

The Procrustean Bed of Science*

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Occasionally it becomes interesting to watch what happens when men think about problems vaguely felt to be connected but whose connection is not clear at the start of such thinking. Ideas seem to come into mind from various sources and combine loosely in various ways—none too logically or systematically. Perhaps no clear conclusions or definite hypotheses are reached. A sort of "mental game" is played with ideas—certain aesthetic juxtapositions of thoughts may occur in this so-called "stream of consciousness."

This sort of thinking may well go on before a scientific hypothesis comes into articulate form in the mind of a scientist. In the following article on "The Procrustean Bed of Science," I have allowed myself to play this game of ideas concerning problems vaguely and long felt to be connected in some important way**—and am hoping that this way will turn out in the end to be logical and systematic. However, my present major concern is with the *process* of such thinking and not with the end *per se*. The reader should *not* look for a systematic analysis here, but should watch and perhaps enjoy the process itself—and try to participate empathically in that process.

"Can Science Save Us?" asks George A. Lundberg. "Yes," he answers, "if we spend for research in *social science* what we have recently been spending (in billions of dollars) for the advancement of the physical sciences."

A colleague of mine remarked on Lundberg's proposal: "People prefer to invest financially in *physical* scientific research because such investigation does not threaten to question their morals and social values (even though the results of such research, under their present morals, may threaten their civilization!) But social scientific research is felt as a potential threat against their customs and traditions."

In other words: Who can set limits or bounds to man?—man himself! Ralph Waldo Emerson declared: "Man is the dwarf of himself."

What do we *want*—what are our *purposes*? Within the limits of our conscious or subconscious goals, we set bounds to science itself. Aristotle's "final cause" (conceived as human purpose) operates in subtle ways to set up "boundary conditions" within which various sciences can (or cannot) carry on "objective" investigations.

"Boundary conditions"—what are they? In physics they are quite important but often neglected in popular discussions. For example, in order to predict how a cord of a certain length will vibrate when plucked, we must know, among other things, the tensions on the cord *assumed fixed at both ends*. If, however, we apply impulses at one (*free*) end, the vibration on the cord will move quite differently than if both ends are fixed, and the impulse applied, say, at the middle of the cord. The boundary (and/or the initial) conditions* of the cord (and impulse) are necessary information in order

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** It should be stated that this material was set obtained by what the psychologists call pure "free association", since I have mulled over these problems for some years.

* Including the mass per unit length (linear density) of the cord.

to predict the cord's vibrational behavior under impulses. In this example we can control the boundary conditions. This is not always so in physics: the initial and boundary conditions of planetary motion are "given" (via observations) and at present beyond our control.

In biology and psychology the question of our control of boundary conditions raises certain embarrassing and puzzling questions, but even in physics some problems arise: it seems that our purposes of inquiry and manipulation of physical bodies may determine the initial and boundary conditions we impose upon those bodies. In engineering, for example, we may wish a sample of steel to stand up under certain limits of stress (for carrying some load), and we then impose as a condition for bending or breaking of any particular sample, this upper limit of stress. It obviously appears that there is human purpose in engineering problems, it makes itself felt in setting up initial, or boundary, or limiting condition for physical experiments. The "objective" inquiries of the engineering physicist are set within the framework of human goals and purposes. To be "objective" includes "having objectives!" But to be "objective" is also to "allow the observed facts to speak for themselves," and to be "objective" is also to "allow the logical consequences of any rational inquiry to lead where they may." The word "objective" has, therefore, several and rather different facets. And science, as a human enterprise, reflects these several facets and tries to integrate them in itself. How successfully?

Old Procrustes used to force his guests to fit his bed by stretching or cutting his guests to size. (The desire to get the "facts" to conform to a given system of ideas is perhaps more ancient than the Procrustean bed.) Have you ever seen a picture of Pavlov's dog—the one whose conditioned salivary reflexes were tested? The dog is carefully boxed in a frame, standing with legs bandaged and tied to the frame, and with the eyes blindfolded. The dog can hear and smell and salivate. The odor of meat and the sound of a bell are given simultaneously as stimuli. The dog salivates. In due time the sound of the bell alone brings on the salivation. Everything is carefully checked—all the variables are "controlled." Just two sensory stimuli and one response are (presumably) involved. Everything else is "held constant." I wonder! What is going on "inside" the dog who is tied and blindfolded? How would you feel under those conditions? Would you salivate—or perhaps just froth at the mouth from frustration? And what about all the other internal variables? Why not tie up his tail (or did they?) and why not plug up all his apertures, fore and aft? How "controlled" can an experiment get? Talk about Procrustean beds!

Of course Pavlov was also trying to keep the dog from moving around during the experiments—but is a dog tied up and blindfolded the same as a dog moving freely and unsuppressed? What do we want to study: a boxed up, blinded dog, or a dog on the loose? We set up the boundary conditions in terms of our purposes. But are we always aware of what those boundary conditions may be doing to an intricate delicate organism? Yet what else can we do and still be "scientific" in our methods? But what do we learn about "dogs" under such "controlled" conditions? We learn about a "controlled" dog. Shall we now generalize what we have learned to dogs (and men) in daily life situations? We can try it—but the generalization (as usual) is doubtful, and in this case perhaps especially so!

Yes, we set up boundary conditions in terms of our purposes. What are the purposes of Pavlov and his followers? In general, to find out why and how animals and men behave the way they do (in their normal milieu?). In particular, however, Pavlov has some guiding hypothesis: "Conditioning of isolated responses (R) by isolated stimuli (S) is how animals learn." In terms of that hypothesis, the boundary conditions of the experiment are purposely set up. The blind-dog-in-box is "isolated" from other stimuli and "controlled" and examined in regard to a particular "isolated" response

(salivation). Some things may be noticed in the way of S-R correlations, under these laboratory conditions. *What would happen if no such correlations were found?* I suspect that the Pavlovians would inject the dog's spinal cord with anaesthetic—thereby eliminating (or rather "suppressing"?) some more suspected "variables." And if that didn't give results, they might remove the head from the body and sustain the head's life by blood perfusion pumps. And if that didn't work, they might try cutting certain nerves and even go in for cerebral lobotomies and lobectomies. By this time they have a "dog" cut down to a mass of nerve fibers with nasal and auditory sense organs and a salivary gland. And if they cut off all other nerve fibers save those synaptically "hooked up" from those sense organs to the gland, positive results are almost guaranteed (if what is left of our dog is still alive—and if you still want to call that "life!") Procrustes could really learn from these Pavlovians!

"Cheshire-Puss," said Alice. "Would you tell me, please, which way I ought to go from here?" "That depends a good deal on where you want to get to," said the Cat. The Pavlovians certainly know where they want to go and they seem to know how to get there. But some other psychologists have become rather disinterested in the whole trip. I wonder why.

It is easy to get annoyed with the Pavlovian reflexologists, but it is not easy to propose alternative experimental methods or theories (though the Gestalt psychologists have made some good stabs at it); and sometimes the reflexologists are very careful to recognize beforehand what it is they are and are not doing, or trying to do. Thus Householder and Landahl, (1:1), who concern themselves specifically with the supposed S-R events in the organism, declare at the very outset of their work:

"Doubtless there are often and perhaps always countless other accompanying events within the organism and interacting to a greater or lesser degree with those events here mentioned, but no scientific theory can account for everything, and still less for everything at once. We wish, therefore, to define our schematic reacting organism as one consisting solely of receptors (sense-organs), effectors (muscles), and a connecting set of neurons, the whole and parts being affected by the physical or physiological environment only insofar as this acts as a stimulus *via* the receptors. We wish to consider to what extent behavior can be accounted for in terms of such a model. In undertaking such an inquiry, we freely and expressly acknowledge that much is left out, and we emphatically refuse to make any claim in advance as to the range of the behavior that can be so accounted for. This is an empirical question to be experimentally decided. But a hypothesis cannot even be refuted until it is clearly formulated." They further point out that even their "neuron" is schematized and does not exhibit the functional complexities of the living neuron.

Surely all that is an honest statement. Instead of cutting down a living dog to a collection of fixed neuron paths with some receptors and effectors at the ends of those paths, and then identifying the living dog with such a collection, these scientists merely propose a simplified schematic, mathematical model with certain defined properties, and then see what logical conclusions can be deduced therefrom that may correspond more or less closely with a certain limited kind of animal behavior. No claim is made that this abstract model (even if verified in its particular area of animal behavior) is *The True Explanation* of even that area of animal behavior. Other models and other hypotheses may do as well, or better.⁴

As another case in point, we may consider the following quotation from James J. Gibson, (2:214): "Is learned behavior mediated by the perception or is perception only an incidental accompaniment of learned behavior . . . do we adjust to the world because we see it or is our seeing of the world the result of our adjusting to it? Is learning a matter of insight or does insight

⁴ A discussion of various theories of brain function will be found in R. W. Sperry (3:381).

follow upon learning? The issue is not merely a verbal dispute, for differing opinions yield quite different experiments. Neither is it trivial, for it involves a choice of the direction in which a science shall move."

Hence, the basic type of experimental set-up is *chosen* in accordance with the theoretical and philosophical preconceptions of the experimenter. As Bertrand Russell once half jokingly point out: In the United States, the experimental situation for learning gives us the picture of, say, a hungry white rat chasing around in a "blind maze" with great pep, vim and vigour, eventually solving its practical problem by chance hits and misses, trials and errors (*a la* Hume); while in Germany, we have, say, a hungry chimpanzee quietly inspecting or surveying the total open situation in perception, and by innate contemplation suddenly achieving at once an insightful solution (*a la* Kant).

We have here once more the Procrustean beds made by scientists (i. e., psychologists). The answers to many questions are given *via* the choice of basic methods or techniques of the experiments—which choice is itself apparently guided by theoretical presuppositions that strongly force the experimental data to fit those basic presuppositions. As already mentioned, the experimental results are "objective" within the operational contexts *subjectively* chosen in accordance with some theoretical ideas or purposes. To achieve wisdom at this point, is to recognize consciously and honestly what we (*qua* scientists) are actually doing!

Man's need for intellectual security in a complex world expresses itself most often in a persistent attempt to enclose that world within certain categories of thought. Something to hold on to. If only we can foresee or control observed events, we feel more secure. And happy is the man who is secure. However, there are various forms of this security. Self-reliance and honest recognition of our limitations, in an observed world that is accepted as always having some hazardous features, is a state of mind which can give sufficient security and happiness to *some* men. For most of us, however, security is obtained through reliance upon some "order" believed to be quite external to, and independent of ourselves. Some system of fixed categories of explanation is proclaimed able to describe that which *exists* in the "real world." The history of philosophy, science, and theology is replete with such proclamations providing intellectual security for those who held to such beliefs. I will not gainsay the right of a man to believe in such doctrines, but I submit as an alternative proposal for philosophy of science the notion that all categories of scientific explanation are *formulated* as tentative hypotheses by men, and have some empirical and uncertain verifications or confirmations which do not *prove* (in any absolutely final manner) those hypotheses. The desire for finalism and absolutism cannot, I believe, be satisfied by scientific concepts. Nevertheless, there are those philosophers and scientists who feel to the contrary, and hope and believe that someday, somehow, the "True Laws of Nature" will, at long last, be "discovered." Their conviction may well force them to persist in their quest for such "Absolutes" and may even drive them to uphold a particular hypothesis as one such "absolute." Once more the Procrustean bed makes its appearance: *ad hoc* assumptions are devised to *save* the "true theory" from any empirical inadequacies. The theory is chopped down or stretched out to fit upon the bed of experiments. I am always amused in such cases, that the scientist who does this sort of thing is apparently not aware of the fact that *he* is doing the chopping or stretching, while persisting in his belief that he is still "discovering" the "True Laws of Nature." Such faith is a wonderful thing! For without it, I suspect, much of our science would not have come into being. This seems to be a *pragmatic* justification for such faith: it "gets things done" in science. Nevertheless, there appears to be a growing body of scientists who "get things done" without motivation by that particular ontological view. Men like Dirac and Heisenberg seem to do creative scientific work under the conviction that they are merely formulating working hypotheses able to

predict logically what is given in experimental observations. The hypothesis is not of a picturable "objective reality," but an intellectual tool to deal more or less adequately with the mutually describable world of more or less reliable observations.

In a certain art museum in New York City there is a very provocative statue by (I believe) Rodin. It is provocative of puzzlement—and this, because it seems to portray something manifestly absurd: a man's figure from the waist up is seen busily engaged in using a mallet and chisel to carve the lower portions of his own body from a solid block of unformed stone. Man is portrayed as self-creative. How did this man get started? From whence the hammer and chisel and the initially necessary upper portions of the man? There is here a richness of sculptured symbolism that defies adequate verbal expression. Man can do nothing significant without intellect and the tools of intellect, but granted those abilities, man can begin to carve out and control the rest of his nature and modify the world around him. This is Procrustes in a new light: the "bed" of stone is shaped into a man by that living intelligence which helps distinguish man from all other creatures. It is easy to invoke an *external* deity in interpreting the work of Rodin, but I think it is even more intriguing to "deify" man himself as the creator and modifier of his own essential being. Given man as intelligence, the rest may follow. For some, the intelligence of man is supernaturally God-given, for others it comes through natural evolution of species. However, when some of my theological friends have heard me interpreting Rodin's statue as "man's creative and self-directive intelligence" and negatively shake their heads, rhetorically asking: "But Who first put the mallet and chisel and upper portions of man there?"—my non-derogatory but rather facetious answer is: "Rodin did that!" It is *man's* conception of man that seems all important. Who can set boundaries to man? Man himself!

REFERENCES

1. Householder and Landahl, *Mathematical Biophysics of the Central Nervous System*.
2. James J. Gibson, *The Perception of the Visual World*, 1950.
3. R. W. Sperry, *American Scientist*, 40, April, 1952.