

PSYCHOLOGY FROM A BIOLOGIST'S POINT OF VIEW

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THE BASIC PROBLEM

A student of the philosophy of science might be tempted to say there are as many biologies as there are biologists, if account is taken only of the men whose exceptional insight and productiveness have guided the growth of the science. The same may be true of psychology, and perhaps we can do no better than accept Cattell's characteristic definition—"Psychology is what the psychologist is interested in *qua* psychologist." There are, however, some general principles about which biologists and psychologists are in substantial agreement. One of these principles is that no factual findings have scientific significance until they are fitted into the appropriate niche in the integrated system of knowledge.

The neurologist finds this orientation especially difficult because almost all experiences and activities of men and other animals involve nervous functions and his field has no boundaries. The human brain is the most important thing in the world, for, as Gibbs (1) expresses it, "Human history is a history of the brain activity of the human race" (p. 1505). This relationship ties neurology closely with psychology and also with psychiatry, sociology, and every other human interest. But when the neurologist tries to find out just where his findings tie in with psychology he is puzzled. There are so many psychologies that one wonders what it is all about.

The interested spectator who sits on the fence watching the game sees two opposing teams and, on the side lines, a goodly number of other psychologists who do not join either faction. In one

team the partisans of traditional dualism contend for a sharp separation of the conscious, or "spiritual," activities from the unconscious, or "physical," thus splitting the world as we experience it into two universes, one of which has been characterized as "spiritual reality" or "ideational reality" and the other as "physical reality." Opposed to these radical spiritists are the mechanists, who insist that, since the search in both science and philosophy is for unifying principles, and since it has not been possible to explain how a non-physical agency can act upon a physical structure so as to influence human conduct, we must search for physicalistic principles of sufficiently wide import to embrace all the known phenomena.

The more radical members of the second group, apparently accepting the traditional doctrine that anything "spiritual" is *ipso facto* nonphysical, take the easy way out and deny that conscious experience of any kind has scientific or operational significance. This despite the fact that the very denial is a conscious act. This exclusion of everything mentalistic from psychology is obviously a defense reaction against the primitive animistic mythologies which still survive in every human culture. But even though mind is called an epiphenomenon, it is nonetheless a phenomenon, a natural event, and a place in the system of nature must be found for every natural event.

The spiritists' quest for a psychology released from the limitations imposed by the laws of the physical world, and the objective psychologists' insistence that only observable physical processes

are significant for psychology, seem to be irreconcilable. The controversy points again to the fact that the basic problem of psychology is, as it always has been, the exact nature of the relationship between our knowledge of the objective world and the subjective experience of knowing and all other conscious acts.

My purpose here is to examine, from the standpoint of mechanistic biology, some of the diverse fields of inquiry which must be integrated before this basic problem can be formulated in accordance with physical, physiological, and psychological principles now generally accepted. The divisive tendencies of current scientific movements are retarding progress.

The key factor in the current controversy about the nonphysical nature of the human spirit really hinges on a definition: Just what do we mean by physical structure and what are its properties? We must define the physical before we can talk rationally about the nonphysical. A brief summary of a few principles of current physical science is prerequisite to further consideration of the meaning of the word "physical" in biological and psychological contexts.

PHYSICAL SCIENCE OF TODAY

The history of ideas about the nature of the physical world records three revolutionary periods. The Greek period, typified by Aristotle and Euclid, dominated formal thinking for two thousand years and is still influential. Beginning in the middle ages a second revolutionary period culminated with the Newtonian system of mechanics. The third period began with the twentieth century, as exemplified in relativity and quantum mechanics. It is still in its infancy and its findings are more revolutionary than any of the preceding.

The fundamental conceptions of physics are in flux. New methods have revealed new facts which require new principles, and some principles formerly regarded as axiomatic are now suspect. The absolutes of earlier times are now treated relativistically, with radical reorganization of the science of mechanics.

To put it briefly, natural science today regards our cosmos as a stupendous mechanism (physicalism) composed of innumerable subsidiary mechanisms, all bound together in accordance with lawfully ordered principles. We do not adequately understand any thing or any event until we know the mechanism that produces it and the principles in accordance with which it operates. A mechanism is defined by D'Arcy Thompson (7) as ". . . whatsoever checks or controls, and guides into determinate paths, the workings of energy" (p. 291). Accepting this definition, the science of mechanics deals with energy and the "whatsoever" that controls its workings.

The mechanism makes some specific kind of product and the nature of the product is the crucial issue in its organization. This product may be material arranged in a different way or place, or energy in a different pattern of manifestation. Or it may be matter transformed into energy or energy into matter, for these are known to be interconvertible in quantitatively measurable relations (Einstein's conversion equation, $E = Mc^2$). In view of this last point the distinction between matter and energy becomes rather fuzzy, and any manifestation of an energy change is a physical event.

The belief now current among physicists is that the various kinds of atoms are relatively stable and different patterns of energy. There are no different kinds of energy. The so-called thermal, electrical, and other energies are differ-

ent patterns of manifestation of one common measurable quantity which in our ignorance we call energy. Nature as a whole is process. There is nothing static about it anywhere.

In a natural mechanism the materials and energies used may come from a wide field and the product made is in turn delivered to the surroundings. It follows that the active structure, the machine itself, must be so defined as to include the entire field with which it has transactional relations. The mistaken popular notion that a machine is a passive inert structure operated by an outside agent is derived from the artificial machine with a human operator. It is true that a lathe in a machine shop has no value as mechanism without the operator who starts it, stops it, and controls its action. This means that, from the operational standpoint, the operator must be regarded as an integral part of the mechanism. In natural mechanisms it is more evident that the operator is inside the apparatus. The apparatus itself is the operator; that is to say, the machine operates itself. No natural mechanism needs a djinn or any external operator to run it or tell it what to do. This, we believe, is as true of a man as of a solar system or a volcano.

Classical physics as formulated in Newtonian mechanics deals with inert solid particles of matter which differ in mass and are pushed about by forces acting upon them. These forces are considered to be manifestations of energy, and the movements are measurable in arbitrary units of space and time. Twentieth century science, on the contrary, finds that matter and energy are different manifestations of the same unknown something and that in some domains of physics space and time in the objective world must be treated relativistically with reference to each other. In subatomic physics they

cannot be measured in arbitrary units, with the observer as a fixed point of reference.

A physical mechanism is defined dynamically. It may make some particular product, repetitively, because it is so organized as to do this by virtue of this organization. But if the organization changes its pattern so as to deliver a different kind of product, a factor is introduced which may properly be called creative. Even a repetitive performance like that of some particular chemical reaction exhibits the property of transforming a pattern of material or energy into a different pattern, and this capacity is the source from which creativity, as here defined, is derived. Creation does not imply that something is made out of nothing. The scientific problem is to discover the laws in accordance with which these changes take place. Since the operating forces are manifestations of energy, it is evident that energy as such has creative efficiency. In other words, its activities are not stereotyped in rigidly predetermined patterns. These patterns are constantly changing by conversion as they interact with one another, and this capacity for change is responsible for cosmic and organic evolution and for the orderly processes of growth of living individuals. This perhaps is what Whitehead had in mind when he said, "creativity is ultimate"; that is to say, it is something which science cannot explain or analyze further.

This intrinsic creativity of physical processes is not a metaphysical speculation. It is an observed fact, and if it were not so our cosmos would now be in a state of homogeneous equilibrium at the lowest level of organization. In view of these dynamic and creative properties of the physical universe, and of our incomplete knowledge of the laws in accordance with which the successive changes take place, we can set

no limits to the kinds of products that natural mechanisms (physicalisms) can make. If now we wish to push further into the domain of psychophysics, account must be taken of this change in the climate of science which has come within the memory of men now living.

The modern mechanist is not a materialist in the classical sense. We grant that he deals only with physical structures and their operations. The operating body is always a mobile structure, which may be relatively stable as we see it in a mountain or a cat, or it may be a specific pattern of energy manifestation in which no particulate matter is recognizable, as in a ray of light. Usually it is a combination of both, as in a volcano or a thinking man. In current science by "mechanistic" we mean physicalistic, and these words now have meanings which are quite different from those of fifty years ago, although the latter are still current in both common speech and scientific literature.

Subsequent references to relativity and quantum mechanics do not carry the implication that the psychobiologist thinks that these principles, as now formulated in mathematical physics, are adequate to give a satisfactory explanation of the mind-body relationship. The most that can be claimed for them in this connection is that they may be steps toward the discovery of the still unknown principles that satisfy the requirements of the problem.

THE NATURAL HISTORY OF THE SPIRIT

My understanding of current scientific thought about some of the properties of the natural world has just been outlined. It is physicalistic throughout. Let us see now where the opposing psychologies mentioned at the beginning of this essay stand in the light of this evidence.

Many years ago I said (2) that introspection is as manifestly a biological method as is reflexology, and this principle needs re-emphasis today. Conscious experience influences conduct. It is therefore a factor of behavior. We may go further and say with Edwin G. Boring that a conscious experience is itself a behavior, a bodily act which may be observed introspectively just as we observe other kinds of behavior. Introspection, like the other methods of observation, is, of course, subject to the hazard of erroneous interpretation. And again it is timely to insist that the dualistic theories merely pile mystery upon mystery and only confuse the issues without explaining anything.

Because man is an animal and because his "spiritual" capacities are demonstrably vital processes, psychology is necessarily articulated with biology; but it does not follow from this that the laws of conscious experience are identical with those of the things of which we have experience. It is, in fact, clear that they are not. Each level of organization has its own distinctive properties, some of which cannot be reduced to those of lower levels (3).

The mind-body problem will never be solved by ignoring the troublesome factors, either those of spirit or of matter. The inquiry cannot be limited to either the conscious or the unconscious factors, because what we are looking for is the relation between the two. It does no good to try to evade the issue as a "pseudoproblem." Traditional materialism (the "crude" variety) and classical spiritism (or, more reputably, "idealism") both involve neglect of a vast wealth of human experience, including common sense and refined scientific knowledge. We cannot choose between materialism and spiritualism. We must have both.

The attempts so far made to find a

suitable formula of psychophysics have led into blind alleys. The chief difficulty arises from the fact that we have no common measure for objectively known dimensions and the relations observed in the process of knowing them. If ever a suitable formula for this relationship is discovered, it will probably be stated in some kind of relativistic terms, and it may dispense with numerical units altogether. Mathematics and symbolic logic are now developing methods of dealing with situations devoid of any quantitative factors, and this may point the way toward hitherto unexplored fields of inquiry in psychobiology.

The human brain controls many of the internal bodily activities and by far the larger part of overt behavior. Its structure is inconceivably complicated and much of the detail is still obscure. There is on record, however, a vast amount of knowledge about nervous structure and the laws of its operation. The products delivered by this mechanism are of many kinds, including growth of the structure itself, a variety of chemical reactions and associated changes in electrical potential, and the excitation of mass movements of the body. These have been thoroughly studied and described in physiological terms.

There is another unique property of some of these operations that cannot be studied by the objective methods of anatomy and physiology, because it is strictly private and can be recognized only subjectively by the person who is operating. Fortunately, we have a mechanism by which this personal awareness can be made public. Ideas can be translated into symbols—words and others—the utterance of which evokes similar symbols in other people. By this indirection subjective experience can be objectified and so communicated. This enables us to develop

a legitimate science of introspective psychology. We do not know the mechanics of this process of symbolizing or the physical laws of its operation, but we have an interesting analogy in the electronic computing machines which perform similar operations with a quite different mechanism. Doubtless there are some common principles in these two kinds of operations.

There are no conscious factors, so far as we know, in most physiological operations; but we know as surely as we know anything in science that all mental acts are vital functions and we know where the organs are that perform them. We know also that the distinctively human types of higher mental functions are added to pre-existing physiological functions in the course of personal and evolutionary development.

Although we do not yet know how awareness emerges within the metabolism of brain tissue, we know that it does so and that it is as truly a physical process as is the transmission of light through apparently empty space. We do not know all about the mechanics of light either, but long ago Helios was banished from science because he could not explain anything. When a weight is lifted by muscular action the cause of the movement is not a disembodied contractility. It is contracting muscle. When a problem in mental arithmetic is solved the operating agent is not a nonphysical mind which activates an inert structural mechanism. It is a living brain engaged in thinking. There is no specific kind of mental energy. Mental work is bodily work, and it is the body that gets tired when we do it. Mind does not move matter. It is "minding" matter that does "mental" work just as it is contracting muscle that does "physical" work. A thought is not a product made by a mechanism, the way bile is

made by the liver. It is the operation of the mechanism, an act, not a material or any other kind of an object. *To split the function from the organ that performs it is scientifically as absurd as is the separation of the properties of any other thing from the object that manifests them.*

The claim of the parapsychologists that psi phenomena in general involve "extrasensory perception," presumably through nonphysical agencies, calls for a critical appraisal of current studies of the mechanics of perception. This inquiry brings out very clearly the fundamental difference between the relations of space and time factors in the acquisition of perceptual knowledge of the objective world and these relations in the higher rational use of this knowledge.

Every perception of a physical object or event and every consciously controlled movement of the body involves a transactional relation of some sort between the "spiritual" and the "physical." In all these activities the conscious and the unconscious factors are inextricably interwoven. The first can be observed only introspectively, the other again introspectively but only by an indirection, by the observer becoming aware of some objective (unconscious) physical events. The act of perception involves the conversion of "physical" processes into "mental" processes, and conversely a voluntary act requires the conversion of a conscious purpose into movement of the physical body. The nub of the mind-body problem lies in the nature of these conversions.

The significant factors of such conversions can be isolated by experimental analysis more readily in the study of perception than of any other psychological processes. We have biological evidence that the internal integrative and regulatory functions of an ani-

mal body must be sharply distinguished from the analytic functions of sensorimotor type which are concerned with the adjustment of the body to external things and events. The physical principles of integration are fundamentally different from those of the analytic functions, and some of the former can be described only in relativistic terms.

The most complicated integrative apparatus known is in the human brain, and the act of knowing is an integrative process which gives us two kinds of knowledge which Sellars (6) has called "perceptual knowledge" and "conceptual knowledge." The former gives us all the information we have about the spatial, temporal, and energetic properties of the objective world. Newtonian mechanics was developed on the basis of this knowledge. This mechanics is of necessity framed in behavioral space and time. Conceptual knowledge comprises those higher rational and emotive functions which cannot be quantified in the numerical units of space, time, mass, and energy of Newtonian mechanics.

This distinction is fundamental. It is explained, in part at least, by the nature of the act of perception and of the apparatus employed. Its neglect accounts for the failure of the earlier attempts to find acceptable laws of psychophysics. This theme cannot be elaborated here. Enough has been done to show that this lead points to a promising field worthy of further investigation.

PARAPSYCHOLOGY

The intimate relationship between objective things and events and our knowledge of them is so commonplace that it is generally uncritically accepted. But the manifestations of hypnotism, telepathy, and the other so-called psi phenomena are so unusual, and in some instances so bizarre, that there is in-

sistent demand that they be either explained or explained away as spurious. The latter has been tried repeatedly without convincing proof.

These phenomena have been under investigation by competent scientists for more than seventy-five years. The workers in this field of "parapsychology" who are now most active are advocates of dualistic theories which have been given wide publicity, but the majority of other scientists question the significance of their findings. This skepticism is due in part to the fact that this field of inquiry was so long contaminated with fraud and delusion that the prejudice against it is still strong. The prejudice has not been mitigated by the fantastic claims made in some of the recent literature. Nevertheless, these are real phenomena which merit critical study by every available method.

It should be recognized and emphasized that the mysteries associated with psi phenomena are of the same order, and no different in principle, as those presented by every mental and intentionally controlled act whatsoever. If parapsychology is to win acceptance as legitimate natural science, it must be fitted into the same general frame of reference as the other branches of psychology and of natural science as a whole. "Parapsychology" is a misnomer, for psi phenomena are either psychological or they are not. If not, what are they?

In psi phenomena the unconscious factors clearly play the critical role. These can be studied only by the methods of objective science and these methods have so far proved inadequate. The same is true for many other unsolved scientific problems. So when Dr. Rhine writes (5, p. 300), "We know by this time that we cannot use a physical theory to explain psi," we freely grant that no satisfactory physical theory has

yet been found; but that is far from proof that it cannot be found. In another passage (4, p. 62) he has insisted that the physics of tomorrow is irrelevant here; we must think in terms of present knowledge. But this is exactly what he does not do. What he does do is to base his argument on nineteenth century physics. As for the physics of tomorrow, which Rhine says is a pointless speculation, we should remember, as Walker (8) points out, that our most valuable instruments of scientific progress are the working hypotheses which look forward by extrapolation from present knowledge in all promising directions. Without these prescient excursions into the unknown, growth would be arrested and science would die of senile sclerosis.

We are surprised also to read that the claim that human mentation as a vital function is "a metaphysical assumption" or "mere conjecture," and that psychologists have the vague notion that mind and body "are somehow fundamentally unified on some complex but wholly unknown physical basis," and that "this half-formulated materialism is taken for granted; it has not been subjected to experiment" (5, p. 197). The fact is that it would be possible to cite literally thousands of experiments devoted explicitly to this problem—experiments made by the most competent neurologists, physiologists, and psychologists we have. These experiments are of many kinds, using a wide variety of methods.

The most instructive of these experiments are based on the fact that all nervous action is accompanied by changes in electrical potential that can be localized and accurately measured. Using the same technique, a particular kind of mental work can be shown to be accompanied by similar changes in potential which are localized in specific regions of the body. The "brain waves"

recorded by the oscillograph of thousands of conscious persons have been studied under a great variety of conditions, and the effects of various kinds of mental experience are clearly seen in this permanent record of the related changes in electrical potential. This is only one among many other methods which have been used to prove that we think with our bodies, and with different parts of the body for different kinds of thinking.

THE SPIRITUAL LIFE

It is possible to mention here only a few samples of the evidence which justifies the conviction that man's spiritual life, in the ordinary vernacular meaning of that term, is a real and significant component of his natural life. For the biologist this means that all mental acts of whatever kind are as truly vital processes as are nervous conduction and muscular movement. This gives us a unitary system of scientifically acceptable principles for everything within the range of human experience.

A man has native capacities for spiritual culture which set him at the highest level of integrative and creative efficiency yet reached in cosmic evolution so far as we know. This physicalistic conception of human nature, which has

been accused of degrading the dignity of man and destroying his spiritual values, really points the way to the most efficient measures for enhancing these most precious human treasures. By setting the spiritual life in vital operational relationship with all other domains of science and of human endeavor, we get the benefit of all the resources of the sciences to reinforce and guide into appropriate channels the efforts of the other agencies of spiritual culture—education, philosophy, art, religion, and all the rest. This is a magnificent achievement.

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(Received October 14, 1954)