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Physics and spirituality: the next grand unification?

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In what light should a scientist regard the assertions of a religion, or of religions in general? One extreme position is the atheistic one of regarding the assertions of religion as falsehoods. Such a position can be sustained only by regarding the experiences which individuals consider as validating their religious beliefs as being explicable in other ways and, in the absence of an adequate research programme to support it, must be considered more as falling within the field of opinion than as within that of science.

The alternative to this atheistic position is that there exists an aspect of reality—that we may for convenience call transcendental—which embraces the subject matter of religion (or as some may prefer to term it, the spiritual aspect of life) and which is not at present encompassed by science. The question then arises whether some future science may be able to cope with this aspect of reality, or whether it will remain forever beyond the scope of science. The general aim of science being to gain as full and accurate a picture of reality as possible, one would expect logically that scientists in general would take a keen interest in such questions, just as they do in topics such as those of the fundamental constitution of matter, or of the mechanisms of life. In practice, however, such questions have been almost entirely split off from scientific consciousness, in some cases as a result of an atheistic point of view and in others because present science seems to be so far removed from anything spiritual that the suggestion of the possibility of a merging of the two seems improbable or even absurd.

While it may have been the case that such questions have been split off from scientific consciousness in general, there has been a significant minority of scientists who have tried to apply the methods of thought and analysis of the scientist to those aspects of reality that (unless one adopts as an article of faith the idea that all these aspects will in due course either be explained or 'explained away' within the current framework) seem to lie outside the scope of science in its present form. At the present time we can see the emergence of something which, while not being exactly a consensus of opinion, at any rate forms a collection of mutually consistent ideas as to the general form of a possible new understanding of nature, and of what might constitute appropriate means of investigating nature, that goes beyond and is more flexible than is the current conventional framework. These ideas are not well represented in the standard literature—probably, in the last analysis, because they represent the same kind of threat to current scientific dogmas as scientific discoveries have presented to religious dogmas in the past. (There has even been a suggestion, in the editorial pages of a prestigious scientific journal, that a particular book should be burnt because it propagated dangerous ideas.)

It will be my task in what follows to explain the ways in which current scientific orthodoxies are being challenged and to convey some idea of the alternatives presently emerging. A number of important themes here include the questions of the validity of reductionism and the universality of quantum mechanics, as well as that of the relevance of mystical experience. My own thoughts in this area have been much influenced by the writings of David Bohm (1980) and Fritjof Capra (1975). I have

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benefited also from discussions with a number of scientific colleagues, including in particular Michael Conrad, Dipankar Home, H R Nagendra, Steven Rosen and Richard Thompson, as well as with the members of two spiritual movements that have attempted to elaborate suitable concepts in the area being discussed (the Transcendental Meditation movement and the Brahma Kumaris World Spiritual University).

The validity of reductionism

One of the points of tension between orthodoxy and the new thinking is the question of the extent to which the approach of reductionism (i.e. studying a complex system in terms of its component parts) remains a valid one in quantum mechanics. Supporters of reductionism quote various examples from physics (e.g. phenomena of the solid state) and from chemistry (e.g. explaining the properties of a molecule) as proof that the reductionist approach still applies despite the conceptual changes wrought by quantum mechanics. In other situations, however, the reductionistic approach (with its implication that the properties of a system can be satisfactorily determined by observation of that system alone) breaks down. Consider, for example, the following situation. A colleague B sends us a beam of polarised particles which are individually polarised according to a rule that he alone knows. We cannot find out exactly how each particle in the beam is polarised because an observation of one component of the spin will in general alter the values of the other components. And yet we cannot say (as is often permissible in quantum mechanics) that the individual spins are undefined, since in this case a perfectly definite spin has been given to each particle by our colleague B. This example shows in the simplest possible way how in the quantum domain it is possible that information *outside a system* may be needed before a full description of that system can be given, thus contradicting the reductionist point of view.

The example just given displays a common feature of many of the arguments that support orthodoxy, namely that the successful applications of a particular principle are emphasised, while the situations where the principle cannot be successfully applied or where there are some difficulties with the standard view are ignored or overlooked, creating thus a distorted account of the true situation.

A very similar situation to that just described, but one which is of considerably more practical relevance, was given by Niels Bohr (1958) who observed that the uncertainty principle would ultimately limit the degree to which one could understand biosystems in terms of the methods of quantum mechanics. If we try to overcome our ignorance regarding the internal nature and constitution of the biosystem under study by performing suitable observations, then we must at some point come up with a problem like that previously encountered, namely that observing a system disturbs it slightly at the quantum level. Biosystems are examples of systems where, just as in the case considered above, we do not have the degree of control over the internal structure of the system under investigation that we do in general have in physics and chemistry. In the example previously given, a colleague determined the state of the system in a way not accessible to us in detail; in the case of biosystems nature does precisely the same thing.

Biosystems illustrate again the way successful applications of a particular principle are emphasised while the situations where problems occur are ignored or overlooked. Conventional thinking works adequately at the molecular level, where the change of the structure through observation is not an overwhelming problem. It would become a problem, however, if we were to try to explain biosystems in detail at the level of the wave function. The successes of molecular biology in no way detract from the force of Bohr's argument, which applies in a regime different from that with which biology is currently concerned.

The universality or otherwise of quantum mechanics

The question of the universality of quantum theory has been discussed in detail by David Bohm (1980). He considers as an illustrative example the way in which insurance companies use statistical tables to predict the probability that a given person will die of a specified disease within a specified time period. The existence of these statistical laws in no way excludes the possibility of other laws existing which would determine the precise conditions of death of a given individual policy holder (e.g. death caused by an accident, the details of which are in principle describable by the laws of mechanics). Similarly, Brownian motion can be described either statistically or in terms of the motions of the individual atoms in an individual instance of an experiment.

Analogously, one can argue that no contradiction is involved in supposing that under suitable conditions alternative descriptions of systems to the quantum mechanical ones may be possible, and that possession of these descriptions might permit particular predictions to be made that were more definite than those which quantum mechanics provides. Bohm notes that many physicists retain a belief that such ideas are not to be taken seriously because of the arguments against them that have been made in the past. These arguments have now been shown to be invalid and they can in fact be refuted directly by means of explicit counter-examples.

The question of the universality of quantum mechanics is closely bound up with the issue of measurement. Does the measurement theory of quantum mechanics (Dirac 1958) give a satisfactory account of the outcome of all possible experiments, as is often asserted, or not? The facts of the situation are confused by the fact that a physics experiment constitutes a special situation. An experiment is normally set up specifically to find out information that can be interpreted in the light of current physical theories and thus ultimately in terms of quantum mechanics. It should be no surprise, then, to find that the measurements done in practice are ones that conform to the idea of measurement prescribed by the quantum theory and there is no reason to conclude from this fact (as those who hold to the Copenhagen interpretation of quantum mechanics do) that the quantum mechanical theory of measurement provides a theory of all conceivable measurement processes. There is no real reason why all information gathering devices, and in particular devices based on different concepts as to what kind of information is being gathered, should fit into the formal scheme provided by the quantum mechanical theory of measurement, which is based on the assumption that to every measurement is associated a specific Hermitian operator.

Complementary descriptions

The probable inapplicability of the reductionistic and quantum mechanical modes of description in certain areas of nature serves to focus our attention on the possibility already mentioned that descriptions of nature may exist that supplement the conventional quantum mechanical one. A detailed working out of this idea has been given by Michael Conrad, Dipankar Home and myself (Conrad *et al* 1986), to which source the reader is referred for a fuller account of the ideas than can be given in the space available here. In this paper we noted firstly that descriptions in science (and also the methods of observation to be used) are not necessarily *absolute* in the sense of being equally suitable for use in all situations. For example, in a biological context, where some kind of selection process has been effective, terms such as perception, purposive behaviour, decision making, learning or adaptation are often very useful, although such terminology is not suitable for systems in general. In the same way, one may hypothesise that the language of quantum mechanics may properly apply only in a limiting case where some regular order (which it may be helpful to think of as being analogous to the order in a crystal) makes for particular mathematical simplifications. We gain then a consistent view of nature in which the two categories of description complement each other; neither on its own containing the full story. This feature of complementarity contrasts with the conventional hypothesis that of the two descriptions the quantum mechanical is fundamental while biological descriptions are derivative.

One can go further: the conceptual picture which has just been described allows in principle a deep

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unification of biological phenomena and quantum phenomena (cf Stapp 1982, Villars 1983). In this conceptual unification, a concept in the one mode of description, such as the making of a choice, goes over in the other description into a corresponding concept (which in this particular instance is the collapse of the wave function). This unification is reminiscent of Einstein's unification of gravitation and inertia, in that in it two phenomena that are at first sight completely different in nature are seen to be ultimately the same. By virtue of this unification it can be said that certain features of quantum mechanics become comprehensible in their own right, rather than having to be arbitrarily postulated as axioms.

The complementarity idea may be particularly relevant to the phenomenon of the effectiveness of performance of biosystems. The picture proposed leads to the possibility that the asymmetric kind of order which exists in biosystems as a result of selection processes may not have the kind of regularity that quantum mechanics describes, and hence may well not fit into the quantum mechanical scheme. As a result, for biosystems quantum mechanics might be systematically in error. Since the general effect of natural selection is to improve the performance of biosystems over the time, it might be expected that biosystems would be more effective than quantum mechanics would lead one to expect. This, if we like to think of it in these terms, is a valid way of introducing into science ideas that are collateral with vitalism. In this connection it may be noted that the arguments that have been presented in this section, suggesting that biological descriptions and quantum descriptions may complement each other, go a long way towards legitimising the unorthodox approach of Sheldrake (1981), who regards certain biological concepts such as that of a morphogenetic field (a field postulated to account for the development of form) as being fundamental.

An important moral to be drawn from the above discussion is that one should not overstress the value of mathematical analysis in science. In the biological sciences we find concrete illustrations of the fact that science can sometimes proceed very well without any equations. It may be an overidealisation to presume that one can always make a precise connection between concrete physical reality and a mathematical object of some kind; some aspects of reality may be better captured by other, nonmathematical, types of conceptual entity. These can lead to models which can be tested just as successfully against reality as can models based on equations.

Introspection as a scientific tool

We can take the idea of complementary descriptions—which, as exemplified by the descriptions found in biology, are 'softer' than the numerical descriptions used in physics and chemistry—one stage further by taking account of descriptions of the *inner* reality which is found by introspection. Discussion of this more delicate experiencing of reality, which includes what is commonly called mystical experience, serves to bring the topic back again to the subject of physics and faith, the overall theme of this issue of *Physics Education*. Here Fritjof Capra has been a leading figure in promoting the view that mystical experience complements the knowledge of reality that we gain through the use of orthodox scientific methods (Capra 1975). In this context the question immediately arises whether, in talking about introspective knowledge in general and mysticism in particular, we may not be venturing outside the boundaries of what is legitimate in science. I shall respond to this question by posing another, which is dependent on the fact that, although mystical experience is not an element in current science, mathematics certainly is. The question is, why should the thinking involved in doing mathematics (which is as introspective in character as is meditating) should serve as a legitimate component of science, while mystical experience does not?

If this question seems a strange one to the reader, this is almost certainly because the meditative states of the mystic are not recognised parts of his life, even though he has in fact probably experienced them to some degree on particular occasions. Someone who is familiar with such experiences, on the other hand, will see the question of legitimacy to be misconceived; rather the questions that arise relate more to how one may overcome the problems that face one in obtaining 'good' data and to how to integrate mystical knowledge adequately with our ordinary frames of reference.

The primary goal of meditation is not that of gaining intellectual knowledge capable of being formulated compactly in terms of words, but rather that of gaining through the experience a new kind of perception and understanding of reality that will transform the ways a person acts in life. But it is by no means the case that no propositions in words can be made about such experiences, and indeed the literature of mystical experience is extensive. It is not feasible in the space of this article to attempt to give the reader any detailed vision of what this kind of knowledge is like, but I can recommend study of a work such as the classical *Yoga Sutras of Patanjali* (trans. in Shearer 1982) as possibly providing a faint hint as to the kind of thoughts that are involved.

The interpretation of what mystics have written is complicated by the fact that different mystics have used many different languages and different styles of description, while again different mystics have spoken on the basis of different levels of development. Indeed, more and more clarity of mind is necessary before the subtler perceptions of mysticism can be understood and realised, paralleling the way that clarity of mind is required in order to work with subtle *mathematical* concepts. If one understands these facts, and avoids such traps as presuming to be able to judge the various aspects of mysticism without having had the relevant experience or training, one will in all probability be able to recognise that there is indeed a consistent body of knowledge that can be gained through this deeper means of introspection.

As to the significance of mystical experience, the natural reaction of the physicist is to debar conscious experience from the framework of discussion altogether. This may be satisfactory as far as the study of matter is concerned (although not even in that case if, as Wigner has suggested, consciousness collapses wave functions), but it becomes a dubious doctrine if the conscious individual himself is our subject of interest. It is a natural extension of arguments previously given to consider that descriptions of a conscious individual in quantum mechanical terms may have to be supplemented by descriptions in terms of his thought processes, just as previously it was proposed that similar supplementation may be necessary for the case of nonconscious biosystems.

> Truth is ever to be found in simplicity, and not in the multiplicity and confusion of things.... He is the God of order and not of confusion
> **Isaac Newton**

From a general viewpoint, when we describe our thought processes we are describing some of the mechanics involved in the expression in action of our intelligence. Logically, the subtler experiences of mysticism can also be interpreted as being a part of the workings of intelligence in nature (which characterisation can, in principle, also include the divine intelligence). Because of our consciousness we can have direct knowledge of these processes that is not accessible to the usual means of investigation of science and, as previously noted, it is illogical to rule out this kind of knowledge while accepting the use of mathematics.

Paths for the future

I have here presented the reader with a number of concepts that are quite far removed from those found in traditional ways of thinking. I have suggested in the first place that there is no good reason to suppose that the current physical laws represent the end of the road for science. It is largely the limitations on thinking that the current framework imposes (especially in view of the standard advice that it is best not to worry about the *meaning* of quantum mechanics) that make it impossible to see that it is in fact quite a restricted framework for viewing nature as a whole. Secondly, complementarity and concepts associated with complementarity seem to be crucial for handling the interpretative problems that will arise if one attempts to go beyond quantum mechanics and encompass alternative perspectives on reality. Finally, the subtle experiences of reality found, for example, in meditative states may have a fundamental role to play as data in future science.

A possible aim of this future science may be what the Brahma Kumaris have called 'combining the power of science with the power of silence'. The power of science is the capacity it gives us to understand nature in very specific terms, giving us thereby the ability to control nature and to create very many of those things that we desire to have. Experiencing silence, on the other hand, gives us a power whose achievements may be easier to see if they are defined in negative terms, as for example the *absence* of conflict, confusion, fear and anger. Up to now the two kinds of power have been separated and one could almost say that the existence of only the one has been acknowledged officially. Now the future holds out to us the possibility of combining the two.

Finally, in order to avoid leaving the sceptical reader with the idea that nothing of a concrete nature is involved in the things about which I have been talking, I should like to comment very briefly on two examples of more concrete research. First, there are now many experiments (e.g. Wallace and Benson 1972) which measure the effects of psychological techniques such as meditation on parameters which can be measured by more objective means. The implication of such research is that the mind–body interaction is now an experimental matter, not just one of philosophical interest. One tangible outcome of such research is that it is becoming accepted in the medical profession that it is not sufficient to treat disease on a purely physiological basis. As yet, however, there is little acceptance of the idea that a spiritual component may also be involved in matters of health.

My second example is of a successful preliminary attempt, with which I have been involved, to put ideas from mysticism into a more concrete form. This consisted of a computer model of a developmental process, based on descriptions of the mind given by Maharishi Mahesh Yogi. These descriptions were originally themselves derived from the Vedas, which are some of the earliest expressions of mystical experience. Circumstances have not yet allowed the continued development of the model to a point where it might compete with the kind of model of the mind built by workers in the field of artificial intelligence, but the fact that the model worked at all clearly refutes the commonly held view that mysticism is totally devoid of meaningful content.

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