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Holding Course Amid Shifting Paradigms

by Roger W. Sperry

I once suggested that the 1980s might well be called "the decade of emerging new paradigms". This semi-serious assessment refers to the explosive outburst during this period of new worldviews, new "visions of reality", "new sciences" (of mind, of life, of qualities, wholeness . . .), new epistemologies, ontologies and what not. Beyond a growing sense that we are in a period of fundamental ideologic change, we yet lack any consensus regarding the exact nature of what this change is, or its cause, meaning, or where it may be leading. It is in the context of this unprecedented upsurge in novel world outlooks and the associated flux in shifting and emerging paradigms that I try to support a case for holding firm to a scientific view of reality that we already have–specifically, the view spawned some 20 years ago in the widely documented, so-called cognitive, consciousness or mentalist revolution of the 1970s (Baars, 1986, Dember, 1974, Gardner, 1985, Matson, 1971, Palermo, 1971, Sperry, 1987).

Following an era of some two centuries or more of "scientific materialism", the recent turnabout in the conception and treatment of the conscious mind has vastly transformed previous scientific descriptions of ourselves and the world. A changed way of thinking, explaining, and understanding is instilled. New principles of cognitive and emergent causation supersede the older atomism, mechanism and value-empty determinism of prior physicalist views, and affirm human values to be today the most strategically powerful driving force governing the course of world events–the key to our global predicament and its solution.

Described as "a virtual Copernican Revolution" (Manicas and Secord, 1983) and a "reenchantment of science" (Griffin, 1988), among other things, the new outlook most assuredly calls now for a global mind change, a thorough-going shift to a new value-belief system, new transcendent guidelines,

life goals, and new ways of thinking and living. Upholding a changed scientific interpretation of the creative forces that made and move the universe, it yields a changed set of answers to some of humanity's deepest questions. Intrinsic evolutionary directives provide an ultimate moral-spiritual basis for environmentalism and wilderness values, population balance, protecting the rights and welfare of future generations, and for other measures which would serve to help insure a high-quality, sustainable world with an ever-evolving future. Implemented worldwide (through the United Nations, for example), the resulting type of global mind change would go far to rectify today's self-destructive trends and to preserve and enhance the evolving quality of the biosphere.

Even so, examination of the underlying conceptual developments behind this sweeping paradigm turnaround does not, I believe, encourage hope for a continuing further shift in wished-for directions that might, for example, provide some sort of supernatural transcendence or afterlife for the conscious self. In other words, I think today's new trends toward "wholeness", "subjectivity", "qualities", and so on, do not presage a further degree of general loosening or change in the conceptual foundations of mainstream science–nor imply either that science ought hereon to be viewed as "enculturated" after some two centuries of common-sense understanding that if there is any enterprise in the human venture that stands out as being relatively free of cultural or other conceptual bias, it is science.

At least that is the position I try to support and recently expressed as follows:

> *. . . our new acceptance in science of consciousness and subjectivity, the mental and cognitive, or spiritual does not–as frequently inferred–open the doors of science to the supernatural, the mystical, the paranormal, the occult, the otherworldly–nor, in short, to any form of unembodied mind or spirit. The strength and promise of the new macromental outlook is in just the opposite, that is, in taking our ultimate guideline beliefs, and resultant social values out of the realm of the supernatural and otherworldly uncertainties and grounding them in a more realistic realm of knowledge and truth, consistent with science and empiric verification. (Sperry, 1991a, p. 255)*

This being an area, however, where final answers still lie far beyond us, my aim in what follows is simply to explain a possible analytic interpretation of the recent outburst of new approaches in science and its conceptual foundations along with some supporting considerations–not with the idea that these lead to any final conclusion, but merely in hope that these factors and the related arguments may be better recognized and taken into account in further appraisals of the many pros and cons.

Introductory Resumé

In brief overview, the principal reason I think the current wave of paradigm shifts and new thinking in science is not apt to continue into a further stage of a more extreme brand of metaphysical reality is that most of these recent trends can be traced to, and appear to be best viewed as outcomes of, the consciousness revolution that immediately preceded them. If this is so, they are then dependent upon an interactionist model of the mind-brain relation which would logically rule out the existence or transmission of conscious experience in a disembodied state. More specifically, our new treatment of the contents of subjective experience established by the 1970s' cognitive revolution is based upon the idea that conscious mental states are emergent properties of brain processes. As such, any separate existence apart from the living functioning brain, of which they are dynamic properties, would seem to be a logical impossibility–as would also their manifestation, expression, or transmission in phenomena such as telepathy, reincarnation, channeling, clairvoyance, psychokinesis, and such like.

In this view, science, during the past two and a half decades, has already undergone a major corrective transformation in its conceptual foundations. The result, as I see it, places basic science and its conceptual approach in a more complete, coherent and stable state today than was the case with its preceding reductive physicalism or materialism, which itself has been a paradigm of unquestioned spectacular success in many ways, and appeared to be irrefutable for more than two centuries.

Dependence Upon Special Interpretation

My case for holding to, and working with, the newly defined scientific paradigm that we already have is based on a particular analysis and interpretation of both the cognitive revolution and also the current boom in emerging new paradigms. It is an interpretation that is definitely open to correction, with some half dozen or so competing alternative accounts currently being proposed for these same worldview developments. What follows, therefore, becomes in large part an attempt to support and justify this special interpretation in the light of various contested alternatives. In order to judge its relative credibility, it is essential that we start from an accurate understanding, which in the past has not always been easy. The following account, spelled out in greater detail than elsewhere and expressed largely in nonspecialist terminology, may well appear to some readers to be overly simple and often redundant. The key concepts, however, though quite straightforward and obvious once they have been grasped, nevertheless do

not fit into the traditional philosophic dichotomies with which we are familiar and, for this and related reasons, already have a long history of misinterpretation (see Natsoulas, 1987, Ripley, 1984, Sperry, 1991b, 1992).

In a time when it has become common to observe that there are almost as many theories of consciousness as people writing on the subject, it is important to note, first, that the interpretation defended here is not just another individual opinion. Rather it represents the mainstream working conceptual framework, over the past twenty years, for a whole discipline of science, that which specializes in mind and behavior. We thus deal not so much with philosophic opinion as with the factual recorded history of a paradigm shift. The leading question is not whether mentalism or materialism may ultimately be correct, or reductionism or holism and so on, though these and related concerns are directly involved. Primarily, however, the question is one of factual historical record, "What happened in psychology to cause the 1970s' shift from behaviorism to mentalism or cognitivism?"

The answer I arrive at will attribute the shift toward cognitivism–and also, therefore, the present-day trends toward "wholeness", irreducibility and subjectivity–to conceptual developments in the mind-brain, behavioral and cognitive sciences. It is an answer that largely by-passes the "new physics", Bell's theorem and "nonlocality" (see Klotz, 1988), and also ecologic interconnectedness, Whiteheadian "process" philosophy, and various other things to which these same trends have also been ascribed. This includes general systems theory, information theory, philosophic realism, structuralism, computer science, and nonlinear dynamics, to mention just some of the other alleged sources. Many of these alternatives undoubtedly helped contribute to today's outlook in various secondary, supportive, reinforcing, and/or sociologic roles. In my analysis, however, the critical key factor was the overthrow of the determinist logic of traditional reductive physicalism with its centuries-old reasoning that formerly had been taken to rule out any real functional or causal role for the mind or consciousness.

I assume throughout that it is now an agreed fact of history that behavioral science in the 1970s underwent a major paradigm shift in which long-dominant behaviorist doctrine denouncing mentalistic explanations gave way to a new cognitivism, and that this involved a diametric turnabout in the explanatory status of conscious mental constructs. Conscious awareness and all contents of subjective experience had previously been banned from the explanations of science on the grounds that, in addition to formidable methodologic difficulties, the materialist paradigm already provided a complete, closed, and coherent system. In theory and in principle, materialist doctrine left no place for conscious or mental forces, and it had absolutely no need or use for them. Their inclusion, furthermore, would seemingly

have to violate the conservation of energy and other established laws. "Mental states cannot interact with physical states", or "Mind does not move matter" was the long-accepted verdict, and "No physical action waits on anything but another physical action." Nevertheless, in the early 1970s after a half century of strict behaviorist renunciation, conscious subjective states quite suddenly, "almost explosively" (Pylyshyn, 1973), gained acceptance in mainstream behavioral science as causally interactive agents, legitimate for scientific explanation of conscious behavior and its evolution (Baars, 1986, Dember, 1974, Gardner, 1985, Matson, 1971, Palermo, 1971, Sperry, 1987). In my interpretation the achievement of this long-delayed breakthrough was finally effected only through recourse to a different form of causal determinism. In other words, it was achieved only by making a change in the basic ground rules of scientific explanation.

A Modified Form of Causal Determinism

In the traditional atomistic or "microdeterministic" view of science, everything is determined from below upward following the course of evolution. In this view, brain states determine mental states, but not vice versa. In the new view, however, things are determined reciprocally, not only from lower levels upward, but also from above downward. In the reciprocal "two-way" or bidirectional model, a molecule, for example, rather than being governed solely by its atomic make-up, becomes also the "master of its inner atoms" and electrons. In chemical interactions the space-time course of its atomic components is determined by the overall configurational properties of the molecule as a whole, as well as the other way around (Sperry, 1964). This is illustrated, for example, in the often very different chemical properties of mirror image forms of the same molecule. In reference to brain function

> *the simpler electric, atomic, molecular, and cellular forces and laws, though still present and operating, have been superseded by the configurational forces of higher-level mechanisms. . . . these include the powers of perception, cognition, reason, judgment, and the like, the operational, causal effects and forces of which are equally or more potent in brain dynamics than are the outclassed inner chemical forces. (Sperry, 1964, p. 20)*

Thus the traditional one-way "bottom-up" view, based in a heretofore supposedly closed, complete scheme for describing the entire natural order including brains, was perceived in the new outlook to have a flaw or inadequacy in its one-way logic that omitted the downward control. A shortcoming was perceived that left an opening by which conscious subjective experi-

ence might be included in a causal interactive role (Popper, 1972, Sperry, 1965).

By combining the old "bottom-up" atomistic determinism with an added concept of "top-down emergent determinism", a way was found at long last by which subjective causality might be included within the classic objective account of science. Moreover, the new bidirectional approach made this possible without any loss in the many proven benefits of the conventional one-way approach (except, of course, for former assumptions that materialist determinism had been a logically airtight and complete system). In the reformed scheme, the microdeterminist chains of causation already covered in the brain-behavioral and other sciences need not be disrupted, intervened or disposed of. Mostly they are maintained in their existing form and simply surrounded, enveloped, or "supervened" by higher-level cerebral systems. The resultant downward causal effects are evidenced not in a reordering of events within the local details of the brain process, but in the way the lower-level components are ordered relative to things outside the given cerebral process.

The bidirectional emergent interaction model places emergent properties in a stronger role. Their irreducibility is demonstrated, as is their downward control over lower-level components. Their evolution as novel causal entities is held to introduce into the cosmos (and to science) new control phenomena and forces in their own form and in their own right. Inclusion of both the bottom-up plus the top-down type of inter-level determinism is claimed to be necessary in order to obtain a complete picture of (causal) reality. This double-way, reciprocal form of causal determinism applies not only within the brain, but throughout nature to emergent properties in general. It follows accordingly that traditional "scientific materialism" as applied throughout the sciences has been in error all along. For, in its exclusive atomistic, reductive physicalist approach, it has logically excluded not only mental but also, in principle, all autonomous macro emergent or holistic causation. Instead, it has made these all reducible to the elemental forces of physics and eventually, in principle, to an even more elemental "theory of everything".

For neuroscience, acceptance of mental causation in the above form does not imply any alterations within the already described chains of neuronal causation–as did, for example, trying to insert conscious influences through "quantum jump" effects at synaptic junctions between brain cells, attempted unsuccessfully in the past by Arthur Compton, John Eccles (1953, 1992), and many others. Instead, consciousness is inserted within higher (cognitive) domains of brain processing, which are as yet neither described nor understood (Sperry, 1965). Mental states, as they successively

emerge, for example in a train of thought, are conceived to interact functionally, as emergent wholes, at their own cognitive level in a progression governed by its own special mental dynamics. These higher-level yet-to-be-discovered dynamics of mental progression are presumed to be determined by emergent network properties interacting as irreducible entities, and as subjectively experienced. The dynamics and laws for causal progression at the mental or cognitive level are thus quite different from those in the lower-level neurophysiology.

Such a sequence of higher-level cognitive dynamics exerts concomitant downward control over its neurocellular, molecular, atomic, subatomic and other embedded and enveloped constituents by programming their schedule and course of activation–again, as seen from outside the system and thus without disrupting the laws of microchain causation within these embedded lower-level components. At the same time, as traditionally assumed, the higher-level mental dynamics are also reciprocally determined by, and dependent upon, their lower-level neurocellular, biophysical, chemical, and other components. We are not yet at this date in a position to visualize in detailed or concrete form just how the emergent cognitive patterns might operate as functional wholes in neural network dynamics. That they nevertheless do, however, is strongly indicated in several lines of evidence, such as that from gestalt psychology. What we subjectively perceive, feel or remember, as demonstrated in early gestalt studies, can be shown to depend on the gestalt, pattern or configuration of the neurocellular elements involved, as much as and, in some contexts, more than it depends on which particular neural elements carry the pattern. Subjective meaning is thought to be acquired on the so-called "functionalist" principles of modern computational philosophy (Fodor, 1981, Gardner, 1985), involving interaction of these brain-process gestalts with one another as wholes, and also with the ongoing contextual matrix of network dynamics (Sperry, 1952)–just as a word may acquire different meanings in different sentences and contexts.

Our current "macromental" model of causal determinism is actually a micro plus macro plus mental model, in which emphasis is given to the new macro and mental features. The mental is a special instance of the macro–but sufficiently special to warrant separate mention. In this "double-way" bidirectional model, neither of the reciprocal upward and downward systems of "causal" control are of the common single-level, sequential type of causation ordinarily thought of as a cause-effect sequence. Both the upward and downward control systems are exerted continuously and concomitantly over time during a given sequence of cognitive processing. It is important to note further that these inter-level upward and downward forms of determinism are not symmetric, but quite different in kind. Thus the two counter-flow

control systems do not collide, conflict, or in any way counteract each other.

As indicated above, a relativity factor also is involved. The programming influence of the mental on the lower-level constituents is not evident from within the given cognitive brain process itself, where the known laws of neuroscience still apply. Relative to the rest of the organism and the outside world, however, the programming of the constituent neurocellular activation is determined also, and more prominently, by the surround of higher-level cognitive dynamics, with the higher-level process carrying the lower-level elements. This idea has been simply demonstrated in what has been called "the rolling wheel analogy", in which it can been seen that a wheel rolling downhill carries along its embedded molecules and atoms "regardless of whether the individual molecules and atoms happen to like it or not" (Sperry, 1969). Each individual molecule is governed in the usual physiochemical manner relative to neighboring events within the wheel. Relative to the rest of the world, however, the behavior of the molecule is determined more prominently by the macro properties of the wheel as a whole. More than a mere shift in frame of reference (Vandervert, 1991), the inclusion of both frames of reference for describing causation takes us from the former incomplete reductionist paradigm to the more complete emergent interactionist, neomental, or "macromental" position.

The new model involves an added emphasis on the space-time or pattern factors in causation as opposed to the material, physical factors. The space-time patterning of component entities, in and of itself, is endowed with causal efficacy. The collective spatiotemporal arrangement of physical masses, particles, forces, fields, and so on becomes in itself causal, with effects not accountable for in terms of the lower-level laws. In any but perhaps the most ultra simple cases, these space-time interrelations are far too complex (over and above those of the three-body problem) to be explainable by, or reducible to, existing laws for lower-level interaction. These critical space-time factors are thus lost in attempts to reduce lawful explanations at a given level into laws that apply to the lower-level components. In contradiction to continuing contentions that the causal paradigm of classical Newtonian physics allows no room for consciousness (for example, Stapp, 1991, Popper, 1972) the above described solution for inserting the causal influence of mental states in brain function is achieved within the general Newtonian framework.

The Turning Point: Relevant Chronology

To more precisely distinguish the interpretation supported here, it will help, first, to further extend the historical background beyond the disciplinary level of mainstream doctrine to include that of individual personal precursor views that appeared in the decade prior to the 1970s' turnaround in mainstream psychology. Second, we need also to recognize that the closely involved reductionist-wholist debate has an extremely long history, traced by some philosophers back to Aristotle and Democritus. This debate is still going strong today. The issues therefore are by no means simple, or easily settled. For the historical background, there is thus good reason to focus first of all not on any particular individual arguments but on the prevailing majority view and its fluctuations in recent decades.

Following a prolonged period in which scientific reductionism and "logical positivism" had been in favor, the majority view in the 1920s underwent a strong swing toward recognition of emergence and holism, particularly in writings on emergent evolution (such as Morgan, 1923, Ritter, 1919, Smuts, 1926). By the 1940s and '50s, however, emergent-wholist theory again was gradually losing ground to reductionism and by the early 1960s had sunk to an extreme low, overwhelmed by a strong pervasive upsurge of reductionism, occasioned in part by continued successes in physics but generated especially by dramatic new advances in molecular biology. Thus, by the early 1960s, reductionism again reigned–not only in physics (Feynman, 1963), but also in biochemistry (Platt, 1959), molecular biology (Crick, 1966), psychology (Skinner, 1964), information theory (Simon, 1962), philosophy, (Armstrong, 1968, Dennett, 1969, Hook, 1960, Klee, 1984, Putnam, 1960, Smart, 1963), and nearly everywhere–including even in gestalt psychology, the early prime stronghold of configurational theory (Khler, 1960). General Systems Theory also at this time was accepting reductionist logic as a basic structural principle (Bertalanffy, 1956, Sperry, 1991b).

This strong upswell of reductive physicalist thinking, described by philosopher Thomas Nagel (1971) as a "wave of reductionist euphoria", was soon again, however, to give way to an opposing wave of holism, emergence and "irreducibility" (for example, Bertalanffy, 1968, Koestler and Smythies, 1969, Laszlo, 1972, Pattee, 1973, Polanyi, 1968, Popper, 1972). This most recent wholist movement has since continued to burgeon into an extreme new high that still today is gaining further ground both within and outside science, extending even into cosmology (Harris, 1991), and a "postmodern" theology (Griffin, 1988). This latest mainstream swing from one extreme to the other, rather abrupt in terms of historical precedents, poses a key question: "What happened that served to break the 1960s' wave of reductionism and turned it around into a general new all-time high for wholism, a devel-

opment so marked that today it prompts proposals for a new 'science of wholeness'?" (Harman, 1992). What was it that turned the "reductionist euphoria" of the 1960s into the current boom in holistic "new sciences"? Also, in this same period, what prompted the rise of "The New Philosophy of Science" (Manicas and Secord, 1983)? The logical answer, I believe, is found in the same conceptual developments that enabled the revolutionary turnabout in our understanding of consciousness.

The five-year period starting from about the mid 1960s thus becomes, in this analysis, a crucial turning point in the history of both the reductionist debate and also that of the mind-body relation. Secondarily, it also will be seen that this same period becomes a turning point as well for the fact-value or science-values dichotomy (Edel, 1980), and also for the ancient paradox of freewill and determinism (Deci, 1980). Further, it is these collective changes that, in our present view, are inferred to have set the stage for the subsequent rush of epistemic outbursts of the 1970s and '80s. In this interpretation, the current swing from reductionism to wholism has much in common with the concomitant swing from behaviorism to mentalism. Both shifts can be seen to be interlinked and inseparable. Both are dependent upon the new model of causality which includes "top-down" emergent determinism. The same modified concept that placed mental states in a causal role also refuted the adequacy of traditional "bottom-up" physicalism and gave emergent macro qualities in general (including the mental) a new irreducible causal status. This "flow of history" analysis, as I tend to think of it, accounts as well for the broad array of new epistemic trends of the past two decades, all of which appear to share in common the rejection of traditional materialism. Four major transformative developments visible in the recent literature are taken to be involved, all related, and all traceable, to origins in the same critical five-year period. These include

1) the diametric turnabout in the causal status of consciousness
2) the shift from extreme reductionism to extreme holism
3) a new recognition and wide acceptance of "top-down" emergent determinism
4) a sudden, still-continuing upsurge in radical new outlooks and paradigms in science and philosophy.

All four can be understood and accounted for in terms of the basic concepts required for the turnabout on consciousness.

This brings us to another critical point in my argument, namely, its dependence upon an assumption that the 1970s' changeover in mainstream psychology from behaviorism to cognitivism and my own similar shift to

mentalism were both effected on the same theoretical basis, that is, on the same shift to the same new mentalist paradigm. Support for this is twofold: first, it hardly seems plausible that the powerful, seemingly incontestable physicalist paradigm of science with its rigorous exclusion of mentalistic explanation–along with its behaviorist counterpart in psychology–could suddenly, after having successfully fended off all challenges for centuries, have been toppled twice within a few years by two different mentalist theories. The ruling dictum of the materialist era that mind does not interact with matter, and its time-tested reasoning, supposed to be logically cohesive, complete, and irrefutable, is hardly something in which one would expect to suddenly find two separate errors. This alone appears to justify the assumption that in both instances the rational basis behind the new mentalist/cognitive thinking has to be, in essence, one and the same.

Second, the assumption gains added support from the historical record and chronologic correlations evident in the following brief outline of the early expressions of the new "mentalism".

- 1964 An initial brief statement of downward causation in application to evolution, molecular and organismal behavior, including nonreductive downward control of the mental over the neuronal in brain function (Sperry, 1964, pp. 2, 20). This posed a direct challenge to the then-prevailing reductionist outlook and came at a time well before the onset of any awareness of a coming paradigm shift (for example Eccles, 1966, Feigl, 1967, Nagel, 1971, Rogers, 1964, Skinner, 1964).

- 1965 First full presentations (Popper, 1972, Sperry, 1965). The new outlook was described by Karl Popper as "a solution to . . . the classical Cartesian body-mind problem", explaining "interaction of mental and physical states" and bringing "a different view of the world". I presented it as "An Alternative Mentalist Position" that "restores the mind to the brain of objective science", and "a long sought unifying view" that "would eliminate the old dualistic confusions, dichotomies, and paradoxes"; also as a scheme that gives "plenty of free will, provided we think of free will as self-determination", and finally as an "objective explanatory model of brain function that neither contradicts nor degrades but affirms age-old humanistic values". The mentalist/cognitive paradigm is still viewed today in very much these same terms.

- 1966 Wide exposure in a reprinting in The *Bulletin of the Atomic Scientists* (Sperry, 1965) instigated by biochemist-futurist John Platt. This bulletin, with its famous "doomsday clock" and subtitle *Journal*

of Science and Public Affairs, gave very broad exposure in those years, not just among physicists.

- 1969 More specialized presentations: 1) in *Proceedings of the National Academy of Sciences* (Sperry, 1969a), later published in full 2) in *Psychological Review* (Sperry, 1969b); 3) in philosopher Marjorie Grene's international "Concepts of Mind" Workshop (Grene, 1974); and 4) in the 1969 *Proceedings of the Association for Research of Nervous and Mental Diseases, a Program on Perception and its Disorders* (Sperry, 1970a).
- 1970 *Critique in Psychological Review* by Dalbra Bindra (1970), and my response to Bindra (Sperry, 1970b) also in *Psychological Review* (perhaps these two combined were most influential in tipping the scales). By the following year publications in psychology were beginning to express growing awareness of a general paradigm shift (Palermo, 1971).

A competing concept, the "computer program analogy" of mental function, also could be said to qualify in respect to chronology, and is frequently cited as having had a strong influence in bringing about the consciousness revolution. Presented at length in a 1960 book by Miller, Galanter, and Pribram (1960) and more pointedly in a later text by Ulrich Neisser (1967), the computer analogy was surely influential in opening the way to a new appreciation of cognitive factors in a control role in brain function. The computer-program relation, however, can equally well be viewed, like most other physical phenomena, in traditional analytic reductive physicalist terms, and generally was so taken prior to the introduction of downward causation in the mid 1960s. In itself, the computer-program analogy does not demand a shift to mentalism, nor to a causal or emergent view of conscious experience, and it clearly had not done so by 1963-64 when the ongoing debates in psychology between behaviorists and phenomenologists (for example Koch, 1964, Rogers, 1964, Skinner, 1964, Wann, 1964) continued in the same vein as before, essentially unaffected by any new mentalism. Further, the impact of the volume by Miller et al., plus the influence of related work of this period with computers, information theory and Artificial Intelligence, had failed collectively to alter the basic "in-principle" reductionist position and thinking of leaders in the field (Simon, 1962).

The factors responsible for psychology's sudden swing to use of mentalistic explanation (Pylyshyn, 1973), following a half century of rigorous renunciation, were not clear at the time and still today remain subject to ongoing controversy. Mainstream psychologists tend to overlook emergent interaction and the above cluster of related developments in favor of various

others more directly affiliated with research programs and theory within psychology itself. As yet, however, there is no consensus. The various subfield groups still vie with one another in ascribing the origins to their own specialty (examples: Amsel, 1989, Baars, 1986, Bolles, 1990, Dember, 1974, Gardner, 1985, Matson, 1971, Palermo, 1971). In my estimation, the majority of these alternative views either fail to stand up in historical examination or they deal with subordinate theories of the behaviorist period which are not critical to behaviorism per se as an overarching paradigm making psychology consistent with neuroscience and the other natural sciences (Reese and Overton, 1972, Skinner, 1964).

Behaviorist doctrine, for example, was heavily invested, in its early stages, in conditioned reflex learning (Koch, 1964). This included reliance on pre-natal conditioning to an extent that the very concept of instinct as posited in European ethology (Lehrman, 1953, Lorenz, 1937) had become a term of derision. Behaviorism's denunciation of any inheritance of behavior traits was supported by abundant, seemingly unequivocal experimental evidence that the growth and formation of nerve connections is, by its very nature, entirely diffuse and nonselective (Hamburger, 1990, Weiss and Taylor, 1941). The case against instincts, however, was totally turned around in the early 1940s by new experiments showing that intricate inherited nerve networks can indeed be grown into the brain directly, unaided by learning, and organized with great precision through an elaborate scheme of genetically controlled chemical coding of individual cells (Sperry, 1951).

Soon after this, another serious flaw in behaviorist theory was pointed out by Karl Lashley (1951) in his critique of chained associations as a basis for serial order in behavior. Lashley used language as a main example, and this was reinforced by linguist Chomsky (1959) with an added suggestion that the deep structure of language is not learned, but inherited. Such inheritance, previously unthinkable, by the mid-1950s had become theoretically plausible as a result of the growing evidence of the high precision and complexity of inherent chemo-affinity factors in fetal brain organization (Sperry, 1956). Other theoretical thrusts of the behaviorist era, including the extreme peripheralism, the environmental or "empty organism" emphasis, and Hull's Stimulus-Response scheme for a comprehensive theory covering all behavior, also came into decline and helped contribute to a growing loss of confidence in the so-called behaviorist answers.

For present purposes, the main point to note here is that none of these kinds of theoretical setbacks, individually or collectively, served to overthrow behaviorism per se as a conceptual framework, a philosophy of science, or overriding metatheory that rejects introspective mentalistic explanations and restricts behavioral science, like the other natural sciences, to what

is objectively observable and measurable. Remaining "behaviorists" today defend their position with claims that the exclusion of mental constructs had been only a methodological principle. Actually at the time, and in harmony with brain research, physics, and the rest of science, it was much more than this. Behaviorist thinking, through the 1950s as in the rest of science, excluded any interactive influence of conscious subjective qualities on the course of physical brain function. Conscious states, that is, were held to be epiphenomenal, not causes of behavior (Skinner, 1964, Wann, 1964, p. 135).

Mind Merged with Matter: Is It Materialism? Dualism? Mentalism? Or? . . .

The new conception of mental states in a causal interactive role was classified by Popper (1972), and by many others since, as a "dualistic" solution. This was in accord with past terminology in which "mentalism" had traditionally been equated with dualism. In contrast, however, I have described this new form of mentalism from the start (Sperry, 1965) as a quite different intermediate position which is monistic, not dualistic. In my view, mental phenomena as dynamic emergent properties of physical brain states become inextricably interfused with, and thus inseparable from, their physiologic substrates. At the same time, they are taken to be distinguishable from the brain substrate in the way that an emergent property is distinguished from its infrastructure, even though it is critically dependent upon the dynamic spacing and timing of the component events. Though mental states, at present, are not observable or measurable, they are presumed, in principle, to be something accessible to eventual scientific description "like the interior of the Earth" (Sperry, 1969), with further advances in technology. It thus becomes a moot question as to whether this modified concept of a mental state as a dynamic emergent retaining its subjective quality or "raw feel" should now be called a "material" or a "mental" process.

Either way, the overall outcome is a coherent hierarchic view of nature with increasingly complex physical systems having diverse emergent properties which include the mental emergents of the brain-mind system, all part of a monistic natural order. The traditional difference between the physical and the mental (as subjectively perceived) is deliberately retained, but with these previously separate, dual realms now inextricably merged. Questions and opinions are continually raised as to whether this type of mind-brain solution ought to be called materialistic or mentalistic. It is only natural that persons with previous investments in one or the other should want to call it a modified form of their former position. Confirmed dualists Popper and Eccles (1977), for example, espoused it as dualistic "psychophysical interac-

tion", whereas I preferred to call it a nondualistic "new", "neo-" or "alternative" mentalism (Sperry, 1965). The latter better serves to distinguish the new features. It emphasizes the reductive physicalist errors of the past, and also the revolutionary, radically revised world-outlook and story the new solution brings to science. I have outlined elsewhere other reasons (as in Sperry, 1965, 1980, 1987, 1991b) why "mentalism" seems to me, overall, to be preferable to "materialism", at least from the standpoint of behavioral science.

About ten years after Popper and I had separately described this new solution to the mind-brain problem (Popper, 1972, Sperry, 1965), and some four years after its adoption by mainstream psychology in its new mentalist paradigm (Dember, 1974, Matson, 1971, Palermo, 1971), the same solution was rediscovered by philosopher Mario Bunge (1977, 1980), but renamed as a new "emergentist materialism"–with myself conveniently misclassified as a dualist, and psychology's shift to cognitivism not mentioned. This ongoing controversy over terminology has caused puzzlement and confusion from the start (Bindra, 1970, Sperry, 1970b). Psychologist Thomas Natsoulas (1987), specializing in the history of consciousness, correctly points out that the new answer blends together features from previously opposed solutions, and then, in reaction to its misclassification as "dualism", calls it a type of "physical monism". Certainly Bunge's "materialism" and Natsoulas' "physicalism" find more ready acceptance in modern science and philosophy than does "mentalism". In retrospect, it might accordingly have been wiser had I used an emergent materialist/physicalist label from the beginning. However, it still seems to me a mistake overall to abandon the age-old common-sense distinction between mind and matter, the mental and the physical. This basic common distinction long preceded the varied philosophic jargon and scientific terminology. The highly distinctive specialness of conscious states with their subjective qualities does not go away just because they are taken to be emergent properties of physical brain processes.

Background Assumptions

The views here outlined reflect a background mainly of experimental research in the brain-behavioral sciences, but undertaken initially with the riddle of consciousness as the ultimate guiding attraction, and accordingly with some heed to associated mind-brain philosophy (Trevarthen, 1991). In these days when it seems to be open season on theories of consciousness, it is still worth remembering that the brain-behavior sciences provide a rich and special source of direct, pertinent evidence regarding the nature of consciousness and its correlates and requisites. This includes many kinds of

variations in the comings, goings and quality shifts of consciousness in correlation with different forms of electrical, chemical and surgical intervention, changing brain states, different brain structures, innate anomalies, and so on and on. Any proposed theory should be, at the least, consistent with this accumulated mass of data.

The issue remains unproven as to whether everything is endowed from the start with an inner psychic or nouminous dimension (Berry, 1988) or whether, as is more commonly inferred, psychic experience is instead a relatively late achievement of evolution and confined to brain networks. Like most neuroscientists, I believe a wide collection of observations strongly favors the latter, such as the fact that consciousness is found not in the heart or the liver, but in the brain, where, in turn, it is associated not with all but with only certain cerebral systems. Further, these special cerebral systems, in turn, exhibit awareness selectively, in some states only and not others (such as dreamless sleep, coma, or epileptic seizures). Overall, the evidence of this kind has long been taken in neuroscience to rule out the central tenet of Whiteheadian and of recent "process" philosophy that attributes to most physical entities an inner mental or psychic dimension. The recent upsurge in the acceptance of consciousness, nevertheless, has had a reinvigorating effect in process philosophy where the change tends to be interpreted as vindication by modern science of the tenets of Whitehead (Berry, 1988, Birch and Cobb, 1981, Griffin, 1988). These panpsychic concepts of Whitehead and process philosophy, however, were around for decades earlier and actually played little or no part in the cognitive/consciousness revolution.

The secret of the mind-matter mystery thus appears in mind-brain science to narrow not only to the brain, but to certain select structures and processes within the brain which vary consistently in the evolutionary ladder. Color perception apparently exists in the tiny hummingbird brain, presumably with something similar to the same conscious color sensation we ourselves experience–probably also true for the pinhead brain of the honeybee and many insect species, at least in prototype. All in all there is growing reason to suspect that the secret trick for generating consciousness could turn out to be some relatively simple form of network processing or programming, something that computer-cognitive science may already be close to discovering. A remaining key question at present, however, is whether the infrastructural network components for the emergent subjective quality must be living. Or can subjective emergents be formed from a non-living infrastructure? In either case, one of the most profoundly important implications of the final answer regarding the generation of consciousness, once it is in, is bound to be its bearing on the other central question with which we deal

here, namely, "Is consciousness (however it is generated) causally interactive, or is it an acausal epiphenomenon? Is it consequential or inconsequential?"

The views expressed above come also from a background that is not particularly conducive to reliance on "deep intuitive inner knowing" as an alternative to the scientific mode. One learns, for example, of forms of insanity in which inner "voices", a radio, TV, or computer, or some other such fantasized inner delusion is defended with elaborate and quite rational inner logic. This and many other examples demonstrate the general principle that the mind's inner knowing and reasoning, left to itself, may arrive at all kinds of weird and wonderful convictions. The logical "computational" sequence of cerebral reasoning seems a relatively simple feature of information processing that may be much the same whether used to defend a scientific or an insane conclusion. The critical difference lies in how the inner mental conclusion checks out when tested by interaction in the outside "real" world.

The scientific method has been characterized and defined in a variety of ways. To me its real essence lies not in special cognitive features, types of conceptual organization, technological approaches, and such like, so much as in the insistence that any "truth" arrived at, via whatever inner cognitive processing, is not to be trusted until checked and double checked, by experiment or otherwise, for its consistency with outside reality. This checking process which occurs naturally in the course of ordinary behavior is assumed to be an important natural aspect of the evolution of mind. Science, however, formalizes and maximizes the principle in contrast to other avenues to "truth" such as inner revelation, authoritarian dogma, philosophy, or faith. Historically, this is how science got its start and has since proven itself whenever directly challenged by other modes of knowing. It is a view that puts science beyond the culturally dependent status claimed for it in the recent conjecturing of postmodern (sic), anti-foundationalist philosophy (Rorty, 1982). It lifts scientific reasoning out of the realm of conceptual contingencies of culture, tradition, metaphysics, and so on, to ground it directly in the interactions of reality itself.

A related assumption that the mind-brain system evolved within, and in close integration with, the outside real world, means also that subjective "common-sense" impressions acquire a fundamental reality status not easily undermined by philosophic conjecture or by scientific theorizing, including, for example, the weirdness of non-locality, Bell's theorem, wholesale instantaneous interconnectedness, an "observer-dependent reality", or other counter-intuitive figments of the "new physics"–that Einstein himself and other physicists could not accept (see Klotz, 1988). Like most biologists exposed to the study of evolution, I take a realist position that assumes a world exists out there regardless of whether I or anyone else happens to per-

ceive it. The laborious excavation of a giant ammonite or a large dinosaur femur from its cretaceous matrix leaves little patience with a philosophy that these and their world did not exist until our observation.

An Already Powerful Paradigm Made Stronger

Science, over some three hundred years, has proven itself against all rivals to be our most successful and effective means for explaining, understanding and for working in and with the world in which we live. More than any other approach–philosophic, religious, mystic or occult, or that of secular humanism, or of just plain common sense–science has succeeded in being able to "clear the mystery and show the way" in the realm of the natural world. All this success, however, is counterbalanced in that this same science has insisted, as its basic premise, that the entire universe, including the human psyche, is driven throughout solely by mindless physical forces of the most elemental kind. These elemental forces are inferred to rule a cosmos that is utterly indifferent, purposeless and fatalistic, devoid of any higher meaning, values, freedom of choice, or moral priority. The stark descriptions of science add up, from a human standpoint, to an overall life-view of "cosmic meaninglessness" (Provine, 1988). This bleak outlook, plus today's growing uneasiness about the kind of world into which an "age of science" seems to be leading, along with recent indications of emerging changes in our worldview presuppositions (Harman, 1980), collectively give good reason for intensive reexamination of the metaphysical (and also of the supposed physical) foundations of science.

Such reexamination in my own case has served mainly to freshen and further strengthen a general earlier impression that modern science, fortified with its recently modified concepts of consciousness and causation, is today stronger than ever, and that it provides the best route available to an understanding of the true nature and meaning of existence. I continue to see the key to long term, high quality survival to be in a shift worldwide to faith in the type of truth upheld by science (Sperry, 1972, 1991a). It cannot be overemphasized that in this conviction I do not refer to the traditional materialist science of the past two centuries, but rather to the new science spawned by the cognitive (consciousness) revolution of the 1970s with its revised principles of subjective and emergent causation, and top-down determinism. I am presuming further that these new principles, since their establishment in psychology, have gained sufficient ground in other disciplines that they now can be judged to represent the dominant majority view. In other words, what started as a revolution within a single discipline has become a revolution for all science.

Throughout the different sciences, previous inadequacies inherent in traditional materialism are increasingly being recognized and variously resolved within subdisciplinary specialties. Within the behavioral sciences, for example, the new treatment of mental states, applicable to the animal as well as human mind, promptly brought a more cognitive, mentalist approach in comparative psychology and ethology (Griffin, 1988)—not to mention strengthened "animal rights" concerns. It provided also a long-sought sound determinist basis for the cognitive, humanistic, and therapy-centered schools of psychology, plus other approaches involving introspection such as research on personality, values, motivation, and the like, proponents of which during the reign of behaviorism had been obliged to put up with second-class rating because they were "not scientific". The way was cleared as well for a return movement to so-called common-sense or "folk" psychology (impossible under behaviorism) and for the ascendance of a largely new cognitive science encompassing computer science, artificial intelligence (AI) and information theory in conjunction with cognitive psychology and cognitive neuroscience. Many participants with backgrounds in physics have sensed the makings of an emerging "new science" that stands in striking contrast to conventional reductive physicalism.

The bidirectional model of causal determinism, applicable to causal understanding in general, has found ready welcome also beyond psychology in biology, systems theory, evolutionary theory, and other disciplines including philosophy and theology. Systems theory, for example, since the mid 1960s has become a different entity, infused now with emergent interaction, irreducibility of the emergent whole (in principle as well as in practice), and down-level causal determinism, all implanted by the conceptual developments requisite for shifting conscious experience from a noncausal into a causally interactive role (Sperry, 1991b).

Of most interest, in respect to possible metaphysical or cultural bias in science, are those impacts that affect the overall scientific worldview as a whole, bringing changes that help, for example, to bridge the former "two cultures" gulf between the humanities and the sciences—changes of a kind that now enable, for the first time, a logical derivation of moral directives from the type of physical reality upheld by science. Especially critical is the changed treatment of human values, and also the changes in the age-old freewill-determinism paradox. Both of these are central and basic to concepts of the self, personal agency, intentionality, ethics and morality.

The long-established antithetic relation of science and values, known as the science-values or fact-value dichotomy (Bixenstine, 1976) and recognized to be one of the outstanding shortcomings of traditional physicalism, is today diametrically turned around. Subjective values, no longer treated as

being merely parallel or epiphenomenal to brain function, become instead causally interactive in the new treatment and thus qualify as legitimate causal constructs. Science no longer spurns values, nor is its cosmology value-free. According to the new mentalism, we are ruled not merely by the fundamental forces of physics, but also, and more critically, by human values. Human values, as indicated at the outset, become the most strategically powerful force shaping modern civilization, the key to our global predicament and its cure.

Today's turnaround in the traditional science-values dichotomy is effected, further, in that the new descriptions of non-human as well as human nature no longer eradicate the rich emergent macro phenomena and qualities we customarily value in our world by reducing them to the elemental forces of physics. All the higher emergent macro, mental, vital and social forces are now given their due as causal realities. In an additional corrective thrust, current views of the brain's methods for cognitive processing recognize a sequence of steps by which subjective moral values can be logically derived on the basis of scientific facts; that is, the old "naturalistic fallacy" is avoided (Rottschaefer, 1987, Sperry, 1985, 1988). Since the mid-1970s, it has become increasingly evident overall that we are in an entirely new era with respect to values (Edel, 1980). From an ethical or humanistic standpoint, the consciousness revolution might equally well be called also a "values revolution".

Another legendary problem with the physicalist paradigm has been its bothersome principle of complete causal determinism (or quantum "probabalism") in that such determinism directly contradicts our universal common sense impression that we possess freedom of will. The free will-determinism paradox is probably the most notoriously baffling riddle posed by scientific materialism and, from the humanistic standpoint, the most damaging, in that scientific determinism logically destroys any real purpose, intention or moral responsibility. Up through 1964 this age-old enigma was still being looked upon as a deep unfathomable paradox of nature, something we just have to learn to live with (Rogers, 1964). Today's mentalist doctrine provides a resolution of this old dilemma in an answer that preserves both determinism and free will, but each in a modified form (Deci, 1980, Sperry, 1965, 1980).

Free will is maintained, but not in a manner that makes us or our volitions completely free of all causation. This would make our decisions and behavior meaningless, reflecting mere random caprice, unaccountable and insignificant with no predictive reliability. This is not what we want, nor is it what we subjectively experience. What we experience, rather, is the capacity to do what we personally, voluntarily choose, wish, intend, or decide to do.

This kind of subjective power to determine what we say and do is exactly what is provided in our new mentalist view. A person's behavior is still determined, but not, as science previously asserted, by the brain's unalterable physico-chemical processes, nor by external environmental factors. Rather, what we cognitively will to do is determined by the higher-level complex cognitive properties of the conscious mind or self. The key determinants take the form of non-reductive emergent and subjective properties of the high-order brain processes of volition and intentionality. The "inexorable" laws of brain physics and chemistry are still important determinants, but, as a result of evolution, these lower-level forces are now controlled and programmed by the higher-level mental agents. Our behavior accordingly is mentally determined and moral responsibility is preserved.

Conclusion

Science today is very different from the science we knew 30 years ago. The change is not in the approach, methodology, or everyday practice of science, which are little affected. The change, rather, is in the type of truths and physical reality science upholds, and the projected picture of ourselves and the world. The natural order as posited by science is no longer, on the new terms, incompatible with human values or the most precious and sacred things in life (Byers, 1989). The new cosmology, embracing emergent causation, makes possible the derivation of transcendent moral guidelines from the worldview of mainstream science. The current outlook on existence supports a more biocentric, less anthropocentric "man is the measure of all things" morality. Context-dependent principles replace the moral absolutes of 2000 years ago, and social priorities emerge that are more realistic, sustainable, and more adequate for the type of world we face today. The result, in effect, is a new moral compass based in the credibility and universality of science. Being neutral and nonexclusive, it has exceptional potential for global acceptance by diverse ethnic, national and cultural constituents and can, if implemented soon enough, offer a humane, non-catastrophic way out of our current global crisis.

The one remaining outstanding negative feature of science, still not rectified in the new outlook, is the continued scientific renunciation of the existence of conscious experience in unembodied forms, thus denying the possibility of a conscious afterlife. The question of whether this is indeed a negative rather than positive feature (when all the pros and cons are rationally balanced out) remains open to debate. In an earlier, brief discussion of this and related problems (Sperry, 1992), I was convinced that an improved, more wise and sophisticated interpretation of existence and its meaning, in

terms of the new paradigm, might conceivably succeed in dispelling, through a higher level of understanding, the natural inherent human desire to continue in a conscious future, even after life.

This issue, however, and all others raised in these re-examinations of science, may not matter in the light of a very real and rapidly growing possibility that the enormous built-in momentum in today's global population explosion and the irreversibility in related ecologic degradation could now carry us and the ecosphere past "the point of no return". This mounting threat of total cosmic oblivion overrides today all other concerns, and overturns many ethico-moral imperatives that prevailed without question in the past. Traditional, national, ethnic, religious and cultural loyalties become subsidiary to survival. New higher moral perspectives of survival must now overrule even long-esteemed humanitarian traits which evolved in human nature itself, but without regard to the projected effects in today's kind of world. In the context of today's worsening global situation and our imperiled future, perhaps the most important feature of the described new outlook of science is its provision of a prescription for long term, high quality survival and a way out of our current global predicament.

Without going through the intervening logic, recently reviewed elsewhere (Sperry, 1991a), the type of global mind change and moral priorities that emerge may be inferred from a few of the more salient features, sketched in brief as follows: The implicit supreme plan for existence by which moral right and wrong are determined (Fletcher, 1987), traditionally imputed to divine intellect, is reconceived in terms of the overall design and upward thrust of evolving nature, with special focus on our own biosphere. Humanity's creator thus becomes the vast interwoven fabric of all evolving nature. The creative forces and creation itself become inextricably interfused, making it immoral, even sacrilegious, to degrade earthly existence or to treat it merely as a way station. The evolutionary process, no longer governed merely from below by chance gene mutations, becomes a gradual emergence of increased direction, purpose, and meaning among the forces that move and govern living things. An unpredictable, ever-evolving open-ended future becomes a sine qua non for higher meaning. The "highest good"–no longer reduced to subatomic physics or set apart in another, dualistic existence–works out to be an open-ended, ever-evolving quality of life and all existence, and includes protecting the "rights of the unborn" billions of the many generations hopefully to come.

In short, the working paradigm of science, that has proven itself to be tremendously successful for over two hundred years, has now been further rectified and improved in a manner that retains former strengths and corrects some serious humanistic weaknesses. Nothing is lost and we gain a

whole new and better way of perceiving and understanding ourselves and the world.

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