

## Unexpected Symmetries in the "World Knot"

Apparently disparate monist and dualist views  
on mind and matter are held to be symmetric.

Gordon G. Globus

The enigma of the relationship between mind and matter has held the attention of scientists and philosophers as well as humanists and mystics throughout history. The problem was termed by Schopenhauer the "world knot," presumably because so many issues are tangled up in it. In attempting to extend a previous biological explication of the "psychoneural identity" solution to the problem of mind and matter (1), I found that an interesting symmetry obtains between monist and apparently disparate dualist accounts. Further, it is possible to develop a view that encompasses this symmetry in terms of Bohr's complementarity principle. It is of interest to apply this discussion to theistic views which are closely related to views on mind and matter. To the extent that my arguments are valid and supported by scientific data, this allows for some simplification of the world knot.

### The Identity Theses

Although the two main versions of the identity thesis, psychoneural identity and central state materialism, have been much discussed of late by philosophers, the status of these theses remains problematic (2). The most comprehensive statement of the psychoneural identity thesis would seem to be Feigl's now classic monograph *The 'Mental' and the 'Physical'* (3).

Central state materialism has been presented by Place (4), Smart (5), and Armstrong (6). According to Borst (7), the identity view is that "mental states are quite literally identical with brain states: any given mental state is, roughly, a brain state, brain process, or feature of a process in the central nervous system." In its strong form, in accordance with the principle of Leibniz concerning the strict identity of indiscernibles, it would maintain that mental and neural events possess *all* properties in common. In this article I begin by formulating an identity thesis by focusing on scientific as well as philosophical considerations.

The ontological claim that mental events are strictly identical with neural events unfortunately coalesces the perspectives of both subjective (S) and objective (O) observers. The term "mental events" implies the perspective of S who has the mental events immediately given "by direct acquaintance" (3) (without inference), whereas the term "neural events" implies the perspective of O who is presumably observing the brain of S. Thus O cannot have S's mental events by direct acquaintance because they are private to S; for example, O cannot experience S's pain. For S, there are no neural events by direct acquaintance—that is, that his own mental events are physically embodied is not directly known by S, unless he observes his own brain in the manner of O using Feigl's imag-

inary "autocerebroscope" (3). Mental events contain no information about any neural embodiments, for example, S's pain does not have the typical characteristics of physical objects in that S cannot see his pain or touch it. Nor is there anything about pain which seems at all like neurons. For information about the neural embodiments, observation in the manner of O is required.

Just as mental events contain no information about neural embodiments, the neural events per se contain no information that these events are neurally embodied. It does not appear that the brain codes or represents in any way its own structure. (The nervous system has no sensory apparatus directed toward its own structure.) For example, neural events in S's brain do not code the size or shape of S's neurons, although they might code this for O's neurons if S were to observe O. To emphasize that these events held identical with mental events have no information about their own physical embodiments for the subject who has these events, in contrast to the observer, I shall refer to them as "pure events" or "events-per-se."

I propose that a strict identity thesis can be formulated in three distinct ways, if the varying perspectives of S and O are taken into account.

1) From the perspective of both S and O, mental events with which S is directly acquainted and to which his term "my mental events" (and equivalent terms) refers is identical to that which O's term "S's neural events" refers. I shall call this formulation psychoneural identity.

2) From the perspective of S, mental events with which S is directly acquainted and to which his term "my mental events" (and equivalent terms) refers is identical with pure events. I shall call this formulation psychoevent identity.

3) From the perspective of O, that to which his term "S's mental events"

The author is an associate professor in the Department of Psychiatry and Human Behavior, California College of Medicine and School of Social Sciences, University of California, Irvine 92664.

(and equivalent terms) refers is identical with that to which his term "S's neural events" refers. I shall call this formulation *psychoneural identity*. (The italics here indicate that O must make an inference to S's mental events from S's behavior because he cannot have them by direct acquaintance.) Failure to distinguish among these formulations has led to considerable confusion. I shall argue that strict identity does not hold for the psychoneural identity formulation but does hold for psycho-event and *psychoneural identity* formulations.

A rejection of the psychoneural identity formulation would seem to imply a rejection of Feigl's position as well, because he states: "The identity thesis that I wish to defend and clarify asserts that the states of direct experience which human beings 'live through' . . . are identical with certain (presumably configurational) aspects of the neural processes in these organisms. . . . [W]e may say, what is had-in-experience and . . . knowable by acquaintance is identical with . . . what the science of neurophysiology . . . describes as processes in the central nervous system" (3). More concisely put, Feigl asserts: "The raw feels of direct experience as we 'have' them . . . are empirically identifiable with the referents of some neurophysiological concepts" (3). The only apparent distinction between Feigl's statement and item 1 above is that the former points to the referents of the concepts of the science of neurophysiology, and the latter

points to the referents of neurophysiological terms which O uses when he actually makes observations on S's brain.

The central state materialism position would seem comparable to the *psychoneural identity* formulation above. O's term "S's mental events" refers to the presumed but unobserved causes of S's behavior which O directly observes. (All O actually has to go on is S's public behavior, not S's private mental events.) As Campbell expresses it, ". . . mental terms get their *meaning* by reference to the behavioral effects of the mental states they denote," but the various mental events and processes are themselves "*postulated causes* of segments of behavior belonging to various recognizable patterns, and that the mental causes are given their names in virtue of their postulated connections with those behavior patterns" (8) (all italics mine). Since the causes of behavior can be ascertained empirically to be states of the nervous system, it can be argued that the postulated mental events which also are held to cause behavior can be identified with states of the nervous system. I shall argue that this position, although tenable as far as it goes, is insufficient.

#### An "Autocerebroscope" Experiment

I shall provide a basis for evaluating these formulations by performing an imaginary experiment with a version of Feigl's autocerebroscope. Imagine a duplicate brain which exactly cor-

responds both anatomically and physiologically to S's brain and is connected with his brain by a device such that every event in his brain instantaneously produces a corresponding event within his duplicate brain. Now, S observes a stimulus object, for example, a mandala, so that there are events in his brain and equivalent events in his duplicate brain. At the same time in addition to observing the mandala, S observes the duplicate brain.

Figure 1 illustrates in a visual mode the situation of S's brain in the imaginary experiment. The configuration of light energy reflected by the mandala, M, impinges on the retinal receptor and is transduced to a neural representation (9) (representation events) of the mandala. This neural representation provides S with information about M, that is, S can only know M through his neural representation of it. These representation events are designated (M), the parentheses indicating that a representation has taken place which precludes strict identity between the mandala, M, as stimulus object outside of the nervous system and those neural events, (M), in correspondence with it. Now given the conditions of the experiment, the neural events which are (M) occur both in S's brain and in his duplicate brain. But when S observes his duplicate brain which contains (M), he has in his own brain a representation of (M), that is ((M)). ((M)) cannot be strictly identical with (M) because a representation subsequent to transduction at a sensory receptor cannot be strictly identical with that which it represents, but can only be in some form of correspondence. Now, if in this experiment we ask S to describe his phenomenal experience, he will report that he sees two distinct phenomenal entities, a mandala and some neural events in the duplicate brain, which phenomena are clearly not identical in terms of his experience.

This experiment illustrates why there cannot be strict identity in an ontological sense between mental events and neural events. The only information that S can obtain about his events actually being embodied as neural events is through his sensory receptors—that is, the term "neural" implies observation of the physical embodiment of the events. But an obligatory transformation obtains at the "transformation boundary" (9) of sensory receptor-transducer systems which are the most peripheral aspect of the nervous system. This gives S no advantage in

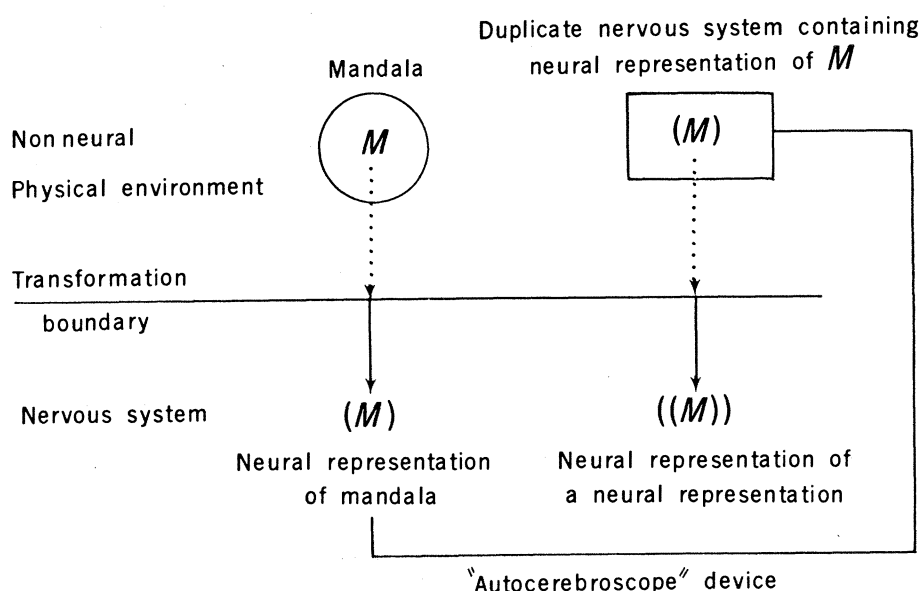


Fig. 1. An autocerebroscope experiment in which a subject views a mandala, M, forms within his brain a representation, (M), of the mandala, and then views a duplicate of his brain containing (M) and therefore forms another representation, ((M)), of his first representation, (M). See text for more explanation.

observing his own neural events compared to any conceivable observer of S. Thus, information about neural events can be gained directly only from its representation, ((M)), but ((M)) cannot be identical with (M) because of the obligatory transformation that occurs at the receptors of S or any O. To summarize Fig. 1, some (neurally embodied) events-per-se are a representation, (M), of a mandala, M, and (M) is identical with the phenomenal mandala; other (neurally embodied) events-per-se are a representation, ((M)), of a representation, (M), and ((M)) is identical with phenomenal neural events. We should not expect that neural events we observe in the autocerebroscope situation appear strictly identical with the corresponding mental events in that representations of representations cannot be strictly identical with representations.

### Representations of Representations

That there is a difference between representations (first order representations) and representations of representations (second order representations) can also be demonstrated by considering the nonneural physical environments of S and O (Fig. 2). (Figure 2 is not intended as a model of brain functioning but as a paradigm of neural representation.) The nonneural physical environment of S, ( $P_S$ ) (which includes the rest of S's body), is not congruent with the nonneural physical environment of O ( $P_O$ ) because S's brain is part of  $P_O$  whereas O's brain is part of  $P_S$ . The stimulus, M, is transduced at S's transformation boundary. Various aspects of M are represented as events in S's brain, for example, location (L), extension (E), frequency of reflected light (C), and other aspects (X). The binary representation proximal to S's transformation boundary is intended to convey that M produces a particular change in S's brain. [Whether this change is the digital event of nerve impulses, the analog events of the graded slow potential "junctional microstructure" (10), or both, is irrelevant to the present argument.] But as M is for S, so are S's neurally embodied events L, E, C, and X for O. Various aspects of L, E, C, and X are represented as events in O's brain; for example, for O, S's L has location, extension, frequency of reflected light, and other aspects. Figure 2 illustrates, then, that the events-

per-se in S's brain which correspond to a stimulus impinging on the transformation boundary are quite distinct from the neurally embodied events observed by O.

The distinction (3) between private events to which S has "privileged access" and public events which to both S and O are "intersubjectively confirmable" now may be apparent. Public events are distal to all conceivable sensory receptor-transducer systems such that at least roughly corresponding representations of those public events can occur in the brains of all conceivable observers. (If M in Fig. 2 also had been represented for O, that representation would have been roughly equivalent to S's representation.) There

is a highly limited class of private events, however, which is proximal to one unique sensory receptor-transducer system and distal to all other conceivable sensory receptor-transducer systems. It is held that these events are strictly identical with the mental events of S. But for any O, these events as embodied must be transduced at the sensory receptor level, so that O's events as second order representations cannot be identical to S's events as first order representations; hence S's events are irrevocably private, unless some imaginary device, such as an electronic corpus callosum (11), were available to register events in S's brain directly as events in O's brain without having to cross O's transformation boundary.

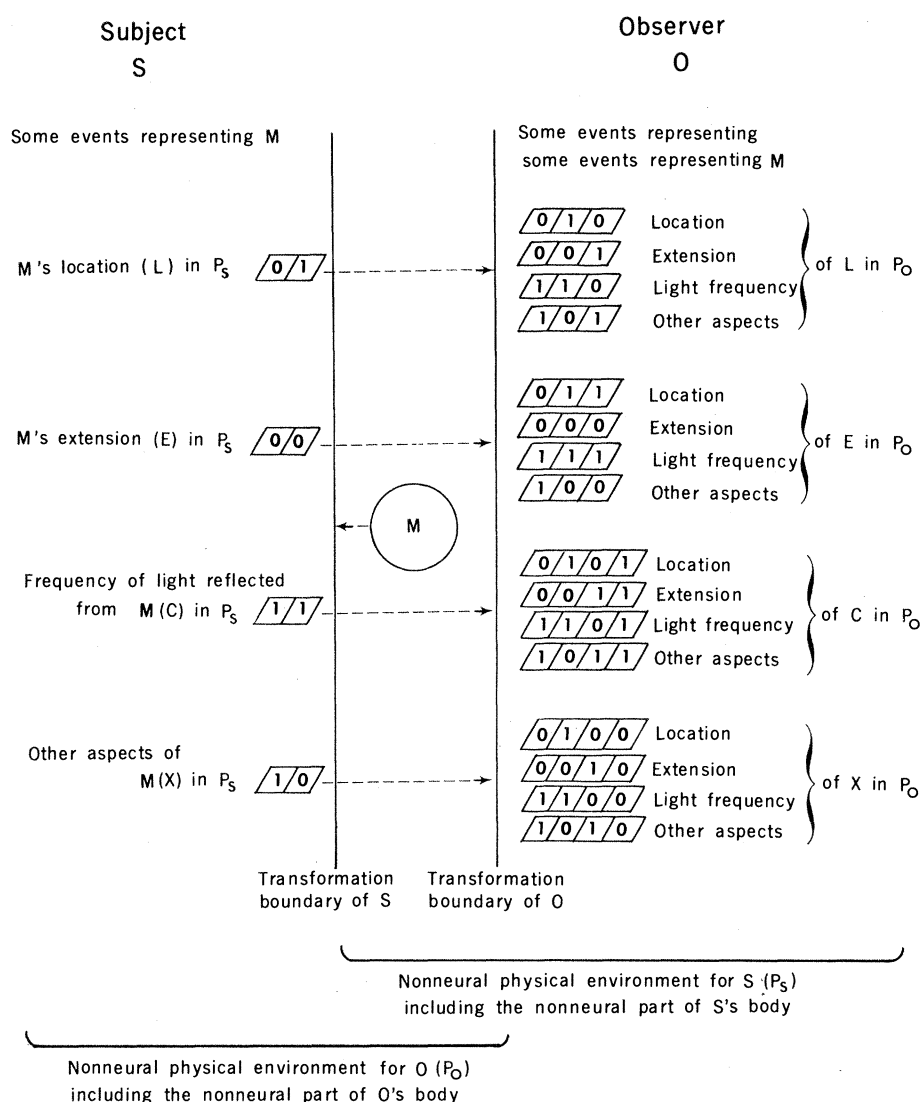


Fig. 2. A representation and a representation of a representation. On the left, the subject, S, views a mandala, M, and events occur in his brain that represent such aspects of the mandala as its location, L, extension, E, frequency of reflected light, C, and others, X, in his nonneural physical environment  $P_S$ . On the right the observer views not the mandala but the events that represent the mandala in S's brain which forms part of O's nonneural physical environment,  $P_O$ . The events that occur in O's brain therefore represent the neurally embodied events that represent the mandala in S's brain.

## Rejection of the Psychoneural Identity Formulation

The preceding discussion suggests that the psychoneural identity formulation has insoluble problems as a strict identity thesis. The private-public discrepancy which is intrinsic to the formulation is obfuscating because it contains the perspective of both S and O who are on different sides of S's transformation boundary. Further obfuscation results from some mental events, for example, the phenomenal mandala which S has by direct acquaintance, being first order representations, whereas other mental events, that is, the phenomenal neural events which O has by direct acquaintance, are second order representations, as illustrated in Figs. 1 and 2. It is very easy for O to fall into the error of talking about his phenomenal neural events which are second order representations, ((M)), and which he has by direct acquaintance, as being identical with S's mental events which are first order representations, (M), and which S has by direct acquaintance. But even when O is quite careful to talk of these neural events, (M), as distal to his own transformation boundary and corresponding to his phenomenal neural events, ((M)), he still cannot hold strict identity between (M) and S's mental events. For what S has directly as mental events contains no information about neural embodiments whereas what O refers to as neural events is physically embodied, that is, what S has by direct acquaintance (or refers to with his term "my mental events") is pure events, whereas what O refers to with his terms for neural events is neurally embodied events. Thus, what S has by direct acquaintance does not have all properties in common with what the science of neurophysiology's concepts refer to, as Feigl holds, since the former is (or refers to) pure events whereas the latter refers to neurally embodied events. In the same manner, what S has by direct acquaintance does not have all properties in common with what O's term "S's neural events" refers to since pure events and neurally embodied events are quite different. On these grounds, I reject the psychoneural identity formulation.

I shall argue now that the psychoevent and *psychoneural* formulations are not faulted on this basis. Clearly, for S on the psychoevent formulation, neither the mental events which he has by direct acquaintance nor the pure

events which occur in his brain contain information about their own physical embodiments. But the situation is unfortunately much more complicated from O's perspective on the *psychoneural* formulation. O's term "S's neural events" refers to a physical embodiment, but does his term "S's mental events" also refer to a physical embodiment? Here there is a gap in the argument, because S's mental events are postulated causes of observable behavior but are not directly observed. The issue then becomes a classical one: Can a cause of behavior be nonphysical? The various materialist answers are well known: (i) The only causes that science has found necessary to assume in the nonpsychological sciences are physical causes. (ii) It is unparsimonious to assume a second nonphysical cause, and in any case, it is most difficult to conceive of something nonphysical affecting something physical. (iii) A complete account of behavior seems possible in principle in terms of physical causes—at least there are no data available against the notion that behavior ultimately can be so accounted for.

I must emphasize that it is not the argument in favor of only physical causes of behavior that creates difficulties for central state materialism. It is the criticism that the thesis does not account for the phenomenal experience of S that is difficult to handle. The thesis is acceptable from the sole perspective of O, but as soon as S maintains, for example, that he directly experiences pain which does not have physical characteristics, the account becomes incomplete. A possible solution to this phenomenalist objection is then a version of epiphenomenalism which Campbell (8) has termed "central state materialism plus." A physical causal account of mental events determining behavior is held, "but human mental life also embraces awareness by phenomenal properties" (8). These experienced phenomenal properties are functions of the brain but do not in turn affect the brain. Unfortunately, as Campbell notes, "One who holds to the theory must just grit his teeth and assert that a fundamental, anomalous, causal connection relates some bodily processes to some nonmaterial processes. He must insist that this is a brute fact we must learn to live with, however inconvenient it might be for our tidy world-schemes" (8). Campbell's "new epiphenomenalism" would seem to be a rather inelegant solution to such a magnificent problem.

## Unexpected Symmetries

The discussion so far has led to two formulations of an identity thesis which I have argued are acceptable on philosophical grounds, and which also are consistent with empirical evidence from the neurosciences. From S's perspective, mental events are strictly identical with pure events (psychoevent identity) and from O's perspective, S's mental events are strictly identical with S's neural events (*psychoneural* identity). I have pointed out that this latter perspective provides an incomplete account. I will now point out the relationship of these formulations to classical approaches to the world knot. The possibilities include: (i) only psychoevent identity; (ii) only *psychoneural* identity; (iii) both psychoevent and *psychoneural* identity; and (iv) complementary psychoevent and *psychoneural* identity.

If one approaches the relation between mind and matter only in terms of psychoevent identity, one obtains a dualism of mind and matter. Any S from his perspective proximal to his unique transformation boundary can hold that there are two fundamentally distinct realities. One reality comprises physically embodied events (matter) and the other reality comprises pure events without physical embodiments (mind). On the present analysis, S has two distinct kinds of information by direct acquaintance. Because S's events represent physically embodied events which are distal to his transformation boundary, S has information about what comprises the physical world distal to his transformation boundary. To the extent that these events represent something, S maintains that there are "somethings" external to himself. But S also has by direct acquaintance the events-per-se, that is, the representation per se as distinct from what is represented, which representation contains no information about its own physical embodiments (12). If only S's perspective is taken, a dualist conclusion can be reached because S never can know that objectively his pure events are neural events, as the above discussion details. The most widely held version of such a dualist thesis is Cartesian interactionism which considers mind and matter to be distinct realities which affect each other. It should be noted that the interactionist assumption is an attempt to explain the empirically observed correlation between mental events and neurally embodied events, and is secondary to the basic assump-

tion of two realities. In effect, this dualism reduces to the psychoevent identity formulation.

But if one approaches the relation between mind and matter only in terms of *psychoneural* identity, one obtains a monistic materialism. The perspective here eschews being proximal to any transformation boundary but entails being distal to all transformation boundaries. We can construct such an objective perspective by using a public and peripatetic television camera which is distal to all conceivable transformation boundaries. This imaginary camera has a special capability of observing brains and bodies while conducting interviews. As the camera roves the physical universe, observing especially human organisms with living brains, we watch the monitor television screen. Now, the only events that appear on the screen are physically embodied. (We find no Cheshire grin without the cat!) When focused on subjects it is empirically ascertained by interview that both reports of mental events by S and inferences from observations of S's behavior correspond perfectly to physical neural events. That the subject does not know how his mental events are neural events is irrelevant. The subject cannot know this as these events cannot contain information about their own neural embodiments. But from the general perspective of the camera, the subject's ignorance is certainly no rationale for maintaining that mental events are not physical.

A dualist might argue that when we "watch" the physically embodied events that "appear" on the screen we tacitly have introduced the transformation boundary of the watcher and thus pure events. This is the crudest of errors, he insists. But the materialist rejoins that just as his subjects are ignorant of their mental events being in fact neural events, he himself is so ignorant and that ignorance is hardly a firm basis for asserting a second reality. In effect, this materialism reduces to the *psychoneural* identity formulation.

A problem with both dualism-psychoevent identity and monism-*psychoneural* identity is that each holds their particular perspective to be sovereign, when actually the perspectives are symmetrical to each other. Where the perspective proximal to the transformation boundary finds some variety of pure event, the symmetrical perspective distal to this transformation boundary finds some variety of cor-

responding neural event. Thus, symmetrical systems will be constructed. There would seem to be no a priori reason for favoring one over the other because the choice of perspective in relation to the transformation boundary is entirely arbitrary. Further, each perspective alone is limiting in that the symmetry itself cannot be taken into account without both perspectives being utilized.

One solution to this is a variety of psychophysical parallelism which does hold simultaneously both perspectives. In terms of the present discussion, this is a much more sophisticated position than the Cartesian position with its ad hoc assumption of interactionism. Pure events (mental events) are parallel with but do not interact with physically embodied events (neural events) because the difference is only a function of the perspective of the observer in relation to the transformation boundary. It is not that the two realities are parallel; rather, it is that parallel observations are made and that each observation produces a different version of reality. The empirical experimenter does not observe any interaction but only a *psychoneural* correlation (*psychophysical* correspondence) which, to be parsimonious, implies nothing about interaction and nothing more than parallelism. In effect, psychophysical parallelism reduces to both psychoevent and *psychoneural* identity formulations.

But this position is unsatisfactory because it is impossible to be simultaneously both proximal and distal to the same transformation boundary, as the above discussion explicates. This is a fundamental limitation inherent in our capability of making observations. Although equal in status, the perspectives cannot be applied concurrently and each provides different accounts of reality, just as light appears to be a wave or a particle depending on the method of observation, which methods cannot be applied simultaneously.

Thus, psychoevent and *psychoneural* identity are complementary in Bohr's sense (13). Indeed, Bohr considered his principle of complementarity to be a general philosophical principle and suggested its application to the relationship of mind and matter, although he did not systematically work out the position (14). I have tied his concept here to the identity thesis and detailed the underlying nature of the complementarity. In sum, two complementary versions of the identity thesis,

intrinsic to which are independent and mutually exclusive methods of observation, are necessary to account for the relationship of mental events and neural events. Although objections to Bohr's notion of complementarity have been raised on philosophical grounds (15), the present discussion explicates how complementarity is inherent to the problem of mind and matter on biological grounds by virtue of the obligatory transformation boundary at the interface between the nervous system and the rest of the physical world. One perspective is distal to all transformation boundaries and the complementary perspective is proximal to one transformation boundary. A complete account requires complementary perspectives in relation to this transformation boundary.

The advantage of this complementarity conceptualization now may be apparent. A complete account of reality entails more than mind, more than matter, and something different from both mind and matter. The account of reality is a function of perspective in relation to the transformation boundary and this reality cannot be conceived of independent of perspective. According to the complementarity principle, light is not just a wave, not just a particle, and surely not a "wavicle" (both). What light "is" depends on the experimental arrangement used to determine what light is and light has no reality independent of that experimental arrangement. The relation of the present application of Bohr's complementarity principle to the problem of mind and matter would seem to be deeper than a simple analogy to its application in quantum physics. Rather, both applications illustrate the use of a general philosophical principle.

## Events and Embodiments

Because the present argument relies heavily on notions of "events" and "embodiments," I now discuss these concepts more generally, as the event-embodiment relationship is a crucial aspect of the world knot. I define event as any change in a physical organization (a change in structural embodiment)—that is, for the duration of observation a change in the physical organization is an "event" whereas no change in the (steady state of the) physical organization is a "no event." Now, it is well known that to the extent that any physical structure is a

nonrandom arrangement of the components of that structure, the structure contains information or negentropy. But an event is simply a change in the structure which for biological systems can be in the direction of either more or less entropy. Of course, on the second law of thermodynamics, the overall direction of change in the universe is held to be in the direction of increased entropy. Given a system of orthogonal components, any randomly occurring change is as much an event as a nonrandom change in a highly organized structure of interdependent components. Sequences of events and no events add a temporal dimension to the statically conceived cross section of structural embodiment.

Now, it is apparent that if one observes events from a perspective distal to the structure embodying the events, one can only have information about the events as they are embodied—that is, one has representation events corresponding to the embodying structure and any changes over time in that structure. But if one observes events from a perspective proximal to the structure embodying the events, that is, if one is the embodying structure, one can only “have” events-per-se without any knowledge of their physical embodiments. This complementary distinction between events-per-se and their physical embodiments is precisely the distinction made earlier between mental events (pure events) and their neural embodiments. The latter distinction would seem to be but a special instance of the former. Indeed, it might be argued that the human brain is the most highly evolved example of a physical organization which embodies events—that is, that the brain structure comprising neurally embodied events has developed during evolution as that structure maximally capable of embodying events. We ordinarily think of the brain as a structure highly evolved for information representation and processing in terms of neural events, because we focus on negentropy. But keeping in mind the definition of event as any change in the embodying structure, we can see that the brain’s capability for the peculiarly rapid changes of electrical events, in the form of the firing of digital nerve impulses and the widespread and efficient transmission of these impulses to other neurons which may fire in turn, provides an extraordinary capacity for embodying events. In contrast, the

liver, heart, kidney, nonmammalian brain (and computer) are less evolved (or less appropriately constructed) for complex changes in structures which comprise the embodiments of events. In effect, the brain is a physical organization highly evolved for the efficient and rapid embodiment of complex spatiotemporal change. Its capability for thus embodying events is identical with its capability of mind; less evolved organs, organisms, and machines have only a “protomind” to the extent that they are capable of embodying events.

I have considered thus far events and the structural embodiments of events. “Pure event” obtains from the perspective which is (is coterminous with) the embodiment. Pure events are the changes in the embodiment but these events cannot represent in any way their own embodiment, although they can represent other embodiments. To represent as events its own structural embodiment, the embodiment must change so that it is no longer the “itself” it represents. If it does not change but remains itself, it cannot represent itself, because representation requires change. Further, an event embodied by distinct types of digital element in a computer is equivalent whether the embodied event comprises a shift in electrical potential in one type or a shift in the orientation of a magnetic field in another type. The digital computer element has only a change in its organization, which is the pure event, but cannot represent its own organization. In contrast, embodiment obtains from a perspective external to the embodiment. From this perspective, we have both the embodiment and the events embodied, for example, we can distinguish the types of computer element which embody electrical potential or magnetic changes, but the embodied events objectively obtained are not identical with the pure events per se obtained from a subjective perspective which is coterminous with the embodiment.

*It is impossible to have at the same time and at the same order of representation both pure event and the structural embodiment of that event.* To have the pure event, one must be congruent with the embodiment of the event, but to have the embodiment, one must be distinct from—not coterminous with—the embodiment. As one cannot at the same time be both coterminous with and not coterminous

with the same embodiment, this is not a logical possibility. Those pure events which one has when one is the embodiment cannot be identical with those embodied events which one has when one is distinct from the embodiment, as Fig. 2 illustrates. This argument underlines again the private-public distinction and the difference between mental events and neural events. Indeed, the problem of mind and matter is but an instance of the more general case of this relationship of pure event to event-embodying structure.

### Neither Events nor Embodiments

I outline in this section an implication of the preceding discussion, although I do not provide a detailed defense of the implication. Having considered pure event, event-embodying structure, and their inherent complementarity which does not allow simultaneously both pure event and physically embodied event, I suggest that there is yet another logical possibility about which one might speculate; it is the possibility of neither pure event nor event-embodying structure. Now, if there were no events, which I have defined as no change in a physical organization, there would be no time. [The following discussion of time is derived partly from Capek (16).] A succession of only no events is intrinsically timeless, that is, beyond time, because there is no possibility of a succession of events (and no events) which is the dynamic embodiment of time. Developed from the converse perspective, the concept is one of a “dynamic structure” which is the embodiment of a succession of embodied events (and no events). The dynamic embodiment here is the structure inherent in any sequence. The succession of events embodied in a dynamic structure provides objective time (17). When one is external to the dynamic structure, time is the sequence of embodied events, as in the movement of a clock or firing of neurons.

But what could be the meaning of the instance of no embodiment? It refers to the absence of physical things, at its limit a total disappearance of matter. It would seem that the absence of matter implies a continuum which is homogeneous and relative throughout. Indeed, the instance of neither pure events nor physically embodied events implies the resorption of event, matter,



and time into a primal undifferentiated "neutral reality" which is none of these. This neutral reality lies beyond all events and their structural embodiment, beyond mind and matter. When embodiments ultimately break down, in accordance with the second law of thermodynamics, then this neutral reality obtains. Indeed, from the perspective of the neutral reality, embodiments are deformations or warpings of the neutral homogeneous continuum which is otherwise beyond time and matter—that is, they are discontinuities which structure part of an otherwise homogeneous continuum that, on the second law of thermodynamics, ultimately resorbs such structure. I suggest that the notion of a neutral reality which is neither event nor embodiment, derived from considerations relating to the problem of mind and matter, has interesting similarities to the relativity theory notion of a time-space continuum, derived from considerations of physics, although it is beyond the scope of this article to discuss the suggestion further.

The present concept of neutral reality should be distinguished carefully from the Spinozan double aspect idea. For the latter, neutral reality has both a mental and physical aspect depending on one's method of observation, but is neither in itself. For the present argument, neutral reality does not have mental and physical aspects because it is beyond the mental and the physical. Nor are the mental and the physical aspects of some mysterious third reality which is variously accounted for on the methods of the observer. Instead, mental and physical events are held to provide a complete account of (not neutral) reality. The apparent differences between the mental and the physical are a function of the kind of information available to the observer. If coterminous with some particular embodiment, events so embodied cannot represent their own particular embodiment. If not coterminous with the particular embodiment, events otherwise embodied can represent the particular embodiment. The so-called different aspects of a neutral reality are on the present discussion but different information about not neutral reality available to subjective and objective observers depending on their vantage point in relation to the transformation boundary. Neutral reality can have no aspects, as it has resorbed event, matter, and time.

## Theistic Views

As the history of ideas attests, views of God and views of the relationship of mind and matter are closely related. The psychoevent identity thesis and the psychoneural identity thesis correspond, respectively, to traditional Western church doctrines of God as spirit on one hand and materialistic atheism on the other hand. I shall point out briefly and unsystematically in this section the relation of both the complementarity and neutral reality notions developed above to theistic views. This is of especial interest in that these theistic views are generally considered to be "mystical," yet I shall suggest that they are quite congruent with the present discussion developed from a Western scientific and philosophical paradigm.

There is a common mystical notion, especially prevalent among "counterculture" youth, that all reality is ultimately the "mind of God." In order to explore this notion, consider the cosmos as comprising the whole of all physical structures which embody events. (In keeping with this cosmic perspective, only stellar masses will be considered, for purposes of simplification.) Changes in the relationships between stellar masses allow any observer to consider the cosmos, excluding his own pure events, as an event-embodying structure. This is the perspective of the astronomer whose brain represents, proximal to his transformation boundary, the distal cosmos just as O represents S's brain in Fig. 2. But what of the complementary perspective, designated G, which is coterminous with the embodiments, that is, coterminous with the cosmos? From G's perspective there are only pure events, because for G there is no information that these events are stellarly embodied any more than a subjective observer (S) has information that his events are neurally embodied. The events embodied by any structure cannot represent its own structure. Such pure events, on the perspective of G and S, are not physical, but are mental. Now it follows that if one chooses to conceive of "God" as coterminous with the cosmos, that is, coterminous with all physical structures that exist, then an irreducible level of events which do not contain information about their own embodiments occurs—ultimately on God's perspective there are only pure events or mind, which is precisely

the mystical thesis. Just as we ultimately must come to pure events in considering the unique event-embodying structure of the brain, so must we ultimately come to pure events in considering the event-embodying structure of the cosmos.

To the extent that an observer takes an objective perspective which provides an account of event-embodying structures, G's perspective cannot be appreciated. But to the extent that the observer can focus solely on his own pure events, G's perspective can be appreciated, which perhaps explains why the experience of a deeply felt unity or merging with God is more the domain of the meditative mystic than the experimental astronomer.

I have developed my argument in this article within the framework of science, starting with empirical findings and conceptual considerations relating to neural events. But I maintain that it is possible to come to similar conclusions if the argument is developed within other frameworks. I suggest that a framework of mysticism, for example, is comparable to the scientific framework that I have used, and illustrate this possibility by considering "neutral reality" which is neither event nor embodiment. In the framework of science, neutral reality is beyond event, matter, and time, and encompasses all forms which eventually must merge into the neutral reality. All local forms or embodiments move toward the neutral reality following the second law of thermodynamics while at the same time the continuum of neutral reality is quite independent of or "beyond" those forms. Thus the purely geometrodynamical properties of time-space are prior to any material embodiments. (Perhaps the phrase, "unmoved mover" conveys the essence of this idea of neutral reality.) There is a comparable mystic conception of God which is highly similar to the present conception of neutral reality. Both entail a conception of ultimate reality which is beyond all mind and matter, comprising an impersonal, indivisible, timeless, undifferentiated, infinitely extended, primordial unity, "the One" toward which spirit and substance evolve. Indeed, the mystic notion of "the one in the many" may be construed as the many frameworks within which one may reach, from many starting points, the one fundamental idea of neutral reality. Similarly, "the many in the one" may be construed as the

resorption of events and embodiments into that neutral reality.

I would speculate that in separate ages and places man has used comparable logic in discussions of the same problem and has come upon the various equivalent notions of time-space continuum, neutral reality, and God. The framework within which the problem is discussed may be neurobiological, as in this article, or mathematical. But the framework could also be that of Christian mysticism, Jewish cabalism, Buddhism, or sorceric as in the teachings of the Yaqui Indian Don Juan (18).

Thus, it would appear that there is truly "nothing new under the sun" (19). Although mysticism seems antithetical to science, yet certain core ideas appear to be similar. Indeed, as Holton's (14) discussion of "complementarity beyond physics" emphasizes, Niels Bohr appreciated the antiquity of the complementarity conception, as indicated by his use of the ancient Chinese Taoist yin-yang symbol in his personal seal. Perhaps the antithesis is primarily methodologic, in that mystical knowledge assumes a perspective proximal to one transformation boundary, whereas scientific knowledge assumes an objective stance distal to all transformation boundaries. The present account of the identity thesis in relation to the world knot suggests that these perspectives are complementary (20). Further, the notion of complementary psychoevent and psychoneural identity formulations provides a rapprochement between humanistically oriented dualist views and symmetric scientific monist accounts. Thus, the scientist can maintain the "spirit" of dualism while in no way compromising his materialist account by adopting complementary perspectives in relation to the transformation boundary. I suggest that empirical scientific findings relating to this interface between the nervous system and the world extrinsic to the nervous system combined with careful philosophical analysis can lead to some simplification of the world knot.

#### References and Notes

1. G. Globus, *Phil. Sci.* **39** (4), 291 (1972).
2. J. O'Connor, Ed., *Modern Materialism: Readings on Mind/Body Identity* (Harcourt, Brace & World, New York, 1969); D. Rosenthal, Ed., *Materialism and the Mind/Body Problem* (Prentice-Hall, Englewood Cliffs, N.J., 1971); E. Polten, *Critique of the Psycho-Physical Identity Theory: A Refutation of Scientific Materialism and an Establishment of Mind-Matter Dualism by Means of Philosophy and Scientific Method* (Mouton, The Hague, in press).
3. H. Feigl, *The 'Mental' and the 'Physical'* (Univ. of Minnesota Press, Minneapolis, 1967).
4. U. T. Place, *Brit. J. Psychol.* **47**, 44 (1956).
5. J. J. C. Smart, *Phil. Rev.* **58**, 141 (1959).
6. D. M. Armstrong, *A Materialist Theory of the Mind* (Routledge & Kegan Paul, London, 1968).
7. C. Borst, introduction in *The Mind/Brain Identity Theory*, C. Borst, Ed. (MacMillan, London, 1970).
8. K. Campbell, *Body and Mind* (Doubleday Anchor, Garden City, New York, 1970).
9. The term "representation" as used in this article means that neural events consequent to a stimulus impinging upon the senses are in some kind of correspondence with the stimulus and by virtue of that correspondence can represent the stimulus. Whether the representation is veridical or whether the form of representation is iconic, isomorphic, or a Fourier transform, is not relevant for this discussion. The term "transformation boundary" will be used to designate the interface between the nervous system and the not nervous system (the environment, which includes the rest of the body). This interface is at the various sensory receptor-transducers where the initial transformation of stimulus energy to neural representation occurs. By the term "embodiment," I refer to a physical organization or structure, a change in which I term "event"; for example, "neural embodiment" refers to a neuron and "neurally embodied event" refers to some change in the neuron, such as electrical depolarization of the cell membrane.
10. K. Pribram, *Languages of the Brain* (Prentice-Hall, Englewood Cliffs, N.J., 1971).
11. The corpus callosum is an anatomical structure that connects corresponding points on the right and left cerebral hemispheres.
12. M. Polanyi [*Science* **160**, 1308 (1968)] appears to point to this same issue in terms of "from-at" conceptions: "When we look at words without understanding them we are focusing our attention on them, whereas when we read the words, our attention is directed to their meaning as part of a language. We are aware then of the words only subsidiarily, as we attend to their meaning. So in the first case we are looking at the words, while in the second we are looking from them at their meaning: the reader of a text has a from-at knowledge of the word's meaning, while he has only a from awareness of the words he is reading." Thus, we have a from knowledge of a representation per se and a from-at knowledge of what is represented. I have discussed and defended elsewhere (1) the idea that most events in the brain do not represent anything distal to the transformation boundary but are intrinsic events of the brain representing nothing but serving to "process" representation events. These processing events are held to be identical with consciousness-per-se in contrast to representation events which are held to be identical with the contents of consciousness-per-se. Also see K. Sayre, *Consciousness: A Philosophical Study of Minds and Machines* (Random House, New York, 1969).
13. N. Bohr, *Atomic Physics and Human Knowledge* (Wiley, New York, 1958); *Essays 1958-1962 on Atomic Physics and Human Knowledge* (Wiley, New York, 1963).
14. A. Petersen, *Quantum Physics and the Philosophical Tradition* (M.I.T. Press, Cambridge, Mass., 1969); G. Holton, *Daedalus* **101**, 1015 (1970). N. Brody and P. Oppenheim have attempted to extend Bohr's complementarity principle to the mind-matter problem [*J. Phil.* **66**, 97 (1969)]. They argue that the properties (M) of mental entities, that is, privileged access and no bodily location, and the properties (B) of bodily entities, that is, public and with a bodily location, are noncompatible when referred to "in statements that do contain explicit reference to concepts of some theory of scientific psychology." M and B entities are "theoretical posits" or "entities inferred from observations." This noncompatibility is resolved by the complementarity principle which relativizes noncompatible properties as a function of mutually exclusive experimental arrangements from which these properties are inferred, just as noncompatible wave and particle properties of light are relativized by mutually exclusive experimental arrangements. "Hunger" is used as an illustration. It is a B entity when conceived of as a state of the organism, for example, in terms of certain hypothalamic centers which are studied by means of certain neurophysiological experimental arrangements. But, hunger is an M entity when conceived of as an experience of subjects which determines their behavior, as studied by means of certain experimental arrangements which involve setting up "cognitive dissonance." A major defect in this argument is that there is nothing mutually exclusive in principle about the experimental arrangements. One can accomplish in principle a cognitive dissonance study and infer an experience of hunger while at the same time making neurophysiological observations of the hypothalamus. Nor is there any compelling reason that one must posit an experience of hunger in a cognitive dissonance experiment rather than a state of the hypothalamus. Indeed, as behaviorists such as Skinner [B. Skinner, *Beyond Freedom and Dignity* (Knopf, New York, 1971)] and ordinary language philosophers such as Ryle [G. Ryle, *The Concept of Mind* (Hutchinson, London, 1949)] have argued convincingly, it is unnecessary ever to assume M entities in any experimental arrangement. In contrast, the experimental arrangements to demonstrate wave and particle properties are mutually exclusive. Further, wavelike properties are not directly inferable from the arrangement which demonstrates particle properties, and vice versa. I conclude that Bohr's principle of complementarity has been applied incorrectly in this argument.
15. P. Feyerabend [*Phil. Sci.* **35**, 309 (1968)] has discussed critiques of Bohr.
16. M. Capek, *The Philosophical Impact of Contemporary Physics* (Van Nostrand Reinhold, New York, 1961).
17. When one is coterminous with the dynamic structure, one has no sense of objective temporal duration, because there is nothing but a sequence of pure events. Since one does not have the physical embodiment of pure events, one cannot have any change in those physical embodiments; hence, there can be no succession of embodied events that comprises objective time. A succession of pure events is therefore intrinsically timeless, that is, a sequence of pure events simply is, without any spatiotemporal units. I believe that a full explication of this argument will answer the objection of Sellars and others to the identity thesis, that is, that the mental and the physical differ in spatiotemporal "grain" [W. Sellars, *Science, Perception and Reality* (Routledge & Kegan Paul, London, 1963); P. Meehl, in *Mind, Matter and Method*, P. K. Feyerabend and G. Maxwell, Eds. (Univ. of Minnesota Press, Minneapolis, 1966); M. Capek, *Scientia* **104**, 687 (1969)].
18. C. Naranjo and R. Ornstein, *On the Psychology of Meditation* (Viking, New York, 1971); C. Castaneda, *The Teachings of Don Juan* (Ballantine, New York, 1969).
19. The metaphysical fictions of Jorge Luis Borges seem to me to contain in striking fashion many of the theses of this paper as well as the historical process within which it is continually rediscovered [J. Borges, *Labyrinths*, D. Yates and J. Irbay, Eds. (New Directions, New York, 1969)].
20. T. Blackburn has made a similar point in discussing "sensuous-intellectual complementarity" in science [*Science* **172**, 1003 (1971)].
21. I thank M. L. Werner for continuing discussions and I. Savodnik for patiently critical critiques of many drafts. Comments by G. Maxwell are appreciated. M. C. Werner's stop-the-picture method was helpful.