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c7 The Mind/Brain Issue As A Scientific Problem

John Eccles, in his opening address, noted that the Mind/Brain problem is at the center of a revolution *necessitated* by the relatively recent discoveries of modern physics. However, as Daniel Robinson has reviewed for us, philosophers have been concerned with this problem for some time and have provided us with a variety of answers which are encapsulated by the labels dualism and monism. Dualistic theories are ordinarily distinguished as parallelist or interactionist and monism has engendered multiple aspects and identity proposals. Philosophers have also stated, and this view was affirmed here by Robinson and Watkins, that scientific experiment and observation will yield little, if any, resolution of the question as to which of the philosophical positions is the correct one. These thoughtful scholars suggest that what is needed is more philosophical analysis, or perhaps the acceptance of one viewpoint because of its overwhelming logical persuasion.

As a scientist I cannot accept either the premise that scientific experiment and observation are irrelevant to an issue of such fundamental import nor the view that therefore we should continue the analysis much as philosophers have done for almost three millenia.

When in science a question arises that appears to be unresearchable the scientist asks whether that question has been properly phrased. As Medawar has stated so succinctly "science [in common with politics] is the art of the possible." Ordinarily, problems that appear to be resistant to research are so either because the appropriate technical (and that includes analytical techniques such as forms of mathematics) resources have as yet not been invented or because the question has not been broken down into meaningful (i.e. precisely interrelated) subquestions.

Scientists using the techniques of behavioral psychology, information engineering and brain physiology are addressing prob-

lems on the interface between brain and mind. Thus, the difficulty with the Mind/Brain issue appears to be conceptual rather than technical (as our philosophical contributors suggest). But rather than continue the century old debate as to which philosophical position is correct, I will approach the problem from a different vantage.

The logical possibility exists that the Mind/Brain issue consists not of one global problem but a set of specific and interrelated questions. If that should prove the case, then experimental observations might well become relevant to one or another of these questions. Further, it could turn out that each of the more global philosophical "positions" is correct with respect to one or another of these specific questions.

Using this approach it is possible to discern at least three very different questions that compose the Mind/Brain issue. These questions are: 1) how to characterize existential reality 2) how to characterize the transactions between an organism and its environment and 3) how to characterize the organization of the universe (including the biological universe).

Philosophical inquiry has approached the first question, the nature of existential reality through introspection. Scientists have approached the same question by making experiments and observations on the physical universe. Both introspection and physical science have yielded the same result: one must take into account both the observer and the observed. As an example, in philosophy Brentano characterized the essence of self-report to be the ability to distinguish between perceiver and the perceived and between intent and act. This principle is usally referred to as "intentionality." In physics Heisenberg and Wigner (e.g. 1969), among others, have clearly stated that the science of physics deals primarily with probability correlations among *observations*, and that the referents of those observations must be inferred.

Thus both philosophy and science arrive at an existential dualism. The scientist investigating the material universe is thrown back upon his own observation as critical; the introspective philosopher finds "self" only when he can distinguish a difference between intention and that which is intended.

Questions as to the "existence" of each of these "realities" and whether the one can be "reduced" to the other are subsidiary questions to which I shall return shortly. For the moment it is sufficient to understand that dualism is composed of a duality in which neither the material nor the mental can ultimately be examined (at least at present) without recourse to the other.

Are there any observations or experiments that are relevant to this issue? I believe there are. One such question concerns the evolution of intentionality. Are apes self aware? If so, are monkeys? Other mammals? What will the results of answers to these questions have on our existential experience of intentionality? Will the centrality of intentionality to the Mind side of the Mind/Brain issue be jeopardized if animals other than man can be shown to possess intent?

Another relevant experimental observation concerns the specialization of function of the hemispheres of the brain, as Eccles (e.g. 1970) has repeatedly pointed out. If both hemispheres display intentionality and their behavioral output can be separated, are there then two selves? And if there are, does that not mean that a two hemispheres-two minds correlation becomes established? And if not, then the quest for what brain process does correlate continues and doesn't it make a difference to the Mind/Brain issue whether total brain hemisphere processes or e.g. linguistic processes correlate with mental processes? Aren't precise definitions of Mind dependent on such observations?

It is, of course, with just such precise definitions that questions about the Mind/Brain issue must be asked. So far we have asked about the existence of Mind and Brain—their reality in experience. Mind so defined becomes identified with intentional being, with "self"—self-awareness, self consciousness. Being, awareness and consciousness can however be conceived either as states (relatively enduring configurations) or as functions (relationships among relatively enduring configurations). Two very different theoretical frames are derived depending on which conception is pursued.

Gilbert Ryle first defined mind in terms of minding, a function. Minding is behavior. Minding is paying attention. And there is a considerable body of scientific knowledge concerning behavior and

attention. The consequences of behavior (technically these are called acts when they rearrange environmental configurations and reinforcements when they rearrange organismic states, e.g. Pribram 1971;) and of paying attention (or not paying attention) are well documented scientifically. When these consequences are framed within the Mind/Body issue they lead to an interactionist view.

Popper and Eccles in their recently published book "The Self and its Brain" (1977) develop the case for such an interactionist viewpoint. Unfortunately, they do not clearly distinguish between Mind as state and Mind as function so that the thrust of their argument often loses force and the experiments described by Eccles do not address the specific problem to which they are appropriate.

It should not be surprising that Popper as one of the most influential heirs of Mach's emphasis on sensory experience and the consequent positivism of the Vienna Circle espouses a position in which Mind as function — as minding — acts upon the physical universe which in turn influences Mind as state through the senses. But note also that other equally perspicacious philosophers of the Vienna Circle such as Feigl (e.g. 1960) could bring to flower an identity position from the same roots.

Perhaps this difference between philosophical views stems from the confounding of Mind as state and Mind as function already noted. If emphasis is placed on minding as function, its interactive properties become paramount. If, on the other hand, emphasis is placed on Mind as state, correspondences, identities between states (configurations) will be sought. In biology and physics, Helmholtz (e.g. 1863) and Hertz, (e.g. 1956) for example, looked for such correspondences e.g. between the physical stimulus as described by instruments, and the resulting experience as described by verbal response. Hertz used the terms *Bild*, image, and *Darstellung*, representation, as a construction or model of reality which is best described in mathematical terms. Whereas Machian functionalism leads to interactions by way of the senses and behavior, Helmholtz and Hertz's structuralism leads to modelling, a cognitive constructional activity which searches for identities.

Popper combines these historical traditions by making his third world (Mind as function) the medium for interaction between

Brain (World 1) and Mind as state (World 2). But he fails to point out, as does Hertz, that interaction occurs only to the extent that World 3 identifies World 1 with World 2—i.e., the limits of interaction are described by the limits of the *identity* between model and what is being modelled ("reality").

Further, by creating World 3 as apart from World 2, World 2 the mental world, becomes restricted to the sensory world of Mach, from which cognitive activity is derivative (Mach) rather than integral (as proposed by Kant, 1963). Neuropsychological research (Pribram, 1971, Chap. 17) has indicated that the Kantian view must at least be seriously considered.

Max Jammer, in this conference, has given a superb account of these differences between Mach's functionalism and the scientific approach developed by Helmholtz and Hertz. Toulmin (in Janik and Toulmin's "Wittgenstein's Vienna," 1973) also gives a detailed account of these developments. Feigl's views and those derived from them such as Grover Maxwell's thoughtful and thought provoking paper presented at this conference appear to me to be kin to the structural approach. "Multiple aspects" of some partially perceived identity are not altogether different from the "models" of reality espoused by Hertz.

I am inclined to accept this structuralist approach to the Mind/Brain problem because it can subsume the others and bring to bear additional scientific evidence. The concept "structure" in this sense is not to be confused with morphology or anatomical structure. Structure here means the structure of process, the meaning used by Hertz, Levi-Strauss (1963) and by Merleau-Ponty (1963). Process involves one state becoming another. Functional interactions are thus encompassed.

A structural approach to the Mind/Brain issue discerns systems of states some of which are hierarchically related, others are processed in parallel, while still others interact to produce new states. Examples of such systems are information processing devices. There is a hierarchy of configurations—at the lowest level are electrical circuits which are organized into flip-flops, then into "and" "or" gates and "nand" and "nor" configurations. From these more complex computational elements are constructed. These are then combined into the hardware "brains" that we

call computers. To operate, i.e. to function, these "brains" must interact with an appropriate environment through input-output devices (hardware sense organs and effectors). Without such devices the computer does not function, nor does it function without programs which constitute its appropriate interactive environment. One might say that without programs computers won't mind. They won't attend, they won't change their configurations, their states. Programs and hardware are certainly different in function and realization—perhaps as different as Mind and Brain.

Still there are identities, as well. There is a truism in the information sciences that anything that can be realized in a program can be constructed in hardware—and vice-versa.

What is it that shares this identity? It is called the "structure" of the process. It is this structure which we recognize functional program and functioning computer to have in common. It is the same commonality as that which characterizes the structure of a symphony which we recognize whether it is realized as an experience in the concert hall or as the score in sheet music. A variety of realizations—score, tape, disc, performance, shares an identity in structure which we can experience in appropriate circumstances.

The structural approach therefore does not deny an apparent dualism in Mind/Brain. It does, however, suggest that a better description might be that of a duality (a set of symmetry relationships) which has certain properties in common. It can explain the apparent dualism in terms of a hierarchy of knowledge systems (Sociology, Psychology, Physiology, Chemistry, Physics) which, when explored in a reductive direction, yields ever more material descriptions until the limit is reached in microphysics where such descriptions become almost totally mathematical—i.e. descriptions of relationships among observations rather than of relationships among observables. (There is therefore an ultimate paradoxical circularity to the hierarchy). When, by contrast, the explorations are performed in an upward direction in the hierarchy, conventions must be established in order that the exploration may proceed. The theories of relativity established the role of such conventions in physics, the periodic table based on atomic number is such a convention in chemistry, and *mental* language

(consensually i.e. socially validated) provides this convention for psychology (Pribram, 1965).

Note that with this view, intentionality is derived by looking upward in a hierarchy which is comprised of the biological organism is his eco-system. The convention becomes established that the organism can distinguish between himself and his environment and that this distinction characterizes mental life, or mind. Other conventions adopt other distinctions. For example, the functional approach is characterized by the convention that mind is to behaving biological *bodies* as force is to *masses* in motion (i.e. behaving).

It is this conventional aspect—the fact that one must choose a frame within which exploration proceeds—that makes plausible the varieties of philosophical approaches to the Mind/Body issue. I have tried here to make explicit which frame, which convention, proscribes which philosophical position. I have also therefore attempted to show that each position has merit and to discern that merit. In short, the Mind/Body issue appears to me to yield to a set of *complementary* theories, each of which has explanatory power and limits.

Unity is therefore to be achieved when the relationships between the complements that characterize the theories are clarified. Ultimately understanding the complementarities may devolve on understanding what goes on at the limits of the theories. Thus, does the fact that microphysical theory is a description of observations rather than of observables mean that "ultimately" the universe is made up of observations, i.e. Mind, or does it mean that we simply cannot in this instance, use the ordinary neurophysiological mechanisms of "projection" (e.g. Bekesy 1967) to construct an apparent physical reality as we normally do for the mechanistic universe? As a scientist I believe it is this type of question that can now supplant the earlier philosophical analyses. As a scientist, also, I believe that experiment and observation will have a high yield of contributions to make in answer to such specific questions.

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