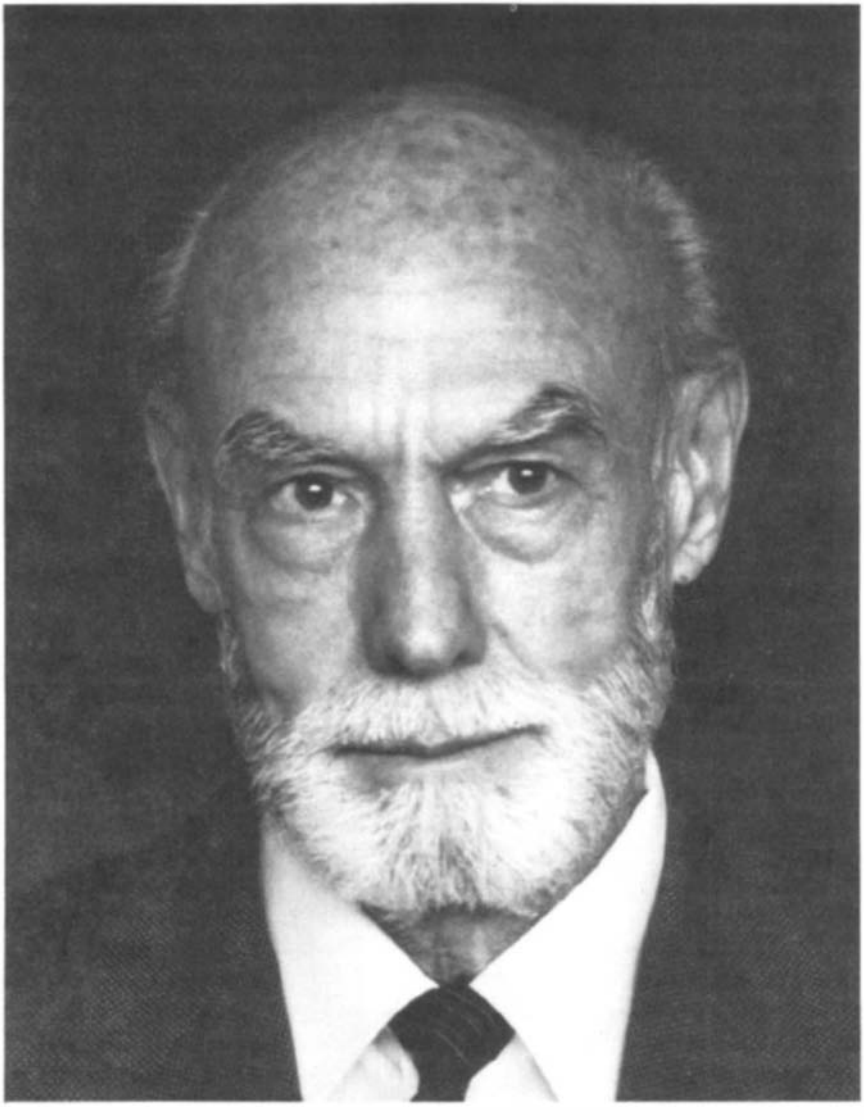

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CHANGING PRIORITIES

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INTRODUCTION

Rather than address select aspects of neuroscience, or particular problems with which I happen to have been involved, or to personally reminisce about golden "days that are no more," I plan to respond to the kind invitation to write a prefatory chapter for this volume with a few observations bearing on matters that, while personal in some respects, are also of general ongoing concern to all of us in science and particularly to the future of neuroscience as a discipline.

We used to say that there are two kinds of scientists: those fired-up by a problem and searching for methods to get the answers, and those highly trained in some method who are searching about for some amenable problems. While most of us line up somewhere between these extremes, there is much to be said for, at least in principle, giving preference where possible to problem priorities over methodology. What follows is, above all, problem-oriented and attuned throughout to the query, "What difference does it make?—especially ten, twenty, or more years from now?"

In terms of governmental funding and in other respects, it has become apparent that the overall federal rating for neuroscience is not as high today as it was prior to the Nixon budget reforms of the early 1970s. Nor does it appear that the decline is something temporary from which funding can be expected soon to recover. Nor is it restricted to neuroscience; science in general has been affected with certain exceptions such as cancer-related, energy-related, and other select projects where a major application to current quality-of-life problems is obvious. These changes in relative funding can be assumed to reflect real changes in social priorities and in society's

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collective judgment of the importance of science and what it contributes. We read in *Science* (Sawhill 1979) of the "public disillusionment" and "today's more jaundiced view" of science and that "faith in the beneficence of scientific endeavor and the promise of technology has been steadily eroding."

An underlying cause for these changes can be seen in the new and growing recognition of mounting global, so-called "crisis" problems which science is alleged to have helped to create and which in addition are complicated by social value problems for which science is apparently unable to provide answers. When the quality and even survival of civilized society is potentially in threat, what difference does it make to Congress or the public whether we find some new nerve connections in the brain, some new transmitters or receptors, and so on? Even the ever-strong humanitarian appeal of medical advancements that might eventually save hundreds of thousands of lives does not fully escape the new unspoken perspective of a world already afflicted with population imbalances in the hundreds of millions. The overwhelming priority of the growing demands of today's "global crisis" problems was already perceived in the late 1960s (Platt 1969) to be of sufficient magnitude and urgency to warrant mustering the scientific community in an all-out crash attack with the implication that to continue the practice of "science as usual" is morally indefensible.

Although little has happened in the interim to reduce the specter of global breakdowns, it seems that considerable has happened to discourage public feeling that science and improved technology can be counted on to bring solutions. While the world's production per capita of most major products of the basic biological source systems has already peaked and started on a long downward trend (Brown 1979), world demand continues to rise at the rate of 6 million people per month with predictions of inevitable social turmoil as peoples and nations grow more desperate.

Earlier hopes that science might rise to the occasion with "green revolutions" and other technological answers begin to fade. Science and improved technology, we come to realize, merely make it possible to better maintain more people in better style, for a while, until new limits are reached and the same problems reappear, along with new ones, and all on a greatly magnified scale. Science and advanced technology, whether medical, agricultural, military, energy-related, etc, are now seen, in the long run, to put us in an escalating vicious spiral of technology-population-energy-pollution-etc increases, in which we are now firmly entrapped. There is no reflection here on science or technology per se, of course. As we say, Utopia is tomorrow's level of technology combined with the population levels of the nineteenth century. Remedial suggestions, however, that might in any way involve the highly sensitive, value-laden factor of population controls

promptly raise a host of moral issues and value conflicts for which, again, science, it is held, does not provide answers.

Futurists and common logic concur that a substantial change, worldwide, in lifestyle and moral guidelines will soon become an absolute necessity. On a planet of finite resources, the laws and mores of a freely increasing population must eventually be replaced by those of a regulated population, and the sooner this inevitable shift occurs, the better for the residual quality of the biosphere. In brief, it becomes increasingly evident that the prime, urgent need of our times is not for more science and improved technology, medical or otherwise, but for some new ethical policies and moral guidelines to live and govern by.

Once this conclusion is perceived, the common tendency is to by-pass science to look elsewhere for answers. Problems that resolve to basic issues in ethics and morality are traditionally supposed to be beyond science. It is argued that science which describes facts cannot be used to prescribe values. Prevailing doctrine in modern philosophy asserts that it is logically impossible to derive values from a set of scientific facts, or to infer what ought to be from what is. In view of the collective effect of various considerations of this kind, it is hardly surprising that public faith in the promise of science and technology "has been steadily eroding."

A DIFFERENT APPROACH

In what follows I try to defend a position directly counter to the above, which would, in effect, not only restore to science any loss in public favor, but would go further to give science, and the scientific endeavor generally, a new public image and a higher societal role of top priority. On the proposed terms, science becomes the prime hope for escape from the vicious spirals of advancing civilization, but for other reasons. A different approach to the public support and role of science is suggested in which science is upheld, not because it begets improved technology, but because of its unmatched potential for the shaping of ethical values. In the worldview perspectives and truths of science we will find the best key to valid moral guidelines. The arguments are adapted to today's priorities and grow stronger, not weaker, as current global conditions worsen. Even basic "pure" research and the practice of "science as usual" emerge on the proposed terms with a heightened social and moral approval.

The usual appeal to medical, educational, technological, and other direct benefits is by-passed and our bets are placed instead on certain less obvious human value implications that stem from brain research. Particularly relevant are recent changes in concepts relating to the mind of man, the nature of the conscious self, freedom of choice, causal determinacy, and to the

fundamental relation of mind to matter and to brain mechanism. Some of man's most enduring concerns are involved, i.e. whether consciousness is mortal or immortal, cosmic or brain-bound, or reincarnate, and the like. It is in terms of the humanistic implications along these and related lines that neuroscience has always had its special interest and greatest meaning. Ideologies, philosophies, religious doctrines, world-models, value systems, and the like will stand or fall depending on the kinds of answers that brain research eventually reveals. It all comes together in the brain.

In brief, recent conceptual developments in the mind-brain sciences are seen to bring changes in worldview perspectives that revise the ultimate criteria and frame of reference for determining human value priorities and resolving value differences. A broad shift of conceptual framework regarding science and human values is involved. Promising prospects can be seen, especially as these changed perspectives apply in those global crisis areas wherein lie today's most serious threats to the quality of life, and where differential outcomes in the resolution of value conflicts tend to have tremendous social consequences. For example, even a slight shift in the delicate balance of value perspectives on the abortion vs right-to-life issue could mean the difference, in itself, of literally many millions of lives, pro or con, in the next few years—with enormous secondary impacts as well—and all compounded on future generations. Similar wide-ranging, quality-of-life consequences result from a shift of values in regard to energy-environmentalist issues, species' rights, and other global concerns.

It is our present contention that a scientific approach to both the theory and the prescription of ethical values is not only feasible, but is by far the best way to go, offering the most promising, perhaps only, visible hope for future generations. The supporting arguments have already been expounded in some detail elsewhere and may be found in the original articles cited and their references (Sperry 1965, 1969, 1972, 1977, 1980). Rather than assume prior knowledge or laboriously restate the reasoning in different words, it is more expedient for present purposes to simply list below some of the principal postulates, propositions, observations, and inferences as excerpted with minor changes from the previous accounts. Because the subject matter ranges somewhat afield from neuroscience, overlap and redundancy are risked rather than the reverse. Some attempt at logical ordering is maintained, but the cross logistics mount rapidly, and a quick grasp of the whole may be found preferable to a logical sequential approach.

COLLECTIVE POSTULATES AND PROPOSITIONS

Subjective Values in Objective Perspective

•In addition to their commonly recognized significance from a personal, religious, or philosophic standpoint, human values can also be viewed objec-

tively in causal control terms as universal determinants in all human decision-making. All decisions boil down to a choice among alternatives of what is most valued, and are determined by the particular value system that prevails.

•Human values, viewed in objective, scientific perspective, stand out as the most strategically powerful causal control force now shaping world events. More than any other causal system with which science now concerns itself, it is variables in human value systems that will determine the future.

•Any given brain will respond differently to the same input and will tend to process the same information into quite diverse behavioral channels depending on its particular system of value priorities. In short, what an individual or a society values, determines very largely what it does.

•As a social problem, human values can be rated above the more tangible global concerns such as those of poverty, pollution, energy, and overpopulation on the ground that these more concrete problems are all man-made and are very largely products of human values. Further, they are not correctable on any long-term basis without effecting adaptive changes in the underlying human values involved.

•The human value factor in biospheric controls stands out as the primary underlying root cause of most of today's difficulties. The more strategic way to remedy mounting adverse global conditions is to go after the social value priorities directly in advance, rather than waiting for man's values to change in response to changing external conditions. Otherwise we are doomed to live always on the margins of intolerability, for it is not until things begin to get intolerable that the voting majority gets around to changing its established values.

•Recent developments in the mind-brain sciences eliminate the traditional dichotomy between science and values and support a revised philosophy in which modern science becomes the most effective and reliable means available for determining valid criteria for moral value and meaning.

Value Theory

•A science of values in the context of decision theory becomes conceivable extending into all branches of behavioral science and forming a skeletal core for the social sciences.

•The seemingly endless complexity of human values is greatly simplified by viewing values in hierarchic structures which are goal dependent, and further, by restricting attention to those areas that are involved in social conflict.

•The innate components of the value structure, which include inherent psychological as well as biological values, can be treated largely as a common invariant denominator of human nature, allowing the focus of atten-

tion to be directed to problems of the acquired, cognitive, ideological values where the major sources of value conflict arise.

•On analysis, values are found to be correlates of directed activity. They are always relative to some purpose, goal, or aim, explicit or implicit, and structured in goal-dependent hierarchies. Any concept or belief regarding the purpose and value of life as a whole, once accepted, then logically supersedes and conditions the entire hierarchy of value priorities at subsidiary levels. Values at the ideological plane become ordered and ethical issues judged in accordance with the conceived ultimate purpose of life as a whole. This latter will logically imply at the same time an associated worldview or universe scheme that is consistent.

•Because of the hierarchic structure of values the search for improved ethical guidelines can be narrowed to the search for what ought to be most valued. This in turn leads to problems of the highest determinants of value priorities—the "life goal," "world model" concepts and beliefs that lie at the heart of the problem of moral judgment and logically condition the value structure at all levels.

•Societal values, especially of the kind people disagree on, are always dependent upon, and relative to, some general frame of reference containing the premises, beliefs, presuppositions, etc on which the reasoning about priorities rests. The question may be raised "What makes one reference frame superior or supersedent to another?" and then, "Is there some ultimate frame of reference for values that could logically and rightly be accepted and respected by all countries, cultures, governments, and creeds, and by mankind in general, as the final supreme standard when it comes to judging ethical priorities, resolving value conflicts, and as a guideline for human judgment generally and international decision-making in particular?" The practical need for some such unifying global standard becomes more and more evident for things such as world population control, conserving world resources, protecting the oceans and atmosphere, and for various other modern world problems that increasingly require united effort on a global scale.

•What is needed ideally to make decisions involving value judgments is a consensus on some supreme comprehension and interpretation of the universe and the place and role within it of man and the life experience.

Dependence on Mind-Brain Concepts

•Beliefs concerning the ultimate purpose and meaning of life and the accompanying worldview perspectives that mold beliefs of right and wrong are critically dependent, directly or by implication, on concepts regarding the conscious self and the mind-brain relation and the kinds of life goals and cosmic views which these allow. Directly and indirectly social values depend, for example, on whether consciousness is believed to be mortal,

immortal, reincarnate, or cosmic and whether consciousness is conceived to be localized and brain-bound or essentially universal, etc.

•Recent developments in mind-brain theory revise the ultimate criteria and our ultimate frame of reference for determining value priorities. Problems of values, ethics, and morality (questions, i.e., of what is good, right, and ethically true and of what ought to be) become, in these revised terms, something to which science, in the most profound sense, can contribute fundamentally and in which science should be actively and responsibly involved.

•Current concepts of the mind-brain relation involve a direct break with the long-established materialist and behaviorist doctrine that has dominated neuroscience for many decades. Instead of renouncing or ignoring consciousness, the new interpretation gives full recognition to the primacy of inner conscious awareness as a causal reality.

•The phenomena of conscious experience are conceived to play an active, directive role in shaping the flow pattern of cerebral excitation. Instead of being parallelistic and acausal, consciousness in the present scheme becomes an integral part of the brain process itself and an essential and potent constituent of the action. Consciousness is put to work and given a use and a reason for having been evolved in a physical system. Subjective phenomena including values are brought into the causal sequence in human decision-making and behavior generally and thus back into the realm of experimental science from which they had long been excluded.

•The seemingly irreconcilable dichotomies and paradoxes that formerly prevailed with respect to mind vs matter, determinism vs free will, and objective fact vs subjective value become reconciled today in a single comprehensive and unifying view of mind, brain, and man in nature.

•The swing in psychology and neuroscience away from materialism, reductionism, and mechanistic determinism toward a new, monist, mentalist paradigm restores to the scientific image of human nature the dignity, freedom, responsibility, and other humanistic attributes of which it has long been deprived in the materialist-behaviorist approach.

•A nonreductive holistic world model and interpretation of physical reality is supported in which the qualitative pattern properties of all entities are conceived to be just as real and causally potent as those of their components. This preservation of the qualitative value and pluralistic richness of physical reality stands counter to the common tendency to correlate science with reductionism.

Toward the Prescription of Values

•Instead of separating science from values, the current interpretation leads to a stand in which science becomes the best source, method, and

authority for determining the ultimate criteria of moral value and those ultimate ethical axioms and guideline beliefs to live and govern by.

•The classic *fact-value* and *is-ought* dichotomies of philosophy logically dissolve in the context of cerebral processing. The operations of the brain are already by nature richly replete with established values and value determinants, both inherent and acquired, with the result that incoming facts regularly interact with and shape values. The resultant value system, along with conceptions of what ought to be, is determined in very large part by the factual input.

•Changing to an ethic based in science would entail in large part a substitution of the natural cosmos of science for the different mythological, intuitive, mystical, or "other-worldly" frames of reference by which man has variously tried to live and find meaning. The aim is not to eliminate value controversy and differences of opinion but only to bring these into a domain set by an agreed-upon frame of reference supported by science—not with the idea that scientific truth is absolute or beyond question, but only with a conviction that it does represent the best and most reliable, credible, and dependable approach to truth available.

•Once science modifies its traditional materialist-behaviorist stance and begins to accept in theory and to encompass in principle within its causal domain the whole world of inner, conscious, subjective experience (the world of the humanities), then the very nature of science itself is changed. The change is not in the basic methodology or procedures, of course, but in the scope and content of science and in its limitations, in its relation to the humanities and in its role as a cultural, intellectual, and moral force. The kinds of interpretations that science supports, the world picture and attendant value perspectives and priorities, and the concepts of physical reality that derive from science all undergo substantial revisions on these new terms. The change is away from the mechanistic, deterministic, and reductionistic doctrines of pre-1965 science to the more humanistic interpretations of the 1970s. Our current views are more mentalistic, holistic, and subjectivist. They give more freedom in that they reduce the restrictions of mechanistic determinism, and they are more rich in value and meaning.

•Accepting as self-evident the ultimate value of what man generally has held most sacred, namely, the cosmic forces that made, move, and control the universe and created man, and interpreting these in accordance with science, one emerges with a value system that includes a strong reverence for nature promoting the values of the recycle philosophy, population regulation, protecting and enhancing environmental quality, and the like.

•In the eyes of science, to put it simply, man's creator becomes the vast interwoven fabric of all evolving nature, a tremendously complex concept that includes all the immutable and emergent forces of cosmic causation that control everything from high-energy subnuclear particles to galaxies,

not forgetting the causal properties that govern brain function and behavior at individual and social levels. For all of these, science has gradually become our accepted authority, offering a cosmic scheme that renders most others simplistic by comparison and which grows and evolves as science advances.

•Science becomes man's best channel for gaining an intimate understanding of and rapport with those forces that control the universe and created man. This is not to suggest that science take on the functions of religion; but only that there might be mutual and other benefits from a fusion of the two.

•The future of science will be very different depending on whether science is recognized in the public mind to have competence in the realm of values. Reciprocally the future of society also will be very different depending on whether its value perspectives are shaped from science and the worldview of science or by other alternatives that now prevail.

THE KEY TO QUALITY SURVIVAL

Implicit in the foregoing is the conclusion that our top social priority today is to effect a change worldwide in man's sense of value. This translates by hierarchic value theory into a change in what is held most sacred. What is needed, more specifically, is a new ethic, ideology, or theology that will make it sacrilegious to deplete natural resources, to pollute the environment, to overpopulate, to erase or degrade other species, or to otherwise destroy or defile the evolving quality of the biosphere. This is exactly what is found to emerge from our current approach to the theory and prescription of human values. Relying on the kind of truth supported by science we arrive at an ethic that promotes an ultimate respect for nature and its creative principles, including those of its peak thrust into the highest reaches of man's mind, along with corollary value criteria which, if applied worldwide, would promptly set in motion the kinds of corrective legislation and other trends and pressures that are needed to remedy looming global disaster conditions.

On the terms proposed the utility of science takes a different form. Society would look to science not only for new technology and objective knowledge but, more importantly, for the criteria of ultimate value and meaning. Each advance of science brings increased comprehension and appreciation of the nature, meaning, and wonder of the creative forces that move the cosmos and produced man. Even "science as usual" gains, in this context, a heightened social significance and moral support. The special, key role of neuroscience and brain research will be readily apparent.

It remains to further stress a point already implied, namely, that for science to fully qualify and function effectively in this changed role, it will be necessary that we abandon an entire mode of scientific thinking long

referred to under the general rubric of "scientific materialism." Moves to abide by the truths of science, as opposed to unproven claims from other sources, have had sporadic support since Francis Bacon. What is new today is the shift in science from reductive physicalism to a holist-mentalist paradigm and the changed interpretations and perspectives that this brings. Among traditional views that consequently require correction is that predicating the impotence of science in regard to value judgments along with much of the doctrine associated with reductive mechanistic determinism that for many decades has characterized science and our scientific outlook. This was the thinking of Karl Marx and is the reason that the more materialistic and animalistic aspects of human nature are put first in Soviet philosophy before man's more idealistic, more spiritual components. The issues at stake are not minor. They involve not only the public image of science, the relation of science to human values, and the kinds of values science upholds, but also some of our more basic concepts in science concerning physical reality, mind and matter, and the nature of causation.

CAUSAL DETERMINISM: THE CENTRAL ISSUE

The issues narrow to opposed views of causation that are basic and central to everything stated thus far. One view holds that the causal forces and laws operating in nature are fully explainable in purely physical terms and are, in principle, ultimately accountable on the basis of quantum theory, the elemental forces of physics, or in some more unifying field theory eventually to be found. Physicalist, i.e. materialist, determinism is assumed to prevail throughout nature in this view and all higher level interactions, including those of the brain, are presumed to be reducible and accountable, in principle, in terms of the ultimate fundamental forces of physics.

Opposed to this long dominant physicalist-behaviorist interpretation is the view which we here uphold and which has recently been gaining increased acceptance particularly in the behavioral sciences. It contends that the higher forces and laws of causation, as seen for example in classical mechanics, in physiology, and in brain function and behavior, cannot be fully explained by the laws of quantum mechanics or by the mechanics or laws of any other ultimate physical force or field. The higher entities and their causal properties and laws of interaction are conceived to be causal realities in their own right and not determined completely (though they are in part) by the causal laws and properties of their components. The larger, higher, more molar properties are perceived to be just as real, just as causal, and in many ways to be of more importance than are the more basic physical properties of their subsidiary components. In this view the fundamental forces of physics are only building blocks used in creating bigger, more competent entities and forces. The patterning of the building components,

i.e. their arrangement in space and time, becomes a distinctive key factor in making things what they are, and is not determined solely by the properties of the parts themselves.

To attempt to explain an entity in terms of its parts and then the parts in terms of their parts and so on, results in an infinite regress in which one is left at the end trying to explain everything in terms of next-to-nothing. At each step of the way critical pattern components of causality are lost and the explanation becomes less and less complete at each lower level. To attempt to include, even in principle, the pattern factors, i.e. the space-time components, by invoking the "interactions of the parts," the "organizational relations," etc at each step, sounds good but is an empty lip service. We have no science for the space-time components, no science of the organizational relations and interactions. Particularly we have no science for the collective form in which these are present at each level of the infrastructure. Even the relatively ultra-simple interactions involved in the classic "three-bodies problem" are too much.

Our present view holds further that when a new entity is created the new properties of the entity, or system as a whole, thereafter overpower the causal forces of the component entities at all the successively lower levels in the multi-nested hierarchies of the new infrastructure. In other words whenever an entity joins forces with others to form a new whole, the position that it is forced to take in the universe and its subsequent course through time and space and its eventual fate are thereafter determined more conspicuously by the new properties of the system as a whole than by its own original properties. A degree of self-determinacy is lost to the parts as soon as the higher powers of the new whole become superimposed. Although the causal forces at the lower quantal, atomic, molecular, etc levels in the infrastructure continue to operate in full force as usual they are enveloped, encompassed, overwhelmed, superseded, supervened, and outclassed by the new causal properties that emerge in the whole. Evolution, in the course of compounding new compounds continuously adds new entities and new phenomena that embody new qualities, new causal forces, and principles with new scientific laws and control properties.

The new emergent phenomena, not reducible, in principle, to their parts and deserving to be recognized as causal realities in their own right, are in many respects more powerful and dominant features of reality than are the lower properties of the components. Instead of a universe completely controlled by quantum mechanics and the basic forces of physics, science presents, by this interpretation, a universe controlled by a rich profusion of qualitatively diverse emergent powers that become increasingly complex and competent. Any randomness, chance, caprice, or chaos that may be operating at the quantum level, as modern physics insists, gains little expression because it is effectively superseded and controlled by higher level forces

that are anything but random. The higher levels involve much more than mass probabilities. The creative, interlocking web of evolving nature is not blind or chance-like but becomes, as it progresses, rich in irreversible, directional, ever more complex constraints that tend to keep things moving in a trend toward higher and more competent forms.

In the brain, controls at the physico-chemical and physiological levels are superseded by new forms of causal control that emerge at the level of conscious mental processing, where causal properties include the contents of subjective experience. Causal control is thus shifted in brain dynamics from levels of pure physical, physiological, or material determinancy to levels of mental, cognitive, conscious, or subjective determinacy. The flow of nerve impulse traffic and related physiological events in a conscious process is no longer regulated solely by events in kind but becomes caught up in, enveloped, and moved by the higher mental controls, somewhat as the flow of electrons in a television set is moved and differentially patterned by the program content on different channels. Just as the programming variables of a TV monitor have to be included in order to account for the electron flow pattern of the system, so also in the brain the subjective, mental variables of cerebral function have to be included to give a full account of the flow patterns of neural excitation. The mental events of conscious experience and the physico-chemical events of the infrastructure are not conceived to be in a parallelistic relation like that of "two languages," "two logics," or of "two complementary aspects of one and the same situation" in which a "purely physical determinacy of the CNS" is preserved as MacKay (1980) and others would have it. This shift from a causal determinacy that is purely physical to one that includes conscious subjective forces that supersede the physical—in other words the shift from a materialist, reductionist, mechanistic paradigm to a holistic, mentalist paradigm—makes all the difference when it comes to using the "truths" of science as criteria of ethical values.

MARXISM INVERTED

In trying to assess possible social repercussions and the outcome of a societal shift to an ethic founded in science, it would be unfortunate and misleading if one were to rely on Marxism and the Communist World as an example. According to our latest mind-brain theory and its implications, Marxist-Communist doctrine is founded on some basic errors in the interpretation of science and of what science stands for and implies in reference to human nature and to social and worldview perspectives. As a result, the kinds of values upheld in Marxist doctrine are almost the diametric opposite

from those which emerge from a scientific approach on our present terms.

If the growing competition between Communist and Free World countries is to continue to be in part a battle for men's minds, it may be worth a few words in closing to point out some of the ideologic value differences that result even though the intent in both cases is to exclude dualist "otherworldly" criteria in favor of the truths of science. Some of the basic starting differences include the following:

1. First and foremost, Marx accepted the long established—but now largely overthrown—view that science, of necessity, leads to and supports a materialist philosophy that rejects subjective mental phenomena as causal and predicates instead a purely materialistic determinancy for the CNS.
2. The doctrine of reductionism was accepted as applied to nature in general and human nature in particular.
3. Also intimately related to the above, Marx failed to recognize the key principle of "downward causation," i.e. the causal control that higher properties in any entity, whether a society or a molecule, invariably impose over the lower properties of their infrastructure.
4. Marxism, further, lacks any theory that serves to resolve the *is-ought* fallacy or the traditional dichotomy that has heretofore kept science and human values separate.
5. Marxism also lacks the "free-will" concepts we have today that free individual and social decision-making from mechanistic determinism.
6. Marx opted for a throughly homocentric value system that makes man the measure of all things and gives precedence to the basic material needs of man over the quality of the biosphere, as well as over man's higher psychological needs. There is no justification in science for this latter choice and it is, in some respects, an inversion of nature that puts the welfare of a part of a system above that of the system as a whole.

Basically, according to Marx, what counts in human affairs and changes the world are man's actions in fulfilling his material needs for subsistence, not man's idealisms, philosophy, or ideology. He emphasized that the materialistic-animalistic needs must come first and that the higher human pursuits are built upon and depend on the more basic components. On the other hand, Marx failed to appreciate that the higher idealistic properties in man and society, once evolved, can then supersede, encompass, control, and take care of the lower material needs; that this is the way of evolving nature and when it comes to rules for progress, works better than the inverse. One of the best refutations of Marxism is Marxism itself in that it was not Marx's actions in satisfying his material needs for subsistence that changed the world, but his philosophy, visionary ideas, and Communist ideology.

A value system that puts its ultimate good in the welfare of the "Party," and at the same time pointedly scorns reverence for nature, does little to help remedy most of our mounting global crisis conditions which today are the overriding concern. There is nothing in Marxist doctrine to help control overpopulation, curb pollution, conserve resources, preserve the environment, protect endangered species, etc. Nature in Marxist materialism is not something to be revered but almost the reverse, i.e. something to be battled and subjugated, transformed, mechanized, and exploited to satisfy man's (mainly material) needs. The forces of nature as interpreted by Marx in the materialist tradition are blind and unprincipled (Bell 1975), not something rich in quality, wonder, and beauty, harmoniously controlled with countless checks and balances, and full of creative strategies, constraints, and principles that have been time-tested for success in creating, preserving, and improving the quality of the biosphere, including man.

In Marxism not nature but technology and production power are idolized. Cathedrals for Marx are factories and skyscrapers, and the beautiful dream is to transform whole continents by industrial progress with "huge new populations springing up as if by magic" (Ryanzanoff 1963). The narrow focus on class conflict in an industrialized society also does nothing for the major ailments of the planet today and again is expressed in terms of the mechanistic determinism of the more material and elemental needs and components in man's makeup at the expense of the higher psychological needs and more idealistic components. The causal power of cognitive ideals that behavioral science recognizes today, was, on principle, dismissed. Where nothing is sacred and there is no higher meaning (beyond that of the "Party"), everything loses meaning. In its homocentric emphasis on the more material needs and aims of man, technology, industry, and production power, combined with its demeaning view of nature, Marxism, in direct contrast to the views we reach above, seems to represent almost the epitome of the worst forces that have caught up with us today to produce most of the adverse crisis conditions that threaten the future. The basic relevance of brain research to all these issues can hardly be overemphasized.

IN SUMMARY

In the context of today's mounting global problems the relative demand for medical, educational, and related social benefits that derive from the neurosciences is diminished. At the same time the human value spin-offs of brain research are thrust into a strategic position of top concern because of their key role as criteria for policy priorities and decision-making guidelines. Recent conceptual developments in the mind-brain sciences rejecting reduc-

tionism and mechanistic determinism on the one side, and dualisms on the other, clear the way for a rational approach to the theory and prescription of values and to a natural fusion of science and religion. Science can be upheld as the best route to an increased understanding and rapport with the forces that made and move the universe and created man. The outlines of a value-belief system emerge that include an ultimate respect for nature and the evolving quality of the biosphere, which, if implemented, would set in motion the kind of social change needed to lead us out of the viscious spirals of increasing population, pollution, poverty, energy demands, etc. The strategic importance of neuroscience and the central role of prevailing concepts of the mind-brain relation to all of the foregoing remain evident throughout, as does also the direct relevance of efforts to bring added insight and substantiation of these mind-brain concepts through further advances in brain research.

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