The Impact and Promise of the Cognitive Revolution

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Opening a new era in science, psychology's cognitive revolution contradicts traditional doctrine that science has no use for consciousness to explain brain function. Subjective mental states as emergent interactive properties of brain activity become irreducible and indispensable for explaining conscious behavior and its evolution and get primacy in determining what a person is and does. Dualistic unembodied consciousness is excluded. A modified two-way model of interlevel causal determinism introduces new principles of downward holistic and subjective causation. Growing adoption in other disciplines suggests the two-way model may be replacing reductive physicalism as the basic explanatory paradigm of science. The practice, methods, and many proven potentials of science are little changed. However, the scientific worldview becomes radically revised in a new unifying vision of ourselves and the world with wide-ranging humanistic and ideologic as well as scientific implications.

Reflecting on a century past, with an eye to the future, what I have to say is colored in no small part by a concern long shared with the late B.F. Skinner, namely, "Can APA, or any other organization, count on another hundred years?" Skinner's answer became increasingly less optimistic, especially in his last decade. He concluded, "The more we learn about human behavior, the less and less promising appear the prospects." Reflecting a similar vein of increasing concern, I see a possible ray of hope in psychology's cognitive revolution and what it could mean in bringing new perspectives, beliefs, and values—in short, new mind-sets and a new way of thinking—much needed if humanity is to survive the next century.

During APA's first hundred years, psychology is said to have gone through three major revolutions. In addition to the recent shift to cognitivism, there were the two earlier revolts, which were associated with J. B. Watson and Sigmund Freud. I believe that, of the three, the current so-called *cognitive*, *mentalist*, or *consciousness* revolution is the most radical turnaround—the most revisionary and transformative.

A main theme I want to stress concludes that in the cognitive revolution psychology is leading the way among the sciences to a new and improved, that is, a more comprehensive, adequate, and valid conceptual foundation for scientific as well as for all causal explanation and understanding. Any perceived irony here is indeed quite real. Psychology, after having been put down for decades by the so-called *hard* sciences as not being really a science, is now turning the tables—in effect, asserting that reductive physicalism or *microdeterminism*, the traditional explanatory model of science (including behaviorism), has serious shortcomings and is no longer tenable.

Other disciplines, even physics, are beginning to agree and join in, discovering and adopting the new antireductive and emergent insights, including, for example, computer science, neuroscience, biology, anthropology, evolutionary and hierarchy theory, general systems theory, and of course, quantum theory, among others (e.g., Blakemore & Greenfield, 1987; Campbell, 1974; Checkland, 1981; Gell-Mann, 1988; Gleick, 1987; Goodwin, 1978; Greenberg & Tobach, 1988; Grene, 1987; D. Griffin, 1988; D.R. Griffin, 1981; Laszlo, 1972; Piaget, 1970; Popper & Eccles, 1977; Stapp, 1982; Wasow, 1989). Each discipline, however, appears to have a different version of how these innovations came about, each finding the origins in its own particular field.

I strongly believe that, in the long run, history will show that among the sciences, psychology was actually the first discipline to overthrow its traditional mainstream doctrine in favor of the new paradigm. By the early 1970s, mainstream psychology already had adopted the new outlook (Dember, 1974; Matson, 1971; Palermo, 1971; Pylyshyn, 1973; Segal & Lachman, 1972), whereas the other fields came to it later, especially during the 1980s. In effect, most have just been following and developing varied forms and applications of what, in essence, is the same basic new core concept. At least that is the conclusion I have come to and will try to support.

Advance Overview

First, it will help to have a quick review of some of the salient features of the cognitive revolution as I see it: the essence of this revolt, what it means, and some of its

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consequences and future implications. Most important, the cognitive revolution represents a diametric turn around in the centuries-old treatment of mind and consciousness in science. The contents of conscious experience, with their subjective qualities, long banned as being mere acausal epiphenomena or as just identical to brain activity or otherwise in conflict with the laws of the conservation of energy, have now made a dramatic comeback. Reconceived in the new outlook, subjective mental states become functionally interactive and essential for a full explanation of conscious behavior. Traditional microdeterminist reasoning that brain function can be fully accounted for in neurocellular–physiochemical terms is refuted, as are also former assumptions that traditional materialism provides, in principle, a complete coherent explanation of the natural world. The cognitive–consciousness revolution thus also represents a revolt against the long-time worship of the atomistic in science. Reductive microdeterministic views of personhood and the physical world are replaced in favor of a more wholistic, top-down view in which the higher, more evolved entities throughout nature, including the mental, vital, social, and other high-order forces, gain their due recognition along with physics and chemistry.

It is important to stress, however, that the cognitive changeover from behaviorism to the new mentalism does not carry all the way from one previous extreme to the opposite, that is, to a mentalistic dualism. The shift, rather, is to a quite-new heterodox position that integrates and blends aspects of prior opposed solutions into a novel unifying synthesis (Natsoulas, 1987). The new position is mentalistic, holding that behavior is mentally and subjectively driven. This, however, does not mean that it is dualistic. In the new synthesis, mental states, as dynamic emergent properties of brain activity, become inseparably interfused with and tied to the brain activity of which they are an emergent property. Consciousness in this view cannot exist apart from the functioning brain.

A new reciprocal form of causal control is invoked that includes downward as well as upward determinism. This bidirectional model applies not only to control of the emergent mental over the neuronal in the brain but also to the emergent control by wholistic properties in general throughout nature. Accordingly, it has also been gaining ground in other sciences. What started as an intradisciplinary revolution within psychology is thus turning into a major revolution for all science. As a consequence, scientific descriptions—not only for behavior, cognition, the self, and so on, but for all physical reality—are being vastly transformed, with wide humanistic, philosophic, and epistemologic as well as scientific implications. Like the Darwinian and Copernican revolutions, to which some authors now compare it, the cognitive revolution leads to a combined ideological revolution, as defined by Karl Popper (1975). Alternative beliefs emerge about the ultimate nature of things, and a changed cosmology brings a new set of answers to some of humanity's deepest questions.

To many psychologists, such claims for the cognitive revolution will seem a lavish even fanciful overstatement. I believe, however, that firm substantial backing can be found for each of these assessments, plus many more yet-unmentioned extensions. Toward a preliminary understanding of why the impacts should be so profound and far-reaching, consider the fact that the cognitive revolution, as here conceived, involves radical changes in not just one but in two core concepts, consciousness and causality, both of which have extremely wide, almost ubiquitous application to everything we experience and try to understand. In view of this alone, it is obvious that the paradigmatic shift to cognitivism–mentalism, following centuries of rigorous materialism, is bound to have numerous far-reaching consequences.

Among further effects, this turnabout in the causal status of consciousness abolishes the traditional science–values dichotomy. That we are in a new era today in respect to values is well recognized (Edel, 1980). Thus, the cognitive revolution, from an ethical standpoint, might equally well have been called a values revolution. The old, value-free, strictly objective, mindless, quantitative, atomistic descriptions of materialist science are being replaced by accounts that recognize the rich, irreducible, varied and valued emergent macro and holistic properties and qualities in both human and nonhuman nature. Subjective human values, no longer written off as ineffectual epiphenomena nor reduced to microphenomena, become the most critically powerful force shaping today's civilized world (Sperry, 1972, 1991a), the underlying answer to current global ills and the key to world change.

A different approach is opened also and a resolution offered for that age-old enigma, the freewill–determinism paradox. Blending previous opposites in a heterodox middle-way position, the new cognitivism retains both free will and determinism, each reconceived in modified form and integrated in a way that preserves moral responsibility (Deci, 1980; Libet, 1992; Sperry, 1964, 1970). Volition remains causally determined but no longer entirely subject to the inexorable physiochemical laws of neurocellular activation. These lower level laws become supervened by higher level controls of the subjective conscious self in which they are embedded (just as, introspectively, it seems to be). The implications become critical for a scientific treatment of personal agency and social interaction (Bandura, 1989; Smith, 1983). Overall, we still inhabit a deterministic universe, but it is ruled by a large array of different types, qualities, and levels of determinism. In retrospect, we would not want it otherwise; especially, we would not want to live in an indeterminate, noncausal, and thus random, chaotic universe, totally unpredictable and with no reliability or rational higher meaning.

In sum, the type of reality and worldview upheld by science is thoroughly transformed, greatly enriched, and more appealing as well as more credible. A fundamentally changed picture of ourselves and the world gives scientists an entirely new outlook on existence, a whole new story

(Augros & Stanciu, 1984) plus a higher social role and enhanced public image. The vast gulf of mutual incompatibility that has long separated the world of science and that of the humanities (Jones, 1965; Snow, 1959) is abolished and replaced by a congenial continuum. Most important, perhaps, for the growing numbers among us who, like Skinner, see real concern about prospects for another 100 years, these renovations of the cognitive revolution provide a new way of knowing and understanding, a unifying new vision, in which some see a rational solution to our global predicament in the form of more realistic guideline beliefs and values to live and govern by.

Perspectives That Need to Be Clear

Before going further, I need to clarify some frequent misconceptions. First, at a time when it seems to be open season on personal theories of consciousness, it is important to recognize that what we deal with here is not just personal, obscure, or even minority theory or opinion but rather with the actual working conceptual framework and dominant doctrine for the past two decades of the whole discipline of science that specializes in mind and behavior (Baars, 1986; Gardner, 1985) and thus best speaks for science as a whole on these matters. Also, my main focus here is not on the philosophic abstractions, such as whether mentalism or reductionism may ultimately prove correct, but on the recorded fact of a turning point in the history of science and its cause.

Second, when I speak of behaviorism here, I mean behaviorism per se, in the sense of an overriding paradigm, metatheory, or working framework for psychology in general. The reference is not to any of the various subordinate theories, practices, and approaches to behavior, learning, or brain function that may have become associated incidentally by coming into vogue during the half-century reign of behaviorism. It is the overriding conceptual paradigm itself that the cognitive revolution has overthrown, especially the renunciation (in common with the other natural sciences) of mental or subjective factors as valid constructs for causal explanation.

Third, my concern throughout is not with any esoteric, radical, or other recent fringe development but with the central working premises of the solid scientific mainstream. Science viewed as a whole, its history, what it stands for, its principles, conceptual foundations, applications, and implications are what shape the present position and treatment. Remaining, adamant behaviorists represent a respected minority challenging the new principles but no longer represent mainstream psychology.

Fourth, in view of salient misconceptions (e.g., Bunge, 1980; Chezik, 1990; Peterson, 1990; Pirolli & Goel, 1990; see Natsoulas, 1991; Sperry, 1992), it is worth repeating that the type of mentalism upheld here is not dualistic in the classic philosophic sense of two different, independent realms of existence. In our new macromental or holomental synthesis, mental states as dynamic emergent properties of brain states cause behavior but are not dualistic, because they are inextricably interfused with their generating brain processes. Mental states in this form cannot exist apart from the active brain. At the same time, mental states are not the same as brain states. The two differ in the way a dynamic emergent property differs from its component infrastructure. It is characteristic of emergent properties that they are notably novel and often amazingly and inexplicably different from the components of which they are built. The recognized methodologic difficulties posed by the use of introspection, however, are not remedied.

Furthermore, my reasons for bypassing quantum theory, the most frequently cited source of the new worldview, in favor of mind–brain theory needs as least brief mention. In the present view, quantum mechanics, as a conceptual framework, fails to give a complete, coherent account of events at macrolevels nor does it subsume classical Newtonian laws as commonly inferred from the mathematical equations. Both quantum and Newtonian theory fail, in our present view, to adequately cover an important key principle, namely, that the collective spatiotemporal patterning per se of physical masses—or of particles, energy sources, or other mass-energy entities—exerts causal influence in and of itself. To explain and understand the macroworld with its endless different entities and relations, one does not even expect in this scheme to find the answers in quantum mechanics (the ultimate reduction) or in any "superstring" or other such "theory of everything." These subatomic features are the same for any macro entity, be it a great cathedral or a sewage outlet. Furthermore, these universal common subatomic elements are supervened and superseded in the two-way causation paradigm model through the downward control exerted by the higher level components in which they are embedded. Again, what counts are the different spatiotemporal patternings of the components at all levels and between levels—their one- to four-dimensional Gestalts. This space–time causality, or *pattern factor*, prevents reduction, as a rule, of macro to lower level microphenomena. It also rules out the transposition of subatomic properties upward to the macroworld. Overall, none of this applies, of course, with respect to most radiation phenomena. Also, it is important to keep in mind that the new paradigm does not dispose of either quantum or Newtonian theory. It merely supplements these by adding the supervening, irreducible but highly critical space–time pattern factors.

Contested Historical Aspects

Now, some 20 years since the cognitive revolution marked a major turning point in the history of science, we still lack any satisfying consensus as to its exact nature and source, its driving rationale, or its precise meaning for the future. Within psychology itself, different subfield interest groups continue to vie over these and related questions (e.g., Amsel, 1989; Baars, 1986; Bevan, 1991; Bolles, 1990; Chezik, 1990; Keil, 1991; Kendler, 1990; Lamal, 1990; Natsoulas, 1987; Simon, 1991; Sperry, 1980, 1991b; Wasow, 1989). If the overall impact and potential implications are anything like those inferred here, it becomes

crucial to better understand the true nature and essence of the cognitive revolution.

The story of this revolt, as I interpret it, was not one of finding new positives to support the important role of cognition, many of which were already long evident. Rather,the story is one of discovering an alternative logic by which to refute the seemingly incontestable reasoning that heretofore required science to ostracize mind and consciousness. How the discovery of this new logic came about is most easily explained in terms of the historical context out of which the new reasoning arose. Throughout the behaviorist–materialist era, extending well up into the 1960s, the age-old riddle of the mind–brain relation involved a contradictory paradox. On the one hand, it seemed obvious from common experience that our behavior is mentally driven. On the other hand, from the standpoint of neuroscience, it seemed equally obvious that a complete account of brain function, including the brain's entire input–output performance, could be provided in strictly objective neuronal–biophysical terms. In the explanatory system of neuroscience, absolutely no place could be seen to include the likes of conscious or mental forces, and the same applied for behaviorist psychology. Behaviorism as a philosophy of science (Skinner, 1964) made the science of mind consistent with that of neuro- and the other natural sciences. On this basis, the antimentalist tenets of behaviorism seemed irrefutable throughout behaviorism's heyday . As humanist Andrew Bongiorno (personal communication, April 1991), now in his 90s, recalled, "For half a century behaviorism reigned supreme in academe." To overthrow behaviorism would require an overthrow also of the conceptual foundations of neuroscience and of science in general.

What then led to its downfall? Or, to put it another way, What made cognitivism suddenly rise in its own right, no longer under the restrictive dictates of a reigning behaviorism, as in the earlier days of Edward Tolman, but rather as a new and independent positive paradigm predicating a worldview and tenets of its own that stood opposed to the long-dominant doctrine of the behaviorist–materialist era? Whatever caused this turnabout, it came with a startling suddenness, described in the early 1970s by Pylyshyn (1973, p. 1) as having "recently exploded" into fashion. It was as if the floodgates holding back the many pressures of consciousness and subjectivity were suddenly opened. What caused this abrupt turnabout has continued to puzzle many leaders in the field (Boneau, 1992).

Mind-Sets in 1964

As late as 1964, there still was no incipient sense of the impending turnabout, as evidenced in various conferences, books, and articles of and about the period (e.g., Bertalanffy, 1968; Eccles, 1966; Feigenbaum & Feldman, 1963; Feigl, 1967; Hook, 1960; Koch, 1963; Manicus & Secord, 1983; Nagel, 1971; Simon, 1962; Smythies, 1965; Wann, 1964). Within psychology, the continuing debates between phenomenologists and behaviorists were going on as before, without shaking the dominant reign of the behaviorist doctrine (Koch, 1963; Wann, 1964). In 1964, humanist Carl Rogers, who had searched during his long career for a scientific foundation for what he called "subjective knowing," was still summarizing the situation in reference to volition as "an irreconcilable contradiction" and "deep paradox" (p. 40) with which we just have to learn to live. In September of the same year, the eminent neurophysiologist John Eccles reaffirmed at the Vatican Conference on Consciousness his reasoned conviction as a scientist, in line with physiological tradition, that consciousness is totally superfluous from the standpoint of neuroscience. But then, expressing what many of us, nevertheless, felt, he added, "I do not believe this story, of course, but I do not know the logical answer" (Eccles, 1966, p. 248). Finding this logical answer was close at hand and would be the key factor in making possible the cognitive revolution as well as Eccles's own notable campaign, embarked on shortly afterward, extolling "psycho–physical interaction."

By 1971 it already was clear that many psychologists had come to recognize that their discipline was in the process of a major paradigm shift, in which behaviorism was being replaced by an opposing new mentalism or cognitivism (Matson, 1971; Palermo, 1971; Segal & Lachman, 1972). Thus, the revisionary concepts of the new paradigm—those concepts that finally broke the materialist logic, in which science had been locked for more than 200 years—must by then not only have been introduced but have become sufficiently clear and convincing to cause mainstream psychology to start swinging its support to the new mentalism. During the interim, therefore, between 1964 and 1971, something must have happened to reveal the long-sought logical answer to the baffling impasse over consciousness and its role in science.

Key Factor

What happened, I believe, was the discovery that (a) the traditional logic by which consciousness had been excluded from scientific explanation and which supposedly was closed, complete and incontestable, was in fact basically flawed or incomplete and (b) this inadequacy could be rectified through a different form of causal explanation. An alternative (bidirectional, top-down as well as bottom-up) form of causal determinism was perceived that put mind and consciousness in a functionally interactive, nonreductive, and ineliminable causal role (Popper, 1972; Sperry, 1964, 1965), thus breaking the long-standing impasse and irreconcilable contradiction of the mind–brain paradox.

The reason why this particular attempt to legitimize consciousness succeeded, whereas innumerable others had failed, lies in the use of a quite different approach. Previous efforts had stayed within the traditional reference frame, attempting to insert consciousness within the chains of causation already covered in the brain–behavior sciences, for example, at synaptic junctions between brain cells (Eccles, 1953). By contrast, the successful effort preserved intact the lower level chains of causation already dealt with in science and simply encompassed or embed-

ded them in a higher level (yet-to-be-described) cognitive system of cerebral processing. In this way, subjectively experienced conscious qualities, viewed as irreducible emergent dynamics of brain processing, could be given objective interactive causal influence without contradicting the earlier gains of science. In other words, success was attained only by changing the rules of the game, that is, by inventing a different paradigm for scientific causal explanation.

Notably, this same seven-year period is also marked by a second extraordinary polar shift in the prevailing mainstream view regarding another age-old controversy, the debate over wholism versus reductionism. After various ups and downs since the late 19th century, reductionism rose to a new high in the mid 1960s. Referred to in historical perspective as a "reductionist euphoria" (Nagel, 1971), it was bolstered especially by successes in molecular biology (Crick, 1966). This wave of extreme reductionism soon gave way, however, to a new outburst of wholism, with an acceptance of the concept of the irreducible whole (Checkland, 1981) that still continues today in what appears to be an all-time high for wholism in the long history of this polemic.

In my present analysis, both of these shifts—to mentalism and to wholism—are interlinked, tied to, and dependent on the revised model for causal determinism. Both depend on the causal reality of irreducible emergent phenomena that interact as wholes at their own macro-level and in the process carry their embedded constituents along a space–time course determined by emergent interaction at the higher level. Subjective agency may thus be viewed as a special instance of downward control, a special case of emergent causality in the reciprocal up–down paradigm for causal control.

Faced with the question of which of the two alternate views of causation, the old one-way or the new two-way model, might be the more valid, mainstream psychology, in a move involving hundreds or thousands of critical specialist minds, viewing the issue from all different subdisciplinary angles, chose collectively to switch from the traditional one-way tenets of behaviorism to the bidirectional views of the new mentalism. Many reasons supporting this choice can now be seen that, without going into detail, add up to the fact that much is gained and nothing is lost (as traditional microdeterminism per se is preserved). In briefest possible terms, the new double-way model combines traditional bottom-up microdeterminism with novel principles of emergent, top-down macro and mental causation (Dewan, 1976; Natsoulas, 1987; Popper & Eccles, 1977; Ripley, 1984; Rottschaefer, 1987; Sperry, 1964, 1991a, 1991b).

A strengthened concept of the irreducible whole is provided, including the demonstration that the spacing and timing of infrastructural components is in itself causative. In any but perhaps the most ultra simple of hierarchic systems, immense space–time complexities (same-level, as well as multinested interlevel pattern factors) rule out reduction to lower level laws, even in principle. This and an additional factor of the relativity of reference frames and other details are recently reviewed elsewhere (Sperry, 1991b). Illustrated in simple physical examples, such as the space–time trajectory of a molecule within a rolling wheel, a flowing eddy, wave action, a flying plane, and others, the existence and importance of downward causation for an adequate description of the natural order seems obvious (see Popper & Eccles, 1977, p. 209).

Psychology in the Lead?

The fact that the conceptual developments legitimizing consciousness apply also to emergent, macro, and holistic properties in general is fast becoming recognized in other disciplines. Following the mentalist changeover in psychology, which started in the 1960s and was established by the early 1970s, the new paradigm began to gain ground also in other fields. Never before in the history of science has there been such an outburst of new sciences, new worldviews, new visions of reality, new epistemologies, ontologies, and so on. The 1980s, especially, might well be called the decade of emerging new paradigms. We soon had the new "systems view of the world" (Laszlo, 1972), the new "worlds 2 & 3" of Popper (1972), the *Tao of Physics* (Capra, 1977), the "cognitive view of biology" and the new "science of qualities" (Goodwin, 1978), the *Aquarian Conspiracy* (Ferguson, 1980), the "new view of animal awareness" (D. R. Griffin, 1981), "new dialogue with nature" (Prigogine & Stengers, 1984), *The New Story of Science* (Augros & Stanciu, 1984), the "new philosophy of science" (Manicus & Secord, 1983), the "new evolutionary epistemology" (Greenberg & Tobach, 1988), *The Reenchantment of Science* (Griffin, 1988), *The Return to Cosmology* (Toulmin, 1982), and the list goes on.

All of these developments share one central thrust, namely, the rejection of traditional reductive (or microdeterminist) physicalism, heretofore accepted as a seemingly incontestable, complete, and coherent working paradigm for science, time tested over centuries. All of the above recent visions, outlooks, sciences, philosophies, and so on thus depend in final analysis on the presumed existence of some newly perceived flaw, incompleteness, or inadequacy in the traditional microdeterminist reasoning. We yet know of only one such flaw that would qualify, namely, that corrected by the concept of *emergent determinism,* as it was invoked in changing the causal status of consciousness. Microdeterminist reasoning in itself is not rejected, only the longtime assumption that it gives a complete and sufficient account. The day-to-day practice, methodology, and previously proven potentials of science are little changed. Nothing is lost and a whole new outlook on existence is gained.

Toward a High-Quality Sustainable World

The second part of my thesis, the promise, calls for a change of mind-set. We go back to Skinner's concern about making it to another APA centennial. Most of the foregoing is dwarfed by the question of survival, fast be-

coming the overriding imperative of our times, a "cause of all causes which, should it fail, all others go with it." Nothing in science today is of more basic importance than the effort to save science and all the other hard-won legacies of eons of evolution.

By now it is widely agreed that what is needed to remedy our present self-destructive course is going to involve major changes worldwide in human thinking and behavior. What discipline is in a better position or better qualified than behavioral science to point out what has gone wrong and provide sound remedial proposals—especially, given psychology's new worldview? For the first time, the cognitive–mentalist paradigm now makes possible a science-based approach to Global Forum type questions, such as "What kind of world do we want and what must we do to get there?" A new approach can be seen to ultimate moral issues, such as "What ideals best guide existence on planet Earth?" and "What constitutes the highest measure for right and wrong and social justice?" What follows illustrates some of the answers that appear to logically flow from the new outlook, along with corresponding logistics for a possible way out of our global predicament. They are expressed here in language not so much for fellow scientists as for the informed public and religious and political leaders whose understanding is most needed. Any directives in this realm are always debatable. At least, however, they give a possible start, providing a target to aim at.

The bottom-line message is as follows: We can now look to science to save the world, not through new improved technology, green revolutions, and the like (which only stave off and thereby magnify the eventual downfall) but instead by providing more realistic and sustainable beliefs and values to live and govern by. This message is not new, but it received rather short shrift from both scientists and ethicists when voiced initially (Sperry, 1972) in opposition to the then-prevailing science–values antithesis (Bixenstine, 1976; Edel, 1980). The value–belief arguments still hold, however, and current ambient attitudes seem more receptive.

Science, Values, and Survival

Today's mounting global ills will not be cured merely by applying more or better science and technology. Despite the marvels and apparent successes of science and technology, the gains are typically offset by the ever-expanding demands of a growing human population. Amidst rising population pressures, almost anything that enables more people to fare or thrive better—a new energy source, an aqueduct, another mass transit system, or even environmental reform—inevitably has the long-term result of a further escalation in our collective problems. Until population is stabilized, this vicious spiral paradox means that many seemingly desirable innovations with obvious short-term benefits just serve in the long run to put us deeper and deeper into a no-win position. Thus, slowly but surely, our civilization becomes ever more deeply enmeshed in a vicious spiral of mounting population, pollution, energy demands, environmental degradation, urban overcrowding and associated crime, homelessness, and hopelessness. With one thing reinforcing another, we become more and more firmly entrapped year by year.

What is needed to break this vicious spiral is a basic revision worldwide in human life-styles, aims, and attitudes, with redirection of social values and policy toward more long-term priorities that will preserve an evolving quality of life for future generations. A major reconception of the human venture is called for, a higher overarching perspective including ultimate goals and values, or as Einstein put it in reference to atomic power, "We need a new way of thinking if mankind is to survive"(cited in Clark, 1972, p. 717).

The new way of thinking, spawned by the cognitive (consciousness) revolution, shows strong promise in this direction. Reversing previous doctrine in science, the new paradigm affirms that the world we live in is driven not solely by mindless physical forces but, more crucially, by subjective human values. Human values become the underlying key to world change (Sperry, 1972, 1991a). In large part, the "battle to save the planet" becomes a battle over values.

The reason conventional values are not working today and have been driving our entire ecosystem toward collapse is because the starting assumptions are wrong for modern times. Human values are not absolute; they are not immutably prefixed by natural law or divine ordination. Human values by nature are evolutionary, interrelated, and conditional on the context in which they evolve (Pugh, 1977). To cling to unchanging values in a rapidly changing world can be fatal.

For centuries it has been the starting assumption that because human life is special, even sacred, the more people the better. "Go forth and multiply and take dominion. . ." was morally good at the time the scriptures were written. Two thousand years later, however, with the global situation reversed and an exploding world population with its multiform side effects threatening to destroy everything we value, it follows that because human life is precious, even sacred, less is better. "Retract and multiply less" becomes today's prime imperative. Such an inescapable reversal in our basic starting assumptions overturns an entire complex of long-revered, centuries-old tradition. Today's world calls for a whole new, higher outlook, with moral convictions that can override long-cherished value systems of the past, including long-esteemed traits deeply inherent in human nature itself but evolved without regard for the projected effects in today's kind of world. A more far-sighted vision is required for what it means to be humane.

Considering the massive carryover and long-term momentum in world population growth and assuming that ecologic irreversabilities plus social-system breakdowns are bound to occur well in advance of the final crunch, there may be much less time than we think. Twenty-five years ago we could still see a choice: Either adopt new, more sustainable values by foresight or have them forced by the mounting intolerabilities in living conditions (Sperry, 1972). Today, almost everywhere we

turn, the signs of overload, overcrowding, and intolerability are showing. Rising demands for subsistence in a direly depleted, degraded ecosphere are not the sole concern. In numerous subtle and unsubtle ways overpopulation tends to desensitize humanity and demean the individual person as increasingly expendable. Our sense of the specialness of human life, its meaning, singular worth, dignity, and wonder undergoes an insidious, unobtrusive but inexorable erosion to which our inherent human nature is particularly vulnerable. The process is so slow and the habituation capacity of the human brain so great that the adverse trends, spread over decades or even generations, tend to be taken for granted.

Instead of our longtime social evasion of sensitive population issues, we need intensive study and open debate toward informed views of what optimal population levels might be, regionally and globally, and what ideals to strive for in an overall guiding plan for existence on planet Earth. We urgently need bright new utopian goals we can at least aim for, instead of drifting further with outdated guidelines of a distant past.

It is important to remember that the more rarity, diversity, and contrast in our lives and in the world we live in, the greater the value and meaning. A world overrun, dominated by, and designed to maximize, equalize, and homogenize the "human carrying capacity" automatically degrades and demeans human life. We all tend to adjust to our own personal "baseline of happiness," below which life is depressing and above which it is rosy. Our baselines do not need to be all identical and equalized; the proven benefits of biodiversity do not stop at the human social order.

The overall immensity and many facets of the global rescue effort we now face, environmentally and in social and moral priorities, not to mention the international legislation needed to implement and secure the various reforms, add up to a most formidable task. When we add in the urgency now required to ensure a decent viable ecosphere, the hurdle seems almost insurmountable.

We are well past the point at which we can leave to the next few generations the type of ecosphere that they deserve or that we inherited. The increasingly hard choices ahead will further pit growing human needs against the rest of nature. Decisions not to have additional much-desired children, to forego lucrative industrial profits, and to abandon cherished livelihoods, for example, might all come more readily were they reinforced by the pressure of a public moral sense, backed by the power of a religiouslike conviction. In short, a noncatastrophic outcome to what has seemed a losing battle would appear to demand nothing short of a rapid conversion of all humankind to a changed sense of the sacred, a changed sense of ultimate value and the highest good. Such a shift at the very top would then condition the entire hierarchy of social values and thus tend to drive all the other reforms.

Science-Consistent Guidelines

Aside from the urgency factor, some of us see a possible ray of hope in the outlook now emerging from the consciousness–cognitive revolution in science. A new way of thinking and perceiving that integrates mind and matter, facts and values, and religion and science brings more realistic insights into the kinds of forces that made and move the universe and created humankind. A deep moral basis is provided for environmentalism, population balance, and other measures that would preserve and enhance our world, instead of destroying it. Humanity's creator becomes universalized in the vast interwoven fabric of the grand overall design of all evolving nature, with special focus on our own biosphere. The cosmic forces of creation become inextricably interfused with creation itself. Evolution, driven by emergent and subjective dynamics from above downward as well as from below upward, becomes a gradual emergence of increased directedness, purpose, and meaning among the forces that move and govern living things.

The highest good is seen in an ever-evolving quality of existence, with a continuing open-ended future as a sine qua non for preserving higher meaning. The sanctity of human life is perceived in a framework in which the very definition of human rights includes and depends on the rights and welfare of coming generations (Sperry, 1991a). Perspectives of this kind, based in the credibility and universality of science and taken as a common core for human value–belief systems, might prove an acceptable foundation at the United Nations on which to build a system of world law and justice and at the same time help to arouse a deep sense of outrage at what modern humanity is doing to itself and its future generations.

The promise of the cognitive revolution is multiform, but in the context of today's global ills and our imperiled future it may be seen to rest in its bringing to science a higher role and level of meaning, one that uses the emergent properties of specialized brain processes to offer new beliefs and value systems for the 21st century.

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