Fruits of Time:

Nature and the Unfolding of Difference

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Introduction

This book presents the encapsulated results of a continuing journey of inquiry and discovery. It belongs together with a group of previous works of mine on the same general topic, though it is meant to be fully understandable on its own. The other works lay out various aspects of the project in more detail. The intention of this book is to give a concise and accessible summary of the results and the reasonings behind them. A primary concern is that no specialized knowledge on the part of readers should be necessary. An Appendix is provided for the additional benefit of more knowledgeable readers.

The diverse set of writings that includes this book are united by their central concern with a single multifarious question. What I have sought to become clear about is whether or not certain basic natural phenomena explored by physics, primarily fields of force (around a magnet, for example) and electromagnetic radiation (light, radio waves, etc.), are or arise from physical goings-on which are potentially intelligible in their full detail. For example, light propagation is known to be in some ways *like* an ordinary wave such as a wave on the surface of water, but nowadays the notion that light is actually vibrations in some unique substance present everywhere in space (called "aether" or "ether") is considered archaic. Here it is not as if some superior alternative basis for understanding light propagation came along to take the place of the "ether." All that happens is that the "classical" explanation based on the idea of local vibratory motions on the part of some underlying material is given up. There is no modern, post-classical causal account of light to replace the old kind of causal account. If such a thing were possible, it would need to have some fundamentally different basis, somehow a propagation that is distinctly not a wave in a material medium though it resembles one in certain respects. Because no such fundamentally different account is contemplated, the question about the physical nature of light

propagation ceases to be attended to and is forgotten about, a scientific impulse apparently lost to history.

But is this general abandonment and renunciation of the "ordinary language" question about the physical nature of light (and related phenomena) warranted, merely because of the demise of classical physical models involving matter in motion? Is it a secure assumption that there can be no fundamentally different, post-"ether" causal explanation, merely because of the absence of constructive ideas as to what it would look like? An obvious way to go about finding out is to put some sustained effort into the question, What, then, is light, *if not* motions in some pervasive material? If no headway can be made, one might then at some point have to accede to the renunciatory stance. But not only has this question remained unanswered to this day; it never became a living question for twentieth-century physics. For reasons that are, I believe, entirely pragmatic and strategic rather than rigorously logical, the question itself as to how to identify the causal activity of light was given up by physics along with the classical type of answer framed in terms of "ether." Scientists do still talk about light propagation in terms of oscillations in the electric and magnetic fields, but this account is not given the ontological weight it once had by being interpreted as referring to actual vibrating substance or stuff. The limit of this still-useful conception involving oscillating field-components is that the basic question about the physical explanation of "fields" has never been answered. Light is certainly a "field" phenomenon, but without some idea of the nature of the causal activity this refers to, there is no causal conception to take the place of the old model of a wave-disturbance in a material medium.

In short, the real situation today is not just that the ether is thrown out; it is that the very investigative impulse which would seek to describe light propagation (for instance) as some continuously unfolding process is effectively abandoned. Because it has no official status in the annals of advancing physical knowledge, the question about an actual

physical or causal explanation of light (and other "field" phenomena) comes to be seen as no longer legitimate. And wisely, it might be said; after all, how would it be possible to describe a physical "process" without talking about "stuff" undergoing some motion or change? What other kind of physical occurrence could the light "wave" be? In any case, when it comes to causal explanation of phenomena, twentieth-century physics follows a pragmatic course of renunciation and forgetting. This is something that rarely if ever fully comes across in any science literature: Insofar as one understands the phrases "physical understanding" and "physical explanation" in a commonsense way—and I have found that reasons for not doing so do not ultimately hold up—then it has to be said that with all the brilliant accomplishments of modern physics, understanding and/or explanation of "how the world works" at a most basic level is simply not part of the picture at present.

"Of what, then, do the brilliant accomplishments of physical theory consist, if not of a furtherance of understanding of how the physical world operates?" This is a very important question to get straight about. The achievements of this science have so far consisted of a large amount of precise and eminently useful systematic knowledge about the measurable effects of radiant energy (for instance), that is, its modes and patterns of interaction with directly perceivable matter (such as a detection device). The formal expression of such empirical knowledge, which is essentially mathematical in form, makes up the whole of what is today called physical theory in this area. But the presumably basic question, *What is* light as a physical, causally active and effective, wavelike process? is not addressed by "theory" in this specialized sense; instead this is a non-mathematical question which as such is shunted aside and forgotten about in the modern practice of physics. Does this mean that this physical *question* is permanently defunct, every bit as scientifically dead as the old kind of answer to it which was based on the idea of a wave in a special pervasive substance? Does the question itself be-

come untenable and impossible once this particular kind of answer is repudiated? Or has physics merely followed a pragmatic imperative to focus concern exclusively on developing "theory" in a special formalistic sense of the word, namely, quantitative modeling—the function of which is something other than causal or physical explanation—purely for the sake of efficiency in technical progress? My inquiries have consistently found in favor of this second possibility, which suggests that the pursuit of genuinely explanatory questions may not have been logically and scientifically refuted but merely put to one side for practical reasons, meaning that it still has prospects and might be rehabilitated.

This deeply neglected issue of the ultimate causal explainability, if any, of light and other pervasive physical phenomena falling under the rubric of "fields" (as in "field of force"), along with the related topic of what it is that current "theory" does instead of really explaining phenomena, is not a matter of specialized or academic interest only, but has important implications for worldviews in the general society. For example, it has consequences for basic attitudes regarding the general value and potentiality of science, and even for the tension between scientific and religious worldviews, as explained briefly below.

So why does this basic issue of physical explanation in fundamental physics rarely if ever see the light of day? Because the reigning contemporary position regarding this question—which is very seldom stated explicitly but largely "goes without saying"—is that prospects for what I would call a genuine physical explanation of these fundamental physical phenomena have proved to be nonexistent, and therefore the question is not worth considering. The most prevalent and well-established expression of this position is a statement to the effect that certain features of the physical world revealed by physics in the twentieth century defy any and all explanation "in ordinary language," and can only be "described" in a mathematical "language." This statement and similar ones cry out for critical examination as to whether and in what

sense a mathematical construction amounts to "language" of physical description, explanation, or understanding. But it is clear that such statements mean to say that any effort toward a genuine physical explanation of basic physical phenomena as described above is fruitless and anachronistic. This standard view of the matter long held by the experts has seeped into the public consciousness as a bedrock implication of its tutelage in science which no longer needs to be stated. Not only has this view had the most authoritative sources and supporters, it has also been quite useful and fruitful as a doctrine of scientific method, amounting to a philosophical foundation for efficient progress in physics. However, to assume that the assumptions behind this official renunciatory stance on the question of physical explanation are permanently valid truths as opposed to provisional, useful, even at times indispensable, but essentially pragmatic positions is, I think, a mistake of major consequence. It might not be going too far to say that this particular erroneous (as I see it) understanding has resulted in a major misdirection in a broad global culture of ideas, due to the prestige and influence accorded to physics. This is not so much the fault of individual scientists and interpreters of science as it is the result of a process in the advancement of physics that may have been inevitable.

The topic of explanation in physics, including the basic question about when and whether any genuine explanation occurs, is currently mired in a great deal of confusion, not only on the part of philosophers of science but in the public mind. On the one hand, it is not hard to find assertions by prominent physicists that their science is on the verge of explaining everything about the physical universe, perhaps even in a "Grand Unified Theory." The inclination to convey this comes from reflecting on the brilliant successes of theoretical physics and the nearly sweeping scope of application of the theories taken together, as well as from the continuing creativity of the field. Generally, in fact, physicists do not speak in a negative or resigned tone at all when speaking about prospects for an eventual complete explanation; rather, the

whole business of "understanding the world" is typically discussed in terms of positive possibilities. But it is important to note that these are conceived and understood by them in the mathematical mode of thought, for example, they talk about equations and formulas, about the goal of "unification" (of laws and formal principles), about uncovering the "symmetries," and so on. There is an unspoken guiding presumption that physical knowledge consists ultimately of "laws," that is, formulas that "describe" and predict quantitative observations; viewed in this light, the powers of physics are entirely ascendant.

On the other hand, this sanguine tone about prospects for physical theory runs straight against another prevalent message—from this author, for example, but also from highly regarded physicists such as Richard Feynman and others—to the effect that there has in some sense been a default of explanation, even that physics has in effect abandoned the enterprise of physically explaining phenomena. After all (the argument may go), quantum theory successfully covers (i.e., models and predicts) some very weird phenomena going under names such as "nonlocality," "quantum tunneling," and so on, and far from being explained by this most prestigious of theories, these phenomena instead remain just that—weird, perplexing, baffling. Instead of a feeling that things have been explained by this powerful theory, science is left in bewildered wonder as to how such things could take place physically. Obviously this calls for considerations about the *sense in which* these successful theories succeed and are "powerful," a topic touched on at points in this book and discussed more thoroughly elsewhere.[1] Another example supporting this second general view, saying that current physics has abandoned efforts to really explain phenomena, is what is known as Einstein's special theory of relativity. Electromagnetic radiation has a central role in this theory, yet the whole topic of the actual nature of activity in empty space (such as light propagation) is deliberately pushed to one side and left untreated (nor does the "general" relativity theory address

this topic, limited as it is in its core content to mathematical expressions for the physical field). Again, what "theory" accomplishes here is obviously something other than explanation in the ordinary sense of a physical and causal account of a phenomenon.

The best antidote to the confusion over what "explanation" in physics means or would mean, I believe, is to understand in view of these and other examples that modern mathematical theory does not in any resounding sense explain physical phenomena but at most can be said to "describe"—or better, to model—quantitative aspects of phenomena as they present themselves to scientific measurement, and that the estimable successes of "theory" in this sense of the word are entirely (leaving aside any "beauty" seen in them by the mathematical mind) a matter of utility in the advancement of physical knowledge through the power of prediction (in various senses), rather than with explanation. I have argued elsewhere that "explanation" in physics, whether or not it occurs, is really not so elusive in concept but has to do with narrative accounts of physical causation; I refer the interested reader to Part One of my 1994 book.[2] While it is clear to me that the science of physics is indeed characterized by a broad default of any genuinely explanatory underpinning to its knowledge, I am also convinced, against the main drift of current thinking, that this is not a permanent condition.

Deep acceptance of the conclusion of a *permanent* breakdown of causal-physical understanding when it comes to certain elemental aspects of nature (the source of which, as I see it, is really a pragmatic decision by physics as to what kinds of concerns are immediately important) has supported a variety of trends in ideas. Many people have reasoned that if science has encountered a realm of facts it cannot really understand, then this exposes once and for all the hubris of the Enlightenment worldview of scientific rationalism, favoring the fortunes of religious and mystical worldviews. Also, it is highly likely that the recent ascendancy of relativism and constructivism about knowledge has drawn sustenance, directly

or indirectly, from this same epochal modern conclusion about the limits of "ordinary understanding" in physics; for example, there has been much talk about the demise of the scientific myth of objectivity based on certain results of quantum physics. This points to the potential timely importance of the questions I have been trying to revive in my books: The current trends of ideas along these various lines at the very least lose one of their major sources if it should turn out, as my own inquiry has indicated to me repeatedly, that the well-ingrained standard conclusion is wrong and that in actuality all facts and phenomena known to physics have physical explanations which might well at some point be intelligibly conveyed in verbal meanings. Major currents of contemporary ideas would be seriously undermined. (To reassure certain readers, though to the disappointment of others, I do not propose reviving explanatory ideas from earlier physics such as "ether" and absolute space.)

This book is not a rebellion against established physics in favor of some idiosyncratic alternative proposal. It does not seek to criticize any theories or replace them with something else. Instead it offers an overall reading of the stated or implied results of modern physics which seeks to show that in spite of the renunciatory outlook of the current era of physics, a clear prospect for thorough physical intelligibility can be seen in these results taken as a whole. In envisioning these prospects I am following in the footsteps of certain major twentieth-century thinkers whose work in this area has been largely forgotten or ignored. The basic procedure is to sweep aside the pervasive fog created by the convenient analogies and models which are naturally resorted to for easy communication and discussion—"particle" and "wave," for example—and provide a glimpse of the truly extraordinary actual nature and implications of modern findings, which are in no way conveyed in, but are rather covered up by, the useful concepts and models. What is revealed in this way turns out to be far more wondrous and inspiring, at least to me, than the facile resorts to religious mysticism and similar ideas that

are found in some of the more popular literature on “weird” and “spooky” physics.

Chapter 1

Interlinked Questions: The Nature of Light and the Nature of Reality

The evidence of everyday experience (enhanced by science) attests to the pervasive happening of a propagative causal process commonly called light; there is an efficacy in the growth of green plants, the casting of shadows, and a host of other observations. Light is electromagnetic radiation, which happens literally everywhere, pervades reality, not only in the form that underlies visual perception but also in the form of radio waves, radiant heat, X-rays, and so on. Staying with everyday experience, there is *something*—a causal process, if nothing else—that is reflected by objects and enters our visual apparatus of eye and brain. So what happens when electromagnetic radiation happens, that is, radiates or propagates? What is the actual physical activity that takes place such that there is this transmission of influence at tremendous speed? Simple experiments leave no doubt that it is in certain respects analogous to a wave. But if not a wave-oscillation in omnipresent substance or "ether," then what is it? The startling fact is that even today, with all the brilliant achievements of modern physics, this simple question remains unanswered. More than this, the question has not been on the agenda of physics for about a hundred years. As discussed in the Introduction, the question itself, let alone any particular answers to it, is today consigned to the category of obsolete scientific notions, and this is accomplished largely through the simple procedure of never bringing it up.

It is often suggested, contrary to what I have been saying, that the question about the nature of light does have a contemporary answer, and that this answer consists of talking about "wave-particle duality." "It is a double-aspected phenomenon, both wave and particle; what's wrong with that?" My consistent experience in inquiring into these matters is that nothing covers up the truth more effectively than a

ready-to-hand model or semantical option that lubricates discourse by providing the illusion that something is being said by way of a physical understanding. In this case, "wave-particle duality" covers up the real findings of advanced physical investigations, namely that light propagation is *neither* local vibrations in a pervasive medium *nor* a train of traveling bits of matter. Talking about wave-particle duality as if this constituted a modern physical understanding of the light "wave," as opposed to a useful hybridization of outmoded physical descriptions, is one factor contributing to the misleadingly positive assessment of the current status of explanation or understanding in physics. Another factor, as noted in the Introduction, is the celebration of the successes of existing mathematical theory as if these were successes not only at prediction and "unification" of laws but also at explanation or understanding. What happens here—and this has consequences for how people think about many things—is a general failure to differentiate between "theory" in the current acceptation of the word (in physics) and actual physical explanations of phenomena.

Seeing through these sources of sanguinity, the real upshot of the standard (tacitly accepted) views is a beforehand dismissal of all prospect of a genuine physical explanation of how the propagation of light actually unfolds from one stage of its process to another (not to mention how various kinds of interactions with matter actually take place). The implicit reasoning guiding this monumental dismissal runs something like this: Beginning with Einstein, physics has banished from theoretical considerations the idea of an "ether" of pervasive material to serve as a medium of light waves. But it does not seem possible to conceive of a physical wave that is not a wave in a material medium. Therefore (and for other reasons as well) it seems most sensible and fruitful to keep following a time-honored doctrine in the methodology of science which is embodied in Isaac Newton's phrase, "hypotheses non fingo," "I spin no hypotheses," when it comes to unobservable causes of gravity, light, and so on.

This meshes perfectly with the influential ideas of David Hume, Ernst Mach and others who have argued that science properly limits its concerns to discovering and formulating the laws of nature in precise quantitative models, the result being that all legitimate "theory" is essentially mathematical in form.

Once this general position on the aims and prospects of science has been adopted, then the very impulse to seek underlying physical and causal explanations of how light propagates, for example, or how a force field passes an influence to matter causing it to accelerate, comes to be regarded as belonging to an archaic way of thinking bearing the suitably archaic name of "natural philosophy." Attitudes on this topic today are such that a physicist is to be entirely forgiven for finding it astounding, even risible, that anyone would try to look for some "commonsense" verbal description of how a "field" influence (such as light propagation) actually operates in propagating and interacting with matter. Elsewhere I have discussed the philosophical sources of the standard renunciatory view, and I do not repeat those detailed criticisms in this book. Here I propose simply to once again ask the old "natural philosophy" question about the physical nature of light audaciously, as if in expectation that an answer to it will eventually be fully ascertainable. The preliminary approach to the question is to consider a wide range of relevant physical findings with the aim of assessing whether these findings either individually or taken as a whole appear to be something of which physical sense might be made, or whether would-be natural philosophers are admonished to follow the lead of the specialists and reconcile themselves to an "ultimate irrationality"[3] when it comes to fundamental physical realities as revealed to modern physics.

In pursuing the question of physical explanation afresh, a logical first step is to talk about the most overt and undeniable characteristics of light, and then later to address those intriguing and perplexing properties discovered by the advanced investigations of twentieth-century physics. The

primary foreground characteristic is that light propagates. This means, first of all, that it passes from one place to another, taking some element of time to do so; as such it can be detected (i.e., have perceptible effects) first here, then there, and so on in a linear series; for example, a light beam can pass through tinted glass and be altered in its make-up, then produce a spot of a certain color on the wall. To repeat, there is at present no answer to the question, What happens when light propagates? What describes the propagation as an unfolding physical process with causal continuity? But there are at least a few things that can be said about this form of propagation with considerable certainty. For one thing, it has a structure that is *in certain respects analogous to* a wave-disturbance in a material medium, such as a sound wave or water-surface wave. The common property that light propagation shares with such ordinary wave-disturbances can be described in a general way by saying that in both cases there is a reiterative series of phases or cycles. This analogy of light to a wave is deducible from quite simple experiments, known about for centuries, which display a phenomenon called "interference" (or more properly, "superposition").

Another major thing that can safely be said, I think, about light, and which should be made note of whenever the wavelike property is discussed, is that it is not actually any kind of disturbance in a material medium, that is, that any use of the idea of present extended substance undergoing oscillations serves strictly as an analogy, not a description of the actual process. In a previous era of physics light was generally thought of as just such a wave in a specially postulated material medium called "ether," but this idea is now generally thought (correctly, as it seems to me) to have been definitively repudiated; reasons for its abandonment arise both from relativity physics and from quantum physics.

What can be said with considerable certainty, then, is that instead of actually being a wave-disturbance in some kind of material medium, light is some cyclic, reiterative, causal process of a fundamentally different sort. But of what sort,

exactly? In this chapter I sketch the outline of a proposal, which continues to unfold in succeeding chapters, for how a wide range of causal properties of light propagation, including wavelike structure as well as the perplexing "quantum" properties, can be accounted for once the basic nature of physical processes of this general class, that is, empty space or "field" processes, is correctly identified.

The path I suggest toward the possible goal of for once correctly identifying the "field" as consisting of a distinctive and intelligible form of physical activity (and the subsidiary goal of understanding propagating radiation as a distinctive physical process) is not a gruelingly difficult path, but it does demand sustained attention to a very specific topic of questioning which at first may be difficult to fix in one's mind. It requires thinking about what is meant by, and what can be meant by, physical "reality." That is, it demands what philosophers call ontological thinking. This may sound scary, but actually it should not be daunting to anyone interested enough to have gotten this far. The best way to get comfortable with it is to plunge right in and do some ontology. The discussion of ontology as applied to the study of nature and physical phenomena will lead directly back to the question whether the nature of empty space processes is such as to potentially be fully comprehensible as a matter of "ordinary language" physical explanation.

One might say that there is in both ordinary and scientific understanding a category or class comprising entities, factors, or processes which are both real and physical. The basic question of physical ontology is this: According to what concept is this category delineated, or in other words, to what concept must something conform in order to be a real physical entity, process, or causative factor? One traditional answer is that any real physical something must consist of material, which means, of molecules, atoms, and their components understood as smaller particles, in short, it must be a material object or stuff actually present somewhere in space. Here one thinks of a "real thing" as what is "there," simply

present in space through a certain duration of time designated "now." This is a concept of reality given by "there-ness" or presence, that is, the traditional concept of the material object characterized primarily by occupation of space. Despite the profound mysteries revealed by recent physics, the world is still largely in concert that this concept of reality is the only possible one, so that if it has broken down then what is left is a permanent inscrutability (when it comes to this level of physical reality). I will lay this out in some more specifics. Nearly all twentieth-century and contemporary thinking on these questions is divisible into two camps: (1) a tiny minority of thinkers completely outside the mainstream who believe that "classical" explanation in terms of moving material—the "thing or stuff" concept of reality—remains a viable option even today for understanding light and related phenomena, and that the classical ether in some form should be rehabilitated; and (2) those holding the official, established view that classical materialistic explanation is archaic *and* moreover that since the classical concept seems the only clear and definite concept of physical reality (agreeing on this point with those of group (1)), the only course is to continue to renounce the old "natural philosophy" (the quest for real physical explanations with or without "ether") entirely. These two groups fully concur on the presumption that apart from the classical concept of physical reality there can be no "ordinary language" physical explanations.

But not all thinkers on the subject have gone along with this shared assumption. A very small number of respected thinkers constitute a third group. Their intuition is that it is possible to accept the complete demise of the classical picture of reality based on given locality and occupying presences without giving up physical explanation, or in other words that "natural philosophy" not only remains a living possibility when classical explanatory models are renounced, but finally has its first genuine realizable prospect at that point. Alfred North Whitehead and Milic Capek have both urged consideration of an alternative concept of physical real-

ity that might be applied in fundamental physical explanations, one based not on "thinghood" and "presence" but on "process," "event," "activity," and the like, as though these terms could form an account of reality that did not depend on present material as given elements of explanation. The general suggestion in their work is that natural philosophy can and should be continued in spite of the demise of classical explanatory concepts. (I want to make it clear at the outset that my approving references to Whitehead in this book have only to do with his basic, guiding insights about modern physics and do not imply a positive assessment of his developed physical theory except to say that it might be worth taking another look at; also there is no implied intention whatever to promote the later metaphysical ideas for which Whitehead is much more famous.)

This idea that physical explanation might live in the death of classical models stands outside the shared assumptions of positions (1) and (2). Nevertheless this genuine alternative to the current debate puts forward an appealing prospect inasmuch as the rationalist in us, seeking always to make sense of things and thus troubled or aroused to inquiry by the persistent mysteries of modern physics, would be gratified by some fresh prospect of understanding in this area. If thinkers such as Capek and Whitehead are right (and one might mention Maurice Merleau-Ponty as well), one can maintain rationalism (meaning here the general idea that all realities should be presumed capable of rational comprehension) in the face of these threats from physical findings, and one can do so with full acceptance that experiment and analysis has taken advanced physics well and definitively beyond the possibilities of the classical concept of physical reality. For instance, one could be in full agreement with the bulk of current opinion regarding the demise of the classical ether of pervasive substance, yet continue to seek to understand light as a wave*like* process embedded in an intelligible context or medium in some sense, a sense to be drawn from and elaborated in terms of the proposed alternative concept of physical

reality (which will have to do with the concepts of "event," "process," etc. as characterizing a fundamental substratum of nature). In sum, there are strong attractions from the standpoint of rationalism in the idea that what the extraordinary findings of modern physics show is not the ineluctable inscrutability of things at all, but rather the need for an alternative ontological concept.

In support of the plausibility of such an alternative concept of reality as put forward by these few thinkers, one can point to the fact that in ordinary language there is an "event" context as well as a "thing" context for the term "reality." A certain basic conception of reality is mobilized when, for instance, we ask whether an event "really happened," or "Does that *really* go on?" Arguably this is a different usage, literally a different meaning, of reality, one shaped by the context of talking about events or processes rather than about objects or things. Already visible in this concept of reality (if it is such) is one major advantage over the classical materialist concept, which is that it does not force the traditional philosopher's dilemma about the nature and reality of causal connection. The classical view is burdened with this problem because its picture of the physical world is based on the concepts of discreteness and contiguity of different parts or elements, for example, two side-by-side objects or segments of space; in short, it is a conception in which any "difference" (in parts of space and time, for instance) entails *separateness*. Real casual connection (between different events) is excluded. A shift away from this ontology of nature to one in which physical reality is irreducibly "events," "process"—in sum "transition"—is as I see it an opportunity to recover the connectedness that lends narrative intelligibility to physical explanations, as discussed at other points in this book. In brief terms, a material thing may or may not play some role in causation (it could "just sit there"), whereas physical events (on the proposed view) involve causation intrinsically by their arising out of and passing into other events. On the classical view, physical elements, as

material things, are just as much real if there are no causal transitions or transformations, indeed if nothing happens at all in nature save the persistent presence of matter. On this concept the very existence of change, development, evolution, "process," in nature is something that must be explained (by God's initial input, for example). But if causation is intrinsic to physical reality, not merely happenstance or contingent to it, then there is every assurance of a fundamental narrative-causal intelligibility to things. Some further elaborations of this general point occur in the course of this book.

One may legitimately suspect that this claim for two different "meanings" of reality—real things versus real events—is a case of being tricked by language. On the other hand, there is a strong case to be made that it is a distinction which is usefully reflective of the way things are, of the different ways in which the world differentiates into identifiable particulars; if so, then "process," "event," "occurrence" might have a valid claim to convey the nature of reality *independently* of "presence." The difference in usages itself—"real things" versus "real events"—seems in a way elementary, but with it we have already had something of an introduction to an obscure topic of philosophy, namely the two contrasting ancient traditions on the nature of reality or "being," known as the "Parmenidean" and the "Heraclitean" traditions, which differently emphasize these meanings of reality. What is of interest here is only that this difference in contexts of use of the word "real"—things or objects versus events—is useful as a way to initially defend the shift in thinking that must in any case take place, I believe, if fundamental physical factors such as radiation, fields, and "particles," are ever to be understood in terms of the exact nature of the underlying processes that give rise to them.

For the traditional or classical worldview (prior to approximately 1900), the concept of "there-ness" or "presence"—"reality" in the first sense—determined the way physical reality was to be understood from the beginning in each and every case. A real physical event had to consist of