

A. N. Whitehead

The Interface of Science and Philosophy

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I.

How should science and philosophy be related? This is an important question, the reply to which tells us quite a lot about both the general culture and the particular views of the answerer. At one extreme is the answer that there is no difference; at the other extreme, that there is no connection. Most of the serious answers, through most of Western history, lie somewhere in between.

Since Kant, the most influential answers in the West have been toward the latter end of the spectrum. Science has sought its autonomy from philosophy, and philosophy has sought its autonomy from science. The close connections that characterized most Western thought in earlier centuries have disappeared. Following Whitehead, my commitment is to bringing them much closer together.

In the process of separation, the word "science" itself has become misleading. It should be replaced by "the sciences". When scientific thought divorces itself from philosophical questions, it abandons the level of generality at which it can seek unity or coherence within itself. Each science develops its own conceptuality, its own methods, and its own conclusions with little regard to others. Autonomy from philosophy leads to autonomy from other sciences as well.

Beyond this, the several branches of what outsiders may view as a single science, such as physics, become largely autonomous from one another. Relativity theory and quantum theory, for example, are quite autonomous in relation both to one another and to other branches of science. A few physicists are interested in developing a more comprehensive theory that encompasses both, but most are content with separation.

This fragmentation of science into many largely autonomous sciences would have been unthinkable to most scientists as recently as a century ago. It constitutes one of the most important intellectual and cultural developments of the twentieth century. Even though most philosophers systematically define philosophy in a way that renders it unaffected by the findings of the sciences, the fragmentation deeply affects the general sense of the role of reason in shaping human thought.

If there cannot be unity among the sciences, there is no reason to suppose that comprehensive thinking is possible anywhere else. If coherent thought cannot work in the sciences, there is no reason to expect it to be effective in life in

general. Whereas in the eighteenth century the achievements of a unified science led to the exaltation of reason, today philosophers compete with one another to emphasize its limited capacities. Reason can function in analysis but not in synthesis. It has technical and practical roles to play, but it cannot be looked to for answers to the "big" questions. If philosophy has a role to play with respect to these questions, it is to show that they are unanswerable or even meaningless.

This cultural development has tended to cut religion off from philosophy and even from reason. If philosophy can throw no light on the big questions, and if these are the questions with which religion deals, then religion must develop its autonomous approach. It may appeal to revelation. Indeed, the appeal to revelation has played a central role in the most sophisticated forms of Protestant theology in this century. In these, the scope of what is known by revelation is carefully delimited, so that believers are unlikely to affirm dangerous ideas. But in less intellectually sophisticated circles, the dethroning of reason has opened the door to all sorts of superstitions and cults. These appeal even to some highly educated persons.

The cultural consequences of the fragmentation of thought have also been felt in the political arena. During the middle years of this century, the reaction against reason opened the door to extremes of nationalism that in turn led to a deep revulsion. In the latter part of the century, political ideals have lost most of their appeal; and in the abandonment of "ideology", the world has turned to instrumental values, chiefly economic growth, as the only goal around which consensus can be formed.

Obviously, these twentieth century developments have far more complex explanations than I have offered. But the fragmentation of thought into smaller and smaller compartments and the denial of the capacity of reason to achieve any inclusive understanding of the world or of human existence are major contributors. Whereas once a university education was expected to provide a graduate with an overall way of understanding reality, today there is no department in the university that considers such a goal meaningful. At least in the United States, those individuals who achieve personal convictions about the purpose of life do so more in spite of their education than because of it.

It is my opinion that people cannot live without some sort of picture of the world. Those who suppose they do not have such a picture are likely to have an uncritical one. Often these uncritical pictures of the world are damaging both to them and to others.

Similarly, each of the sciences involves a picture of the world. That they vary from science to science does not reduce their influence on specialists in any one branch. But because many scientists suppose they are just doing science, and that this does not involve any picture of the world -- or only one that is validated by the science -- the picture is not brought under criticism. Often the scientist em-

ploys one picture of the world at work and another at home, and perhaps still another at church, without ever asking questions about their relationships.

This is unhealthy both for individuals and for society. It is true that reason cannot arrive at ultimate truth unaffected by the concrete socio-historical context in which it is exercised. There is no purely neutral, objective, historically-unconditioned reasoning. But reason can do far more than it has been allowed to do in the late twentieth century. And what it *can* do to overcome error and fragmentation, it should be allowed to do.

2.

There have been many twentieth century thinkers who have tried to counter the sharp separation of philosophy from science and thereby to work against the dominant fragmentation. The impulse toward more inclusive thought has often come from the side of scientists. A few physicists seek a grand unified theory. Others have tried to show that in principle all scientific laws can be derived from the basic laws of physics. Still others have tried to swallow the sciences in an idealistic system. And many others have worked patiently to connect bits and pieces of the academic jigsaw puzzle.

Early in the century there was a burst of such activity in response to the profound changes taking place in physics. With the collapse of what is often, somewhat misleadingly, called the Newtonian worldview, those who recognized the need for some inclusive world picture engaged in a variety of thought experiments. Many then, and in more recent years, have been commendable. It is my judgment that among them one stands out as more profound and thoroughgoing than the others, and that is the speculative philosophy of Alfred North Whitehead. Within the rather limited circle of philosophers who are seeking a unifying picture of the world, a good many share my view.

Even those of us who see Whitehead as having offered the best alternative to the dominant fragmentation do not suppose that Whitehead was correct in all of his hypotheses. Indeed, my initial claim about his achievement would be compatible with the view that as the twentieth century wore on, the scientific conclusions on which he based his speculations were superseded by others that are incompatible with his theories. This possibility has been of considerable concern to me personally, since it is my goal to think philosophically and theologically in a way that is coherent with the knowledge gained by the sciences. In my effort to realize this goal, I have used Whitehead's conceptuality. But if that conceptuality no longer connects me to the frontiers of scientific thought, then my project fails.

It is evident that this is an acute problem for any philosophy that is closely related to science. It always remains subject to correction or change by develop-

ments in the sciences. One of the main reasons that philosophers have sought autonomy from the sciences is their desire to avoid such dependence. They limit philosophy to what can be affirmed on more stable grounds.

But the price of such independence is too high. It leaves us fragmented and adrift with regard to the deepest questions of life. The philosophy we need is one that provides a coherent, if provisional, way of understanding our world and ourselves. Accordingly, I accept the task of revising philosophy as empirical knowledge leads to change in scientific theories, and I have tried to be alert to evidence that calls for the modification, or even the rejection, of Whitehead's speculations. Certainly, Whitehead himself called for continued testing of his hypotheses.

3.

The most direct challenge to Whitehead's concptuality came a quarter of a century ago when physicists at California Institute of Technology announced that Whitehead's theory of relativity had been empirically invalidated. Of the half dozen alternatives that had been proposed to Einstein's theory, all the others had failed earlier tests. Accordingly, the scientists proclaimed that with the refutation of Whitehead, only Einstein's theory remained.

Those who are accustomed to the separation of philosophy from science may wonder why the failure of Whitehead's theory of relativity would be important with respect to his philosophy. The answer is that Whitehead's reason for proposing a mathematical alternative to Einstein's theory *was* philosophical. Einstein's appeal to the curvature of space-time as something real assumed a substantial character of space-time that Whitehead believed it could not have. He pointed out that geometers had shown that any space that can be treated by one geometry, such as elliptical, can also be treated by other geometries, hyperbolic and Euclidean. This meant that space-time is not the sort of thing that can, in itself, be either curved or straight.

Accordingly, Whitehead developed a mathematical formula that could account for all the then-known relativity phenomena, based solely on multiple time systems. His formula had successfully accounted for additional phenomena as they were discovered. But the scientists at Cal Tech announced that it predicted a gravitational influence on tides by remote heavenly bodies, and that these could not be detected.

On examination it turned out that this announcement was somewhat premature. It employed a crude model of the distribution of mass within the universe that predicted a much larger influence than would a more careful model. But during the following years, more and more refined measures were attained with the same result. It became clear that Whitehead's formula was incorrect. Did this

mean that Whitehead was wrong about the ontological status of space-time? If so, his whole conceptuality would require extensive revision, if not outright rejection.

A more careful reading of Whitehead's text led to the recognition that Whitehead had anticipated the possibility that the formula that he worked out in great detail would be empirically proven erroneous. Accordingly, he offered a second formula without unpacking it. This one, he stated, was mathematically equivalent to Einstein's. Virtually no attention had been given to this formula during the intervening years. But more recently Dr. Robert Russell has unpacked it. It turns out that in fact its predictions are identical with Einstein's, but that it still makes no appeal to curvature of space-time. Like the now refuted formula, it is based on multiple time systems.

It is difficult to say, therefore, whether Whitehead's philosophy is compatible with contemporary relativity physics. That physics has developed for generations with Einsteinian conceptuality. Since Einstein's formulae work, few physicists are interested in exploring another conceptuality that can in principle predict the same data. Only a philosophical interest could lead to such exploration, and philosophical interest is relatively rare among physicists.

There is, of course, some interest among scientists in integrating relativity theory and quantum theory. But if the interest is in integrating relativity theory in its Einsteinian form with quantum theory, then Whitehead's theories cannot help. Indeed, a Whiteheadian will conjecture that that task is impossible. For Whitehead to help, relativity theory would have to be reconstructed on different lines.

Relativity theory has led to one important conclusion anticipated by neither Einstein nor Whitehead. That is the Big Bang. Whitehead's speculations were of an everlasting universe that changed very gradually. He thought in terms of successive cosmic epochs composed of different kinds of entities. Our present epoch he called the electromagnetic one. He conjectured that somewhere in the vast reaches of space other types of entities might be emerging that would some day become dominant. But there was no place for abrupt beginnings in his vision.

As the Big Bang moves from tentative hypothesis to well-confirmed theory, it requires a radical change in Whitehead's cosmology. Its challenge to his basic thinking, however, is far less than would be the establishment of a substantial character of space-time. Whiteheadians differ on exactly how the adjustments are best to be made, but that they can be made without rejecting the basic conceptuality is clear.

4.

Quantum theory is another area in which there have been vast changes since the time that Whitehead wrote. Since he did not mathematically develop a quantum theory, the situation here is quite different. The question is whether his basic understanding of the nature of reality is compatible with what is now known about quanta.

Here the answer is less problematic in one sense, but equally so in another. It is less problematic in that the ontology Whitehead developed, largely independently of quantum physics, is a quantum ontology. The actual world consists in four-dimensional unit events most of which are minuscule in size. Whitehead calls these unit events actual occasions.

The actual occasions constitute a field, and each occasion can be thought of as what that field is at that locus. In other words, each is the unification of that field from its particular perspective. Each is a throb of energy deriving its character largely from the field in which it is located. The development of quantum theory has not invalidated this vision.

Nevertheless, the answer is problematic for much the same reason that Whitehead's theory of relativity is problematic. Just as with the dominant relativity theory, the basic concepts with which this theory has been developed are, for Whitehead, unsatisfactory. Light, for example, has been considered for some purposes to consist in particles; for other purposes, waves. The particle-wave duality in physics has been used to justify paradoxical formulations in other areas of thought. But both "particle" and "wave" are concepts that arise in substantialist thought. From a Whiteheadian standpoint, an adequate quantum theory should be formulated in terms of a field of events.

The physicist, David Bohm, agreed with Whitehead and developed such a theory. He has shown that the data can be explained in this way more coherently. But because the predictions are the same, few physicists are interested. And most philosophers do not think of their task as helping physicists develop more accurate ontological assumptions.

This means that a Whiteheadian relativity theory and a Whiteheadian quantum theory are possible. On strictly empirical grounds, Whitehead's vision has withstood the challenge of further development of physics after his death. That is, it can be formulated in a way that is consistent with the empirical findings in both fields. On the other hand, Whitehead's thought is not compatible with contemporary physics as it is actually formulated.

As one deeply concerned for the emergence of more coherent and comprehensive thinking, I am not led by this situation to abandon Whitehead's conceptuality. Instead, I rejoice that there is some increase of interest in his philosophy among physicists. Those who are dissatisfied with the incoherence and paradox

that characterize contemporary theory are open to exploring new approaches, and some of these are investigating Whitehead. Unless and until these explorations have been proven fruitless, it seems worthwhile to continue to work with his hypotheses. My hope and expectation is that Whitehead's event-thinking will prove increasingly fruitful not only in bringing unity to fragmented areas of thought but also in suggesting new scientific hypotheses and directions for research.

5.

The deepest division in recent thought is that between the subjective and the objective. The natural sciences are seen as dealing with the world given objectively for human observation. The humanities deal with the world of subjectivity. Since Kant, the dominant schools of Western thought have accepted this division and denied that the findings of the natural sciences and of the humanities have any connection with one another. We have not encouraged scientists to think humanistically about their work or humanists to consider the relevance of the sciences for their interpretation of documents.

Of course, in fact, these two sides of knowledge cannot be kept so separate. Natural scientists are sometimes aware of the history of their sciences and understand that factors other than pure empiricism and logic have shaped the formulation of their theories. Humanists know that views of the world influenced by the sciences affect the self-understanding and emotional life of ordinary human beings as well as intellectuals. Natural scientists are often interested in the humanistic implications of their findings. Humanists make use of new technologies such as computers in their research, and most of them are in fact deeply influenced by worldviews derived from the sciences.

Nevertheless, the gap is enormous. Sometimes it is described in terms of two cultures living side by side with little ability to communicate; sometimes, different language games. Most scientists have difficulty locating their work in the course of cultural and intellectual history; and most historians have resisted interpretations of historical events in terms of natural ones such as changes in weather. None of the separated disciplines encourage reflection about the interaction of the objective and subjective worlds.

On the whole, philosophers have located themselves on the side of the humanities and have encouraged the separation. Some call it a category mistake to introduce knowledge gained by physiological psychology into the philosophical analysis of how we come to know, or epistemology. Scientific information is regarded as irrelevant to ethics. The traditional task of metaphysics has been widely rejected.

In the wider culture, however, there is keen interest in the implications of the new physics for the understanding of the universe and the place of human life within it. Scientists who dare to speculate are widely read. Unfortunately, many of them go beyond the range of their expertise and contribute to the suspicion of such efforts at comprehensive thinking on the part of academicians. Clearly, if we are to reconnect the realms of the subjective and the objective, careful thought must be given to how this is done.

Again, it is my opinion that Alfred North Whitehead's proposals are the best we have. They do not reduce one to the other as did materialists and idealists, but they integrate them in a way that radically overcomes dualism. They give rise to hypotheses that are partly testable and thus far have survived such empirical checks as can be made.

To understand his proposal, we return to the unit events or actual occasions which, in Whitehead's theory, constitute the universe. These are momentary occurrences. They come into being and then, immediately, become past. As past they do not cease to be in all respects. On the contrary, they constitute the data for new occasions. They influence, or flow into, new occasions. New occasions are largely constituted by them. Hence, as an occasion comes into being, it is the reception of the old occasions that make up its world.

But in Whitehead's hypothesis, the new occasion is not simply passive in this process. It is an act of being or becoming, an act of constituting itself out of its data. It is a particular unification of those data. To unify the data requires an element of novelty, since they do not provide their own unity. This act of self-constitution then flows into successor actual occasions.

How do notions of "subject" and "object" fit into this scheme? In the moment of unifying the forces shaping it from the past, the actual occasion is a subject both in the sense of being acted on and of agency. The past occasions that influence it are its objects. These objects are not of an ontologically different order from the new subject. In the moment in which they were actively unifying their past, they, too, were subjects. Every unit event is a subject as it comes into being and an object for all future actual occasions.

This could be viewed as simply a matter of definition. But Whitehead means more than that. He understands a moment of human experience as an actual occasion. It unifies its past and then becomes part of the past of successor occasions. In short, it is momentarily a subject, both as the passive recipient of the past and as the act of self-constitution. As datum for successor occasions it is an object.

Our understanding of the meaning of what it is to be a subject and an object has to come from our own experience. If the term subject is to have any meaning at all it must be derived from our own sense of being subjects. If these are to be more than formal terms in their application to others, we must generalize something from our experience. We must generalize, for example, the way in which

one moment of our experience includes past experiences within it and is thereby informed by them without being totally determined. Whitehead believes that we can generalize "experience" as such. He asserts that every actual occasion is an occasion of experience.

6.

The challenge is to see what features of human experience can be generalized and how far. The dominant philosophy since Descartes has resisted any such generalization even to other vertebrate animals. Even those who, when pressed, acknowledge that evolutionary theory counts against such a radical dualism of the human and everything else, do not allow such generalization to affect their ways of studying other animals.

Fortunately, this rigid limitation is gradually breaking down. A number of researchers have recognized that they understand animal behavior better when they recognize that animals have emotions and purposes and modes of communication not wholly unlike our own. Others have demonstrated that some animals are even able to learn simple human language. Donald Griffin has employed such analogies even in the study of insects.

Clearly Whiteheadian thinkers encourage such developments. Just as it is possible to study human beings purely as objects and to learn a good deal, it is possible to do this with other animals. But just as the purely objective picture of human beings is an abstraction from a much richer reality and is accordingly unable to explain much about us, so it is with other animals as well.

In the formulation of evolutionary theory every effort has been made to exclude explanations that involve the subjective experience of animals. Yet in the end, even an apparently mechanistic principle such as the survival of the fittest makes no sense unless we assume that animals want to live and aim at doing so. Further, in fact we assume that many of them learn from their parents and exercise considerable good sense in the hunt and in their efforts escape. The fittest are often the ones that pursue their goals most intelligently. If biologists would cease to try to exclude the subjectivity of animals from their explanatory schemes, these could be developed more richly and suggest new lines of study.

One Whiteheadian, Charles Hartshorne, has employed the Whiteheadian perspective intentionally in the formulation of an hypothesis for testing. He is a student of bird song. Among the scientifically orthodox, bird song is understood as occurring only because of its contribution to survival in the evolutionary struggle. It is thought to function only in relation to mating and territory.

Hartshorne was skeptical. In the human case it is probable that our capacity for language developed in relation to its survival value. But once the capacity was

developed, it came to be used for many purposes not related to this. Hartshorne suspected that birds enjoy singing and that some of their singing is for enjoyment.

If birds sing because they enjoy it, he reasoned, they would also experience boredom. Birds with very simple songs would be more easily bored and would pause longer between songs. Birds with more complex songs would not pause as long. He gathered an enormous amount of data, and the results, published in *Born to Sing*, support his hypothesis.

We all know that the fact that an hypothesis is supported by data does not prove that it is true. Hypotheses can be disconfirmed by data, but not confirmed. When they fit well into an existing body of well-established theory, they are likely to be accepted rather easily. But since there is virtually no scientific theory that brings the subjective and objective together, an hypothesis such as Hartshorne's is likely to remain simply anomalous. From a Whiteheadian point of view, this is unfortunate. We can hope that an increasing body of theory relating the subjective and objective in the study of animals will develop.

7.

Many critics, even if they concede that the line between human beings and other animals is not as sharp as once thought, believe that at some point the term "experience" becomes misleading. If that is inescapably the case, Whiteheadians can seek other language. Terminology is not the crucial issue. What is crucial, however, if dualism is to be overcome, is to display human experience as an instance of the one kind of entity that is actual. There are not two ontologically different kinds of beings: objects and subjects or matter and mind. There is one kind that is subjective as present and objective as past, and has both physical and mental features. Further, the relation of subjects to objects universally has basic characteristics in common.

Let us consider the possibility of stretching the term experience further and further as we go down the scale. When we go down the scale and come to animals that lack central nervous systems, much of what unites us with more complex animals disappears. We do not suppose that unicellular organisms see or hear. We assume that they lack consciousness. Any sensitivity to light or sound must be very different from ours.

Do they, then, lack experience altogether? Again, the answer depends on how we use the word. For those for whom experience means conscious experience, of course they do. But for many of us, it does not seem strange to speak of nonconscious experience. Indeed, if we follow Whitehead and the depth psychologists, most of human experience is not conscious. Part of our experience comes into awareness and then fades out according to how our attention is di-

rected. In Whitehead's analysis, most of what happens in a moment of human experience lies forever, necessarily, below the conscious level. If we think of experience in this way, it makes sense to suppose that as we go down the scale there is less and less consciousness and eventually none at all. What we have is nonconscious experience.

To say that experience is nonconscious does not mean that it is without emotion and purpose and spontaneity. Even with us it is quite possible to feel strong emotions and behave purposively without being conscious of the emotions of purposes. The behavior of bacteria appears to be purposive. They evade dangers and pursue food. There is some indication that they learn, although this term, too, must be separated from its common association with consciousness. The point is that the behavior of unicellular organisms fits better the expectations generated by viewing them as having some of the properties that characterize human experience than as being mere objects of human perception or lumps of matter.

8.

Some scholars see the value of extending the notion of experience to all living things in some attenuated sense. But many of these balk at going beyond the limits of life. There are two types of arguments for this further extension that Whitehead proposes. One is empirical. If we move from unicellular organisms to quanta, we find some analogies. Quanta are not well understood in purely deterministic, mechanistic ways. They seem to have their own spontaneity. They are more like very tiny organisms than like what we expect if we bring with us the model of material atoms or machines. Whitehead proposes that we think of them, subjectively, as momentary bursts of unconscious emotion, absorbing the feelings of their fields and contributing to its continuation. Thus what is called "energy" from an objective perspective is "emotion" in its subjective occurrence.

Some say that although this is not impossible, there is no reason to engage in such speculation. They argue that even if we suppose that living things have some experiential subjectivity, we can view the inanimate world in purely objective terms. Whitehead thinks there is a serious problem with that strategy.

This problem is that objects are such only for subjects. We have no notion whatever of what objects are in themselves. The effort to understand them as substances broke down during the course of modern philosophy. We may explain objectivity phenomenologically in relation to our own subjectivity, but this applies to what is given to us as present. Even if we extend the status of object to the past, this status of the past depends on the presence now of some subjectivity.

Now relate this to the way we think of the evolution of our cosmos and of life on this planet. We speak of a Big Bang that occurred fifteen to twenty billion

years ago. We trace the development of our solar system, the rise of conditions that made life possible on this planet, and then the emergence of progressively more complex forms of life. Somewhere along the way consciousness appeared.

The hypothesis we are critiquing is that up until this point where consciousness arose there were only objects. Somehow out of pure objects emerged the first subject. If objects and subjects are of ontologically different types, "emergence" is a misleading word. We seem to require supernatural intervention.

But this famous puzzle of the appearance of consciousness in a world of objects is not the most fundamental one. What is still more puzzling is the status of the objects when there were no subjects. Objects exist only for subjects. Hence it seems that these billions of years of development came into being only with the first subject. But even that misrepresents the implication. Surely the first conscious animal could not objectify events that occurred billions of years earlier. It seems instead that the Big Bang came into being only in recent decades when scientists developed this theory. But can something that had no reality until very recently explain the course of events that made life possible and then actual? I for one find this supposition absurd.

It seems far more plausible to think that there have been experiencing subjects as long as there have been objects, and that without both there can be nothing at all. A few of these subjects became somewhat more complex over billions of years, and finally glimmerings of consciousness emerged. In further development these glimmerings became more stable and extensive and contributed to many new developments.

In short, unless we are ready to be thoroughgoing idealists, we need to trace both subjectivity and objectivity back to the "beginnings of time", if there are such beginnings. We cannot think "subjectivity" apart from continuity with our own experience. Taking account of the past, integrating it, and passing it on, in a way that is characterized by nonconscious emotion/energy is what Whitehead proposes as worthy of generalization.

If we think in these terms, we find the sharp separation of the sphere of objective and subjective inquiry intolerable. We are speaking of one and the same reality as present and as past. Both in the present and in the past there are vast differences in the importance of subjective experience, varying from cases in which it is almost entirely a matter of passing on emotion/energy from the past to the future to instances in which there is very significant originality in the present. It is appropriate that the natural sciences study the former instances and the humanities concentrate on the latter. But it is inappropriate to suppose that every field of investigation must fall entirely on one side or the other and that the findings of each be held irrelevant to investigation in the other.

9.

One example of fields that suffer from the dominant dualism is physiological psychology. The orthodoxy of physiological psychology is that it is a natural science. It therefore assumes that all the phenomena in its purview can be explained, and must be explained, without reference to subjective experience. It must, therefore, deny common sense altogether.

Common sense assures us that if I decide to write the word "decide" it is quite likely that this word will appear on the screen. Of course, I may strike the wrong key. If I have had a stroke, this likelihood increases greatly. What appears on the screen is more directly determined by the pressure of my fingers on the keyboard than by my decision. Beyond that, the machine on which I am writing is capable of error. Nevertheless, most of the time my decision has its intended effect, and is usually the crucial variable in the chain of causes determining what appears.

Physiological psychologists have no evidence with which to refute this common sense view. But they have very powerful traditions of teaching against allowing anything subjective to be conceived as a cause of physical events. Chiefly they avoid this by studying phenomena that do not involve clearly conscious decisions. But since they cannot deny the fact that such decisions occur, they require an explanation. Usually, the explanation is that what we subjectively experience as a decision is in fact determined by neural events in the brain. Philosophically speaking, they treat conscious human experience as epiphenomenal, that is, caused by brain events that they can objectify and as lacking any effect upon brain events. The causal chain among physical events is thought to bypass human experience.

It is, of course, possible to bring about various subjective experiences by stimulating different parts of the brain. The dependence of subjective experience on the events in the brain is evident. But the leap from this fact to the claim that all subjective experience is wholly determined by brain events and has no effect upon them is a large one. Its implications seem to undercut the whole scientific project and much else besides. It is made because of theoretical commitments rather than empirical evidence.

A few physiological psychologists have been persuaded by the evidence to reject the orthodoxy of their discipline. Roger Sperry found himself forced by the evidence he uncovered in his split brain research to attribute a causal role in brain events to conscious experience. Sir Roger Eccles came to similar conclusions. Both have received Nobel prizes for their research. But their recognition of the need for a changed paradigm for their discipline has had little effect on physiological psychologists as a group, at least in the United States.

For a Whiteheadian, of course, the common sense view is eminently plausible. A moment of human experience is an actual occasion. Every neuron, moment by moment, is also such an occasion. There are causal relations among occasions. All the occasions in the brain influence the conscious human one. The conscious human one has an effect in all the others. Of course, each moment of human experience also flows directly into its successors; their connection only partly mediated by the brain. Similarly there are many causal relations among the neurons that are not mediated by human experience. But all play some role in all the others.

This means that a Whiteheadian is in principle fully open to learning of the many ways in which subjective human states affect the functioning of the body as well as the many ways in which the functioning of the body affects subjective human states. We rejoice in the softening of resistance to this interactive view in the medical profession. We find a growing willingness among a few philosophers dealing with the mind/body problem to move in this direction. We regret that there is so little openness in the rank and file of physiological psychologists.

10.

In this lecture I have placed the emphasis on the relation of Whitehead's philosophy to some of the natural sciences. My own work has related it more to some of the social sciences, to Christianity, and to interfaith dialog. In these areas the same pattern applies. Whitehead's theories do not connect well to the standard formulations in any of these fields. Instead they propose a different conceptuality for interpretation of the data and for further investigation. Thus far they have not been shown incapable of interpreting the empirical data in the several fields, and they seem to fit well with some of the more creative work being done on several fronts. This is why Whitehead's thought continues to be promising both as a stimulus to further research and as a unifying vision.