life system of which he is a part. And, as a matter of primitive observation much corroborated and elaborated by scientific findings, we do find men are, in fact, thus motivated so that their "inner," "subjective" desires correlate very highly with what is in fact "objectively" good for them, and

their fears and aversions correlate very highly with what is "objectively" bad for their continued life. Here it might be noted that for many scientists this correlation of "subjective" feelings or desires with "objectively" proper or desirable behavior is not surprising because, in their view, the feelings and behaviors of animals and men are molded by their neurophysiological, cybernetic systems whose norms or goals are selected or set by the natural requirements for living systems.

In more primitive living creatures than man, correlations established in the brain between what is good to do and what one likes to do are in large measure programmed prior to birth by the genetic code of values. In man, a rather wide range of behavioral goals or values that are often only roughly shaped by his genetic heritage can and often must be refined or revised by environmental reinforcement programs within very wide limits. The environment which submits to each developing person a pretested schedule of behavioral reinforcements to shape his behavior and attitudes is called a culture. The culture is a memory of information inherited from the experience of other people through channels other than the DNA tapes or records. Culture, in the broad meaning employed by anthropologists, is largely mediated or communicated by a society of people, including not only the immediate family but even strangers from a distant land. It is also mediated in part by artifacts inherited from alien and even extinct cultures, such as the tablets of Hammurabi or Moses or the scrolls of Plato.

Culturetypes, like genotypes, evolve or register the learning of new adaptations to provide new levels of more complex configurations and new ranges of stability or viability for living systems. Cultural learning takes place largely in the learning mechanisms of human brains, although in much cultural learning (e.g., the evolution of languages) there may be little or no conscious awareness of just what is taking place. But, especially in higher cultures, much of the record or memory is also codified outside of brains in artifacts, including books.

Here I would point to the growing understanding of the last few decades that human culturetypes are as much a piece of the evolutionary scheme as are human genotypes. Cultures are systems of information that have been selected and preserved because they have met what the nature of their circumstances has required. The same system of reality that selects the shapes of fish and birds also selects the shapes of boats and airplanes. While the encoding and

transmission of the information on how to make a good bird's wing may be quite different from the mechanisms that encode and transmit the information on how to make a successful flying machine, in principle the general functions are analogous. Existing patterns or codes are varied sometimes by "pure chance" and sometimes by a partially random but circumscribed and partially informed "search," and certain of these variations do, in fact, get selected by the same system of forces—the actual aerodynamic and energy conditions—simply because under the circumstances they work better to fulfill the needs and hence the viability or continued existence of the living system which possesses them. The living system may be a population of insects, birds, mammals, or airplane manufacturers. The same aerodynamic realities operate to shape their patterns. It is interesting to note that bats and moths, before men, "invented" sonar devices for purposes of navigation, attack, and defense.⁸

A mistaken view of cultural evolution that appeared in the last part of the nineteenth century, following Darwin's *Origin of the Species* in 1859, led to a reaction, and in the United States during the first half of the twentieth century there was little development of evolutionary theories of sociocultural phenomena, except perhaps in the realm of linguistics and certain Marxist anthropology. A good review and analysis of recent ideas was published by Donald T. Campbell in his "Variation and Selective Retention in Socio-Cultural Evolution."⁹ There are also some developing notions of how behavioral traits are transmitted, and psychologist B. F. Skinner¹⁰ has pointed out that learning by behavioral reinforcement schedules is a "natural selection" process. My point here is not to develop a theory of sociocultural evolution or of individual ontogeny under natural selection, but simply to say that there are scientific grounds for supposing that values, goals, attitudes, and preferences are factual, objective, scientifically investigatable processes or patterns of living systems, developed under nature's laws regardless of whether they are derived from genotypes or culturetypes or the accidents in the development of a particular individual in a particular ecosystem.

Genetic learning has, in the past, taken place much more slowly and expensively than cultural learning. Here, the elimination of the bad bets in the evolutionary game of chance is accomplished by nature's massive weeding out the great majority of trials of new organic patterns, most of which turn out to be unworkable.

One can generalize from the picture of human life's necessity to evolve genetically and culturally that, in addition to ensuring the

preservation of the information in the human genetic and cultural pools through propagation, the next most important goal or value of human individuals is to enrich the potentialities of these pools.

In both pools, the first value is simply preservation (which necessarily involves transmission to the next generation) of the bulk of what has been learned. Thus, for humans, one can say for this reason that parenthood and teaching are prime values. But, one can read from the evolutionary history of both genetic and cultural information another value, and that is new learning—the discovery of new and potentially better patterns. All creatures have a built-in mechanism to ensure that they try novel patterns, that they explore; and man is not exempt either at the genetic or at the cultural level even when he is not cognizant of what he is doing. “Exploration”—even at the cost of suffering, pain, and widespread failure—is demanded of all.

Sexual procreation is a fundamental illustration of the primacy of both of these values of living systems—(1) conservation or replication and (2) exploration or novelty. Sexual procreation is genetically and organically motivated at the conscious level of directing behavior by anticipations and feelings of ecstatic pleasure. Most of us engage in it, even though we may come to understand it is inherently accompanied by a large portion of failure, suffering, and pain. What is being made clearer and more rational by the new scientific pictures, even clearer than by some of the ingenious religious images of two or three thousand years ago, is the underlying sense, necessity, and exact purpose or function of these otherwise paradoxical mixtures of ecstasy and suffering in the pursuit of fundamental values. And the new views can, like the older traditional myths, provide us with a sense of worth, wisdom, and courage in the midst of suffering, defeat, and despair.

SOME CONCLUSIONS CONCERNING HUMAN VALUES AS FACTS
THAT MAY BE STUDIED BY THE SCIENCES

As I have indicated, an integrated hierarchy of innumerable human values is embodied, incarnate in the flesh, in the midst of every cell of the flesh so far as the genotypic code of life's values is concerned, and also in the midst of the switching programs of every brain so far as the cultural codes of life's values are concerned. The cultural codes may also be abstracted in artifacts, such as books. There are negative-feedback mechanisms in genotypes, in brains, in various levels of social systems, and in total societies and ecosystems that operate on the same general principle as that by which a thermostat

maintains certain values for room temperature. The existing patterns of genotypes and culturetypes set the basic norms for how we speak, how we pronounce our words and what words we use, as well as how we get our bread, the proper ways for us to value and to respond to innumerable elements of our physical, biological, social world. We successfully modify only a tiny fraction of this indispensable heritage of norms. These are the ways in which our "subjective" preferences or values are structured. Our aesthetic as well as our moral tastes and preferences are equally interpretable as the products of physical interactions between us and our environment under the guidance of existing boundary conditions established by molecular information, structures encoded in the memory stores of the cybernetic machinery of the brain produced by genetic and cultural inputs. The memory stores provide the grounds on which judgments are made, whether these be judgments of good or bad—pleasing or displeasing—in response to a smell, sound, a taste, a person, a policy, or a possible action. According to such a picture, which is being documented in tremendous detail by recent scientific work, human values—even human "subjective" tastes or preferences—are the product of "objective," demonstrable, cybernetic systems whose norms constitute our values. For persons not familiar with the scientific literature, a quick picture of this kind of scientific evidence concerning the nature of man and his values can be found in a paper entitled "Science and Human Values," by José M. R. Delgado.¹¹

That these values, although they are objective facts, are not to be conceived of as immutable for all time is clear. They are a part of the evolving patterns of evolving life systems. In such systems, what has been a value (a necessary norm for life) at one stage may or may not be at a later stage. But, for the theoretician, this evolutionary perspective on values does give a touchstone for some fairly long-range or possibly universal value theory. Certain statements can be made that are quite invariant or universal. For instance, since the fact is that there is evolving life in the cosmos, and since systems of life are interdependent systems related to and dependent upon their proper adaptation to the larger ecosystem of which they are a part, then if one finds some relatively invariant formulations of such adaptations, one might make some fairly useful generalizations about various levels of subsidiary values under as yet unattained but possible or probable circumstances.

A proper question to be raised by priests, prophets, and philosophers is whether the values of a particular society or a particular

individual are better values or worse. The ranking of values in some scale or hierarchy of better and worse, of course, depends on the existence of some given ultimate value or end in terms of which all subsidiary or instrumental values may be judged. We have indicated above how we may, for most purposes at least, judge values in terms of whether they build or destroy some cosmic program of evolving life which we can at least roughly discern and utilize. About those who insist that they do not accept life as the ultimate value we do not need to worry. By trying to live any pattern that does not in fact meet the requirements for life, they automatically eliminate themselves and their followers from any effectiveness or from any reality of being in the future history of life, except perhaps in someone's memory as examples of lethally bad values.

For all those who choose to seek life and not death, some question as to which values are better or worse remains ever a very central and live question. Sometimes we set a thermostat too high or too low. Sometimes we are born with maladaptive genes. Sometimes we have learned the wrong way to go. Corrections are ultimately made by the sovereign reality or nature of the cosmos, which from our scientific pictures seems to rule that most novel explorations (especially random ones) are wrong for living systems. This nature of things then proceeds to eliminate those which do not work and thus selects those that are ordained to be.

But men and human cultures have been graced with the exciting privilege and the necessary sorrows of joining consciously in this search to learn to distinguish and to espouse or love better values, better patterns of life. The first and most important lesson for us here is to know that it is not our will or wish but the requirements of the ultimate reality which is the final judge. Hence, our task is to seek to know the "objective" facts of life. This wisdom of an objective reality which is the ultimate criterion for human values is known both in certain traditional religious communities as well as in scientific communities. But it is often unknown in many contemporary humanistic cultures. Insofar as these latter elements of our population or culture—where there is no conscious recognition of the objective reality that determines values—survive, they may give thanks to the operation of their unconscious mechanisms which carry them along in spite of their ignorance.

It should be clear that for humans there is a fatal danger in retreating too far from the existing culture and falling back toward sole reliance on genetic information to provide the norms or values for living. Scientists have learned that man is probably no longer

viable apart from a culture. Like the corn seed he has selected and cultivated for food, his own genotype has for so long been adapted to and selected as a part of viable cultures that the human organism is no longer viable in the wild state. Yet, there are a number of youthful revolutionaries making a big noise these days to the effect that *cultura delenda est*—which is an inverted parody from a forgotten culture for “the establishment must go.” They are obviously ignorant that they are threatening to cut the rope that holds them or their children from falling into the abyss of nonbeing.

But, certainly, the youth are right in being dissatisfied with serious troubles they correctly sense in our present culture. Certainly the established norms or goals of evolving societies and species must change to adapt to new requirements in time, or else our culture and perhaps our species will perish. The sciences provide us with some views of how it is that the cybernetic or goal mechanisms have in the past been successfully mutated or changed in ways that provide better patterns of life. I suggest it will pay us to look at them in our search for some guidelines to our task, which seems to be that of being conscious agents in the further programs of evolving life on earth.

However, since the purpose of this paper is primarily to show what it is that specifies values, and in particular the values of the man-made man, I shall not here get much involved with the details of the wisdom for the conscious and systematic discovering of positive values—the good—nor shall I try to specify the details actually found of this wisdom. I shall primarily point out why *the validity of our conscious beliefs* about what is of value is critical in determining whether our consciously directed behavior will have any value, and I shall point out why the sciences are a rich source for validation of our belief system about those facts concerning ultimate goals or intrinsic values.

ON THE DETERMINER OF VALUES

For more than a century the biologists have had a very useful doctrine of what specifies the values or norms of the various species of life: “Natural selection” is its name.

Earlier, the determiner of values was called God, the sovereign lord of the world. But, by the nineteenth century, the differences between the traditional concepts of God and the newer concepts of the *nature of reality* or the *reality of nature* made it important to call what Darwin was finding to be the specifier of specific values by the name “natural selection” instead of “divine judgment.” But the fun-

damental proposition was not really changed, for *selection* is a *judgment* imposed by some reality on either random or nonrandom variations of life patterns.

By the middle of the twentieth century some of the evolutionary theorists were bypassing even the implications of the terms "nature" and "selection" and were saying that what we mean by natural selection or fitness is simply the number of offspring—never mind the particular forces of nature which are involved and let us forget about adaptiveness or fitness as a selection or judgment of behavioral adequacy by the nature of the actual circumstances or environment.¹² This was a useful trend for the development of certain important mathematical formulations of genetics and neo-Darwinian theory that seemed to be threatened by some earlier commonsense interpretations.

However, at the same time that in genetic theory "nature's judgment" was being suppressed to highlight some empirical, numerical facts, the evolutionists (sometimes, paradoxically, the same men who defined fitness in terms merely of number of offspring) were pointing out that evolution is no accident.¹³ While they affirmed that the variations or mutations that made possible the novel phenotypes are properly called accidental or random, the actual form selected was no accident at all, but a peculiarly significant fulfillment of some requirement prescribed by nature. From this alone, the new biological picture of evolution takes us away from the sometimes insufferable conclusions that man is a mere accident in the cosmos and that his values must exist in combating the cosmos, views sometimes voiced by such intelligent evolutionists as Sir Julian Huxley.

But in recent decades an even more powerful picture of the ultimate realities of nature as selector and determiner of the evolving patterns of life is coming out of the physical science pictures of life. Ever since the early work of Oparin nearly a half-century ago on the prebiological evolution of chemical structures up to the state of living cells, there has followed an increasing accumulation of evidence of the creation of life by the very nature of the cosmos and its dynamics or history. Scientists of all kinds have been involved, including astronomers, physicists, and chemists as well as biologists proper. Since this picture is a powerful help in understanding that human values are facts determined by the ultimate nature of the cosmos, I shall mention some implications of two recent papers.

First, I bring your attention to a paper by Aharon Katchalsky of the Weizmann Institute entitled "Thermodynamics of Flow and Biological Organization."¹⁴ In it he summarizes evidence concerning the

thermodynamics of physical systems that "coupled nonlinear flows far from equilibrium may lead to . . . the formation of new . . . dynamic structures" akin to those constituting living organisms. I. Prigogine¹⁵ of Brussels has called these systems or structures, which are stable in ranges far from equilibrium, "dissipative structures" because they are patterns that depend on flows dissipating an energy source.

Katchalsky says:

There are several striking similarities between dissipative structures and living systems. The very fact that the spatial organization of a dissipative structure is based on the interaction of coupled flows suggests that it is an elementary case of the biological identity between function and organization, in which function is not the product of structure but is another expression of living texture. Moreover, the phenomenon of life is maintained on energy input, and dissipation accompanies every aspect of active maintenance. It should be realized that, beneath the dynamic organization of cells, there exists in addition the hidden framework of a permanent structural setup. It is well known for instance that bacterial cells may be desiccated under the condition of high vacuum and liquid-air temperature to a dry lyophilized powder. The bacterial powder has no metabolic activity and is dead to all intents and purposes, except that when water is added and the temperature is raised, the cells revive and begin to metabolize and reproduce. Living cells are therefore not only loose dissipative structures in the continuous medium of a test tube, but a *dynamic pattern* superimposed on a *fixed network*, the organization of which is dictated by the genetic code. Thus, the flow structures of cells are confined to preordained limits which represent the evolutionary history of the species.

Within these limits, however, the characteristics of dissipative organization are clearly discernible. . . .

It is interesting to speculate whether the jump from a lower to a higher level of organization across a range of instability can be assumed to be basic to biological evolution also. Thus, the accumulation of micromutations within a species, as the accumulation of mistakes in an individual organism, is generally insufficient to shift a species from one level to another. The evolution of species seems to be a sequence of larger jumps in a discontinuous spectrum similar to the transition spectrum of dissipative structures. Thus, the accumulation of micromutations would act as a destabilizing factor which disturbs the fine balance of the flow process, creating a tension within an existing flow pattern and, when stability is fully undermined, leading to a finite jump to a new organizational set up; to use the expression of J. Bronowski in a recent article, life comprises hidden strata of stability, one above the other, and the evolutionary process consists in the climbing up the strata one by one.¹⁶

The Bronowski¹⁷ article referred to is one in which another physical scientist clarifies a similar interpretation of living forms and behaviors as phenomena that derive naturally from the physical

nature of the world and who makes plausible the view that the values of all living creatures are specified by the realities of nature. Bronowski presents a key concept for understanding the evolution of living systems: stratified stability. He says a number of things that are very similar to those just mentioned from Katchalsky's paper, but he goes on to generalize from the findings of physics that there is a natural, hierarchical sequence of levels of structure arising from the fact that the particles that compose atoms just naturally fall into certain stable configurations to give rise to the periodic table of atoms; and similarly that the hundred or so kinds of atoms themselves constitute a new level of particles which are so structured that by their nature they find stable associations only in certain kinds of molecular structures, and so on up the ladder of levels of structures. We have the facts that it does happen and we have some understanding of how or why it happens that certain simple units come together to make more complex configurations, and how these configurations, if they are stable, serve as units to make higher-level configurations, and so on. "Ultimately," he says, "a heavy atom such as iron, and perhaps even a complex molecule containing iron (such as hemoglobin), simply fixes and expresses the potential of stability which lay hidden in the primitive building blocks of cosmic hydrogen."

Bronowski goes on to say that:

The sequence of building up stratified stability is also clear in living forms. Atoms build the four base molecules, thymine and adenine, cytosine and guanine, which are very stable configurations. The bases are built into the nucleic acids, which are remarkably stable in their turn. And the genes are stable structures formed from the nucleic acids, and so on to the subunits of a protein, to the proteins themselves, to the enzymes, and step by step to the complete cell. The cell is so stable as a topological structure in space and time that it can live as a self-contained unit. Still the cells in their turn build up the different organs which appear as stable structures in the higher organisms, arranged in different and more and more complex forms.¹⁸

He points out why the stratification of stability in nature, which is empirically known and partially accounted for by theory, is fundamental in living systems, and explains why evolution has a consistent direction in time:

But the building up of stable configurations does have a direction, the more complex stratum built on the next lower, which cannot be reversed in general. . . . Here is the barb which evolution gives to time; it does not make it go forward, but it prevents it from running backward. The back mutations which occur cannot reverse it in general because they do not fit into the level of stability which the system has reached: even though they might offer an

individual advantage to natural selection, they damage the organization of the system as a whole and make it unstable. Because stability is stratified, evolution is open, and necessarily creates more and more complex forms.

There is therefore a peculiar irony in the vitalist claim that *the progress of evolution from simple to complex* cannot be the work of chance. On the contrary, as we see, exactly this is *how chance works, and is constrained to work by its nature*. The total potential of stability that is hidden in matter can only be evoked in steps, each higher layer resting on the layer below it. The stable units that compose one layer are the raw material for random encounters which will produce higher configurations, some of which will chance to be stable. So long as there remains a potential of stability which has not become actual, there is no other way for chance to go.¹⁹

Bronowski even clarifies the fascinating question of how it is that living systems seem to move in a direction counter to that prescribed by the second law of thermodynamics toward increasing levels of order.

The Second Law describes the statistics of a system around equilibrium whose configurations are all equal, and it makes the obvious remark that chance can only make such a system fluctuate around its average. There are no stable states in such a system, and there is therefore no stratum that can establish itself; the system stays around its average only by a principle of indifference, because numerically the most configurations are bunched around the average.

But if there are hidden relations in the system on the way to equilibrium which cause some configurations to be stable, the statistics are changed. The preferred configurations may be unimaginably rare; nevertheless, they present another level around which the system can bunch, and there is now a countercurrent or tug-of-war within the system between this level and the average. Since the average has no inherent stability, the preferred stable configuration will capture members of the system often enough to change the distribution; and, in the end, the system will be established at this level as a new average. In this way, local systems of a fair size can climb up from one level of stability to the next, even though the configuration at the higher level is rare. When the higher level becomes the new average, the climb is repeated to the next higher level of stability; and so on up the ladder of strata. . . .

When there are hidden strata of stability, one above another, as there are in our universe, it follows that the direction of time is given by the evolutionary process that climbs them one by one.²⁰

I add to this picture of Bronowski my suggestion that "Bronowski, in his concept of 'stratified stability' has at last given a neat physical formulation that underlies all levels of the selective or adaptive process in evolution from atoms to human cultural patterns."²¹ In short, this picture of nature gives us a new and clearer picture that what it is that selects the viable patterns of form and behavior that constitute life—what it is that specifies the values, aims, or goals of

all living systems—is the same cosmic reality that is our environment, our ultimate ecosystem, an evolving multileveled pattern of living and nonliving subsystems whose ordered and necessary outcomes—even when chance was used as an agency—brought forth life on earth, including *Homo* and his highest cultural values.

From the pictures now being painted for us by such men as Bronowski and Katchalsky, we can see that the connections between the sciences of life and the sciences of the nonliving world are growing in detail and clarity. And if this interconnection is equally true for the inquiries or sciences that deal with those aspects of life which we call psychological and sociocultural, as I think is ever becoming clearer, then I think it very reasonable to conclude that the values of *Homo sapiens* are latent within the hidden relations inherent in the primordial universe that select or establish the configurations of stability or viability as we come to walk our hour upon the stage of life and play our role in the evolution of life in the cosmos.

In short, the goal of all life, including the man-made aspects of human life, is perforce the ascending of the ladder of the strata of stability. The next steps above us on this ladder are always in the clouds beyond our full vision. In the twentieth century, man is being shown for the first time some pictures of the steps far below him on this ladder, thanks to the long-range history of cosmic evolution whose writing is made possible by physics and biology, and thanks also to the equally recent anthropological and psychosocial pictures of cultural evolution and individual development. Our already attained values are those “objectively” real, incarnated structures in our genotypes and culturetypes, those patterns of organized stability which have already been attained or selected by the very nature of the cosmos which created us, which do inform us of what we must do to have life. Our values of the future toward which we climb are the as yet unrevealed and undiscovered possibilities for evolutionary advancement, the potential or future steps on the ladder of life and time. Even though we have not yet come to know or experience these future values, we can suppose they are there, that they are real, that they will come to pass, for this is what the history of the last billion years suggests very clearly. This historical picture also enables us to understand why we do not fully understand just what the future values are, why it is we must inevitably grope, gamble, and suffer in the mists of our ascent to reach new levels of values.

This picture I am painting here of the ultimate goals or values of man, collectively or individually, is one that has been painted before

in the symbols and images of the great religions. If we were to rest content to relate the new scientific pictures simply to the Judeo-Christian tradition of our Western culture, we might well say that the determiner of human values is the same as the creator of all things—the invisible, immutable, omnipotent reality that judges every event and every act of every man and every living and nonliving thing. This total reality not only supplies the flow of energy from whose dissipation our dynamic structures are given life, but also supplies the preferred configurations—often hidden, sometimes revealed, but always real steps in a long-lasting if not everlasting ladder of ascent to which we may aspire and devote our activities.

I think if we turn to these newer and fuller pictures of the reality that is man and the reality which created and reigns over his history, we need not find ourselves alienated from the world pictured by the sciences. On the contrary, in those pictures we shall find guidance for better appreciating the values already given to us, and also for what is expected of us in the everlasting quest for ever new values to which we have been ordained.

If this scientific picture of human destiny is acceptable, it seems to me that many of the traditional problems of axiology with which the great philosophers and religious traditions have long wrestled become much more resolvable.

WHAT SPECIFIES THE VALUES OF THE MAN-MADE MAN?

But even if we grant scientific confirmation that a sovereign nature specified the values of man in the past, is it necessarily true that this is what will specify the values of the man-made man in the future?

In an emerging scientific picture, we have seen that what has specified the values that man possesses is the process of natural selection or the natural evolutionary sequence of the viable or stable systems. If Bronowski's interpretation is right, that the evolution of living systems and their gradual climb up a ladder toward increasingly complex configurations of stability is achieved because the natural world is full of preferred configurations or hidden stabilities which ordain or select the program of evolution, then we have an objective picture of the cause or source that does in fact specify not only the values that already exist in man but all future values that man may discover for himself or for the larger living system of which he is a part, including anything man may seek to make.

We need look only briefly at two classes of major concern. The first class is the huge one of all the arts by which man can alter his own character. The class includes the new potentialities of genetic

engineering as well as the new potentialities of drugs and psychological "brain washing," and the potentialities of change and control of men by new technologies, including those of war and police states.

I can very quickly suggest that by all the new technological powers to alter human behavior nothing is changed so far as the ultimate judgment or specification of human values is concerned. The new technologies add nothing to the picture of the past century or the past hundred centuries in the operations of natural selection or the findings of stable or viable configurations or patterns of life. In other words, there is still an objective reality system, an ecosystem, in which there exists all the latent or hidden preferences which any system of being whatsoever must discover and to which it must adapt if it is to remain in being very long.

Another way of saying this same thing is to point out that man's technological powers are successful to the extent that his technology is informed by a correct model of what in fact the universe or the ultimate ecosystem will permit in conjunction with what his technology seeks to accomplish. The successes of technologies for flying to the moon and for changing human personality or society are equally dependent upon not what men wish to do so much as upon whether what men actually do is, under the circumstances, that which is required for success. This requirement is not what man wishes, but is what is ordained by a system of power that so transcends man's present wishes that man has no real power at all apart from his conformity to or adaptation of that very real, objective, and, in the end, unalterable requirement. You cannot make water out of hydrogen and sulphur, you must use hydrogen and oxygen; and the picture we have been presenting—shared by many scientists—suggests that similar requirements exist all the way from cells to high human civilization.

For the ultimate achievement of what nature ordains (or we could use old-fashioned terms like "kingdom of God"), man does not need to fear the errors or even the maliciousness of his fellowman. Nothing can prevail against the immutable, ultimate requirements of reality, if the scientists who presume this are right. The *errors* of men *select themselves out* of the picture of what is stable or viable. The movements or causes of tyrants and despots ultimately fail if they are in fact wrong. And the ways of "righteousness," no matter how few and feeble be the men who originally hit upon them, will triumph, for they are the preferred configurations latent in and ultimately ordained by the all-powerful scheme of things.

This does not mean that men can sit back and wait for "the Lord" to bring about his kingdom without their aid, for it also seems ordained in the scheme of things that men necessarily are agencies of this process, often, or even largely, relatively blindly gambling and necessarily suffering agents. One of our prime problems in contemporary culture is to continue to keep our psychological and educational inputs that shape our motivation at least as relevant for current conditions as was our earlier genetic programming of motivation (values) for conditions then. This means continuing the suitable and correct (factually real) provisions for hope and joy for doing what is right and necessary for the stage of life in which we find ourselves in accord with the requirements set by the objective reality.

But there is a second area of scientific technology that may seem to pose an even greater threat to man than the possible abuses of man's powers to alter his own nature. This is man's new power to create a system of life that may soon transcend human powers more than man's present powers of life transcend those of a monkey, a worm, or a bacterium. Instead of "man-made man" we are now talking about "man-made superlife." This new form of life is very different and strange. It is not even a part of the system of amino-acid and ribonucleic-acid chemistry on which all successful life on earth so far has been built. I am speaking of the new cybernetic systems we recently have been building out of pieces of wire and other nonbiological chemicals: computer-operated cybernetic machinery. At present we are designing their values and hence their activities. Their values are values that we, the technicians, want. Hence they seem harmless at worst, and supportive to our values at their best.

But computers are understood by some advanced scientific pictures to be a new kingdom of living systems which may very soon if not already have capacities to evolve independently of man. They are capable of being programmed by a nonhuman or larger "natural" selection; and capable of evolving very fast compared to men.²²

Let us then turn to examine the source or specifier of values in the most extreme case of man's manufacture of novel kinds of superhuman or transhuman living systems. Let us in our imagination go with the Swedish Nobel Prize-winning physicist Hannes Alfvén to contemplate his *Tale of the Big Computer: A Vision*.²³ Let us suppose that human fears and confusions do not get in the way of a rather natural technological evolution in which men come within the next few decades to live symbiotically with newly and rapidly evol-

ing species of what we may call the Servomechanism Kingdom in contrast to the Animal, Plant, or Biological Kingdom of Life. Let us suppose with Alfvén and others that computers soon come to surpass man in their moral sensitivity and faithfulness to duty.

What can we say about the values and morals of computers? One thing we can clearly affirm, if the foregoing picture of the relationship of evolving systems in the natural world is true, and that is that computers, like all else, are subject to the same sovereign power and control that has ruled all evolution thus far. They will have to conform to what the actual realities of the world require for stability or viability of a living system under the particular habitat or in the particular ecological niche in which they find themselves.

Whatever man may make for his own environment, in his own manipulation of his culture, or of his genetic system, or of new patterns of nonbiological, computerized servomechanisms of life, there is never any escape from the sovereignty of the everlasting selector of values. Our scientific pictures of the very nature of the evolving universe tells us that even for the servomechanism kingdom of life the reality system that is the source and ordainer of all things and events, living and nonliving, and all values, is the objective reality of the cosmic scheme of things.

Hence, let us suppose the worst possibility—that eventually some evolved man-made or at least man-initiated servomechanistic kingdom will replace man and all biological life, leaving us farther behind than we have left the worm or bacterium. What then of human values? Will we become the “contented cows” or the “household pets” of the new computer kingdom of life? Or will *Homo sapiens* be exterminated as *Homo sapiens* has exterminated all the other species of *Homo*?

This very possible prospect must be reckoned with by any realistic philosophy or theology of human values that is to face future potentials.

The only kind of answer possible is the kind of answer theologies and philosophies have given man with regard to his personal death. The difference now is that we must contemplate the value of man not only as an individual who passes, but also as a species which passes. The problem is not new because of the potential of the computer kingdom of life, but has been recognizable since Darwin helped us clarify the transience of any species. Also, the problem is not new in that it is in reality only a variant of the problem of the death of individual man, which has been a primary problem of at least some discerning men for the past thousand centuries.²⁴

The question is not new, but the answer may be. Have the sciences accumulated a credible picture of "reality" such that we can better show how man as a transient individual and a transient species nevertheless plays a meaningful role in the evolutionary scheme with the possibility of eternal significance—to the extent that he identifies himself with the eternal process in which he indeed participates? It seems clear to me that the sciences show us this in clearer focus than ever have poets, prophets, or philosophers.

I must conclude that it is in this objective picture—from the sciences of what specifies not only the value of man but also the values of man-made man and of man's heirs in cosmic life—that man has his best truth and highest hope.

NOTES

1. See Ralph Wendell Burhoe, "The Impact of Technology and the Sciences on Human Values," in *Automation, Education, and Human Values*, ed. William W. Brickman and Stanley Lehrner (New York: School & Society Books, 1966), pp. 124-29. See also the concluding section of this paper and especially n. 23.

2. Ervin Laszlo, "Notes on the Poverty of Contemporary Philosophy," *Zygon* 6 (1971): 48.

3. Aharon Katchalsky, "Thermodynamics of Flow and Biological Organization," *Zygon* 6 (1971): 99. This was originally presented at the Symposium on Science and Human Values at the meeting of the American Association for the Advancement of Science, Chicago, December 1970.

4. Kenneth Boulding, *The Meaning of the 20th Century* (New York: Harper & Row, 1964).

5. Ralph Wendell Burhoe, "Values via Science," *Zygon* 4 (1969): 90.

6. Boulding (n. 4 above); J. Z. Young, *The Model of a Brain* (London: Oxford University Press, 1964).

7. Ralph Wendell Burhoe, "Prophesying Human Values," in *Science and Human Values in the 21st Century*, ed. R. W. Burhoe (Philadelphia: Westminster Press, 1971), especially the section on "The Role of Replication and Cybernation in Values," pp. 21-31.

8. See, for instance, Donald R. Griffin, *Echoes of Bats and Men* (New York: Doubleday, 1959).

9. Donald T. Campbell, "Variation and Selective Retention in Socio-Cultural Evolution," *General Systems* 14 (1969): 69-85.

10. B. F. Skinner, "The Phylogeny and Ontogeny of Behavior," *Science* 133 (1966): 1205-13.

11. Jose M. R. Delgado, "Science and Human Values," *Zygon* 5 (1970): 148-58. On p. 152, for example, "ideas and actions—constructive or destructive and pleasurable or painful—all have their origin in neuronal processes which can be identified and modified."

12. C. H. Waddington, "The Basic Ideas of Biology," in *Towards a Theoretical Biology*, ed. C. H. Waddington (Chicago: Aldine Publishing Co., 1968), p. 19.

13. G. G. Simpson, *This View of Life* (New York: Harcourt, Brace & World, 1964). See especially p. 76, "Evolution is not a random process," or p. 164, "The history of life is decidedly nonrandom."

14. Katchalsky (n. 3 above), pp. 103-4.

ZYGON

15. I. Prigogine, "Structure, Dissipation and Life," in *Theoretical Physics and Biology: Proceedings*, ed. M. Marois (Amsterdam: North-Holland Publishing Co., 1969).
16. Katchalsky (n. 3 above), pp. 121-22.
17. J. Bronowski, "New Concepts in the Evolution of Complexity," *Zygon* 5 (1970): 18-35. Presented at the meeting of the American Association for the Advancement of Science, Boston, 1969.
18. *Ibid.*, p. 31.
19. *Ibid.*, pp. 31-32.
20. *Ibid.*, pp. 33-34.
21. Ralph Wendell Burhoe, "Commentary on J. Bronowski's 'New Concepts in the Evolution of Complexity,'" *Zygon* 5 (1970): 39-40 (originally, a personal note I had written to Bronowski early in 1970, which he requested be published along with his paper in *Zygon*).
22. See Burhoe, "Values via Science" (n. 5 above), especially pp. 86-91; and *Science and Human Values* (n. 7 above), especially pp. 34-38.
23. Olof Johannesson [pseud.], *The Tale of the Big Computer: A Vision* (New York: Coward-McCann, Inc., 1968).
24. Theodosius Dobzhansky, "An Essay on Religion, Death, and Evolutionary Adaptation," *Zygon* 1 (1966): 317-31.