HIDDEN VARIABLES AND THE IMPLICATE ORDER

by David Bohm

Abstract. This paper explains how my ideas of hidden variables tie up to those in the implicate order, and how all these notions are related to my views on religion. Beginning with my work on the quantum theory, it traces how I was led to question the usual interpretation, and goes on to show how both the notion of hidden variables and that of the implicate order were implicit in my thought more than thirty years ago. The further development through quantum field theory brings all the various threads together. Finally, the general world view that comes out of this development is seen to be compatible with a religious approach to life.

I have been asked to explain how my ideas of hidden variables tie up with those on the implicate order, and to bring out how both these notions are related to consciousness, and to religion. In doing this, it would perhaps be best to begin with an account of how I came to these ideas in the first place.

THE DEVELOPMENT OF QUANTUM THEORY

The whole development starts in Princeton around 1950, when I had just finished my book *Quantum Theory*. I had in fact written it from what I regarded as Niels Bohr's point of view, based on the principle of complementarity. Indeed, I had taught a course on the quantum theory for three years and written the book primarily in order to try to obtain a better understanding of the whole subject, and especially of Bohr's very deep and subtle treatment of it. However, after the work was finished, I looked back over what I had done, and still felt somewhat dissatisfied.

What I felt to be especially unsatisfactory was the fact that the quantum theory had no place in it for an adequate notion of an

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independent actuality, that is, of an actual movement or activity by which one physical state could pass over into another one. My main difficulty was not that the wave function was interpreted only in terms of probabilities, so that the theory was not deterministic. Rather, it was that it could only discuss in terms of the results of an experiment or an observation, which has to be treated as a set of *phenomena* that are ultimately not further analyzable or explainable in any terms at all. So, the theory could not go beyond the phenomena or appearances. And basically, those phenomena were very limited in nature, consisting, for example, of events by which the state of a particle could be ascertained. From a knowledge of this state, we could go to a wave function that predicted the probability of the next set of phenomena, and so on.

On thinking what all this meant, it began to occur to me that the quantum theory might actually be giving a fragmentary view of reality. A wave function seemed to capture only certain aspects of what happens in a statistical ensemble of similar measurements, each of which is in essence only a single element in a greater context of overall process. Although John von Neumann had given what purported to be a proof that to go any further would not be compatible with the quantum theory (which was already very well confirmed indeed), I still realized that mathematical proofs are based on axioms and presuppositions whose meanings are often obscure, and always in principle open to question. Moreover, the theory of relativity, which was also regarded as fundamental, demanded a space-time process (e.g., one that could be understood in terms of fields) which constituted an independent actuality, with a continuous and determinate connection between all its parts. Such a process could not be treated solely as a set of fragmentary phenomena that are statistically related.

This requirement becomes especially urgent when relativity is extended to include cosmology. It seems impossible even to contemplate the universe as a whole, through a view, which can discuss only in terms of discrete or distinct sets of phenomena. For in a cosmological view, the observing instruments, and indeed, the physicists who construct and operate them, have to be regarded at least in principle as parts of the totality. There does not seem to be much sense in saying that all these are nothing more than organized sets of appearances. To whom or to what would they appear, and of what would they be the appearances?

I felt particularly dissatisfied with the implicitly contradictory attitude of accepting the independent existence of the cosmos while one was doing relativity, and, at the same time, denying it while one was doing the quantum theory, even though both theories were regarded as fundamental. I did not see how an adequate way to deal with this could be developed on the basis of Niels Bohr's point of view. So I began to ask myself whether another approach might not be possible.

In my first attempt to do this, I considered a quantum mechanical wave function representing, for example, an electron, and supposed that this was scattered by an atom. By solving Erwin Schrödinger's equation for the wave function, one shows that the scattered wave will spread out more or less spherically. Nevertheless, a detector will detect an electron in some small region of space, while the extended spherical wave gives only the probability that it will be found in any such region. The idea then occurred to me that perhaps there is a second wave coming in toward the place where the electron is found, and that the mathematical calculus of the quantum theory gives a statistical relationship between outgoing and incoming waves.

However, to think this way requires that we have to enrich our concepts to include an incoming wave as well as an outgoing wave. Indeed, since further measurements can be made on the electron, it follows that as the second wave spreads out, it may give way to a third, and so on. In this way, it becomes possible to have an ongoing process in which the electron is understood as an independent actuality (which will, of course, give rise to phenomena through which it may be detected). One is thus implying that the current quantum theory deals only with a fragmentary aspect of this whole process, that is, that aspect which is associated with a single observational event.

It seems clear that at this stage, I was anticipating what later became the implicate order. Indeed, one could say that ingoing and outgoing waves are enfolding and unfolding movements. However, I did not pursue this idea further at the time. What happened was that I had meanwhile sent copies of my book to Albert Einstein, to Bohr, to Wolfgang Pauli and a few other physicists. I received no reply from Bohr, but got an enthusiastic response from Pauli. Then I received a telephone call from Einstein, saying that he wanted to discuss the book with me. When we met, he said that I had explained Bohr's point of view as well as could probably be done, but that he was still not convinced. What came out was that he felt that the theory was incomplete, not in the sense that it failed to be the final truth about the universe as a whole, but rather in the sense that a watch is incomplete if an essential part is missing. This was, of course, close to my more intuitive sense that the theory was dealing only with statistical arrays of subprocesses associated with similar observational events. Einstein felt that the statistical predictions of the quantum theory were correct, but that by supplying the missing elements, we could in principle get beyond statistics, to an at least in principle determinate theory.

This encounter with Einstein had a strong affect on the direction of my research, because I then became seriously interested in whether a deterministic extension of the quantum theory could be found. In this connection, I soon thought of the classical Hamilton-Jacobi theory, which relates waves to particles in a fundamental way. Indeed, it had long been known that when one makes a certain approximation (Wentzel-Kramers-Brillouin), Schrödinger's equation becomes equivalent to the classical Hamilton-Jacobi equation. At a certain point, I suddenly asked myself: What would happen, in the demonstration of this equivalence, if we did not make this approximation? I quickly saw that there would be a new potential, representing a new kind of force, that would be acting on the particle. I called this the quantum potential, which was designated by Q.

This gave rise immediately to what I called a causal interpretation of the quantum theory. The basic assumption was that the electron *is* a particle, acted on not only by the classical potential, V, but also by the quantum potential, Q. This latter is determined by a new kind of wave that satisfies Schrödinger's equation. This wave was assumed, like the particle, to be an independent actuality that existed on its own, rather than being merely a function from which the statistical properties of phenomena could be derived. However, I showed on the basis of further physically reasonable assumptions that the intensity of this wave is proportional to the probability that a particle *actually is* in the corresponding region of space (and is not merely the probability of our observing the phenomena involved in *finding* a particle there). So the wave function had a double interpretation—first, as a function from which the quantum potential could be derived, and second, as a function from which probabilities could be derived.

From these assumptions, one was able to show that all the usual results of the quantum theory could be obtained on the basis of a model incorporating the independent actuality of all its basic elements (field and particle), as well as an in-principle complete causal determination of the behavior of these elements in terms of all the relevant equations (at least in a one-particle system, which is as far as I had gotten at the time).

I sent prepublication copies of this work to various physicists. Louis de Broglie quickly sent me a reply indicating that he had proposed a similar idea at the Solvay Congress in 1927, but that Pauli had severely criticized it and that this had led him to give it up. Soon after this, I received a letter from Pauli, stating his objections in detail. These had mainly to do with the many-particle system, which I had not yet considered seriously. However, as a result of these objections, I looked at the problem again, and came out with a treatment of the many-particle system, which consistently answered Pauli's criticisms.

The Quantum Potential and Nonlocality

A more detailed consideration of this extended theory led me to look more carefully into the meaning of the quantum potential. This had a number of interesting new features. Indeed, even in the one-particle system, these showed up to some extent. The quantum potential did not depend on the intensity of the wave associated with this electron; it depended only on the *form* of the wave. And thus, its effect could be large even when the wave had spread out by propagation across large distances. This already introduced a certain kind of *nonlocality*. For example, when the wave passes through a pair of slits, the resulting interference pattern produces a complicated quantum potential that could affect the particle far from the slits, and this explains why a statistical distribution of such particles would have a pattern reflecting the wave intensity. Thus, the well-known wave particle duality of the properties of matter was explained by saying, not only that the electron is a particle that is always accompanied by a wave, but also, by noting that this wave could generally have a major effect on the particle, that reflects the whole environment. And in this way, one was able to obtain a further insight into the crucially significant new feature of wholeness of the electron and its environment which Bohr had shown to be implicit in the quantum theory.

When one looked at the many-particle system, this new kind of wholeness became much more evident. For the quantum potential was now a function of the positions of all the particles which (as in the one-particle case) did not necessarily fall off with the distance. Thus, one could at least in principle have a strong and direct (nonlocal) connection between particles that are quite distant from each other. What was much more striking, however, was that the very form of this connection depends on the wave function for the state of the whole. This is determined by solving Schrödinger's equation for the entire system, and thus does not depend on the state of the parts. Such a behavior is in contrast to that shown in classical physics, for which the interaction between the parts is a predetermined function, independent of the state of the whole. Thus, classically, the whole is merely the result of the parts and their preassigned interactions, so that the primary reality is the set of parts while the behavior of the whole is derived entirely from those parts and their interactions. With the quantum potential, however, the whole has an independent and prior significance, such that, indeed, the whole may be said to organize the parts. In a certain sense, quantum wholeness is thus closer to the organized unity of a living being than it is to that obtained by putting together the parts of a machine.

If the whole is a primary notion in quantum mechanics, how do we account for our usual experience of a world made up of a vast set of independent elements, that can correctly be understood in terms of ordinary mechanical notions? The answer is that when the wave function of the whole system reduces to a set of constituent factors, the quantum potential simplifies to a sum of independent components. As a result, the whole reduces to a set of independent subwholes. One can show that this is the situation that will commonly prevail at the large-scale level. But more generally, the wave function does not factorize, and the whole cannot be divided into such independent subwholes.

To sum up, then, the quantum potential not only organizes wholes; it determines which subwholes, if any, that may be within the whole. It is clear how radically new are these implications of the quantum theory. They are hinted at only vaguely and indirectly by the subtle arguments of Bohr, based on the usual interpretation of the quantum theory as nothing more than a set of mathematical formulae yielding statistical predictions of the phenomena that are to be obtained in physical observations. However, by putting quantum and classical theories in terms of the same intuitively understandable concepts (particles moving continuously under the action of potentials), one is able to obtain a clear and sharp perception of how the two theories differ. I felt that such an insight was important in itself, even if, as seemed likely, this particular model could not provide the basis for a definitive theory that could undergo a sustained development. For a clear intuitive understanding of the meaning of one's ideas can often be helpful in providing a basis from which may ultimately come an entirely new set of ideas, dealing with the same content.

These proposals did not actually "catch on" among physicists. The reasons are quite complex and difficult to assess. Perhaps the main objection was that the theory gave exactly the same predictions for all experimental results as does the usual theory. I myself did not give much weight to these objections. Indeed, it occurred to me that if de Broglie's ideas had won the day at the Solvay Congress of 1927, they might have become the accepted interpretation. Then if someone had come along to propose the current interpretation, one could equally well have said that, since, after all, it gave no new experimental results, there would be no point in considering it seriously. In other words, I felt that the adoption of the current interpretation was a somewhat fortuitous affair, since it was affected not only by the outcome of the Solvay Conference, but also by the generally positivist empiricist attitude that pervaded physics at the time. This attitude is in many ways even stronger today and shows up in the fact that a model that gives insight without an "empirical pay-off" cannot be taken seriously.

I did try to answer these criticisms to some extent, by pointing out that the enriched conceptual structure of the causal interpretation was capable of modifications and new lines of development that are not possible in the usual interpretation. These could, in principle, lead to new empirical predictions. But, unfortunately, there was no clear indication of how to choose such modifications, among the vast range that was possible. And so, these arguments had little effect as an answer to those who require a fairly clear prospect of an empirical test before they will consider an idea seriously.

In addition, it was important that the whole idea did not appeal to Einstein, probably mainly because it involved the new feature of nonlocality, which went against his strongly held conviction that all connections had to be local. I felt this response of Einstein was particularly unfortunate, as it almost certainly "put off" some of those who might otherwise have been interested in this approach. Although I saw clearly at the time that the causal interpretation was not entirely satisfactory, I felt that the insight that it afforded was an important reason why it should be considered, at least as a supplement to the usual interpretation. To have some kind of intuitive model was better, in my view, than to have none at all. For without such a model, research in the quantum theory will consist mainly of the working out of formulae and comparing these calculated results with those of experiment. Even more important, the teaching of quantum mechanics will reduce (as it has in fact tended to do) to a kind of indoctrination, aimed at fostering the belief that such a procedure is all that is possible in physics. Thus, new generations of students have grown up who are predisposed to consider such questions with rather closed minds.

The Implicate Order

Because the response to these ideas was so limited, and because I did not see clearly at the time how to proceed further, my interests began to turn in other directions. During the sixties, I began to direct my attention toward *order*, partly as a result of a long correspondence with an American artist, Charles Biederman, who was deeply concerned with this question. And then, through working with a student, Donald Schumacher, I became strongly interested in *language*. These two interests led to a paper on order in physics and on its description through language. In this paper, I compared and contrasted relativistic and quantum notions of order, leading to the conclusion that they contradicted each other, and that new notions of order were needed.

Being thus alerted to the importance of order, I saw a program on British Broadcasting Corporation television, showing a device in which an ink drop was spread out through a cylinder of glycerine, and then brought back together again, to be reconstituted essentially as it was before. This immediately struck me as very relevant to the question of order, since, when the ink drop was spread out, it still had a "hidden" (i.e., nonmanifest) order, that was revealed when it was reconstituted. On the other hand, in our usual language, we would say that the ink was in a state of "disorder" when it was diffused through the glycerine. This led me to see that new notions of order must be involved here.

Shortly afterwards, I began to reflect on the hologram, and to see that in it, the entire order of an object is contained in an interference pattern of light that does not appear to have such an order at all. Suddenly, I was struck by the similarity of the hologram and the behavior of the ink drop; I saw that what they had in common was that an order was *enfolded*. That is, in any small region of space, there may be "information" which is the result of enfolding an extended order and which could then be unfolded into the original order (as the points of contact made by the folds in a sheet of paper may contain the essential relationships of the total pattern displayed when the sheet is unfolded).

Then, when I thought of the mathematical form of the quantum theory (with its matrix operation and Green's functions), I perceived that this too described just a movement of enfoldment and unfoldment of the wave function. So the thought occurred to me: perhaps the movement of enfoldment and unfoldment is universal, while the extended and separate forms that we commonly see in experience are relatively stable and independent patterns, maintained by a constant underlying movement of enfoldment and unfoldment. This latter, I called the *holomovement*. The proposal was thus a reversal of the usual idea. Instead of supposing that extended matter and its movement are fundamental while enfoldment and unfoldment are explained as a particular case of this, we are saying that the implicate order of the holomovement is fundamental, and that the explicate order of extended and separate forms is only a particularly distinguished case of the implicate order, which is derived from the latter by unfoldment.

This approach implies, of course, that each extended form is enfolded in the whole, and that the whole is enfolded in this form (though, of course, there is an asymmetry, in that the form enfolds the whole only in a limited and not completely defined way). The way in which the extended form enfolds the whole is however not merely superficial or of secondary significance, but rather it is essential to what that form is and to how it acts, moves, and behaves quite generally. So the whole is, in a deep sense, *internally* related to the parts. And, since the whole unfolds all the parts, these latter are also internally related, though in a weaker way than they are related to the whole.

I shall not go into great detail about the implicate order here; I shall assume that the reader is somewhat familiar with this. What I want to emphasize is only that the implicate order provided an image, a kind of metaphor, for intuitively understanding that implication of wholeness which is the most important new feature of the quantum theory. Nevertheless, it must be pointed out that the specific analogies of the ink drop and the hologram are limited and do not fully convey all that is meant by the implicate order. What is missing is the fact that the parts or subwholes not only unfold from the whole, but they unfold in a self-organizing and stable way. On the other hand, in both these models, there is no inner principle of organization that determines the parts of subwholes and makes them stable. In fact, the order enfolded in the whole is obtained from pre-existent, separate, and extended elements (objects photographed in the hologram or ink drops injected into the glycerine). It is then unfolded to give these elements again. Nor is there any natural stability in these elements; they may be totally altered or destroyed by minor further disturbances of the overall arrangement of the equipment.

The Super-Quantum Potential

Gradually, throughout the seventies, I became more aware of the limitations of the hologram and ink droplet analogies to the implicate order. Meanwhile, I noticed that both the implicate order and the causal interpretations had emphasized this wholeness signified by quantum laws, though in apparently very different ways. So I wondered if these two rather different approaches were not related in some deep sense—especially because I had come at least to the essence of both notions at almost the same time. At first sight, the causal interpretation seemed to be a step backwards toward mechanism, since it introduced the notion of a particle acted on by a potential. Nevertheless, as I have already pointed out, its implication that the whole both determines its subwholes and organizes them clearly goes far beyond what appeared to be the original mechanical point of departure. Would it not be possible to drop this mechanical starting point altogether?

I saw that this could indeed be done by going on from the quantum mechanical particle theory to the quantum mechanical field theory. This is accomplished by starting with the classical notion of a continuous field (e.g., the electromagnetic) that is spread out through all space. One then applies the rules of the quantum theory to this field. The result is that the field will have discrete "quantized" values for certain properties, such as energy, momentum, and angular momentum. Such a field will act, in many ways, like a collection of particles, while at the same time, it still has wave-like manifestations, such as interference, diffractions, and so on.

Of course, in the usual interpretation of the theory, there is no way to understand how this comes about. One can only use the mathematical formalism to calculate statistically the distribution of phenomena through which such a field reveals itself in our observations and experiments. But now, one can extend this causal interpretation to the quantum field theory. Here, the actuality will be the entire field over the whole universe. Classically, this is determined as a continuous solution of some kind of field equation (e.g. Maxwell's equations for the electromagnetic field). But when we extend the notion of the causal interpretation to the field theory, we find that these equations are modified by the action of what I called a super-quantum potential. This is related to the activity of the entire field as the original quantum potential was to that of the particles. As a result, the field equations are modified, in a way that makes them, in technical language, nonlocal and nonlinear.

What this implies for the present context can be seen by considering that classically, solutions of the field equations represent waves that spread out and diffuse independently. Thus, as I indicated earlier in connection with the hologram, there is no way to explain the origination of the waves that converge to a region where particle-like manifestation is actually detected, nor is there any factor that could explain the stability and sustained existence of such a particle-like manifestation. However, this lack is just what is supplied by the super-quantum potential. Indeed, as can be shown by a detailed analysis, the nonlocal features of this latter will introduce the required tendency of waves to converge at appropriate places, while the nonlinearity will provide for the stability of recurrence in the whole process.

Out of this emerges a picture of a wave which spreads out and converges, again and again, to show a kind of average particle-like behavior, while the interference and diffraction properties, of course, are still maintained. All this flows out of the activity of the super-quantum potential, which depends in principle on the state of the whole universe. But if the "wave function of the universe" falls into a set of independent factors, at least approximately, a corresponding set of relatively autonomous and independent subunits of field function will emerge. So now, we see that the whole universe not only determines and organizes its subwholes; it also gives form to what have until now been called the elementary particles out of which everything is supposed to be constituted. What we have here is a kind of universal process of constant creation and annihilation arranged into a world of form and structure, in which all manifest features are only relatively constant, recurrent, and stable aspects of the whole.

To see how this is connected with the implicate order, we have only to note that the original holographic model was one in which the whole was constantly enfolded into and unfolded from each region of an electromagnetic field, through dynamical movement and development of the field according to the laws of classical field theory. But now, this whole field is no longer a self-contained totality; it depends crucially on the super-quantum potential. When one looks at the mathematical form of the latter, one discovers that this too is a kind of implicate order. But it is immensely more subtle than that of the original field, as well as more inclusive in the sense that not only is the actuality of the field enfolded in it, but also all the possibilities.

I was therefore led to call the original field the first implicate order, while the super-quantum potential was called the second implicate order (or the super-implicate order). In principle, of course, there could be a third, fourth, fifth implicate order, going on to infinity, and these would correspond to extensions of the laws of physics going beyond those of the current quantum theory, in a fundamental way. But for the present, I want to consider only the second implicate order, and to emphasize that this stands in relationship to the first as a source of formative, organizing, and creative activity.

It should be clear that this notion now incorporates both of my earlier perceptions—the implicate order as a movement of outgoing and incoming waves and of the causal interpretation of the quantum theory. So, although these two ideas seemed initially very different, they proved to be two aspects of one more comprehensive notion.

Analogies to Consciousness

Now, to change the subject, I had long felt that the quantum theory describes processes that are, in certain key ways, analogous to those arising in our experience of consciousness. Indeed, even in my book, *Quantum Theory*, I noted that there is in consciousness an analogy to the quantum mechanical uncertainty principle. To see this analogy, let us compare the precise position of a particle to a well-defined thought, and its precise momentum to a well-defined line of movement and development of thought. One can see immediately that to fix the thought is to make its development unknown and ambiguous, while to fix the actuality of movement and development is to make the precise state of the thought in question undefinable. According to the uncertainty principle, there is a similar mutually exclusive relationship between the fixing of the position of the electron and the fixing of its momentum.

When I came to the idea of the implicate order, I could immediately see that this analogy can be carried very much further. Thus, the very word *implicit*, which we apply to certain kinds of thought, has the same root as *implicate*, and means "enfolded." This suggests that a given thought somehow enfolds further thoughts. As these unfold, they in turn enfold still further thoughts, and so on, thus giving rise to a whole train of thought. This train is, in many ways, rather like the quantum mechanical field, which unfolds into a sequence of particle-like manifestations, each of which enfolds to be replaced by the succeeding one.

So, the analogy of a photon (or an electron) and a train of thought is thus a good one. Indeed, it goes even further than what has just been described. For one has the distinct impression that the conscious content of thoughts emerges from a greater whole of which we are not fully conscious. And within this whole, there is the further faculty of *reason*, which determines the subwholes in thoughts, orders, arranges, connects, and organizes them, and in extreme cases, involves the creative perception of new thoughts. Could we not say that this is, in certain ways, like a super-implicate order?

If we consider language, we see further evidence of an implicate order. For example, as I speak, my words are not chosen one after another. Rather, an entire set of words flows out of an *intention* to say what I *mean*. Our intuitive sense of what is happening here strongly suggests that such sets of words are initially enfolded in the intention, and then unfold in speech. One can also see that, in some sense, the entire language must unfold from a whole, so that words and their meaning are internally related (rather than having each word or set of words held in a kind of separate compartment of memory). An example drawing attention to this can be obtained by considering that in English, nouns such as *alternation* generally correspond to verbs, such as *to alternate*. But there are exceptions. Thus the noun *alteration* has no corresponding verb (which would be *to alterate*). The essential point is that we sense this *immediately* without having to search the meaning systematically. This strongly suggests that a language is enfolded as a whole and that words and sets of words unfold from this whole as required.

To return to the question of meaning, one has here a very strong sense that this also is an implicate order. Indeed, by far the greater part of what we mean is implicit: only a small part is made explicit in thought and language. Meanings are also generally internally related, in ways that are similar to the relationships in the implicate order. Thus, for example, if one sees the meaning of a whole situation, this enters into the meaning of each part of that situation.

What is particularly important about meaning is that it is basically *active*. Thus, as indicated earlier, meanings and *intentions* are inseparably related. What I *mean* to do is what I *intend* to do. And from intention flows action. For example, if a form seen in the dark means "an assailant," the adrenalin flows, the heart beats faster, and one's intention will probably be to run, fight, or freeze. But if, after a second look, it means "only a shadow," the state of the body and the nervous system will be totally different, from which will unfold very different intentions and actions. So what something *means* to us is intrinsic to what we *are*, in the sense that our entire physical and mental state, along with our actions, will be profoundly affected by it. Moreover, through meaning what we *are* is internally related to greater wholes (e.g., to society, which provides a vast general background of such meanings, that we pick up from early childhood on).

It is clear from all this that meaning is an active factor in reality, whether this be on the physical side or on the mental side. And through this, we directly experience the implicate order.

Indeed, it may be said that our experience of the implicate order is much more direct, immediate, and pervasive than is that of the explicate order. However, through our thought and language, we tend to fill consciousness mainly with an explicate content, and thus, we eventually come to feel that the explicate order is the basic reality in all areas of experience.

At this point, it is natural to consider the relationship of mind and matter. We have seen that both of these can be treated in terms of the implicate order. And thus, we understand how they may be related, since they are capable of participating in a common dynamic structure. I would like to propose, however, that not only are mind and matter related in this way, but further, that they both unfold from a common ground, which enfolds them and which is thus the basis of their relationship. Ultimately, this would be the ground of all that is, the beginning and the ending of everything.

Religious Implications

What more could we hope to say about this ground? This is where we come to religion, which has traditionally been based on the consideration of what is essentially the same question.

One can see more generally that a number of further issues arise in the attempt to extend the implicate order to the ultimate, which also arise in religion. For example, there is at least an analogy between how the super-implicate order organizes and even forms and creates the first implicate order and the way in which God is regarded as creating the universe (at least as this is put in many religions). I myself would prefer to regard this as no more than an analogy or a metaphor, that may be useful for giving insight, but that should not be taken too literally. After all, knowledge is limited. We may use scientific knowledge to make an intuitive leap that is part of an unending process of exploration. But I do not think that to do this can provide certainty about the ultimate ground.

Another point that arises here is whether this ground should be identified with a personal God. After all, dolphins and whales are intelligent too. In other parts of the universe, very different forms of intelligence may exist. Thus, there may be a kind of ant heap with an immense collective intelligence. Would one want to say that God is a dolphin, or a super-intelligent ant heap?

If no image or form can be attributed to God, what can then be meant by His personality? I would prefer to set such images aside, and to say no more than that I feel that all emerges from some ultimate ground. When I see the immense order of the universe (and especially the brain of man), I cannot escape feeling that this ground enfolds a supreme intelligence. Although it is not quite so evident, I would say also that this intelligence is permeated with compassion and love.

I realize that all of these remarks imply a veritable hornet's nest of theological questions. I find these very interesting, and hope that because of the similarity of these questions with those arising in the consideration of the implicate order, both sides may learn something important from the exchange. However, my own interest in the implicate order is mainly on what I would call the human side. This includes, of course, its scientific implications, but goes far beyond them. To go into great detail about this would not be appropriate here. But the essential point is that, as I have already said, meaning is a real factor in the world. If the universe means a vast machine to us, our whole being will unfold that meaning in the individual, in human relationships, and in society as a whole. If it means an implicate order, with all internally related to all and to the whole, this also will unfold into a new reality, which will, however, be quite different from the present fragmentary state of affairs. But for this actually to happen, it is not enough that we grasp the meaning intellectually. It must enter deeply into our intentions and actions. That is to say, we will have to *mean* it, in all that we think, feel, and do. To bring this about requires a kind of action going far beyond what we have discussed here. But perhaps an understanding of the issues involved in this discussion will be helpful.