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Mind, Brain and Behaviour: Excursions into Paradox

behaviourist revolution is behind us and the time has come to re-evaluate the psychological scene. eady the trumpets herald a counterrevolution. Arthur Koestler in *The Act of Creation* and even more ehemently in *The Ghost in the Machine,* denounces the impoverishment of contemporary experimental chology, its heroic question begging, its denial of "the humanity of man," its emphasis on "the rattiness the rat."

stler is, of course, partly right and this is the part that hurts. Koestler is also partly wrong because behaviourism as a method discipline (as opposed to behaviourism as an S–R explanation psychological processes) has enriched our ability to reach under-ding even if understanding has not yet come. Further, some and new trends in psychology are ignored in the attempt to unt the counterrevolution. Clinical psychology has not entirely en up its concern with intrapsychic mechanisms for a behaviour ented therapy. And, during the past decade, the most rapid ides in experimental psychology have been made by those rested in cognitive processes. Studies in psycholinguistics and tal learning, in mathematical, and in physiological psychology e all departed radically from S–R formulations while making d use of behavioural techniques.

wholesome enterprise can tolerate revolution and counterrevolu-n. I believe psychology to be wholesome, i.e. while one facet may fashionable and pursued with vigor, another may be incubating resources for subsequent growth and development. Biology, especially the biology of the brain sciences has, over the past lf century been in this state of incubation with respect to ychology. The time is ripe for these contributions to become t. My concern here is with this relation between brain, behaviour d psychology.

r me, as for William James (1950), psychology is the study of nd. For me, as for William James, a great deal about mind is rnt by studying brain. But the route to understanding is not a mple one. Mind is initially introspected. These introspections can ceive consensual validation from social communication. The quistic philosophers have given us the tools for an initial des-ription of mind. It falls to humanists to portray the detail cessary to attain an existential grasp of mental processes, and to ychologists to perform the analytical-synthetic operations that d to scientific – i.e. functional and structural – understanding.

a scientist I approach the problem of the study of mind with an rnament of operations. The experimental techniques that I employ ll naturally into two major categories: those which study what es on outside an organism's skin and those that go on within. My rimary focus of interest is *mind* – the mind of man to be specific. recognize man as an entity because he is contained in a bag, his in. This focus is, of course, an arbitrary one. Were I interested in society and culture, the roles taken by a person might be of greater interest than the person *per se*. Were I interested primarily in the nervous system its organization in invertebrates would be as cogent as that of primates. Were I interested primarily in behaviour, the copulatory contortions of carnivores would be as intriguing as why girl falls in love with boy. But I am interested in mind *first* and in social relations, neural organization, and behaviour second. So, a world divided by skin into an in-here and an out-there is a "reality," albeit an arbitrary reality to my understanding.

Of necessity I share this arbitrary world with anyone who is primarily concerned with man and his uniquely human attributes. Humanists thus fall heir, just as some scientists do, to the mind-brain-behaviour problem. I have already outlined the operations which define mind. Those which define brain (or more inclusively, body) are those which relate to the world inside the skin; those which define behaviour relate to the world outside the behaving organism. Thus as Skinner (1938) has repeatedly pointed out and Tolman (1932) has clearly enunciated, responses are the marks left by the experimental subject on the record which the experimenter takes home to study; actions are the external residues of behaviour.

These defining operations do not, of course, exhaust the complexity of the mind-brain-behaviour problem. But by making them explicit one major misconception may be remedied. The remedy has important consequences. At the moment most textbooks of psychology define their subject matter as "the study of behaviour." The implicit assumption is that the only route to an understanding of mental processes – if one is interested in them at all – is through behaviour. Thus the wide acceptance of the empty-organism approach to psychology. But if my defining operations are acceptable and accepted, behaviour is but one of two routes into understanding – studies of the interior of the organism are conceived to be as helpful as those of behaviour.

An objection to my defining operations is usually voiced when I show where "psychology: the study of behaviour" leads. Of course "behaviour" *is* meant to include the GSR, the EEG, unit neural responses, and paper chromatographic records. But if this is indeed the intended meaning why do behaviouristic authors neglect almost completely these "internal responses" in their texts? Their answer is usually that such details are unimportant to their audience – and that is just the point. Conceived as detail about one

other organ system – a part response which will become manifest behaviour-of-the-whole organism – the internal world of the organism, man, is lost. Only when these internal manifestations are considered, and they often are in clinically oriented research, as ends-in-their-own-right of psychological processes, can a full scientific attack on the problem of mind be engaged.

Let me illustrate by two examples. I attended a concert the other night, the performance of a string quartet. Five hundred or so persons sat in the audience. For two hours, the manifest behaviour of the group consisted of a few arms see-sawing back and forth, a few fingers plunking up and down on some strings and the rocking to and fro of a few bodies. Behavioural observation made a poor show of it on this occasion. But what I experienced, and what my fellow concert-goers experienced, was rich in Beethoven and Bartok. As a scientist I had little urge to record the *behaviour* of the group but I only I could have wired up those contexes to a computerized display, I would certainly have loved to examine in detail the patterns of brain rhythms produced by the quartet.

A second example concerns an experiment performed in my laboratory (Pribram *et al.*, 1967). Monkeys were trained to depress the right or the left side of a split translucent panel on which cues were displayed. A reward was given if the monkey pushed the right side of the panel when a circle was displayed; or if the monkey pushed the left side of the panel when some vertical stripes (of a given area) were illuminated. The monkey pulled a lever to turn on the display which lasted for only 10 microseconds during any trial. Thus, transient potentials were evoked by the display in the occipital lobes of the monkeys. These transients were recorded as were those produced by the panel push and level pull.

The results of the experiment were analyzed by computer and showed a difference between the potentials evoked by the circle and those evoked by the vertical stripes. Another difference in the recording was reliably correlated with the commission of a correct or erroneous response. Finally, and important to this argument, was the finding of a reliable difference in the record which occurred prior to panel press which indicated whether the monkey was about to press the right or the left side of the panel. This last difference occurred independent of whether a circle or stripe had been displayed and irrespective of whether right or left turned out to be correct. Truly, it indicated the "intentions" of the monkeys. In other studies in other laboratories, unit recordings have shown such anticipatory discharges; and more cogent here, such differences in "intention" waves have been recorded in man without any subsequent peripheral movement being actually initiated.

This is but a crude beginning. Yet the power of computer technology has barely touched the neurobehavioural and neurophysiological effort. Much can be done with what is already available at reasonable cost – and more can be expected. There is good reason to believe that by such direct tapping of the brain record a whole host of "non-behaviours" will be opened to investigation.

Let me summarize the argument thus far. I know of mental processes through introspection and validate these introspections by communicating with others about them. As a scientist I perform experiments using behavioural and physiological techniques which are arbitrarily separated on the basis of whether they tell me what is going on outside or inside the skin. With respect to mental processes such as vision, learning, loving, planning (intending) and thinking, these techniques allow me to make observations and experiments which I feel have a bearing on the issue.

I harvest the fruits of behaviourism as added evidence for environmental embodiments of mind; current neurological studies convince me once again that mind would not be but for brain. According to this analysis both brain and book manifest mind. This does not solve the apparent dual nature of the problem before us, yet it takes us a step forward. If the manifestations of mind can be as palpably different as book and brain, then it cannot be the format that is common to all. Nor, of course, is it content; brain waves and print will never be thought identical. That which does characterize the commonality is a property of its function, of the process in which it is enmeshed. This property is ordinarily called organization, or more recently, structure. It is a set of to-some-extent intertranslatable patterns – a language. A Brahms concerto may be embodied in the brain of the conductor as a set of the states of his readiness to respond; in a folio of printed notation placed before him on the podium; in the changing depths and widths of the grooves imbedded in a plastic platter; in the alignment of magnetic particles on a tape; or in the sequence of compressions of air produced by a loudspeaker controlled by a high fidelity system. A computer program may be realized in the switching operations of hardware, in the software of a typed sheet, or the symbol sequence recorded on tape. Crucial is the fact that the spatial and temporal structure of the events occurring in one realization allow considerable, though not necessarily complete, translations to be made into the structure of events occurring in other realizations. The concerto, the program *per se*, corresponds in some sense to mind; the realizations of the concerto and program to the embodiments of mind.

The first consequence of a neurobehavioural analysis of the mind-body paradox, therefore, is a conclusion which highlights both the dual nature (in the Platonic sense) and the identity of mind and its embodiments. Identity, as we have seen, lies in the translatability among embodiments – among the languages in which mind is realized, if you will. Structure is one condition of translatability but not the only one. Common referents is another. Much needs to be done to clarify this issue, whether it be to reach philosophical understanding as here, or for the practical purpose of making machine translation and computerized secretarial service possible.

The problem associated with the dual nature of mind and its embodiments also give ground to some extent when analyzed in terms of the nature of the language in which the mental concept is realized. The fact is that the descriptions of mental processes we ordinarily use in everyday language are in themselves embodiments, realizations of mind. The question resolves itself therefore into clarifying the difference between the mental and the physical-biological languages of mind. I have on an earlier occasion (Pribram, 1965) given the following analysis:

Mental terms are primarily derived from propositional verbal reports of introspection; these verbal reports must be analyzed in the linguistic social context within which the speaker and listener communicate, and interpreted in conjunction with nonpropositional aspects such as the kinesics of the verbal report and other instrumental behaviours supplied by the reporter. But validity is a level loving thing; when levels can become meshed we are apt to consider a report valid. So, to the extent that neural (or other organ system) data extend validity into the biological realm of discourse, mental terms become respectable even to the tough minded physicalist. Ask any physical or biological scientist to discuss vision and he won't bat an eyelid, though this term is no less mental than is its generic concept, perception; and if we recognize perception, what about emotion, cognition, or volition? The difference is, of course, the degree to which meshing of levels of discourse has taken place. In the case of vision, the physical descriptions of the energies that activate the eye, the minute structure of the eye, the afferent paths into and through the central nervous system, and the central control over the optic mechanism are all thoroughly in hand, as are some of the relations between these structures. Furthermore, these descriptions go into the structure of the perceptual events in detail; knowledge at different levels is available about color, pattern, brightness, and visual field. Finally, level by level reference terms are daily encountered, not only in the ophthalmological and neurological clinics, but also in the daily experience of everyone who does bat his eyelids to demonstrate the relation between "I see" and "eye".

Structure, hierarchically arranged by reference terms among levels: This is what the biologist usually refers to as process or mechanism When mechanism is so conceived, it does not violate logic and experience as does the usual extreme mechanistic, reductionist position. The Beethoven symphony to which I am at the moment

listening is not in one sense reducible to the mechanics of the score, nor of the recording, receiver, amplifier, and speaker system which is emitting it; nor is it completely described by the contortions set up in my auditory apparatus by the described wave patterns impinging on my ears. All these and more are components – but something more than this constitutes the symphony. This something more is not mystical. Musicians call it structure,....Or to put it another way, can the search for constants or invariants in the exact natural sciences be properly extended to include the problems faced by the social disciplines? As a *neuro*psychologist my answer is a resounding yes. I would not deny Eve her root biological entity, her identity and unity. Yet the many faces shown by the social Eve are nonetheless real for their evanescence. Physics has gracefully accepted the principles of complementarity and of indeterminancy: one way of looking at the natural world complements, not necessarily supplements, another; what at one level of analysis appears structurally stable and ordered may, at another level, reveal a goodly amount of chaos – and structure is often shown to emerge from the very probabilities that describe the amount of this chaos.

Are matters so utterly different in the biological-social science enterprise which comes to a focus in neuropsychology? If the answer were a simple "no" it should have been given easily by now. Wherein lies the difficulty? I believe that the complication lies in the fact that the behavioural, biological-social scientist interested in the mind-body problem finds his universe to be a mirror image of the universe constructed by the physical scientist who deals with the same problem. And it should not come as a surprise when each of these isomers, the one produced by the physicist and the one produced by the behavioural scientist, on occasion displays properties that differ considerably from one another, much as do optical isomers in organic chemistry.

I believe these images are mirrors because of differences in the direction generally pursued from each investigator's effective starting point, his own observation. The physical scientist, for the most part, constructs his universe by ever more refined analysis of systems of input variables, that is, sensory stimuli to which he reacts. The form of the reaction (cathode-ray tube, solid-state device, chromatography, or galvanometer) is unimportant, except that it provides a sufficiently broad communicative base. Constancies are gradually retrieved from manipulations and observations of these input variables under a variety of conditions. As these constants achieve stability, the "correctness" of the views that produced them is asserted: the physical universe is properly described.

In the social disciplines the direction pursued is often just the reverse. Analysis is made of *action* systems (Parsons & Bales, 1953). The exact nature of the input to the actor (including the observing scientist) is of little consequence, provided it has sufficient communicative base; the effect of action on the system is the subject of analysis. It matters little (perhaps because the cause is usually multiple and/or indeterminable) if a currency is deflated because of fear of inflation, depression, personal whim, or misguided economic theory. The effects of deflation can be studied, are knowable. And once known, the action ***becomes*** corrective; the resulting stabilization, constancy, is interpreted as evidence for the "correctness" of the action that produced the correction. Appropriate norms for the social universe become established.

One striking difference between the two images thus formed is immediately apparent. The physicist's macroscopic universe is the more stable predictable one: "It does not hurt the moon to look at it" (Eddington, 1958, p. 227). For the most part, it is as he moves to ever more microscopic worlds that uncertainties are asserted. The scientist concerned with social matters finds it just the other way round: it seemingly does little harm to the man to look at him; but seriously look at his family, his friendships, or his political-economic systems and what you had started out to look at changes with the looking. Here indeterminancy comes to plague the macrostructure, it is in the stabilities of microanalysis that the mirage of safety appears.

The philosopher of science and the neuropsychologist, interested as they must be in the mind-brain problem, stand by necessity squarely between these two mirror images. If they deny the evidence that there are two images by showing interest in only one, or by denying the "reality" of the other, they are in dangerous waters and liable to shipwreck in the strong currents of mentalism, physicalism, and dualism. Their searches for the one "real" world and its mirror image may well be interminable, since an alternative possibility is equally likely to be a correct one.

The problem can be grasped, however, if it is dealt with in terms of isomeric forms of the same event universe – isomers differing in that their ***structures*** mirror each other. Put another way, the problem resolves itself into a meshing of the descriptive and the normative sciences. The suggestion is that structure in descriptive science ordinarily emerges from the analysis of the relations between systems and their subsystems, that in the normative sciences, it is largely the other way round: structure emerges when the relation between a system and its "supersystem" is studied.

If this view is correct, we should find normative statements about the nature of the physical world when these are constructed from the examination of relations between a set of systems and a higher order system. Is not relativity just this sort of statement? This is not a social scientist speaking about the "criterion problem":

"The modest observer ..... [is] faced with the task of choosing between a number of frames of space with nothing to guide his choice. They are different in the sense that they frame the material objects of the world, including the observer himself, differently; but they are indistinguishable in the sense that the world as framed in one space conducts itself according to precisely the same laws as the world framed in another space. Owing to the accident of having been born on a particular planet our observer has hitherto unthinkingly adopted one of the frames; but he realises that this is no ground for obstinately asserting that it must be the right frame. Which is the right frame?

At this juncture Einstein comes forward with a suggestion– 'You are seeking a frame of space which you call the ***right*** frame. In what does its ***rightness*** consist?'

You are standing with a label in your hand before a row of packages all precisely similar. You are worried because there is nothing to help you to decide which of the packages it should be attached to. Look at the label and see what is written on it. Nothing.

"Right" as applied to frames of space is a blank label. It implies that there is something distinguishing a right frame from a wrong frame; but when we ask what is this distinguishing property, the only answer we receive is "Rightness," which does not make the meaning clearer or convince us that there is a meaning." (Eddington 1958, p. 20).

Obversely, we should find ***descriptive*** statements about the nature of the social world when these derive from a study of the relations between a system and its subsystems. Doesn't the following passage fit this requirement:

"Role behaviour depends first of all on the role positions that society establishes; that is, certain ways of behaving toward others are defined by different positions." (Hilgard, 1962, p. 482)

Aren't statements about roles unambiguously descriptive?

Thus the neurobehavioural scientist is left to discourse in two isomerically related language systems about a structural identity which comprises the universe. Let me summarize in concluding how he got into this fix :

1. There are many embodiments of mind, not just one. Brain and Book are representative of two classes if we arbitrarily divide organism from its environment.

2. Commonality among embodiments leads to the concept of mind. This commonality depends on inter-translatability

among the temporal and spatial organizations, the languages, in which the mental concept is realized. A good deal remains to be done to clarify what makes for translatability.

Structure, however, is involved in some way and an identity of the structure of event processes eases ready translation.

This does not dispose of the problems posed by the dualistic view. Considerable insight is achieved, however, when it is understood that mental terms are in themselves realizations of mind in a language primarily derived from introspection and validated by social concensus

Thus the language ordinarily used to describe mind is social while the language used to describe embodiments is physical-biological.

The universes described by these languages stand in a hierarchical relationship to each other. Thus the introspector stands between these universes which are, of course, only different aspects of the same universe.

And so these aspects face one another much as mirror images or optical isomers, identical in structure but different in properties when realized.

Is the mind-body paradox as illuminated by behaviourism and by the new surge of brain biology which, in this twentieth century characterize psychology.

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