

SCIENCE, CREATIVITY, AND PSI

HENRY MARGENAU

My discussion is divided into two very unequal parts. The longer one has to do with the epistemological aspects of our problems. It deals essentially with the methodology of science and the manner in which it tolerates the incursion of creativity and psi. And finally, I shall make an attempt at an ontology of psi, trying to outline what, in my view, psi does amount to or what, in fact, it is, not just how it works.

I see creativity as implying three ingredients. First of all, novelty. Second, unexpectedness or surprise, and third—significance. The significance can be of a variety of types which stamp the act as poetic or musical or scientific or moral. And secondly, I regard psi as the inexplicable, or at least unexplained élan within the creative act. Or to phrase it perhaps in another way, the clairvoyant drive that propels us when there are no rational principles of control. Now these are succinct definitions of creativity and psi.

The meaning of science is different to different people and a different artifact in different philosophies. Two ancient views are still dominant in today's scientific scene. One is the view held by the empiricists, the people who regard science as an inductive enterprise. Now the point I'm about to make is that so long as you hold this view of science, you will have no room for creativity or psi. This view essentially takes science to be a conglomerate of certified or certifiable facts, so-called data yielded by nature. These data are then put into a sort of pattern, juxtaposed and readjusted until something that appears patterned or "rational" results. The job of the scientist is merely to arrange these pieces, these facts, these data, by repeated trials into different arrangements until a recognizable pattern results. Nature presents all of the components that go into this process. It's man's business to fool around, if you please, until a bit of rational knowledge appears within the potpourri of patterns, i.e., arrangements of the facts.

The simile frequently used to characterize this view of science, this

philosophy of science, is that of a picture puzzle. The scientist gets from God or nature an avalanche of facts which don't make sense in the sequence in which they're offered. He has to put them side by side until a pattern results. When that pattern is complete, the scientific job is done. Of course, there are various shortcomings to this view of science, the major one being its implication that the scientific process can be completed. As a matter of fact, the scientist never completes his job. Whenever he solves a problem, two or three or ten others rear their beautiful heads behind it, beckoning to be solved. So the picture puzzle is not a good simile of the procedures of modern science. Clearly, this version of science has no gaps in which the psi factor can reside. It does not even leave much room for creativity except in the simple and uninteresting sense in which different arrangements might possibly create a pattern, and then might amount to creativity.

Next, there's an even older view, the rationalist's view of science, which takes science to be essentially a matter of reasoning on the basis of a priori principles which are themselves sufficient to convey an ultimate understanding of everything that happens in the world. This view places its major emphasis upon rational cohesion within the pattern that results. According to it, the principles are already there; they merely need to be recognized, pulled down from the Platonic heaven and placed within an orderly system in man's mind. Now this view is by no means dead. There seems to be a revival of it among some modern mathematicians and a cogent argument can be presented for it in terms of a very impressive single example that I will present.

Some six years ago, two mathematicians calculated the number π , the ratio of the circumference to the diameter of the circle, to one hundred thousand decimal places. This was done by computers and was a most remarkable achievement by computers. It has an interesting philosophical meaning. If π merely meant the factual ratio of the circumference to the diameter of a circle, it could never be specified, never be written down with an accuracy greater than six or at most eight significant figures because this is the accuracy with which physicists and other scientists can perform length measurements. Anything beyond six or eight figures is utter nonsense from an empiricist's point of view. What then is the meaning of π to one hundred thousand places? It has a very definite meaning which can be verified yet it is not given by the facts of the world. Well, the one plausible answer, of course, is this: π is somehow inscribed in the ideal sky; it is already there, given in our experience, our potential experience when we're born, residing as an ideal nucleus within our minds. Now that's the rationalist's view. It does not permit creativity, nor does it permit psi because it merely

amounts to the fashioning of the rational pattern, a pattern of ideas out of the overwhelming plenitude of ideas with which our mind presents us.

Now both of these views are, I think, erroneous. There is another view of science which offers an argument like this: It admits in the first place that science accomplishes a distinctive analysis and an organization of human experience. It does not start with any ontological commitments. Experience, at least according to traditional philosophy, falls into two categories; that which we call cognitive which ultimately leads to knowledge and understanding, and that which is non-cognitive, which is of course primarily the precinct of the artist, the religious person, the moral person. I'm going to be dealing only with the cognitive realm.

Cognitive experience can be described, defined vaguely in many, many ways. Let me merely tell you what it is in terms of an example making use of the contrast between English words. An entity may be called a house, a term which is accented by cognitive meaning. It may also be called a home, but home means something a little different and so, insofar as the word home has overtones of meaning beyond those of the word house, it is not cognitive.

Cognitive experience has been divided by traditional philosophy into two types: one is called sensations, the other one ideas or concepts. Now I'm sure Dr. Walter would quarrel with me if I maintained this simple contrast because we know that sensations are not sensations independent of a person's brain in the simplest sense of the word. They contain autogenic factors, so that we can never be sure of their being accurate versions of what is out there in the world. Nevertheless, this kind of immediate experience that assails us from without or sometimes from within (even the introspective awarenesses, the introspective facts which contemplation yields belong here) all these are immediate, extraneous to our mind and certainly not wholly created by it. Scientists do not always recognize the introspective insights and external sensations and they all fall into this same category.

I like to call them protocol experiences for the very simple reason that they serve as protocols, as last instances of verification, in the scientific process. The "protokollon" of a Greek book was the first sheet on which the author jotted down the items, the disparate unconnected items, with which the book was to deal. The book then attempted to unify, organize these discrepant unconnected items. Now I see this immediate sensory direct kind of experience as the "protokol-lon" of the scientist, the sort of thing of which the scientific process is to make sense, which it has to make cohesive and build into an edifice

of understanding. So we call that primary experience, or protocol experience. Now this primary experience contains a kind of fluidity—a kind of novelty emergence, if you please, which is almost creative in my specified sense. I'm speaking here of the ever emerging and perishing particulars of sense, and the main thing that one can say about them is that there is within them no rhyme or reason, nothing which reason can take hold of and fashion into a structure of understanding. In order to make a scientific explanation of these immediate primary facts, one has to translate them into concepts, that is to say, constructs.

Constructs are sometimes called theoretical terms by philosophers of science, and these theoretical terms arrange themselves into logical and rational relations which we regard as composing a scientific theory or theories. Let me focus briefly then upon these concepts. I like to call them constructs because they are actually created by the human mind, and, in their creativeness, psi frequently plays a role, because there are no guiding principles which lead to them. These constructs are set over against certain sensory impressions by definite rules which have generally been omitted by philosophers.

As a scientist, you start with these uncoordinated data, which alone would never suffice to allow you to build an ordered picture of the world. These immediate facts, these protokolla, are impermanent; they're subjective, they're different from person to person; they are non-numerical; they fluctuate; and somehow you have to introduce something into your experience that does not have these unsatisfactory characteristics. Therefore you allow certain experiences to correspond to constructs using what I have elsewhere called "rules of correspondence." * And, of course, one of these that scientists use profusely is Bridgman's Operational Definition. In physics we have operational definitions of mass, energy, and all the rest, and these operational definitions take us from a certain complex in the *P* field to a certain theory in the construct or *C* field. Now these "rules of correspondence" play a larger role than was suggested by Bridgman's operational definitions. They form a link between *P* and *C* fields. This link is not given by nature and, in forging it, the scientist is called upon to use a great deal of what we ordinarily call ingenuity, which however is tantamount to creativity—a choice among many possibles, offering an indefinite range of ambiguities and indeed here one is often helped by a kind of psi that occurs in blessed moments.

Now, the constructs themselves, the terms within a theory, are governed by very general rules; principles of selection, principles of validation. There is a principle of simplicity, which we can make very

* See "The Nature of Physical Reality," McGraw Hill, 1950.

precise in modern mathematics and theoretical physics. There's the principle of logical fertility—things must mean something, differences must make a difference—there are many ways of framing it. There is the principle of extensibility, requiring that the constructs of a theory shall be extensible to a large domain of the *P* plane. There is the principle of causality, which has a selective effect upon constructs. And, finally, there are such things as esthetic principles, notably elegance of formulation and invariance, again in a mathematical sense.

Through the principle of elegance which dominates the choice of constructs in the scientific field, the scientific method makes contact with the arts. This, incidentally, has now come to mean invariance, a term that I inject here for those of you who are conversant with modern mathematics and theoretical physics.

Now, you see, there are various places in this looser context of the scientific endeavor that harbor creativity in psi. First, of course, is in the choice of correspondence in these operational definitions. One of the great achievements of Einstein was to see that such concepts as time, space, distance, mass were not given by the old operational definitions, but rather required new ones, and by changing the operational definitions he was able to present a more elegant and more universal, a more invariant theory—invariant with respect to a larger domain of transformations than was classical physics which had been used since Newton.

Today there is much speculation about tachyons, particles that may travel faster than light. These tachyons are presumably particles with a mass which can surely not be given an operational definition because it is imaginary in the mathematical sense, i.e., the mass is proportional to $\sqrt{-1}$. Now in order to make this whole thing fit, somebody has got to find a way of getting a good operational definition of this imaginary mass. We haven't got it yet. There, creativity and perhaps psi will come into play and some fortunate individual may actually see how this can be done consistently, and then somebody else perhaps will discover these particles some three years later or maybe ten years later. That's the way it goes.

On the other hand, there is room for creativity and psi within the domain of constructs. The principles of validation are loose. They do not prescribe what has to be conjectured, and a fortunate conjecture may actually stamp a given hypothesis into a valid theory. These are the two main places where creativity and psi are activated in science.

If I had time, I would now talk a little about the kind of creativity, the kind of emergence that's called into being by the shift of the scientist's interest from dynamical causality to a statistical causality. In

contradistinction to Einstein, God seems to play dice in the world and this actually gives room to the physicist, to the scientist, and to man in general, to activate choices. The problem of freedom involves the element of creativity in a major way. This is the place where man, himself, in making a decision intervenes in the cosmic process.

Let me now turn to the ontology of psi. Here, of course, I'm on very shaky ground. I now no longer speak as a scientist, but as a rank philosopher, in fact, as one of the victims of that disease called ontology which I ordinarily do not espouse.

What is psi? I don't think you can get away with the customary definition according to which psi is a psychic force. No scientist will countenance that sort of a proposition. One reason is that the word "force" has a very indefinite meaning. It ranges all the way from mass times acceleration (which is the definition of a physicist) to a feeling in my muscles when I press against the table, to an armed body of men called a police force. You've got all these definitions. Hence what a psychic force is I simply do not know. I go back, therefore, to the definitions I gave in the beginning.

Now psi seems to contradict our ordinary view of the world, according to which there are events, placed within a four-dimensional manifold, three-dimensional space and time, the fourth dimension. According to this view—this four-dimensional view of space-time—man as an observer, an experiencer moves along the time axis through the manifold viewing three-dimensional space at particular moments of time. It is our human lot to look at the four-dimensional world through a slit-like opening, and as the slit moves along the time axis, we see a three-dimensional spatial projection of all happenings. Now it may be that ontological existence is simply the forever-fixed automatic record, perhaps a conscious record in the mind of some divine agency of this multi-dimensional continuum which has no past and no future, being four-dimensional. To be human ordinarily means to be limited to a temporal three-dimensional section of the all, a section which travels along the time axis. And perhaps psi is the occasional widening of this slit which offers a view of larger aspects of existence, future and past; perhaps this happens in an erratic way, in the way in which one sees the blue sky through haphazard openings among the clouds. Whenever that slit opens, and for some people the slit only opens at the time of death, you see more than a segmented three-dimensional slice of the four-dimensional universe. And that may be psi.

Now I should add, in concluding, that the present theory of relativity which portrays the whole of existence in four dimensions, is indeed suggestive of the picture I have presented, but unfortunately it is also

insufficient. Here I make contact with something which Dr. Chu said yesterday, when he spoke of the need for a greater number of dimensions. The current view excludes consciousness, which has the peculiarity of being capable of standing at variance with actual happenings. So this means that you have an actual four-dimensional universe and many individual consciousnesses not aware of it or aware of something else. This forces you to match all happenings including mental happenings against a manifold that has more dimensions than four. But unfortunately the total absence of an acceptable theory of consciousness seems to block progress at this point.

SERVADIO: Now I will call on Dr. Bleksley to give us his talk on "Creativity in the mathematical field." Dr. Bleksley.