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In Defense of Mentalism and Emergent Interaction

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The mentalist mind-brain model is defended against alleged weaknesses. I argue that the perceived failings are based mostly on misintrpretation of mentalism and emergent interaction. Considering the paradigmatic concepts at issue and broad implications, I try to better clarify the misread mentalist view, adding more inclusive detail, relevant background, further analysis, and comparing its foundational concepts with those of the new cognitive paradigm in psychology. A changed "emergent interactionist" form of causation is posited that combines traditional microdetrminism with emergent "top-down" control. This emergent form of causation has wide application to causal explanation in general and is hypothesized to be the key common precursor for the consciousness (cognitive) revolution and subsequent boom in new worldviews, "systems thinking," emerging new paradigms, and other transformative developments of the 1970s and 1980s.

In dismissing my mentalistic mind-brain model in favor of an allegedly improved alternative, Vandervert (1991) is in good company. Ever since I shifted to an "alternative mentalist position," following almost three decades of adherence to the conventional tenets of behaviorism and materialism (Sperry, 1965), my modified concept of the mind-brain relation has continued to evoke controversy and criticism (Bindra, 1970; Chezik, 1990; Lamal, 1990; Natsoulas, 1987; Peterson, 1990; Pirolli and Goel, 1990). At the same time, however, it also has received significant support (e.g., Dewan, 1976; Grenander, 1983; Natsoulas, 1987; Ripley, 1984; Rottschaefer, 1987; Wimsatt, 1976), and less than ten years later, mainstream American psychology also went through a similar shift relinquishing behaviorism as its dominant doctrine in favor of a new mentalism or cognitivism — the so-called consciousness, mentalist, or cognitive revolution of the 1970s (Baars, 1986; Gardner, 1985; Sperry, 1987).

This latter well-documented paradigm shift I take to represent, in essence, an overthrow of the centuries-old tradition that science has no need in its

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causal explanations for conscious or mental agents because "mind does not move matter." Instead of being excluded from science, subjective mental states, intrinsic to brains, are reconceived to be indispensible for a full explanation of conscious behavior and its evolution, and are given primacy in determining what a person is and does. My perspective in what follows is centered around the contention that this turnabout in the causal status of mental entities requires a shift to a new form of causality, a shift specifically from conventional microdeterminism to a new macromental determinism involving "top-down" emergent control (and referred to variously as emergent interaction, emergent or downward causation, and also as macro, emergent, or holistic determinism – among other labels). If I am correct, emergent determinism is the key to the consciousness revolution. It provides the only logic we know that can refute prior behaviorist-materialist reasoning, providing at the same time an improved alternative paradigm plus a logical basis for the turnabout in the scientific status of mental or cognitive phenomena.

It follows that the alleged weaknesses or flaws ascribed by Vandervert (1991) to my mentalist position apply also, directly or indirectly, to the new mentalism (cognitivism) of behavioral science. It is hardly conceivable that the seemingly impregnable behaviorist doctrine, consistent with traditional objective physicalism of natural science (Skinner, 1964), should suddenly, after decades (even centuries in the case of physicalism), have been abruptly overturned within a few years by two separate and different mentalist theories.

Subsequent spread of similar emergent/holistic, "top-down" thinking into other sciences, hierarchy philosophy, epistemology, systems theory, evolutionary theory, and related subjects (Blakemore and Greenfield, 1987; Gleick, 1987; Greenberg and Tobach, 1990; Grene, 1987; Laszlo, 1972; Popper, 1978), suggests that this emergent "macro-mental" form of explanation may be in the process of replacing microdeterminism as an improved concept of causation for all science – and for all causal explanation and understanding. The wide-reaching implications, humanistic and ideologic as well as scientific, add up to a new outlook on existence providing for the first time, guideline beliefs and higher values that are consistent with science – upheld by some proponents as the way of the future and the key to quality survival.

It is in this broader context that the perceived weaknesses in my basic mind-brain logic, especially the assertion that "under close scrutiny the proposed mechanism . . . appears to evaporate" (Vandervert, 1991, p. 202) become of more than minor concern and not something that should be left unanswered. In this follow-up I focus on the perceived failings in my mentalist view rather than attempting appraisals of the proposed "systems theoretical" alternative, on the assumption that the latter are better left at this stage to those persuaded of its promise. Regardless of eventual assessments of the proposed "systems" alternative, the cognitive (mentalist) revolution already is a matter of historical record, the disputed pros and cons of which, along with the strengths and weaknesses of the new mentalism, are assured of continuing relevance. Among the many metaphysical and other controversial uncertainties notoriously inherent in mind-brain issues, the cognitive revolution stands out as a dependable factual landmark from which to launch and orient further mind-brain discussion.

My overall impression, to summarize briefly in advance, is that the shortcomings Vandervert perceives in the mentalist mind-brain model are based mostly on misunderstandings that result in part from my own failure to adequately define the new position, and in part from Vandervert's apparent lack of familiarity with relevant background. The "mentalistic," emergent interaction concept of mind and brain always has been difficult to describe because it does not fit traditional philosophic dichotomies. Combining and blending features from previously opposed solutions, it demands either redefinitions of old terms, or the invention of new terminology (Natsoulas, 1987; Ripley, 1984; Sperry, 1990). Whereas my past attempts in this direction have not been overly successful (e.g., Bindra, 1970; Churchland, 1986; Natsoulas, 1987; Ripley, 1984; Rottschaefer, 1987; Savage, 1976; Smart, 1981), it becomes imperative for comparisons with Vandervert's or any other alternative, that the "emergent interactionist" or "macromental" model be first, itself, correctly defined and understood. In what follows I try accordingly at some length to more carefully and fully explain the supporting argument and background, assuming it better to risk redundancy rather than further misinterpretation.

Measurement/Testability Weaknesses

In faulting my mind-brain view in respect to its testability, Vandervert follows and concurs with another recent critic who, after reminding the reader of Popper's "falsifiability" criterion for science, asks how my theory could ever be validated or invalidated: "What proposed study could clarify the *'subjective mental qualities'* and provide evidence that their *'downward causal control'* preempts reductionistic factors?" (Chezik, 1990). In accepting this criticism Vandervert starts his argument on a fundamental misunderstanding.

Behaviorism, which the new mentalism challenges and opposes, is hardly testable as yet, nor is this required or even expected. The same is true for the traditional reductive physicalism of science in general, which also the new mentalism (cognitivism) opposes and would replace. We need to distinguish levels of theory, and particularly between theory and metatheory (Hein, 1969). Though the distinction is not always sharp, the new mentalism qualifies, firstly and most importantly, as metatheory, that is, as an overriding new explanatory paradigm. Primarily the mentalist view contradicts the longstanding principle that the introspective contents of mind and consciousness are not needed in, and must be excluded from scientific explanation. It was proposed from the start as a long-sought unifying view of the conscious self and evolving nature, based on "a stand that admittedly goes well beyond the facts" (Sperry, 1965, p. 77).

In analyzing disputed origins and meaning of the new mentalism (cognitivism), much confusion and controversy can be avoided (see Amsel, 1989) if a clear distinction is made between (1) behaviorism *per se* as an overriding philosophic explanatory paradigm, and (2) the various theories about brain and behavior that happened to be in vogue during the reign of behaviorism (see Reese and Overton, 1972). Metatheory, despite measurement/testability weaknesses, is in some respects equally or more critical to both science and society than a lot of testable theory.

Though presently nontestable, the new mentalist view of consciousness may well become testable in the course of time, with advances in the mind/brain sciences. Meantime, the core concept of emergent interaction, or macrocausation (of which the downward mental control over the neuronal is but one instance), is itself already subject to convincing objective demonstration using simple mechanical models – such as a molecule in a rolling wheel. The direct perception afforded by this simple physical demonstration, and other simple examples (Sperry, 1965, 1987), seems sufficient as Karl Popper agrees (Popper and Eccles, 1977, p. 30) to make the existence of downward determinism already obvious.

The test for metatheory is not by experiment but by exposure in the marketplace of professional opinion through articles, books, lectures and other communication where the new idea is available to all points of view, to be weighed and criticized by hundreds or thousands of minds from all different specialist angles. The principal early tests of the model in question included a 1966 reprinting in *The Bulletin of the Atomic Scientist: Journal of Science and Public Affairs* widely read in the 1960s, not just by scientists; presentation in 1969 to our National Academy of Sciences (Sperry, 1969b) and in the same year to Marjorie Grene's "Concepts of Mind" Workshop (Grene, 1974) including participants James J. Gibson, Allen Newell, Karl Pribram, Hilary Putnam, Richard Rorty, John Searle, and Oliver Zangwill among other eminent philosophers and neuroscientists of the period. The most crucial test consisted of two publications the same and following year in the *Psychological Review* (Sperry, 1969a, 1970a) bringing wide exposure among those most knowledgeable, critical, and professionally concerned.

Only Argument-by-Analogy

In stressing that mine is an "argument by analogy," Vandervert follows the philosopher Robert Klee (1984), apparently unaware of my response to the Klee article (Sperry, 1986). I explained there that whereas the "wheel rolling downhill" may be only an analogy in respect to consciousness, it is a direct, simple, objective, physical *example* in respect to the general principle of macrodeterminism or emergent causation. It illustrates one way in which nonreductive emergent properties determine the interactions of an entity as a whole at its own level, and also exert supervenient downward control, determining the space-time trajectories of its components at all lower levels.

The rolling wheel example shows, further, that these emergent interactions are accomplished without disrupting the chains of causation among the subentities at their own lower levels, nor in their upward determination of the emergent properties. In other words, there is no breach in the previously posited physical determinism within the lower-level interactions. Traditional microdeterminism still prevails within the wheel, but is shown to be neither exclusive nor inclusive for providing a full adequate causal explanation relative to the world at large. The full story requires inclusion of the nonreductive emergent properties with both their sequential same-level action plus their supervenient downward control.

Within the wheel the molecules and their lower-level relations are less affected directly than by indirect downward effects, such as would follow, for example, should the wheel roll into a burning fire or pool of acid. Primarily, however, the envisaged downward control of the micro components is a superimposed intervention in events, not within, nor relative to things within the system itself, but *relative to the rest of the universe*. Once the molecules and other micro components become part of the wheel, their behavior and fate thereafter are determined, not only by their own micro properties but more prominently by the emergent physical properties and laws for the wheel as a whole. The lower level laws fail to include the complex, but specific, spacing and timing of the parts. These space-time, configurational, form or pattern factors are predicated to be causative themselves.

Emergent causation of this kind is ubiquitous, almost universal. Its manifestation differs in different types of systems having different forms of part-whole relations. The diverse underlying mechanisms (for which Vandervert seeks *the* mechanism in abstract energy terms) vary correspondingly. In the functional dynamics of a cerebral network, for example, the mechanisms of downward control are very different and more complicated than those in simple mechanical systems. Despite systems theory teaching, analogies can often be quite helpful (Simon, 1962), especially, as in the case of mind and brain where the cerebral mechanisms for generating conscious experience still lie so far beyond our understanding as to rule out direct illustration.

Dualistic or "Brain-based"?

The "systems theoretical alternative" Vandervert proposes is contrasted to my own model as being "brain-based," implying presumably that mine is not.

In view of its consistent presentation for more than 25 years, hypothesizing consciousness to be a dynamic emergent property of brain processes, inseparable from the brain activity (Sperry, 1965, 1990), it is difficult to understand how this mentalist view could be taken to be anything other than brain-based. The only explanation I think of is that Vandervert misinterprets my position, described as "mentalistic," to be therefore dualistic – a not uncommon error (e.g., Bindra, 1970; Bunge, 1980; Puccetti, 1977; Jackendoff, 1989).

This is an example of where the traditional philosophic terminology does not work and where new terms or new definitions are needed. Although mentalism traditionally has implied dualism, this is no longer the case in our new macromental paradigm (Sperry, 1965, 1980). In the new framework, the meaning of the term mentalistic is retained as it is used in behavioral science to indicate (contrary to behaviorism) that behavior is mentally motivated and that mental states are causes of behavior. Mental states in our new thinking, however, are neither dualistic nor identical to brain states. The difference between mental states and brain processes is the difference between an emergent property or quality and its infrastructure. The subjective quality of mental states as consciously experienced is retained but in a form that is not separable from the brain activity.

This "new mentalism" has been described from the outset as a philosophic scheme that would "eliminate the old dualistic confusions, the dichotomies and the paradoxes, proposing instead a single unified system" (Sperry, 1965, p. 85). There is no provision for disembodied conscious awareness, mind or spirit, the separate existence of which, in the classic sense of dualism, is rendered even less credible than before by providing a monistic explanation. Like Vandervert, I take the nervous system and its organization and properties to be a "basic, preinferential, and undebateable element" and assume this always has been taken for granted in neuroscience.

A major factor contributing to initial assessments of my view as dualistic was its earlier likening to the mind-brain dualist scheme of John Eccles, even by Eccles himself (Popper and Eccles, 1977, p. 373). This came about after my 1965 paper appeared when Eccles adopted its new mind-brain logic, working the new logic into a much strengthened support for his long-held dualist beliefs, and calling it "psychophysical" instead of "emergent" interactionism (Eccles, 1968; Popper and Eccles, 1977). My attempt to untangle the resultant intermixture of scientific and unscientific premises is presented in some detail elsewhere (Sperry, 1980).

Whereas, traditionally one was faced with a choice between mentalism/dualism versus materialism/monism, the concept of non-reductive emergent (macro and mental) causation has introduced new choices such as "mentalistic monism," "monistic mentalism" (or "idealism"), non-reductive materialism (or physicalism), and so on (Dubrovsky, 1988). Emergent macromental causality also provides now a legitimate long-sought causal determinist foundation for cognitive and clinical psychology, as well as humanistic, social (Bandura, 1989), and so-called "folk" psychology.

In respect to this new legitimacy of the subjective in science, it is important to remember that this does little or nothing to remedy the long-recognized methodological difficulties of dealing with introspective entities in science. It does, however, open the door to encourage possible methods of approach instead of just on principle excluding such efforts.

Precursor Issues

As a precursor for his proposed "world-brain-mind" alternative, Vandervert selects social psychologist Donald Campbell's (1974) description of emergent (or macro) determinism because it (1) provides specification of an emergentist principle, (2) specifies downward causation, and (3) has the virtue of using genuine examples from biology (as compared to my own "argument by analogy"). Many readers are bound to wonder from this choice why I should be upholding downward causation as the key to the cognitive revolution if, according to Vandervert, it was not introduced until well *after* the revolution was far advanced, and further, its specification should be attributed to Campbell (my former colleague and friend in the Psychology Department at the University of Chicago, then chaired by James G. Miller, also cited by Vandervert). The answers are found in the earlier history of the idea of downward causation.

Among different types of downward control recognized in hierarchy theory, the type we are concerned with here was included briefly, as pointed out to me by Charles Ripley (Sperry, 1990), in a book on *Causality* by Mario Bunge (1959) who called it "structural (or wholistic) determination" of the parts by the whole. The implications for reductive physicalism and mind-brain interaction, however, appear to have been missed, and instead of using it in his later book on *The Mind-Body Problem*, Bunge (1980, p. 177) misinterprets and rejects outright the idea of downward causation.

My own first description of downward causation appeared in reference to a macrodeterminist view of evolution.

> . . . evolution keeps complicating the universe by adding new phenomena that have new properties and new forces . . . regulated by new scientific laws . . . the old laws never get lost or cancelled. . . . They do, however, get superseded, overwhelmed, and outclassed by the higher-level forces as these successively appear. (Sperry, 1964, p. 2).

Like Campbell's description, this initial statement included (1) specification of an emergentist principle, (2) illustration of downward causation, and (3) "genuine" examples from biological (also physical) science. Contradicting microdeterminist tradition, I asserted instead that a molecule in chemical reactions is "the master of its inner atoms and electrons," and compels its atomic and subatomic components to follow a space-time trajectory "determined by the over-all configurational properties of the whole molecule" (Sperry, 1964, p. 20). Continuing upward, the same downward control principle was affirmed with respect to molecules within a cell, and, in brain function, the atomic, molecular and cellular forces and laws were said to be – "superseded by the configurational forces of higher-level mechanisms. At the top, in the human brain, 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).

These 1964 claims are cited because they constitute an earlier statement, not only of downward causation, but also of its direct application to evolution, brain function, and the new causal status of mind. Evolution, viewed in these terms, becomes cumulatively creative, with a gradual emergence of increased direction, purpose and meaning among the forces that shape and govern living things – rather than retaining the earlier dependence on the blind variation of genetic mutation. Any genetic mutation, in order to survive, must pass through, not only a series of external selection pressures, but also a set of evolutionally self-imposed species-specific requirements including those for conception and development, metabolism, innate behavioral tendencies and preferences, and so on. Since the great majority of genetic mutations are lethal, failing to pass even the earlier hurdles in this series, it follows that the higher the organism in the phyletic scale, the more its further evolution becomes "end- or goal-directed," even purposive in a sense with higher, especially human brains. Things like innate preferences in mate selection or the coevolution of flowering plants and trees with their pollenating birds and insects account for an evolving quality or upward trend toward beauty, diversity and harmony in nature without need to invoke a preconceived "design" or "anthropic principle."

The following year I amplified these same emergent causality concepts in reference to the mind-brain relation and support for "an alternative mentalist position" (Sperry, 1965). This first full statement of the macromental downward control view included neurocellular, reflex, and brain circuit examples, along with scientific and philosophic background, and some of the major human value, ideologic, and free-will implications.

Vandervert's choice of the Campbell precursor poses other difficulties in addition to the time lag of about ten years including: (1) Darwinian selection and "survival of the fittest" are described as "downward causation," but conventional reductionist interpretations of the same thing are not refuted. The concept is somewhat different from the one in general use in that the causation is downward "only if substantial extents of time, covering several reproductive generations, are lumped as one instant" (Campbell, 1974, p. 180). (2) Campbell makes a strong distinction between "organized wholes" as systems and mere "aggregates," and says his model applies specifically to biological systems that involve natural selection, whereas the downward causation principle, as I see it, and I think it is conceived now in cognitive science, physics, chemistry and elsewhere, is not at all confined to biological entities. Even a crystal shaped by successive aggregation of its constituent atoms (excluded by Campbell) has supervenient emergent properties that downwardly determine the destiny of the component atoms. (3) Following earlier views of Polanyi (1962), Campbell (p. 180) has the higher levels of a hierarchy "organizing the real units of the lower level" (p. 180). This too is not an essential aspect of our more general concept. Although it may be part of the story, it is not the important part and not what brought down microdeterminism (Klee, 1984), or provided a logic for mental causation. While it is true *in a supervenient sense* that the higher level laws determine in part the "distribution of lower-level events and substances" (Vandervert, 1991, p. 203), the way Campbell states it seems to include the same error Vandervert is led to in expecting a "reconfiguring" of the molecules within the rolling wheel. (4) In 1974 Campbell still proclaimed himself and his view of causation to be reductionistic, though assenting to two "vitalist's facts" as he called them, whereas we commonly consider downward causation and emergent interaction to be the antithesis of reductionism. Even Klee's 1984 conclusion (misphrased by Vandervert) was that Campbell's and other existing concepts of emergence can be accounted for in microdeterminist terms – with the exception of my own, which he found problematic, but was inclined to pass off with the others.

The term itself "downward causation" was Campbell's innovation and because it has since caught on and has been widely adopted, I too use it, though I think terms such as "emergent causation," "emergent interaction," and "macro- or emergent determinism" better indicate the concomitant supervenient type of downward control involved. The success of downward causation as a label may be ascribed in large part to its subsequent use by Karl Popper (Popper and Eccles, 1977, p. 209): "The existence of 'downward causation' has been asserted by D.T. Campbell [1974] and especially by R.W. Sperry [1969], [1973]. Sperry even suggests that any action of the mind upon the brain is merely an instance of downward causation."

By 1970 I had come to focus on the value implications of the revised outlook inferring that: (1) the traditional science-values dichotomy is abolished; (2) a logical progression from *is* to *ought* is legitimized; (3) the *naturalistic fallacy* is avoidable; (4) the way is cleared, for the first time, for a naturalistic moral code based in evolution and consistent with science; and (5) the higher cultural and other acquired values have power to downwardly control the more immediate, inherent humanitarian traits (Sperry, 1972, 1983). Today Campbell (1991) arrives at similar conclusions (none of which can be sustained should arguments for the causality of consciousness fail), describes his concept of downward causation in a much broader sense, and no longer stresses that it is reductionistic.

Mechanisms of Emergent Causation

Agreeing with Klee (1984), Vandervert (1991, p. 202) claims that I fail to provide a satisfactory mechanism for macrodetermination, adding that the one I propose "under close scrutiny . . . appears to evaporate." The latter is based on his deduction that the atomic structures in the rolling wheel illustration "are in no way reconfigured by the motions of [the wheel]." He infers the same would seem to apply for nerve impulse traffic and its suggested larger context of subjective mental phenomena.

The expectation that downward macrodetermination should thus effect reconfigurations in the atomic or molecular infrastructure of the wheel, or in the neuron-to-neuron activity of subjective mental states – or in the micro components of any macro phenomenon – indicates a serious misunderstanding of what emergent interaction is. From the start I have stressed consistently that the higher-level phenomena in exerting downward control do *not disrupt* or *inter*vene in the causal relations of the lower-level component activity. Instead they *super*vene (Sperry, 1964, 1969a), in a way that leaves the micro interactions, per se, unaltered. These micro interactions and the interrelations of all the infrastructural components become embedded within, enveloped, and as a result are thereon moved and carried by the property dynamics of the larger overall system as a whole, in this case the wheel or the mind/brain process, that have their own irreducible higher-level forms of causal interaction.

A molecule within the rolling wheel, for example, though retaining its usual inter-molecular relations within the wheel, is at the same time, from the standpoint of an outside observer, being carried through particular patterns in space and time determined by the over-all properties of the wheel as a whole. There need be no "reconfiguring" of molecules relative to each other *within the wheel itself*. However, *relative to the rest of the world* the result is a major "reconfiguring" of the space-time trajectories of all components in the wheel's infrastructure.

This retention of microdeterminism is central and basic for understanding the whole macromental paradigm and how it relates to atomistic explanations of the past. It means that most of the prior microdeterminist reasoning still holds, but that it is no longer the whole story as formerly claimed. Microdeterminism is thus not so much refuted or falsified, as it is supplemented. The result brought a whole new explanatory paradigm, a new positive philosophy or worldview with which to uphold the heretofore merely negative anti-reductionist position, previously bemoaned in philosophy because "it breaks through the defenses of a simple one-level physicalism without providing an alternative metaphysic" (Grene, 1974).

Only this roundabout supervenient approach enabled an acceptable resolution in the mid 1960s for the baffling mind-brain paradox in which conscious qualities and intentions, always seemingly crucial from the subjective standpoint, were nevertheless rigorously excluded by the objective causal reasoning of science. Instead of following the usual approaches that previously tried to somehow inject conscious effects into the already established chain of microcausation, the logical impasse was resolved by leaving the microcausation intact but embedding it within higher brain processes having subjective properties with their own higher-level type of causation, and by which the embedded micro events are thereafter controlled.

Any attempt to convert this type of mechanism into abstract "energy-quality" terms (Vandervert, 1991) can hardly be expected to yield much benefit. The actual mechanism of downward causation varies greatly throughout nature depending, for example, on whether the entities involved are solids, liquids, gases, or combinations, and whether the systems are stable and static, or dynamic. The range and sophistication of downward control mechanisms is greatly extended in different types of machines, motors, and other features of industrial civilization, including social institutions. The mechanisms of downward control that apply in electrodynamic current flow within network circuit systems, as in the brain, are yet little understood. We need to know, for example, what it is that makes for functional unity in the dynamics of mind/brain processing. What makes particular neuronal events cohere operationally into functional entities such as a mental image, a percept, or an idea?

In addition to past simple physical examples with which I have tried to illustrate the controversial top-down supervenient control, it may help to mention here the analogy of wave action which comes closer perhaps to the kind of downward causation present in cerebral processing. Consider a molecule at or near the surface of a body of water and its response to passing wave action. Whether the wave is just a ripple or a tsunami, whether it is simple or has complex cross-interference patterns, the surface molecule is caught up in and has to obey whatever rise and fall pattern is imposed by the higher level dynamics of the particular wave action.

Similarly, excitation of a cortical brain cell is enjoined into the higher dynamics of passing patterns of cognitive activity. A train of thought with one mental event evoking another depends throughout on its neurocellular physiology and biochemistry. Nevertheless, like molecules in passing waves in a liquid, the brain cell activity is subject to higher-level dynamics which determine the overall patterns of the neuronal firing, not relative to other events within this particular brain process, but relative to the rest of the organism and its surroundings. The relativity feature is critical.

Rather than in abstract "systems theoretical energy-quality" terms (the ultimate reduction?) the attempt here is to better understand conscious, subjective experience in terms of its actual constituents that still, in this view, largely determine the nature of the conscious experience. It is worth noting in this regard that the macromental outlook – even though it vastly transforms the worldview of science, turns around the traditional science-values dichotomy, and gives science a new set of answers to some of humankind's deepest questions – does not much change the day-to-day practice, analytic approach, or methodology of science. Contrary to many impressions, the traditional analytic, objective, experimental approach of science continues to help as much as ever (or even more) to "clear the mystery and show the way."

A Mind-Brain-World View

Vandervert interprets my mentalist model to be simply a view of "brain and mind," as compared to his own "thoroughgoing interdisciplinary model that describes the relationships among *world*, brain and mind" (Vandervert, 1991, p. 202). This impression is not surprising considering that Vandervert relies primarily, as do many others, on my 1969 description. This was a pared-down version with selective focus on the mind-brain concepts. The key reference for the mentalist view I support is the above-mentioned 1965 introductory article that gives a much more broad and comprehensive treatment with pertinent references to macro and mental causation within the nervous system expressed in neurobiological perspective and terminology. Though less scholarly in being an open-to-the-public, evening "humanist" lecture lacking reference citations, it nevertheless clearly proposes a new mind-brain-world model that "would put mind back into the brain of objective science . . . in a long-sought unifying view," and suggests "a possible answer, not only for the relation between mind and brain but also for that between the outside world and its inner cerebral representation" (Sperry, 1965, p. 85). Overlooked also is the 1964 condensed statement set in the broad context of a macrodeterminist concept of evolution, a view also described a year later by Karl Popper (1972) in his 1965 Compton Memorial Lecture as "a new view of evolution" and "a different view of the world."

The exact nature of the actual relationship existing between the brain's images or perceptions of outside objects and the outside objects themselves is left open with the brain component hypothesized to be, in essense, either (1) a "representation" of the outside object or (2) a "reaction to" or special kind of "interaction with" the outside object. If it is basically a representation, this is presumed to be in the form of some kind of isomorphic, topologic, or codal transform. The second alternative also requires the presence, at some stage, of a representation or registration in the brain of all the outside features perceived, but implies that subjective meaning is derived at some further stage of brain processing through an active adjustment or interaction with this processed sensory input.

Recognizing difficulties with either choice I have tended to slightly favor the second having described perception (prior to my shift to mentalism) as an incipient "preparation to respond," such that subjective meaning is hypothesized to be derived on a "functionalist" basis (Sperry, 1952). A central thesis stressed that the subjectively experienced mental image with its unity, continuity, and constancy is extremely different from the corresponding brain process which is scattered, disparate, and often a spatiotemporally fractured and transformed array of the brain's neuronal events presumed to generate the subjective experience. This observation was later used by Eccles as a "key component" of his argument for psycho-neural dualism (Popper and Eccles, 1977).

On Equating "Systems" Theory with "Wholist/Emergent" and "Hierarchy" Theory

In another perceived weakness of my mind-brain proposal, Vandervert sees no way by which one could measure its "energy-information qualities" described by systems theorists such as Odum (1988), Tribus and McIrvine (1971), or himself (1991). Again, one wonders why, and for what purpose, one would try to measure the "energy-information qualities" of such things as a concept of consciousness or the mind-body relation, or say, the behaviorist paradigm or reductive physicalism for which the new mentalism is an alternative. For some of us, such systems theory approaches and measurements are not the highest standards to aim for. To try to correlate information qualities with energy seems about as useful as trying to correlate the meaning of a message with the chemistry, size, or color of the print in which it is expressed (even making allowance for the fact that "information" here does not exactly mean information). One wonders if any useful correlations obtained, such as food-chain equivalencies, may not have come from earlier more problem-oriented approaches rather than from "energy-quality correlations."

"Systems thinking," a "systems view," or "systems approach" is commonly taken today in popular usage to mean a holistic or anti-reductionistic treatment in which something is conceived and dealt with as an organized irreducible whole (Checkland, 1981; Mandell, 1989). When General Systems Theory (GST) was founded, however, in the 1950s by von Bertalanffy, emergent and hierarchy theory, holism, or the organismic approach, based on the concept of the emergent whole, were hardly new insights. These already had been around for decades and extensively promulgated, along with intensive discussion of the pros and cons of reduction-antireduction issues (e.g., Morgan, 1923; Ritter, 1919; Sellers, 1943; Smuts, 1926).

Thus, the stated intent of von Bertalanffy in proposing Generay Systems Theory in 1955 (Checkland, 1981) was not at all to presume to usurp the prior views and claims of this already well-established field, but something quite different. Bertalanffy's innovation was the suggestion that within different types of systems the organizational relations and interactions of the components, even in different sciences, have enough in common such that if one could learn the abstract principles for such interactions within one system, these principles would then apply to other systems across the sciences (Bertalanffy, 1956; Checkland, 1981). In the special case of part-whole relations this type of commonality had already, of course, been a general presupposition, taken for granted in holist-emergent thinking back to Aristotle and Democritus.

By the early 1960s, however, it was becoming apparent that the potential for the kind of abstract carry-over envisioned in GST was not so high as originally hoped. Interactions within different systems were found to have little of useful significance in the commonalities, and what was shared in common was already mostly taken for granted. The outlook for systems theory was summarized at the time by Simon (1962, p. 467), ". . . while the goal [of GST] is laudable, systems of such diverse kinds could hardly be expected to have any nontrivial properties in common." Nevertheless, systems theory kept alive against this and various other criticisms (e.g., Buck, 1956), in part by riding on the merits of subsumed available theories already developed through more problem-directed approaches such as cybernetics, information theory, game theory, and so on – including holist-emergent theory. Another factor that helped sustain general systems theory is the better terminology it offers for identical holist or emergentist concepts. A third factor, possibly critical, is the added strength and meaning that have been infused into holist-emergent thinking by the macromental developments starting in the mid 1960s which, again, systems theoriests have been quick to appropriate as contributions of systems theory (Checkland, 1981; Laszlo, 1972).

General support in science and philosophy for holist/emergent views, which became quite vigorous during the 1920s and 1930s, gradually declined until, by the early 1960s, reductive microdeterminist thinking had again regained overwhelming dominance in both philosophy (Armstrong, 1968; Feigl, 1967; Hook, 1960; Klee, 1984; Smart, 1981), and in science, including microbiology (Crick, 1966), neurobiology (Eccles, 1966), behavioral science (Skinner, 1964; Wann, 1965), cybernetics and information theory (Simon, 1962), chemistry

(Platt, 1959), and, of course, remained strong in physics, the traditional bastion of microdeterminist physicalism (Feynman, 1963). Even the Gestalt movement, one of the most successful and strong examples of the holistic approach, was claimed by its leading protagonist and philosopher Wolfgang Köhler (1960) to be best interpreted in reductive physical terms.

Bertalanffy himself in this period maintained a position similar to that of modern "in principle" reductionists: "If, however, we know the *ensemble* of the components and the *relations existing between them*, then the higher levels are derivable from the components" (Bertalanffy, 1949, p. 148). His view overlooks, of course, not only downward causation, but also the fact that, except for ultra simple systems, we can never know "*the relations existing between*" the components. These include the enormously complex spacing and timing, pattern and form factors that involve the multi-variate, hierarchic, often dynamic infrastructures, and which, in themselves have causal control influence. Neither present-day science nor mathematics can handle these spacetime factors. No existing laws or principles are adequate. Even the relatively simplistic three-body problem gives difficulties. Not only are the available laws for the lower levels inadequate, but we would need additional laws for the relations between levels in the multiform, multi-nested hierarchic infrastructure, and then further laws for the "between-the-between-level" relations, all of which play a contributing role in the causal influence of the emergent macro properties of the whole – best viewed as a space-time-mass-energy manifold.

Following the mid-century decline, wholism entered a new wave of support after the mid 1960s which has continued to the present time worldwide, and at a higher level than ever before in a long history of waxing and waning (Bertalanffy, 1968; Checkland, 1981; Greenberg and Tobach, 1990; Grene, 1974; Harris, 1991; Koestler and Smythies, 1969; Laszlo, 1972; Pattee, 1973; Polanyi, 1968a, 1968b). The reason for the current new vigor can be found, I believe, in a combined series of developments associated primarily with the rise of mentalism during this period but which at the same time served collectively to strengthen also the status of emergent, wholistic and hierarchy theory.

These collective developments included the following: (1) An emergentist solution was discovered for the mind-brain problem with extensive implications widely perceived to be more credible than corresponding atomistic doctrine. (2) Unlike previous emergent views of mind, which had not threatened other existing mind-brain positions such as mind-brain identity, dual-aspect theory, panpsychism, epiphenomenal views and so on, the new emergentist theory changed the scientific (causal) status of consciousness. (3) Stronger bases for the irreducibility of emergent properties fortified wholistic theory and correspondingly weakened the case for microdeterminism. (4) Emergent-reduction issues were transposed from an abstract framework of epistemology and philosophy to a causality context of more direct relevance for science. Rather than dwelling on questions of predictability in the formation of emergent properties, we asked instead, What are the causal consequences in terms of neuronal and brain function? (5) This led to the concept of emergent downward causation, a direct contradiction to prior atomistic, exclusively bottom-up premises. (6) The logic of a microdeterministic cosmos, thought previously to have been airtight and irrefutable, was shown to have a flaw or shortcoming. (7) Another parallel logic was discovered based in emergent interaction which largely corrected the adverse "mechanistic, materialistic, behavioristic, fatalistic, reductionistic" lifeview implications of the previous physicalism. (8) Anti-reductionism thus became reinforced by a new positive worldview or philosophy, whereas previously it had been largely just an "anti" or negative argument. (9) The impossibility of explaining higher emergent properties by using laws for the lower-level components was substantially clarified by emphasis on the causality per se of the component spacing and timing, and the inadequacy of science to deal with these spatiotemporal pattern factors other than through their automatic inclusion in laws worked out for the higher levels. (10) The collective result, adding up to no less than a new paradigm for causation, provided the potential to radically revise scientific and other causal explanation of most everything at macro levels.

The new concepts that emerged for both macro and mental causality transformed, not only mind-brain, hierarchy, and wholist-emergent theory, but also, by association, general systems theory which, having languished in its original form, had switched its central thrust to the newly fortified and enhanced wholist-emergent thinking. Again, proponents of general systems theory, having played no innovative role in the foregoing series of developments, were nevertheless by the 1970s and 1980s expounding the resultant new thinking as a "systems" contribution (e.g., Checkland, 1981; Laszlo, 1972).

Meantime, applications of the new explanatory paradigm began to be discovered in various other fields and disciplines resulting in a sudden spate of new movements since the early 1970s that break with long-entrenched behaviorist-microdeterminist tradition, as in, for example, animal awareness (Griffin, 1981), evolutionary epistemology (Greenberg and Tobach, 1990), emergentist mind-brain philosophy (Bunge, 1980; Popper and Eccles, 1977), hierarchy philosophy (Grene, 1987; Pattee, 1973), social human agency (Bandura, 1989), folk psychology (Graham and Horgan, 1988; Rottschaefer, 1991), cognitive ethology and other cognitive trends in behavioral and cognitive science (Baars, 1986; Gardner, 1985; Kendler, 1990; Posner, 1989; Ristau, 1990), recent anti-reductive views in physics (Augros and Stanciu, 1984; Bohm, 1970; Capra, 1977; Gleick, 1987; Penrose, 1989; Stapp, 1982), eco-philosophy (Birch and Cobb, 1982), with related economic and panspychic tenets (Berry, 1988), and even a holistic "anthropic principle" (Harris, 1991) – among others.

Many of the above involve original insights, or are presented as such, adding complications to an already formidable "precursor" controversy. I have suggested that we can also include in the foregoing an additional set of concepts that constitute a scientifically sound core within New Age thinking (Sperry, 1991), but which needs to be rigorously distinguished from the conglomerate of unsound non-scientific views and practices such as channeling and other occultisms that have become associated and, as charlatan freeloaders, take advantage of the same lack of conceptual clarification with which we are here concerned.

Hypothesis for a Mutual Common Precursor

Emerging new paradigms, "new visions" and "ways of thinking" appear to be in the wind these days and Vandervert's "emergent interactionist world-brain-mind alternative" may be viewed as another (singular) addition to the growing array of transformative new outlooks that began to appear early in the 1970s and then multiplied almost explosively during the 1980s. An earlier analysis of these revisionary developments suggested that much of the innovation, complexity and often confusing overlap, interrelations, and ramifications might be greatly clarified by appraising the whole movement as an outgrowth of the consciousness revolution that immediately preceded it (Sperry, 1987). A common precursor then became discernible for both the turnabout on consciousness and for the subsequent boom of innovative outlooks, conceived in the form of a changed concept of causal explanation along the lines described above.

This, however, is only one among many other possible interpretations currently being advanced. Within psychology alone, more than half a dozen different interpretations of the new cognitive paradigm and its origins are still being debated after almost 20 years (e.g., Amsel, 1989; Baars, 1986; Bolles, 1990; Chezik, 1990; Kendler, 1990; Lamal, 1990; Natsoulas, 1987; Schneider, 1990), while other authors find the source of the new worldview of science in entirely different disciplines such as physics, ecology, dissipative structures, evolutionary theory, and so on. In what follows the argument for a single "common precursor" as described above is further explained and briefly defended against some competitive views not previously discussed.

Essentially all of the developments in question of the seventies and eighties are found to reject, either explicitly or implicitly, the traditional reductive physicalism of science, and the great majority do so on the basis of emergent theory (rather than using "interconnectedness," or other holistic, ecologic, physical or philosophic concepts). Accordingly, the search for a common precursor can be narrowed to some form of an alternative to traditional physicalism based on emergent properties, something, that is, which refutes and outweighs microdeterminist thinking. Such alternatives that already had been around for some time and had failed to depose the microdeterminist paradigm can be eliminated, including presumably those drawn from the "new physics," the panpsychism of Whitehead and followers, the emergent concepts of Teilhard de Chardin, and the pre-1960 forms of wholism, ecologic theory, Gestalt theory and cognitive and humanistic theory. As concluded previously on an entirely different basis (Sperry, 1987), the search for a common precursor becomes a search for a credible alternative to microdeterminism and which includes a concept so completely incompatible that the behaviorist/microdeterminist paradigm cannot be stretched to encompass it.

Historical evidence indicates that this precursor search can be narrowed further and thereby much simplified by concentrating on a critical time period of about seven years or so between 1964 and 1971. In regard, first, to the 1971 date, there is unquestioned evidence that many psychologists by 1971 had begun to recognize that their discipline already was in the process of a major paradigm revolt. Behaviorism which had reigned supreme since the early 1920s was being replaced by an opposing new mentalism, cognitivism, or humanism (e.g., Dember, 1974; Matson, 1971; Palermo, 1971; Pylyshyn, 1973; Segal and Lachman, 1972). The basic revolutionary concepts, therefore, that gave rise to the new mentalist paradigm must not only have been introduced, but already by 1971 had become sufficiently familiar to cause mainstream psychology to start swinging its support to the new mentalism.

At the other end of this critical time period convincing evidence is also found, though much less definitive, showing that up through 1964 our mindsets in science did not evidence as yet any awareness of the impending overthrow, either of behaviorism or of the more general microdeterminism – and this includes psychology where the turnaround was first manifest. In psychology in 1964 the decades-old debates between phenomenologists and behaviorists were still continuing as before (Wann, 1965) with no success in shaking the dominant behaviorist paradigm with its tenets that made psychology objective, analytic and consistent with the more basic sciences.

The logical impasse between the introspectionist phenomenologic view that mind is all-important and that behavior is *mentally* driven – as compared to the opposed contention of behaviorism and of neuroscience that mind is no more than an explanatory fiction, that mental ideas, motives and feelings have no part in determining conduct and therefore no part in explaining it (Skinner, 1964, 1971) – remained as baffling as ever. It was still being summarized in 1964 as "an irreconcilable contradiction . . . a deep and lasting paradox with which we must learn to live" by Carl Rogers (1964, p. 40) who had spent much of his long career as a humanistic psychologist on the lookout for some way to get scientific sanction for what he called "subjective knowing."

Similarly in the neurosciences in 1964 the same logical impasse was apparent where it was even more striking and clearly defined. Neuroscientists remained fully convinced well through 1964 (as many still do) that one can give in principle a complete account of brain function strictly in terms of neuronal activity, and that neuroscience has no need nor any place in its descriptions for the injection of conscious or mental agency. Eccles expressed this at the Vatican conference of September 1964, ". . . consciousness seems to be absolutely unnecessary. . . . As physiologists we have absolutely no use for consciousnes." Eccles, however, as a longtime dualist, added, "I do not believe this story, of course, but *I do not know the logical answer*" [emphasis added] (Eccles, 1966, p. 248).

Many other examples may be listed including discussions at other pertinent conferences, papers and books of the period, all of which show that in 1964 (and considerably later in many cases) we had as yet no incipient awareness in mainstream science that the microdeterminist paradigm was in any jeopardy (e.g., Armstrong, 1968; Bunge, 1959; Crick, 1966; Feigl, 1967; Hook, 1960; Smythies, 1965; Wann, 1965). The usual individual philosophic views could, of course, be found contesting the reigning paradigm, such as that of Polanyi (1962). Even if one were to grant, however (which thus far I cannot), that Polanyi or some other philosopher already had conceived the sought-for precursor concept, there would still remain the question, What happened during this critical period to suddenly change the relatively obscure individual or minority philosophy into the dominant practicing paradigm for mainstream behavioral science?

Good reason is thus seen to conclude that something special happened between 1964 and 1971 to cause psychology's sudden changeover to mentalism with an abruptness that has been described (Pylyshyn, 1973) as being almost explosive in nature. In other words, something during this interim must have revealed a long-sought logical answer to that "irreconcilable contradiction," the paradox of consciousness – an answer which Eccles, Rogers and all the rest of us had failed to see up through September of 1964.

The resultant narrowed-down time period (even if held as tentative) allows a convenient analytic "chunking" of possible candidate concepts into "too early," "too late" and "critical" categories. In particular it allows one to bypass most of the numerous developments and similar and overlapping insights in other claims that started appearing in the 1970s and 1980s, on the ground that these were reexpressions, later developments, insights by hindsight, or different applications of the sought-for basic key concept. In excluding these as "too late," however, it is important to note, as mentioned, that the great majority depend on a newly strengthened wholism.

The answer which I settled in on my earlier analysis (Sperry, 1987) included the combined sociologic, scientific and philosophic influences of this critical period with the key factor presumed to be the introduction, starting in the mid 1960s, of the new emergent interactionist concepts as described above which served to logically legitimize both mental and macro causation in a new form of causal detrminism. Though still hypothetical and widely contested, this analysis at least gives something specific to shoot at in an area that remains very open and poorly defined.

A quite different answer is advanced recently by philosopher Marjorie Grene (1987) who innovatively ascribes the source of the new mode of thinking to a "watch-maker" metaphor used by Herbert Simon (1962). Others of us (e.g., Checkland, 1981) think Simon was simply using the metaphor, as he states, to illustrate that the evolution of complex hierarchic systems proceeds more rapidly when stable intermediate forms are available, so that each new system does not have to start from scratch. The latter interpretation is favored by other features in the Simon article on "The Architecture of Complexity." Writing as a self-described "in-principle reductionist" (p. 467), Simon emphasizes a "decomposability" approach to "unraveling the web of causes" in complex hierarchic systems. His summary includes "interactions *among* subsystems" and "interactions *within* subsystems" (p. 473), but omits mention of any emergent, supervenient or downward *inter-level* interaction. Subparts of parts are said to interact only in "an aggregative fashion," the detail of which "can be ignored" (p. 473). Taking Simon's summary to be representative of the advanced thinking of the period, one may infer that the concept of downward or emergent causation had not yet been specified in hierarchic, cybernetic, or "AI" thinking of the early 1960s.

Consistent with the foregoing Simon (1991) today, in expressing support for the view that the cognitive revolution involves a shift to a new concept of causal explanation, reinterprets this new causality to mean that "it is essential to explain complex phenomena at several levels, complementary, not competitive" (Simon, 1991, p. 6). In the interpretation defended here, however, the central issue is not so much a question of several or, of how many levels, which always has been there, but of *inter*-level determinism, upward and downward; and the contention that former reliance solely on upward determinism in scientific explanation needs to be supplemented by including the non-reductive causal realities of emergent and downward effects. There is nothing competitive or conflicting about the posited simultaneous upward and downward controls because they involve entirely different mechanisms. The conflict resides rather between the new and old assumptions about causal determinism and in their radically different logical consequences.

In another alternative interpretation, philosopher Ernan Mullin (see Byers, 1987, p. 131) credits Michael Polanyi, the distinguished physical chemist turned philosopher, as the one who developed the notion of downward causation. Polanyi (1962) certainly had long renounced traditional reductive materialism in favor of a more holistic approach emphasizing the highly important role of "tacit knowledge" in epistemology. He supported the common notion of different levels of control and from the 1950s inferred that the higher hierarchic levels are not only determined from below, as generally assumed, but in addition exert a reciprocal downward control influence by setting "boundary conditions," or "constraints" as rephrased by Pattee (1973), on the component interaction.

Polanyi's concept of setting "boundary conditions" is widely accepted in physics and philosophy and applies throughout the foregoing as one form of downward causation. In itself, however, it constitutes a much less upsetting challenge than the *supervenient* type of downward causation relied on here as a key feature of the new macromental mode of explanation. Polanyi's constraints on interactions within the system is a much less powerful mover and shaper of events than envisaged in emergent interaction where the higher-level phenomena (as in the rolling wheel or wave action analogies) physically move, control the timing and otherwise directly and actively determine the main space-time trajectories, distributions and destiny of the lower-level components. In the past, the setting of boundary conditions has not been taken generally to be in conflict with physical determinism, nor to demand a new overriding causality paradigm. Accordingly Polanyi did not particularly stress it and looked elsewhere for the main support for his anti-physicalist views. In any case, as outlined above, the record shows that by the mid 1960s Polanyi's philosophy had failed to change the prevailing microdeterminist mind-sets in psychology, neuroscience, or other sciences.

One might expect to find the most cogent views regarding macromental precursors within behavioral science where the consciousness revolution started. As yet, however, there is little consensus. Different schools and subgroups such as the cognitivists, humanists, learning theorists, linguists, animal behaviorists, computer scientists, motivationists, and perception theorists – to name some of the more prominent – each advance their own special version. Other psychologists favor a general *Zeitgeist* trend of the time. Still others deny that there has been any real revolution (Amsel, 1989; Kendler, 1990) contending that the change is "evolutionary" not "revolutionary."

Another alternative cited in behavioral science is the book by Miller, Galanter, and Pribram (1960) in which the control of computer function by a program is compared to that of brain function by a mental plan with arguments that a complete account of behavior requires explanation at several levels. In accord with the dominant reign of behaviorism and physicalism through the 1950s, however, these authors reject mentalisms and subjectivism. A machine can do what they have in mind. With numerous opportunities in the book to affirm that mental states are causal, they do not do so and jokingly refer to their position at the end as subjective behaviorism. While this book added new strength to the decades-old argument that cognitive factors are important, it did not present a refutation of the microdeterminist treatment of these, nor otherwise justify a switch to mentalism, nor change the prevailing mind-sets of 1964 as described above. Again, the 1964–1971 limits seem to mark a critical interval.

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