TOWARD A SOUND PERSPECTIVE ON MODERN PHYSICS: CAPRA'S POPULARIZATION OF MYSTICISM AND THEOLOGICAL APPROACHES REEXAMINED

by Robert K. Clifton and Marilyn G. Regehr

Abstract. Fritjof Capra's *The Tao of Physics*, one of several popularizations paralleling Eastern mysticism and modern physics, is critiqued, demonstrating that Capra gives little attention to the differing philosophies of physics he employs, utilizing whatever interpretation suits his purposes, without prior justification. The same critique is applied and similar conclusions drawn, about some recent attempts at relating theology and physics. In contrast, we propose the possibility of maintaining a cogent relationship between these disciplines by employing theological hypotheses to account for aspects of physics that are free from interpretive difficulties, such as the ability to create mathematical structures with extraordinary predictive success.

Keywords: Fritjof Capra; mysticism; quantum mechanics; relativity theory; theology; science.

INTRODUCTION

Quantum mechanics and relativity theory have been frequently utilized in the development of various expositions which seek to link modern physics with a particular world view. At the forefront in much of today's popular literature is the attempt by various authors to parallel developments in physics with Eastern mysticism. Fritjof

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Capra's *The Tao of Physics* figures most prominently, although it is not difficult to compile a list of additional references.[1] Popularizations such as this extend even to the classroom. It is not uncommon to find Capra's work listed as a helpful reference in a university physics syllabus, and in one instance it achieved the status of a course text.[2]

There has been a variety of responses to these "New Age" writings. Some respond to such books much as a group of astronomers would respond to someone who purported to show that the earth is flat. The claims are assumed to be so ludicrous that no response is given. Others find that their experience and belief systems "resonate" with the claims of these books. Little is done to question their use of physics in detail. Some within the Christian community, having only a surface knowledge of both physics and Eastern mysticism, experience a sense of threat, for an Eastern metaphysical framework is popularly perceived to be superseding the hitherto uncontested notions of Western religious thought.

The response to Capra within this paper is that the claims in his writings oversimplify a web of complex problems, the key problem being that not enough attention is given to the various interpretations of the physics involved which could contradict the interpretation presented by Capra to establish the parallels he desires. Further, it is dangerous to place so much confidence in scientific theories. Because theories and their interpretations are often ephemeral, the world views that are invoked to support them can become quickly dated. As we proceed, we will chart these views, as well as further problems we see in the writings of Capra. On this basis, we shall challenge the implicit or explicit claim that science validates Eastern mysticism.

After dealing with Capra, we shall apply the same principles formulated in this critique to the works of some Christian theologians in order that a cogent perspective on the relationship between physics and theism can be achieved. There have been many attempts to relate Christian thought to physics. On a popular level, many a sermon has grown in profundity in the ears of its hearers by inclusion of the term *quantum leap*. One Christian thinker writes that modern developments within physics may be seen to give evidence of the Spirit within the physical realm.[3] Other thinkers, such as T.F. Torrance and W. Pannenberg, do not go so far but, similarly, fail to deal adequately with the problem of allowing one's theology to stand or fall on the tenability of a controversial philosophy of physics.

We shall suggest that, though not all have done so, it is imperative for those embarking on the Christian theology and science debate to avoid the pitfalls that Capra's work so aptly portrays. Namely, it is dangerous to wed one's religious beliefs to physical theories that are ephemeral and lead to a wide range of interpretations. Those who engage in such comparative endeavors need to be sensitive to the technicalities of the metaphysical and epistemological issues that arise, and familiar with the vast range of opinion these issues engender. Further, those who draw analogies between physics and Christian faith, or other forms of theism, must address many of the problems Capra largely ignores. For example, in what sense is one justified in comparing different levels of reality, and for what end should such comparisons be undertaken? Such questions seem relevant, in our view, for science has often been wrongly employed to *validate* theological beliefs.

Although our criticisms may appear to leave religion and modern physics in autonomous realms, with little possibility of interaction, we shall conclude with a suggestion by which a more justifiable relationship can be drawn. Rather than attempting to establish a direct connection between Eastern mysticism or Christianity and physics by concentrating on conceptual or methodological issues of modern physics around which many battlelines have been drawn, we shall concentrate on a *general* characteristic of contemporary physics which seems to be recognized by physicists of all persuasions and is considerably less open to many interpretations. We shall illustrate how this characteristic, what we call *positive conformity*, can be related, in a qualified way, to a theistic framework. Though not without its pitfalls, we shall propose that concentration on an idea such as positive conformity can lead to a better relationship between physics and faith than proposals put forth by Capra (and others like him). Though our concern will be to establish a relationship between theism and physics by way of positive conformity, this does not exclude a refinement of the relationship between Eastern mysticism and modern physics that others might wish to propose (see, e.g., Jones 1986, chap. 4).

CAPRA'S MYSTICISM

For the reader not familiar with Eastern thought a brief overview of its central concepts will provide a model for understanding Capra's parallels. Capra (1982) is a strong advocate of a 'postmodernist' view, that is, promoting holistic thinking over and against the alleged dualistic, fragmentary character of thinking often associated with Western culture, traceable from Newton and Descartes (Peters 1985, 193). He holds postmodernity to be characteristic of the thought of Eastern religions: Buddhism and Hinduism, having roots in India, and the closely related Chinese schools of thought, Taoism and

Ch'an (later to develop into the Japanese Zen). These Eastern religions can be further subdivided into schools of thought, perhaps along 'orthodox' and 'liberal' lines. Thus, for example, within Buddhism there are two distinct schools, the Hinayana and the Mahayana. These religions and the various "schools" hold mystical experience to be central.

Eastern schools of thought emphasize two types of mystical experiences, to varying degrees: *nature* or *extrovertive* mysticism and *depth* or *introvertive* mysticism. Within the former, sensory experience still occurs, although objects are transfigured and experienced as one or as part of a whole. The world is no longer viewed as divided or compartmentalized; duality is overcome. Within depth mysticism, sensory awareness of the external world usually vanishes. The mystic experiences an imageless state, devoid of any sense of duality, and usually feels this state to be "an implosion of ultimate reality" (Jones 1986, 45). This is interpreted as a direct experience of reality. Both forms of mystical experience have a similar goal, enlightenment. This involves a cognitive and dispositional transformation of the mystic, by either the integration of nature-mystical experiences on a continual basis or as a continuing effect of an introvertive mystical experience. Of primary importance to enlightenment is cognitive transformation—seeing the world differently. It has been described as a "Gestalt-like switch," a complete reorientation of one's view of the world (Jones 1986, 46 and 55).

Capra structures his parallels around two central features which, he feels, characterize the reoriented perspective of an Eastern sage, whether Taoist, Buddhist, or Hindu. He describes the first as follows: "The most important characteristic of the Eastern world view—one could almost say the essence of it—is the awareness of the unity and mutual interrelation of all things and events, the experience of all phenomena in the world as manifestations of a basic oneness. All things are seen as interdependent and inseparable parts of the cosmic whole; as different manifestations of the same ultimate reality" (1983, 142). The second feature is the mystical apprehension of nature as intrinsically dynamic: that which moves, flows and changes. Both features are related by Capra to what he sees as essential characteristics of quantum and relativity theory.

(As an aside, we note that Capra has come under severe criticism for making generalizations about a holistic mystical world view, thought to be formed at the expense of certain Eastern traditions that do not quite fit into the categories he outlines and draws on in his book. After citing Capra's account of the most important characteristics of the "Eastern world view," Richard H. Jones states that certain Eastern traditions simply cannot fit within Capra's scheme. He concludes by stating: "Any account of Eastern thought that ignores this must remain a truncated one" [Jones 1986, 201–4]. As our concern is chiefly with Capra's use of physics, we shall proceed on the basis of his interpretation of Eastern mysticism, leaving it to an authority to critique its soundness.)

In his early chapters, Capra attempts to establish a basis from which to answer the question of how we "can make any comparison at all between an exact science . . . and spiritual disciplines which are mainly based on meditation" (1983, 33). One of his claims is that both Eastern mysticism and science are empirical (1983, 42). As physicists derive their knowledge from experiments, mystics obtain their knowledge via mystical experiences which are described as direct insights into the nature of reality. This claim has been justly criticized: "If both these methods are empirical, the natural question to ask is, what is not empirical? If insight is empirical, why don't the products of all insights show the similarity to Eastern mysticism?" (Westphal in Clarke et al. 1978, 296). Capra goes further to state that both the physicist and the mystic draw their observations from realms inaccessible to the ordinary senses, one the atomic and subatomic world and the other from nonordinary states of consciousness (1983, 338). But does this not have the appearance of emphasizing the similarities while playing down the differences? Eastern mysticism is simply not "public" or open to falsifiability, as science is. To compare the severely introspective method of mysticism with science in this way is questionable from the onset.

Capra's approach in establishing parallels between Eastern mysticism and physics wavers between two models.[4] On the one hand science and mysticism are seen as *complementary* ways of knowing. Although the objects of inquiry are different, one being consciousness and the other physical reality, a complementary holistic world view emerges from both disciplines. Capra states: "I see science and mysticism as two complementary manifestations of the human mind; of its rational and intuitive faculties . . . . Mystical experience is necessary to understand the deepest nature of things, and science is essential for modern life. What we need, therefore, is not a synthesis but a dynamic interplay between mystical intuition and scientific analysis" (1983, 339). Not only are science and Eastern mysticism complementary ways of knowing, but Capra repeatedly stresses the consistency between them: "The principal theories and models of modern physics lead to a view of the world which is internally consistent and in perfect harmony with the views of Eastern mysticism" (1983, 335). (This statement also exemplifies how

Capra's arguments turn on the illusion, to be criticized shortly, that modern physics determines a unique world view.)

Capra's language illustrates the fact that he goes a step beyond this *complementary* model to assert the *confirmation* of Eastern mysticism by physics. On several occasions his words are unmistakable: "The careful observation of nature, combined with a strong mystical intuition, led the Taoist sages to profound insights which are *confirmed* by modern scientific theories" (1983, 126; italics ours). Elsewhere he states: "The results of modern physics thus seem to *confirm* the words of the Chinese sage" (1983, 247; italics ours). Still elsewhere he states: "The harmony between their views *confirms* the ancient Indian wisdom that Brahman, the ultimate reality without, is identical to Atman, the reality within" (1983, 338; italics ours).

Again, our purpose is to challenge Capra's contention that modern physics confirms Eastern mysticism in any way. This shall be done by examining his portrayal of physics in the light of the interpretive problems to which it gives rise.

INTERPRETATIONS OF QUANTUM MECHANICS AND RELATIVITY THEORY

Before we delve into Capra's portrayals of quantum mechanics and relativity theory, it is important to see how conflicting interpretations of these theoretical structures have arisen.

Two fundamental features of quantum mechanics are that the results of measuring certain physical magnitudes on atomic (or subatomic) systems may in some cases be confined to a restricted set of possible values; and, in general, it is not always possible to predict with certainty (i.e., with probability = 1) which of these values will be revealed upon measurement. In the structure of quantum mechanics, physical magnitudes that can be measured are denoted *observables*. Some interpretations of quantum mechanics arise from an attempt to make sense of the following situation. Suppose one chose to measure the value of an observable R (i.e., energy or spin angular momentum) on a system, such as a particle being acted upon by an electric field. Quantum mechanics predicts a 'spectrum' (sometimes continuous) of numbers, or eigenvalues, r_1, r_2, . . ., each of which is a possible outcome of a measurement of R and is assigned a certain probability of turning up. The central question is: What can one say about the value of the observable R immediately before the measurement? Obviously, if quantum mechanics had predicted that the probability for one outcome, r_i, were equal to 1 and for all other possibilities was zero, the situation would be clear. Since a measurement of R in this case could reveal only one value, namely r_i, we would have no trouble asserting that the value r_i for R in our system existed all along. But what if this is not the case and the measurement outcome is predicted by quantum mechanics to have a spectrum of possibilities, each with a nonzero probability? How does one answer the question about the value of R just before measurement? Of course, one can simply assert that there is no sense in pursuing an answer since quantum mechanics is merely a computational tool, without any direct correspondence to an objective physical reality. However, this is to deny any deeper understanding of the world, and has been resisted by many quantum physicists.[5]

The first response to this predicament is that the value of R is sharp (i.e., determinate) but unknown until measurement reveals it. On this view, which will be denoted *neorealism*,[6] quantum mechanics is simply a glorified statistical mechanics which can be underpinned by a more detailed theory which specifies a dynamics for the intrinsic 'possessed' values of a quantum system's observables. Such a theory is labeled a *hidden-variable theory* and is realistic in the sense that it postulates an objective external world that has entities which possess properties, such as the property of having or not having a particular value of R, independently of whether such a value is measured. The most-well-known neorealistic theory is David Bohm's, in which a 'quantum particle' evolves in time by interacting with an objective 'pilot-field', which is just the usual wave function, Ψ, of quantum mechanics, interpreted as a classical field (Bohm 1952).

A second response is that R has an unsharp or fuzzy value; that is, R does not have a value at all prior to measurement. Instead, the system measured possesses a propensity or potentiality to produce certain results upon one's measuring of R. This idea in quantum mechanics originated with Heisenberg, who derived his concept from Aristotelian physics. The idea, by analogy, is that a seed possesses the potentiality of becoming a plant. Its change consists in the actualization of potentialities (similar ideas are Margeneau's 'latent' quantities and Popper's 'propensities'). Michael Redhead points out that it is unnecessary to regard this view, henceforth labeled the *potentiality view*, as idealistic, even though at first glance it seems to imply that microsystems do not possess properties independently of our experimental probing (Redhead 1987, 49). That is, the view can be understood from a realist stance, irrespective of the relational aspect of these potentialities. Thus this view can be seen, and typically is, as proposing two fundamental modes of existence of attributes—the potential and the actual.

A third view, which we will call the *orthodox view*, is essentially the complementarity interpretation of quantum mechanics as put forth by its principal exponent, Neils Bohr. The value of R before measurement is seen as undefinable and, hence, meaningless. If a system is prepared in a state for which quantum mechanics predicts nontrivial (i.e., $\neq 0$ or 1) probabilities for R measurement outcomes, this action obviates exact knowledge of what value a measurement of R will uncover. The orthodox view is that such a preparation forces the value of R to be undefinable. Consequently, this view sets limits on the applicability of classically familiar concepts (such as position and momentum) but, at the same time, holds that such concepts are the only ones that can describe quantum mechanical phenomena. Another central tenet is that the grounds for definability become realized through mutually exclusive (i.e., complementary) experimental arrangements, and hence microphysical systems are only completely understood by adopting a complementary view of their properties, which, of necessity, cannot all be demonstrated at any one time. This orthodox view is also occasionally accompanied by a no-nonsense, pragmatic view of the quantum formalism in remarks such as: "Strictly speaking, the mathematical formalism of quantum mechanics and electrodynamics merely offers rules of calculation for the deduction of expectations about observations obtained under well-defined experimental conditions specified by classical physical concepts" (Bohr 1958, 60).

Besides these views of quantum mechanics, two more distinct interpretations have made their way into many popularizations and are based upon the alleged central role of the observer and observer's mind in the theory. One is invoked as a response to the question: At what point in a measurement of R does the transition to a definite outcome, r_i, occur? In orthodox terms, At what point does the value of R cease to be undefined? In potentiality terms, when does the transition occur between potentiality and actuality? (cf. Brown 1986). (Note that within the neorealist view the question does not arise, since a determinate measurement outcome merely reveals what determinately existed before the measurement). These questions become especially acute when we recall Schrödinger's cat paradox, in which we are told that "fuzziness" (or 'meaninglessness') of an electron's position, for example, can be transmitted through a measurement device to the macroscopic level. We are then led to assert, in the orthodox view in this case, that the property 'being alive,' a property we are convinced the cat must possess, has the peculiar status of being meaningless or indeterminate. Responding to this problem, a *consciousness-based interpretation* of quantum measurement begins with the premise that human consciousness behaves quite differently from any other object in the universe. By deciding which outcome will materialize, consciousness is held to terminate the chain of possibilities, or indeterminate properties, preventing them from becoming amplified to the level of macroscopic perception.[7]

Since this interpretation of quantum mechanics is widely used to support the Eastern mystical notion of consciousness, it deserves a few comments. For Wigner (see Wheeler and Zurek 1983, 168–81), the view's originator, consciousness is simply "the property of having sensations" (175). A possibility for a measurement outcome becomes actual when it enters this realm of sensations. This is a long way from saying that consciousness is a part of physical theory itself. But, Wigner argues, this view points to a more inclusive theory in which consciousness plays a fundamental rôle. He bases this theory upon the fact that we do not know of any phenomenon in which something influences another without the latter also influencing the former. He admits that the effect of mind on matter in most scientific experimental situations is very small—but insists that it is not negligible; thus he suggests two avenues to pursue this phenomenon experimentally. Yet, what starts out in Wigner's paper as a confident exposition of this interpretation (as evidenced by his statement that it is "not possible to formulate the laws of quantum mechanics in a *fully consistent* way without reference to the consciousness" [Wheeler and Zurek 1983, 169; italics ours]) degenerates into speculations on how to link the psychological study of consciousness with the hope that further examples of the altering of physical laws by consciousness will be uncovered. To talk of embodying consciousness in physics is to make a complicated move look simple, and there has been little progress beyond the speculation stage.[8] Furthermore, this view inevitably stakes the existence of certain macroscopic attributes—for example, those of fossil records—on human observation. This problem has provoked some to ascribe consciousness to animals and inanimate objects. One physicist even suggests it is God's consciousness which sustains the existence of objects and their macroscopic properties in parts of the universe remote from human observers.[9] In any case, our point is that the consciousness view is contentious,[10] speculative, and—most relevant to our thesis—only one of many interpretations of quantum mechanics.

A related (but not as outlandish) position to the consciousness interpretation is espoused by many of the orthodox persuasion. Its idealistic flavor is summed up in John Wheeler's phrase, "No elementary phenomenon is a real phenomenon until it is an observed phenomenon" (Wheeler and Zurek 1983, 184). This *observer-created reality interpretation* emphasizes that in the choice of what is observable to measure (choice of R), an observer chooses what attributes the measured system will take on. For example, by using a measurement device to measure momentum, the measured system is forced to take on momentum attributes (or properties) which, on the orthodox view, are regarded as not really there or meaningless before the measurement. By contrast, the consciousness interpretation takes this one step further by suggesting that not only do we choose which attributes will be exposed in our measured system, but our mind somehow brings into existence the *numerical value* the attribute takes on (i.e., the number r_i).

It is hoped that the preceding review has reinforced the truth that there is not a uniformity of views of quantum mechanics among physicists or philosophers. Obviously, the formalism of quantum mechanics does not entail a unique physical interpretation. Before we continue, it is also important to mention the much-debated problem of nonlocality in quantum mechanics. Nonlocality has a number of different senses in quantum mechanics, depending upon one's interpretation (cf. Redhead 1987, 117), but it (roughly) refers to a mysterious action-at-a-distance that, it is claimed by some, is somehow mediated superluminally between two particles which have interacted for a time and have separated. The existence of this effect turns upon the validity of a theorem, due to J.S. Bell (1964), that assumes the framework of a realistic theory in which a "hidden variable," λ, locally (i.e., subluminally) determines the possessed values of observables or their measurement potentialities in a two-particle correlated system. From this a contradiction with the statistical predictions of quantum mecahnics is deduced, which forces one to give up the idea that λ's determination of these possessed values (or potentialities) can be local. This proof has been generalized in many ways, but it remains true that Bell's theorem tolls only for realistic theories which ascribe either to a neorealistic or potentiality view. Many even believe it fails even to do that! (cf. Selleri 1988). Controversy aside, the alleged nonlocality between two correlated, separated particles (often interpreted as a peculiar kind of entanglement or nonseparability of the properties that such particles possess) is typically the starting point for many popular justifications of the concept of wholeness in Eastern mysticism.

In the philosophy of relativity theory[11] there are only two main positions, but the issues are no more settled. The sides roughly divide analogously to the positions established in the seemingly unresolvable realism/antirealism debate. The more realist position we will label *substantivalism*. Endorsing this position are those who regard the spacetime structure of relativity theory as a kind of substance which separately exists and has specifiable features independent of the existence of the ordinary material objects which 'fill' it. Its opposition, the *relationalist view*, sees the spacetime structure as nothing real in itself but only a systematic way of talking about spatial and temporal relations between material objects (for example, in Leibniz's words space is simply "an order of coexistences"; time is only "an order of successions").

Traditionally, these two metaphysical views of spacetime evolved from the theologically tainted debate between Leibniz and Newton over whether space and time should be regarded as real and absolute. It is often believed, mistakenly, that Einstein's relativity theory vindicates Leibniz's relationalist position and, hence, positivism in general as an appropriate philosophy of physics. (The latter, as we shall see, is clearly the position of Capra.) However, although Einstein "abolished" the ether of Newton's absolute *space*, the debate has been transformed into a disagreement over the ontological status of absolute *spacetime*. In this light, it has only recently been acknowledged that substantivalism is not necessarily ruled out in modern physics. In special relativity the substantivalist can view event locations as basic and Minkowski spacetime as a container or arena for these events. In general relativity this container is curved and is also dynamic, in that it can be acted upon and changed by its contents. In fact, perhaps the ultimate attempt at a thoroughgoing substantivalist approach to general relativity has been Wheeler's attempt at showing that spacetime is the *only* reality and that matter can be seen as merely bumps or curvatures in spacetime (known as geometrodynamics). More recently, in quantum gravity, the idea of quantizing spacetime is central and suggests that there might be some truth to the substantivalist view which treats spacetime as an entity in its own right.

In opposition to these views, relationalists see Leibniz's arguments against Newton as demonstrating that, with respect to inertial motions, the concept of an absolute and unchanging space is ontologically unnecessary. Ernst Mach is also seen as providing "the relational counter-objection" to Newton's bucket experiment, which purported to prove that motion relative to the entity 'absolute space' has observable consequences. Indeed, the influence of Mach's principle in Einstein's general relativity theory has led many relationalists to claim the latter's consistency with their position—cf. Earman 1970. Relationalism is often accompanied by an attempt to reduce talk of spacetime to something more observable and directly apprehendable, such as the causal connectibility between events. These attempts are the so-called causal theories of time—impressive mathematical structures constructed by Robb, Mehlberg, and others to make sense of the structure of relativity solely in terms of the transmission of signals between points (cf. Torretti 1983, 121–29). Their attempts have a definite kinship to the origins of relativity theory in

Einstein's thinking, but remain problematic in some essential aspects. For example, the idea of a spacetime point *per se* does not seem to be reducible to any other "more immediate" concept. If such a reduction cannot be effected, such points must be regarded as real and, therefore, vast collections of such points must be real, and we seem to be led back to a substantival view of spacetime (for specific difficulties facing this reduction, cf. Butterfield 1984).

Resolving this debate is a difficult task (cf. Earman 1987). It certainly is not resolved by Eastern mysticism popularizers, who adopt a position on it without any defense. Also, it will later be seen that building one's theology too close to a particular position on these issues, as Torrance does in his close alliance with Einstein's substantivalist views (which Einstein developed when devising his general relativity theory, is often a dubious undertaking. It is such because, first, little philosophical justification is ever given for the particular view of physics adopted over other equally possible views; and, second, it leaves theology open to sinking unnecessarily into irrelevance due to the ever-changing waters in the philosophy of spacetime theories. Particularly in relation to the Torrance example, one must recall the observations of the philosopher of physics, Arthur Fine: "For relativistic physics, then, it appears that a nonrealist attitude was important in its development, that the founder nevertheless espoused a realist attitude to the finished product, but that most who actually use it think of the theory as a powerful instrument, rather than as expressing a 'big truth' " (Fine 1986, 123).

Finally, it will be important for later considerations to ask whether relativity theory definitively supports the position that time is an illusion. As just observed, one position is that the elements of spacetime ('events' or spacetime points) are often regarded as real. But other questions arise from the peculiarity of time itself in relativity theory. Is *spatialization of time* (i.e., the tendency to regard time as not essentially different from the spatial dimension) a legitimate interpretation of relativity theory's unification of space and time?[12] Certainly there are disanalogies between the two. We can move in space but not in time and the before → after direction in time appears much more objective to us than any direction in space. Time direction is not merely conventional as in the case of space, is it? An attempt to answer this has led relationalists, who take time as reducible to more familiar physical processes, to search for a ground of justification of the direction of time in the irreversibility of thermodynamics. Those of a more substantivalist persuasion often remain unconvinced of this approach (cf. Earman 1974).

A second question intimately related to that just considered is:

What are the implications of the relativization of simultaneity? Does it imply that time ordering of events has no objective significance, thus constituting an argument for the spatialization of time? Further, does it substantiate, in Kurt Gödel's opinion, "the view of those philosophers who, like Parmenides, Kant and modern idealists consider change as an illusion or an appearance due to our special mode of perception" (Gödel 1949, 557)? This latter view is sometimes referred to as the *static interpretation* of spacetime because it presents a dichotomy between matter as displaced statically in time, as opposed to our perception of change and the coming into being of this matter for us. On this view, change and coming into being are not part of relativity theory but merely part of the awareness peculiar to us as living beings. The *now* that each person experiences is simply a reflection of individual ego. However, others are unsatisfied with this view because it fails to explain the facts that our now is not the same as in the reign of George III and that every person we know agrees that this is so. Doesn't the fact that humankind is experiencing the year 1990 suggest the now is physically privileged in some way? This response attempts to argue for the physical plausibility of temporal becoming. The *becoming view*, as it will be referred to here, holds that lapse of time is not simply subjective but retains its objectivity through certain properties intrinsic to the mathematical structure of relativity theory. Further, this view is often defended by arguing that the static interpretation unreasonably postulates the existence of future events, which are unobservable *in principle*. In any case, it has been our intention to show that the philosophical status of time in relativity theory is by no means settled. Anticipating assertions in support of an Eastern mysticism world view—for example, that the world is fundamentally timeless—we should recognize that such ideas must be approached with caution.

CAPRA'S TAO OF PHYSICS

This section will apply the preceding summary of the interpretations of recent physics to Capra's attempts at supporting an Eastern mysticism world view in *The Tao of Physics*. Although there are difficulties with the perspective he gives on mysticism, we will be largely concerned with his use and abuse of physics, in particular of quantum mechanics and relativity theory.[13]

An immediate problem is that Capra frequently implies, through his choice of words, that the technical apparatus of quantum theory itself, rather than the interpretations of the theory, settles fundamental epistemological and ontological issues. Phrases such as "Quantum mechanics tells us" and "Modern physics forces one to believe" are prevalent throughout his writings and imply that the interpretations of recent physics are less contentious than they truly are. But even more striking than the alleged parallels with Eastern mysticism is that he systematically relies on the assumption that both relativity theory and quantum mechanics force today's scientists to a positivist, pragmatist, and idealist philosophy of physics.

Consistent with his idealist slant, Capra depicts physical theories as containing concepts and representations that must not be confused with reality (1983, 35). He observes that physics forces this philosophic position upon us: "Modern physics has confirmed most dramatically one of the basic ideas of Eastern mysticism; that all the concepts we use to describe nature are limited, that they are not features of reality, as we tend to believe, but creations of the mind; parts of the map, not of the territory" (177). However, Capra seems caught in an uneasy tension. The task he sets himself involves demonstrating parallels with Eastern mysticism, from what we know about physical reality, through the mere representations of modern physics. But if these representations are simply creations of the mind, why does he bother to use them at all? He does not put forth any criterion for judging whether the physics concepts he utilizes describe what is real or are only a product of physicists' imaginations (indeed, this is the central problem in every philosophy of science). Further, the fact that mystics apprehend reality directly, without any mediation via symbols, concepts, or abstractions, whereas physicists look upon reality only in these forms, casts doubt upon any parallels between physics and Eastern mysticism. Ken Wilber, an editor of a recent compilation of mystically oriented writings by this century's greatest physicists, sees this as a critique which cuts across everything ever written on parallels: "To even claim that there are direct and central similarities between the findings of physics and mysticism is necessarily to claim the latter is fundamentally a merely symbolic abstraction, because it is absolutely true that the former is just that" (Wilber 1984, 8).

With Capra's idealistic portrayal of science, it is not surprising that he adopts many tenets of orthodox interpretation in tracing parallels and describing the contents of Eastern mysticism. His use of the complementarity principle, in its shifting alternatively between incompatible particle and wave descriptions of the same reality, parallels the description of transcendent reality by mystics (168). The notion of complementarity is extended to the ancient Chinese insight that opposite concepts stand in polar relationship to each other (175). These and other examples are presented without acknowledgment of a position on quantum mechanics, *viz.* neorealism, which in its most well-developed form to date (cf. Dewdney et al. 1988) eliminates the need for complementarity by regarding the basic quantum mechanical entities as particles guided by ontologically distinct pilot waves, so that under *all* experimental conditions a quantum system can be said to have both wave *and* particle components simultaneously (Krips 1987, 63–88). But further aligning himself with the orthodox position, Capra appeals to Bohr's choice of the yin/yang symbol for his coat of arms, stating triumphantly: "Niels Bohr acknowledged the profound harmony between ancient Eastern wisdom and modern Western science" (175).

When not operating explicitly with this interpretation, Capra makes statements in conflict with it: "The human observer constitutes the final link in the chain of observational processes, and the properties of any atomic object can *only* be understood in terms of the object's interaction with the observer. This means that the classical ideal of an objective description of nature is no longer valid. The Cartesian partition between I and the world, between the observer and the observed, *cannot* be made when dealing with atomic matter" (78; italics ours). Although the first sentence is consistent with the orthodox position, the other two are not. In Bohr's own words: "The notion of complementarity does in no way involve a departure from our position as detached observers of nature . . . the essentially new feature in the analysis of quantum phenomena is the introduction of a *fundamental distinction between the measuring apparatus and the objects under investigation*. . . . In our future encounters with reality we shall have to distinguish between the objective and the subjective side, to make a division between the two" (Bohr 1958, 74; italics his). Ironically, Capra admits this distinction on pages 143 and 154. Indeed, the consciousness interpretation, which Capra also invokes, takes the mind as fundamentally different from matter. Clearly, Capra is left no room here for paralleling mystical consciousness, in which subject and object become one in the act of knowing. Also, the observer/observed distinction retained in quantum mechanics immediately evokes suspicion about his claims that both Eastern mysticism and quantum mechanics approach a *thoroughly* holistic world view.

We have seen that not all views on quantum mechanics require the human observer. Capra goes as far as saying: "In modern physics, the universe is . . . experienced as a dynamic, inseparable whole which *always* includes the observer in an essential way" (93; italics ours). But the physicist is far from *experiencing* the universe as a whole; rather, he or she finds certain terms in quantum mechanics referring to how (inanimately or otherwise) properties of a system come to be known.[14] Within two pages, without distinguishing them, Capra brings in both the consciousness interpretation ("Eastern Mysticism . . . *always* includes the human observer and his or her consciousness, and this is also true in atomic physics") and the observer-created reality view of John Wheeler to support his parallels (152–53; italics ours). We have also seen that the former view has thus far been speculative. Yet Capra is comfortable making it central to his entire argument, looking ahead to when Chew's S-matrix theory for elementary particles will finally "bootstrap" consciousness into the physical picture of the world. On discovering the true relationship between the mind and physical reality, one reviewer of the book queries: "Is it too blunt to ask Capra what he thinks philosophers have been trying to do for the last two-and-a-half thousand years?" (Westphal in Clarke et al. 1978, 296).

When not using existing quantum mechanical interpretations, Capra creates his own by muddling them. Denying the reality of matter, he states: "At the subatomic level, matter does not exist with certainty at different places, but rather shows 'tendencies to exist' " (77)—attempting to exploit the potentiality view. But, as usually held, this view does *not* deny the reality of matter (like a Berkelian idealist!). It merely sees matter as having a tendency to become actual *at a certain position or momentum* and does not deny existence to matter per se. In fact, even dynamic attributes (position, momentum, etc.) can be seen as *existing* potentially, and it has already been noted that it is perfectly possible to adopt a *realist* view of a system's potential attributes. But Capra later says that, because "in atomic physics we have to go beyond the concepts of existence and non-existence," like physicists, "the Eastern mystics deal with a reality which lies beyond existence and non-existence" (167).[15]

With respect to relativity theory, Capra again adopts an antirealist stance. Frequently he denies any reality to space and time (e.g., 180). Oblivious to other viewpoints, he quotes a physicist who states that spacetime as a separate physical entity must be abandoned, hoping to support the Eastern view that space and time "are nothing but names, forms of thought, words of common usage" (183). Again, the role of the observer is emphasized, without mention that observations within inertial frames can be made by videotape recorders as well as conscious beings. Using the fact that space and time are inseparably linked in relativity theory, he sees the interpenetration concept in Buddhism as a perfect expression of this (189), despite the fact that space and time do not *exchange* identity in relativity theory. For Capra, Eastern philosophies are " 'space-time' philosophies" with views very close to those of relativity theory (190)—contrary to the statement of at least one expert that "mystics have nothing comparable to a conception of unified space-time" (Jones 1986, 202).

Comparing the higher planes of consciousness reached by mystics with the higher dimensional "relativistic space-time reality" (162) of relativity theory (which he also argues has no reality!), Capra concedes that "these seemingly irreconcilable concepts are generally not the ones the Eastern mystics are concerned with—although sometimes they are" (161; see also 189). He describes the difficulty physicists have in visualizing and interpreting multidimensional reality as similar to the troubles mystics face, prompting one response: "His reasoning is often of this sort: because science and mysticism each have a difficulty with language they are talking about the same thing" (Jones 1986, 202).[16] Capra then construes the unification of entities such as force and matter, and space and time within spacetime as mirroring the Eastern concept of the unification of opposites, without justifying why these entities are to be regarded as opposites, rather than entirely different and separate concepts (i.e., contraries).

Capra does the most damage when he strays into some of the contentious issues in philosophy of time within relativity theory. After citing de Broglie,[17] Capra adopts a static interpretation of spacetime whereby the lapse of time is seen as unreal and "space and time are fully equivalent," spatializing the concept of time (205). This allows him to support the claim that mystics can experience the full span of spacetime, where time no longer flows.[18] To support the transcendence of causality experienced by mystics, Capra tries to use spacetime to argue that physics tells us causality is unreal (206). He argues that time has no preferred direction in relativity theory since spacetime diagrams can be read coherently from top to bottom, or vice versa. Because there is therefore no true before or after, causation cannot exist. Unfortunately, he sidesteps a host of philosophical problems in viewing event order in time as necessary to causality. Indeed, the spacetime relationalist would view the causal structure as the most fundamental underpinning of relativity theory!

Finally in *The Tao of Physics*, and more so in his more recent book *The Turning Point*, Capra makes much of Bell's proof of nonlocality in support of Eastern mystical holism over Cartesian dualism. To support this thesis he states quite plainly, to the exclusion of interpretations differing from his own, "The subatomic particles—and therefore, ultimately, all parts of the universe—cannot be understood as isolated entities but *must* be defined through their interrelations" (69; italics ours). There is a number of problems with this mixing of micro- and macroscopic levels of physical reality and portraying them as bearing essentially the same features. One perceptive reviewer observes about Capra: "The self-styled holist and antireductionist is finally caught in his own parochialism after all. He has followed the oldest of reductionist strategies. As it is with the structure of physics, queen of the sciences, so it must be by extrapolation, with all of nature'' (Gould 1983). Clearly, on the macroscopic level objects remain separate for physicists, and, if anything, this is an argument against what mystics claim. Capra makes the further dubious statement: ''Bell's theorem supports Bohr's interpretation of the two particles as an indivisible whole and *proves rigorously* that Einstein's Cartesian view is incompatible with the laws of quantum theory'' (75; italics ours). In the first place, Einstein is well known to have endorsed realism much more than did Bohr (cf. Einstein et al. 1935), and it is only such a persuasion for which Bell's proof carries implications about the existence of nonlocal, nonseparable effects. Further, Cartesian mind-matter dualism enters neither the assumptions of Bell's proof nor its conclusions; thus it is a distinction that is irrelevant to this context.

It is our view that the foregoing analysis of the deficiencies in Capra's treatment of modern physics in support of his interpretation of Eastern mysticism leads one to the following morals. It is treading on thin ice to attach a particular religious philosophy to the viability of often ephemeral physical theories,[19] especially when one is insensitive to the contentiousness and depth of the interpretive issues involved. In addition, analogies to religious concepts are possible to uncover in many interpretations, but they are often weak and sometimes even incorrect. Such analogies should not be invoked, explicitly or implicitly, for justifying one's religious views. Also, the problem of differing areas of subject matter and levels of reality between science and religion must be acknowledged as a precursor before *any* attempt to understand them together, or to use one as a confirmation of the other, is undertaken. These criticisms illustrate that claiming modern physics validates a world view, such as that of Eastern mysticism, is naive.

PHYSICS AND THEISM

Just as any attempt to draw parallels between Eastern mysticism and physics needs to adhere to fundamental guidelines, the same is true for those who purport to draw a relationship between theistic forms of religion and modern physics. A brief overview of some construals of this relationship and a more detailed critique of a few recent attempts to promote dialogue between theism and physics will set the stage for our proposal (in the next section) for a healthier outlook on the way in which these two approaches to reality can be interrelated. Although the discussion in the present section focuses exclusively on Christian theism, similar observations could be made about the writings of other authors representing other forms of theism, for there is nothing about Christianity that makes it more amenable to the pitfalls we shall identify than, say, Judaism. Rather, we see the problem of establishing too close a link between some interpretation or methodology of physics and theology as more characteristic of theistic approaches in general than, say, Deism. This is because the former envisage an immanent Creator involved in and concerned with the physical universe, which encourages more comparisons between the nature of physical and spiritual reality than belief in an aloof, deistic God. Similarly, the proposal in the next section for a better relationship between physics and Christian faith might also be applicable to Jewish and Islamic theism, or even to Eastern theistic forms of religion.

The relation between science and Christian theism since the seventeenth century has been multifarious, often filled with conflict. First, Newtonian mechanics, with its view of the physical world as composed of material objects moving according to deterministic laws of motion, contributed to the autonomy of science from theology. Rather than God and theology, universal laws became the norm for explaining the natural order. The defensive posture of many theologians (and scientists) in response is known as the God of the Gaps Approach, which was often accompanied by setbacks for theology and religious faith under the onslaught of scientific progress. Leading twentieth-century Christian theological movements have issued more than a call for caution, asserting the compartmentalization of theology and science into incommensurable realms. Neo-orthodox theologians such as Karl Barth drew a distinct line between the revelation of God and the discoveries of human reason, claiming that science can neither contribute to nor conflict with theology. Similarly, existentialist theologians such as Rudolph Bultmann and Paul Tillich emphasized God's activity as discernible only in inward personal experience.

Modern physics has sparked a renewal in discussion of the relationship between Christian theology and science. Although science has recently ceased to be dogmatic, in certain circles it is thought to hold new vistas for Christian theology. Some draw inferences from scientific interpretations and apply them to theological doctrines. For example, nuclear physicist and Episcopal priest William Pollard (1958) feels that the providential action of God is linked to the indeterminacies of nature. He holds that chance is an intrinsic property of the universe—and God determines which value (i.e., which r_i) among the naturally determined probabilities for observables in quantum mechanics actually occurs on a given occasion. Needless to say, this position is limited; it is vulnerable to advances in science that may indicate that the lack of a complete physical theory, and not properties intrinsic to reality, has led to a need to introduce probability into a fundamental level of physics. In a similar spirit, some claim that as determinism was interpreted as excluding human freedom, indeterminacy in nature now allows for it. This exaggerates the range and competence of physics.[20] The indeterminacy that science theorizes about occurs in the subatomic realm and cannot support a concept about a very different level of reality. Although an all-inclusive view of reality may be desirable, science should not be abused by ascribing to it functions far outside its capacities.

Some physicists and Christian theologians have attempted to draw analogies between their two disciplines, for example, by comparing complementarity within physics to the understanding of paradoxes within the Christian faith such as divine providence coexisting with human freedom. An example is a recent article, "Conjugate Properties and the Hypostatic Union" (Bozack 1987), which compares the God-man unity of Christ with wave-particle duality. In it, Michael J. Bozack makes various comparisons, for instance, claiming that the God-man and the wave-particle have properties which transcend either nature acting separately. He shows that wave-particle duality is *most* analogous to the classical notion of the hypostatic union, rather than to the 'heresies' that denied or altered the original doctrine (i.e., Arianism, Nestorianism). Such an attempt demands a response. First, Bozack's purpose, though not stated in the clearest terms, is to use wave-particle complementarity as an aid to our understanding, so often rooted in preconceived, deep-seated views that such a thing as the hypostatic union seems impossible. Taken as a metaphor for understanding rather than as a validation of a religious concept by an appeal to science, this approach is unproblematic. Yet, in our opinion, it can lead to danger because it invites the reader to "read between the lines." The parallels look so remarkable that the theological concept under examination not only gains clarification in the eyes of the reader, but its apparent truth appears to receive confirmation from the scientific realm. The implication is that because it is possible to think a certain way in science, it is legitimate to think the same way within theology.[21] Perhaps this is the reader's problem. Yet, when taking this approach, it is the author's responsibility to clearly delimit his purpose. Second, the approach is intrinsically limited, in the sense that if complementarity is superseded by a different interpretation (such as a neorealistic view in which particles are guided by an ontologically distinct pilot wave), other concepts closely associated with it in the analogy (i.e., the hypostatic union, trinity, etc.), even for learning purposes, often go out of fashion with it (as history has taught us).

Other approaches have evolved which do not focus on relating scientific statements to Christian doctrines but approach the task indirectly. Process theology, for instance, charts a relationship between the two disciplines by way of metaphysics. Other theologians, notably T. F. Torrance, feel there are methodological parallels between the two realms. This approach is important enough to be considered in more detail.

It is not our desire to discredit Torrance's approach; indeed, it is our view that this approach is one of the most plausible and thoroughly worked out. Unfortunately, however, it seems beset by a number of the difficulties previously uncovered. Torrance's main point is that theology should learn from the methodology of science in order to cast fresh light upon its own procedures. Careful not to argue for commonality in the subject matter of these disciplines, Torrance (1984, 87) sees theology as following the same way of knowing as science. What way is this? For Torrance, science, especially physics, is gravitating toward a realist epistemology (244–47). This is exemplified by his evocation of Einstein's later views on the structure of spacetime as objective and real. Torrance adopts a view of spacetime that nearly reads as a substantivalist manifesto: "This is a word in which relations between bodies are just as real as the bodies themselves . . . nature is disclosed to be permeated by the invisible structure of the metrical field which is the source of our forms of thought about it" (72). This new scientific approach to spacetime reality implies a restoration of ontology for the theologian,[22] especially since it shows how we can understand God, whose ontology far transcends that emerging from general relativity.[23] Elsewhere in his book, Torrance adopts three of Einstein's most famous remarks about physics for facilitating a 'rigorous scientific' understanding of God (1984, 243ff.) "In our view, there is a danger with Torrance's approach. It leaves theology overly dependent upon the acceptance of Einstein's substantivalist ideas. Surely this would not be so undesirable if a greater attempt were made to justify these ideas against recent objections to them" (e.g., Earman et al. 1987). Although not in full agreement with her other remarks, this point is echoed by Mary Hesse's criticism of Torrance's work (Peacocke 1981, 281ff.). Her point is that particular physical theories, such as relativity theory, do not necessarily come to us equipped with a unique metaphysical package. Which metaphysics to apply is a very complex question! In our view, theologians of all persuasions should take heed of this and not attempt to build on such insecure foundations. However, if they *do*, theologians should start with a less deferential and more critical view of science.

THEISM AND ITS BEARING UPON PHYSICS

A natural reply to the cases in the previous section is to question whether it is possible to draw *any* relationship between physics and theology without developing an allegiance to *some* philosophy of physics. In this section we aim to show that this *is* possible. This is not to say that attempting to synthesize physics and theism directly, through either their methods or subject matter, has no value whatsoever; but, based upon the lessons learned from our analysis of Capra and various theistic writers, such a synthesis is only as plausible as the interpretation of physics it rests upon. Thus we believe that there is much warrant to pursuing an alternative, possibly less controversial, and more cogent approach. Our main concern is the theistic perspective of modern physics, but we do not intend to claim that theism has a monopoly on science, any more than Eastern mysticism does.

Perhaps the best way to state our vision is by contrast. In his *The Relevance of Natural Science to Theology* (1976) William H. Austin confesses that he is only concerned with the bearing of science on theology, and not the converse. One of his justifications is that science can, "more plausibly than religion," be regarded as a self-contained enterprise with a "sharply delimited scope and purpose" (1976, 3). The second is that one is faced with the question of which theology to bring to bear upon science. By contrast, the thrust of our presentation has been to show that, with respect to views of reality, physics is no less pluralistic than theology. Now we shall consider in greater detail how it is possible to reverse the progression of ideas from physics to theology. Are there basic theistic ideas that can be significantly related to a concept arising from physics which transcends interpretive difficulties?

We begin by considering this statement: "Every experiment is an act of violence which we impose on nature. It must react to the violence, and the law of this reaction can be stated in formulae" (cf. Von Weizsacker, cited in Torrance 1969, 95). Although this is a reflection on quantum theory, it illustrates something more widespread within science, viz., a question that is unanswerable by science: Why is it that our interaction with the world can be stated in rigorous mathematical terms and why does this lead to such predictive success, allowing science to, so to speak, control phenomenal reality? Physicists from Wigner (who calls this a "gift which we neither understand nor deserve" [Wigner 1960, 14]), to Einstein (who calls this comprehensibility of the physical world "incomprehensible" [see Jaki 1966, 440]) have confessed bewilderment as to how such a state of affairs has come about. Indeed this question arises, but is seldom acknowledged, within *any* philosophy of science between the two extremes of realism and instrumentalism. Whether the physicist treats his theories as a guidebook to the reality "out there" or as a cookbook giving us the mere facts of immediate experience, a common question lingers. For the instrumentalist it is phrased: How is it that mathematical formalisms are so successful in expressing regularities among observations? For the realist, contrary to what one might think, the question becomes more crucial: How is it that these formalisms have such success in corresponding with the reality "out there"? Finding an answer to this question will be labeled as pursuing the problem of *positive conformity*: *conformity* because it is the conformity of nature (either "out there" or immediate brute facts) with a certain set of abstract and structured equations; *positive* to cannote that this conformity pushes science in the direction of greater predictive success.

Before we consider objections to this formulation of the problem, we will say where it is intended to lead. As a first approximation, we use the locution "hypothesis," which generally denotes an unproved idea which accounts for something hitherto not understood. Clearly, invoking theistic conceptions as *physical* hypotheses is simply misguided—as Laplace, in his comment on God's existence, assured Napolean: "Sire, je n'ai pas en besoin de cette hypothese." On the contrary, our proposal is to invoke as a hypothesis the conception of man as a creation of God, purposefully endowed with characteristics with which he can describe and anticipate his interactions with physical reality. This can be seen as making sense of the problem of positive conformity by releasing one from the astonishment of a seemingly inexplicable yet useful correspondence between the equations we write down and the phenomena they describe.[24] Although this idea requires much greater elaboration, it should be noticed that it does not have the form of an argument from natural theology, which purports to infer or deduce concepts, such as God's existence, from outside a theistic framework.[25] We are assuming a theistic faith commitment and attempting to make sense of science from that perspective. This approach has many similarities with those who argue that secular philosopy fails to make sense of man's situation in the way that a theistic framework does (cf. Schaeffer 1968). Also, how the problem of positive conformity and a hypothesis of theism stand in relation to each other is reminiscent of Tillich's view of the method of theology as an "answering theology," in that it responds to questions in the human situation by correlating them to answers in theology (Tillich 1951, 31).

Returning to positive conformity, we admit that there have been serious challenges to whether it really constitutes a problem. For example, the view of adaptation has been put forth, whereby the fact that we think mathematically is *not* an extraordinary coincidence when it describes nature, since the laws of mathematics are seen as derived from experience. This view implies that in any other universe it would have been just as possible, as in our own, to weave a mathematical web around the objects within it. But even though granted this point, there is something unsatisfactory about accounting for successful prediction on this view. Granted that the basic elements of logic or mathematics (e.g., numbers) can be constructed out of experience, does this make sense of the fact that highly sophisticated mathematics (e.g. the Hilbert space structure underpinning quantum mechanics, obviously not immediately drawn out of nature; can be constructed for its own sake and later become so successful in prediction and correlation? Further, such success is hardly satisfactorily accounted for within a naturalistic world view in which our emergence from the evolutionary process is fundamentally purposeless. This world view can give no account of why human beings, among all the diverse entities in nature, have the privilege of understanding and anticipating the workings of other components within physical reality.[26] It merely buries the problem in naturalist terminology. As C.S. Lewis puts it: "But this, as it seems to me, is what Naturalism is bound to do. It offers what professes to be a full account of our mental behavior; but this account, on inspection, leaves no room for the acts of knowing or insight on which the whole value of our thinking, as a means to truth, depends" (Lewis 1947, 22).

The antithesis to the view of adaptation is to regard, with Kant, our minds as mathematical by nature; hence the problem of positive conformity becomes unproblematic. On this view, laws in nature are frequently perceived, but this should not be surprising because our acts of cognition create the categories in terms of which we order nature. However, astonishment at how human minds came to be endowed with such a fortuitous yet serviceable construction necessarily remains. In our view, the problem reemerges and the hypothesis of God's purposefully implanting innate characteristics into man, as created in His image, fits well with the Kantian view.

Similarly, scientific realism puts forth a *prima facie* challenge to the legitimacy of positive conformity. Such a view appears to make sense of predictive success by holding that such success is brought about by the fact that certain theoretical terms in physical theories mirror reality. However, in our view, this merely restates the two parts of the problem in attempting to portray positiveness or successful prediction as the explanan and the correspondence between nature and theoretical terms as the explanandum, for the latter correspondence retains its inexplicability in this schema. Barring theism, we have no sufficient reason to suppose that such a correspondence *should* come about.

Are there yet more obstacles in establishing the problem of positive conformity? Although the classical design arguments are profoundly dissimilar to our proposal, an analogue of one of Hume's objections to these arguments, in the words of Philo, can question this problem. His objection was to question the assumption that the world contains evidence of design since the fact that the world is unique removes all grounds for comparative reference to support such a positive judgment (see Rowe and Wainwright 1973, 165).[27] The analogous objection against our arguments would be to question whether the predictive success of science is judgable as success, since there are no other worlds from which to compare this success. In response, we believe it is possible to construe predictive success relative to the rate of scientific progress within our *actual* world. But, in a fuller theological account, there are other sensitive issues as well. For example, although positive conformity seems sensible in the context of a Creator with our practical interests in mind, there are other phenomena in nature which are either detrimental (e.g., earthquakes) or unrelated to us (e.g., star explosions in remote parts of the universe). In the former, theologians should be mindful of the problem of evil in their theodicy; in the latter, they should be wary of injecting a naive anthropocentric purpose into all aspects of the universe. Admittedly, this presentation does not even begin to dissect these issues rigorously. This must be the theme for treatments elsewhere.

Precisely because this proposal does not purport to establish, deductively or inductively, the existence of God, other hypotheses might be possible that account for positive conformity. This will be best brought out by examining a criticism of philosopher of religion Richard Swinburne's recent teleological argument for the probability of God's existence, based upon what he calls "temporal order" (1979, 133ff.). This order is simply regularities of succession, as evidenced in the laws of nature, and is at least part of what we mean by positive conformity. Swinburne's argument is that temporal order is antecedently *more probable* under the hypothesis that there is a God than that there is not, because, among other things, God is more likely to prefer an orderly world in which we can productively "live and learn." While we agree with this statement, it is important to realize that there may be other hypotheses which are not committed to temporal order as a priori improbable. J. L. Mackie has observed that since such probability judgments are necessarily a priori (i.e., although temporal order is empirical, probability judgments on how it might have come about cannot be), then, on an a priori presumption that the universe is completely random and only *apparently* ordered—as a series of dice tosses results in identical throws now and again—it is *not* highly improbable a priori that order would have occurred (1982, 147). Illustrating Mackie's point, we can say that although the theist takes the more common-sense view that the dice was loaded,[28] commonsense notions which usually arise from experience can be no basis for assigning a priori low probabilities to accounts that arise from an a priori commitment to the ultimate irregularity of the universe. Of course the person who is so committed will have difficulty in accounting for the extrapolations of regularity to all parts of the cosmos (spatio-temporally separated from our own) that science frequently makes. But this does not *prove* that one cannot do so, if, such a one can muster enough faith in his (or her) hypothesis.

Just as our approach cannot exclude alternative hypotheses as wholly improbable, it is also true that there might be other hypotheses at least as plausible as theism, which are compatible with positive conformity. We see many of David Hume's sentiments against the original design argument as originating with a desire, not so much to disprove the tenability of "the religious hypothesis," but to demonstrate that other hypotheses can be equally satisfactory. For example, Hume was doubtful that one creative agent, such as one creator God, could be singled out from a plurality of agents which could have been responsible for design. Analogously, we admit the possibility that polytheism could account for positive conformity, just as monotheism can. (For example, one might ascribe a separate god for each law of nature or physical theory and its domain of successful application.) However, the monotheistic hypothesis, and perhaps even the classical conception of God, seems more desirable, due to its simplicity and elegance in explaining a wide variety of human situations—positive conformity being one of many. Indeed, we find it inconsistent that certain atheistic philosophers, on the one hand, choose to side with the Humean objection to the possibility of a single entity behind the workings of positive conformity, only to concede, on the other hand, that science should be entirely free to employ Occam's razor to justify its own use of simple hypotheses in explaining physical phenomena. In any case, it must be said that even if one wishes only to consider hypotheses involving a unique creative deity (God), many conceptions of this entity are compatible with positive conformity, for example, conceptions of a Deistic God, who intervenes only at the instant of the universe's creation, to the conception of a Pantheistic God, who *is* creation (and conceptions of a Theistic and Panentheistic God, which lie between these extremes). Note however, that alternative conceptions and accounts do *not* detract from the fact that positive conformity provides a solid basis upon which theistic forms of religion and modern physics can interact.

The advantage of this example of relating an aspect of theology to science is that it does not seek to convince the atheist or agnostic but, rather, can be employed by those who *already* hold theistic commitments. They can be confident that their faith is reasonable, while freeing themselves from seeking definitive confirmation of their beliefs from science. Also, this approach escapes the inherent changeability of science and its plurality of interpretations, and at the same time avoids the position, unsatisfying to the theist, of segregating theism and science into unrelated realms. Instead, theology and science interlock like a jigsaw puzzle with theological missing pieces to be filled in. Although the subject matter and methodologies of science and theism remain segregated, an overall picture of reality is still attainable.

NOTES

1. The following works have similar themes: *The Tao of Science* (Siu 1957), *The Dancing Wu Li Masters* (Zukav 1979), *The Eye of Shiva* (de Riencourt 1980).

2. In his article "Teaching the Tao of Physics" (1979), David Harrison describes a course at the University of Toronto, titled The Zen of Physics. After mentioning the scientific revolution, which resulted in quantum and relativity theories, he states: "This course will discuss the new world view brought about by this revolution, and investigate the striking parallels between these concepts of modern physics and the basic ideas of Eastern mysticism" (779). A cautionary response arose later, opposing Harrison's approach (Esbenshade 1982).

3. "If energy is the essential basis of the whole material world, this to the Christian is a clear manifestation of the active creative Spirit of God in the physical realm" (Smethurst 1955, 81).

4. Zukav, author of *The Dancing Wu Li Masters* (1979), another popular book from a similar perspective, has aspirations that appear less lofty than those of Capra. He bases his parallels on the metaphor of a teacher (Wu Li Master) and student. As a Wu Li Master begins at the heart of the matter in order to convey the essence of a principle or issue, paralleling physics with Eastern mysticism will drive the student to the essence of the New physics. Zukav initially implies that Eastern mysticism is to be employed as an instructive metaphor in order that the student can learn elementary physics. In keeping with this he states: "This is not a book about physics and eastern philosophies . . . this book is about quantum physics and relativity" (25). But Zukav makes statements that push his program further than his explicit purpose. Implying that Eastern thought has been validated, he states that "the philosophy of physics is becoming indistinguishable from the philosophy

of Buddhism" (296) and, in reference to Eastern thought, claims that this is the view "toward which virtually every physical theory of import in the twentieth century is pointing" (32).

5. Some excellent and very readable accounts of the diversity of the interpretations of quantum mechanics can be found in Herbert (1985) and Rae (1986). More technical accounts are in Jammer (1974) and the more up-to-date book by Redhead (1987), from which we have borrowed some of the treatment of these issues. A variety of crucial primary sources is found in Wheeler and Zurek (1983).

6. The term *neorealism* is borrowed from Herbert (1985).

7. A more radical but equally serious view (thought by many to be the only viable interpretation in quantum cosmology) is that this chain of potentialities/indeterminateness *never* terminates. Each measurement possibility is simply actualized in a separate universe while the universe branches into many parallel universes at each measurement interaction (known as the *Many Worlds interpretation*). A further approach has been to dissolve the various quantum mechanical paradoxes by revising logic itself. On this view, quantum mechanics is seen as initiating a revolution in our conception of logic, much the same as relativity has initiated a shift in our view of geometry (known as the *Quantum Logic interpretation*). But these views are rarely used to establish significant parallels to Eastern mysticism. Zukav discusses these, but (ironically) he is silent about their relationship to Eastern mysticism, other than attempting a parallel of the learning of these unusual interpretations with the process of enlightenment (1979, 106ff., 270ff.).

8. For this reason the consciousness approach is by no means favored en masse, contrary to the popularizations. In a series of interviews with contemporary physicists recorded by Davies and Brown (1986), J.S. Bell remarks: "In my opinion, the difficulties associated with it are underestimated, simply because nobody has developed the theory beyond the talk stage" (54). Also, David Deutsch states that views that "try to give the observer a special place in forming reality haven't actually done so yet. They merely claim that they will one day . . . a claim, a promise, which over 50 years has not been fulfilled" (105). Similarly, John Taylor says: "I don't see consciousness as relevant at all" (113).

9. "If I get the impression that nature itself makes the decisive choice what possibility to realize, where quantum theory says that more than one outcome is possible, then I am ascribing personality to nature, that is to something that is always everywhere. Omnipresent eternal personality which is omnipotent in taking the decisions that are left undetermined by physical law is exactly what in the language of religion is called God" (F.J. Belinfante, cited in Rae 1986, 70).

10. Even Heisenberg remarks: "The observer has, rather, only the function of registering decisions, i.e., processes in space and time, and it does not matter whether the observer is an apparatus or a human being" (cited in Torrance 1969, 96).

11. Excellent and very readable expositions of these issues occur in Sklar (1974) and Angel (1980). More technical and up-to-date treatments are given in Friedman (1983) and Torretti (1983).

12. For example, in his *The Principle of Relativity*, Cunningham (1914, 191) writes (italics ours): "With Minkowski space and time became particular aspects of a single four-dimensional concept; the distinction between them as separate modes of correlating and ordering phenomena is lost, and the motion of a point in time is represented as a *stationary curve in four-dimensional space*. Now if all motional phenomena are looked at from this point of view they become *timeless phenomena* in *four-dimensional space*. The whole history of a physical system is laid out as a changeless whole."

13. Capra also builds part of his thesis around S-Matrix theory. The philosophical issues in particle physics are far more complicated (and less developed) to be treated adequately here (cf. Brown and Harré, 1988). Suffice it to say that

Capra makes the same sort of oversimplifications about controversial issues connected to particle physics as he does about the relativity theory and quantum mechanics. (Also, S-Matrix theory does not seem to be the working paradigm for physicists at large.)

14. In fact, Capra later confesses, in relation to how mystics apprehend unity: "Modern physics, of course, works in a very different framework and cannot go that far in the experience of the unity of all things" (1983, 154).

15. Capra also incorrectly claims that Bohr's orthodox interpretation supports the position that particles have no meaning as isolated entities but only as interconnections or correlations (1982, 69). He then leaps to concluding that subatomic particles are not 'things' at all.

16. This sort of argument also arises in Capra's claim that physics and Eastern mysticism are similar because both contain seemingly paradoxical assertions, such as the idea of complementarity in the former and the "koans" of the latter. In Zukav's case, "picture a massless particle" is presented as paradoxical, and he goes on to query: "Is it a coincidence that Buddhists exploring 'internal' reality a millenium ago and physicists exploring 'external' reality a millenium later both discovered that 'understanding' involves passing the barrier of paradox?" (1979, 224).

17. The relevant de Broglie quotation is also used in Zukav's presentation (1979, 238), but at the same time Zukav adopts its antithesis, that is, the "becoming" view of time described earlier. For him, relativity theory singles out the now, and "sixty-three years before Ram Dass's great book, *Be Here Now*, established the watch words of the awareness movement, Hermann Minkowski proved that, in physical reality, no choice exists in the matter" (1979, 176). This further exemplifies the schizophrenic way in which these authors oscillate between different, often conflicting, interpretations of physics.

18. Zukav makes an even more unconvincing attempt: "*If*, at the quantum level the flow of time has no meaning, and *if* consciousness is fundamentally a similar process, and *if* we can become aware of these processes within ourselves then it also is conceivable that we can experience timelessness" (1979, 240). Note the tension of this view, that time is meaningless or unreal, with that in note 17, in which relativity theory is said, by Zukav, to have established that the now gains meaning and reality through the relativity theory.

19. For example, in Davies and Brown (1986) it is clear (through the interviews conducted by these authors) that certain leading physicists are already anticipating the development of a deeper conceptual foundation than that implemented in quantum mechanics.

20. In light of a more recent study by philosopher of physics John Earman (1986), this also covers up the different senses of determinism certain physical theories can or cannot be said to embody. Perhaps the most startling point in Earman's investigations is that the allowance of arbitrarily fast causal signals undermines the possibility of securing true examples of Laplacian determinism within classical mechanics. This possibility is only restored in special relativity—a central theory of *modern* physics.

21. Such an implication often degenerates into an argument of the form: Since rules for reasoning work well and are widely accepted in one domain, they should produce similar and successful results in other domains.

22. On the return of scientists to an "objective rationality governing nature," Torrance remarks: "It hardly needs to be pointed out that such a view is much more congenial to a classical Christian understanding of the relation of God to the world He has made than the positivistic outlook" (1984, 251). Although this may be so, it does not preclude someone from *consistently* being a physical positivist but a metaphysical realist, avoiding the ruling out of a classical conception of God normally associated with the positivist movement. One also wonders how, in light of such a statement, the Christian beliefs of (for example) the well-known instrumentalist

Pierre Duhem can be accounted for. So against the positivist approach to science is Torrance that he goes as far as commenting that the present ecological chaos has arisen from an instrumentalist misuse of nature by the "detached objectivism of positivism" (1984, 71). However, despite these views, Christians must ask themselves whether there really is a need to transplant battlelines from the philosophy of science into the community of believers.

23. Pannenberg (1987), by comparison, adopts a realist construal of the modern field concept in physics for theological use.

24. Although it is not intended to utilize his reputation as justification, even Einstein, whose epistemology of physics many theologians adopt, *hints* in part at the understanding presented here of positive conformity. "To this [the sphere of religion] there also belongs the faith in the possibility that the regulations valid for the world of existence are rational, that is, comprehensible to reason. I cannot conceive of a genuine scientist without that profound faith" (Einstein, as cited in Ross 1987, 14).

25. Although they spoke against natural theology as traditionally held, Barth and Brunner, both neo-orthodox theologians, debated the ability of man, apart from Jesus Christ, to have *any* valid Christian understanding of nature or creation. Brunner, more in keeping with the Reformed tradition, felt it was possible because nature is God's creation, bearing his signature, thus also having a subjective correlate in man. Barth felt the image of God in man was so thoroughly demolished that no knowledge of God outside Jesus Christ is possible. Our idea is not concerned with the ability of the non-Christian to reach knowledge of God via positive conformity, but rather the hypothesis of God as the author of positive conformity enables the Christian to have a more complete world view.

26. Charles Darwin, considering the belief that there is an intelligent mind behind the workings of the universe, states: "But then arises the doubt, can the mind of man, which has, as I fully believe, been developed from a mind as low as that possessed by the lowest animal, be trusted when it draws such grand conclusions?" (Darwin 1897, 282). However, Darwin's observation by this reasoning undermines any credibility that might be attached to his own evolutionary theory. How can it be trusted? Our account is that such theories *can* be trusted because of a theistic notion of God!

27. Ironically, through Philo, Hume feels free to judge that the "inaccurate workmanship" of the world aggravates the problem of evil and tells against a Creator (Rowe and Wainwright 1973, 194). This is clearly inconsistent with Hume's objection (discussed here) against teleological arguments.

28. We have adapted this metaphor from F. R. Tennants' remark, "Presumably the world is comparable with a single throw of the dice. And common sense is not foolish in suspecting the dice to have been loaded" (*Time* 1980, 54).

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