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Physical Thinking and Social Problems

Gregory Bateson

Institute for Intercultural Studies, New York City

THE PURPOSE OF THIS COMMUNICATION is to call the attention of physicists and other natural scientists to the fact that their scientific help is needed in basic research, which must precede the solution of many domestic and world-wide human problems. It is possible that a small number of carefully selected men with experience in the modern handling of natural science problems might, after intensive training in psychological and anthropological methods, make outstanding contributions in the field of social science.

In the last hundred years physics and chemistry have progressed rapidly while social adjustment has lagged behind. We social scientists simply do not yet have sufficient knowledge to cope with the social problems created by the wholesale application of the other sciences. We are shorthanded and overworked. There is a mass of basic research to be done, and yet we are pressed by real emergency to apply the little that we already know. We have not enough basic knowledge of the mechanics of individual aspiration and large-scale political interrelationships to plan the steps which must be taken to adjust human societies to the availability of atomic weapons.

Anthropology and the other sciences which deal with human behavior are just beginning to feel their way toward those concepts which will be nuclear to social science—concepts around which the developing science will crystallize as physics did around the concepts of mass, length, time, energy, etc. We are today in a Baconian or pre-Copernican stage, and yet our progress in the next few years might be very rapid. We have an enormous mass of collected descriptive material and poorly organized hypotheses, and this mass is certainly ready to assume new and more rewarding shapes the moment a few formative ideas are introduced into the system.

In spite of the dangers inherent in analogic thinking, it appears that many of these formative ideas are going to be akin to the sorts of idea which underlie much of modern physics. Man differs much from the entities of physical theory. He metabolizes, he reproduces himself, and, above all, he learns. And yet a strong case can be made for saying that even such protean entities as man and his communities could be profitably studied by scientists trained to elucidate the workings of multiple interdependent variables. Atoms, astronomical bodies, electric circuits, servomechanisms, and computing machines are the only structured entities for which most of the formal epistemological problems have been worked out, and it is therefore reasonable to challenge the experts in these fields to try their skill upon the most complex entities known to exist in our universe.

It is, of course, impossible to guarantee them success in these more complex fields—no scientist can ever be sure that he will solve his problem—but there are indications that the sort of thinking cultivated by modern physicists and mathematicians will be applicable. This statement may be illustrated by enumerating some of the problems which are basic to all social science and some of the limitations which the physicist has in common with the social observer:

(1) The physicist must include the observer and his instrument within the sphere of relevance of the observation. He knows that whatever characteristic (e.g. a velocity) he is measuring, the result can be regarded as "relatively objective" only after all relevant characteristics of the observer (his own position and velocity) have been systematically included. The field anthropologist similarly has learned to be aware of his own relevant characteristics (types of sensitivity, assertiveness, cultural conditioning, etc.) while he observes the corresponding characteristics of another people. He knows that his own character will systematically modify his perceptions and his interpretations and that his behavior may modify that of the people he is observing. (The case of the biologist is somewhat different. While he is studying the liver of a frog, it is not, in general, his own liver which will distort his observations. He is not subject to the systematic circumstance that his observation of any variable will always be a function of his own related characteristics.)

(2) The social scientist often has to deal with systems of reciprocal causation. In their incipient stages such systems may give simple autocatalytic curves, e.g. when the rate of propagation of a given political tenet is proportional to the number of converts. But such systems rapidly become more complicated. The unconverted may become aware of the heretics in their midst and may behave in such a way as to reduce the activity of the converts—or they may actually stimulate that activity. In any case, we have here a type of system which is familiar to the physicist. He can guess at the significance of any systematic change or oscillation in the resulting equilibrium, and he knows what questions should be asked about the time factors inherent in the process.[1]

(3) The social scientist must deal with the problem of "purpose." In the past, our analyses have too often have been phrased in either crudely causal or else crudely teleological terms. Too often we have postulated some sort of Maxwell's Demon (e.g. the "ego"), who should control the switchboard of the central nervous system, and then we have attempted to analyze this creature's character. Within the last few years it is mainly from the electronic physicists and mathematicians that we have obtained clues which will probably resolve the dilemma between crude causalism and teleology. It now appears that all self-correcting behavior and possibly all types of learning must be based on circular or "feed-back" systems such that effects of behavior at a given moment are fed back to modify the causal system which will shape behavior at a later moment (A. Rosenblueth, N. Wiener, and J. Bigelow, *Phil. Sci.*, 1943, **10**, 18). The whole of our teleological phrasings must now be revised, and new and more searching questions must be asked of all apparently adaptive behavior. Many of these questions will be of kinds which occur most easily to minds trained in modern physics.

(4) Recorded human behavior is significant only when the record includes the context. For example, stamping the foot can only be rated as "assertive" in a certain type of context. But we still lack any satisfactory system for classifying such contexts. A beginning has been made in this field by application of topological analysis (Kurt Lewin) to the temporal and spatial relations of preceding and expected events. It has further been argued that acquiring greater facility in learning in a particular type of context, *i.e.*, learning to learn, may be equated with learning to "expect" this type of context. This would imply that learning to learn (deuterolearning) is equivalent to the process of character formation. Further advances in the field of character formation and the classification of contexts could be expected from mathematicians and designers of computing machines, who handle problems of this order.

This series of examples could be multiplied almost indefinitely by referring to such matters as: conditioned reflexes, goal gradients, rote learning, interpretation of psychological tests, interpersonal relations, systems of value and conflicting incentives, systems of libidinal symbolism, and problems of social manipulation. In all of these fields the first steps have been taken toward logicomathematical analysis.

Enough has been said to indicate that the social sciences have plenty of work for physicists and other natural scientists to do. In conclusion, it is worth stressing that "the elimination of war as a means of settling international differences" is a project requiring basic and applied research ranging from learning experiments on rats, through comparative studies of simple communities, up to analysis of the most complex phenomena of contact between contrasting cultures.

[1] For analysis of systems of this kind, see G. Bateson's *Naven* (Cambridge Univ. Press, 1936, Chap. XIII) and L. F. Richardson's "Generalized foreign politics" (*Brit. J. psychol. Monogr.*, 1939). It is worth calling special attention to this paper in which a physicist has made important contributions to the social sciences.

Scanning Science—

At a recent meeting of the Board of Regents of the University of Michigan reductions were made in some of the salaries, and several instructors were dismissed. A resolution was adopted that where any department has two or more full professors, only the senior by date of appointment shall at any time receive a salary of more than $2,500. Law and medical professors, if they practice their respective professions, are to receive $2,000, and if they do not, $2,500. The psychological laboratory has been discontinued for one year.

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