Self-Awareness and Scientific Method[1]

George F. F. Lombard

Graduate School of Business Administration, Harvard University, Boston, Massachusetts

THE RECENT SUCCESSES of the natural sciences have arisen from the use of controlled experiments. In teaching and research they receive primary attention. This is entirely appropriate to the needs and opportunities of those sciences: the whole history of controlled experiments in them has been that they are fruitful of new knowledge. Their history in the social sciences, with few exceptions, is that they have not. Since one man's meat is frequently another's poison, the techniques of the controlled experiment are not what I wish students of human behavior would learn from the natural sciences. My reasons for this reside in two familiar but neglected skills without which science has nowhere progressed.

I

Experiments may fail for many reasons: only those based on relevant observation of nature have any chance of fruitful results. Since before Galileo's "fantastically artificial" neglect of friction in his experiments with motion, the experiments of natural scientists have, on the whole, been relevant to the nature of things; the results of the polls taken before the 1948 elections are evidence that many in the social sciences have not.

Claude Bernard said, "The experimental idea is by no means arbitrary or purely imaginative; it must always have support in observed reality; that is to say, in nature."[2] This concept of experiment is quite different from one current in the social sciences today, namely, that the limit of experiment is the ingenuity of the experimenter. But how are scientists to know what is relevant to nature? The difficulties here are great, especially so because research itself may distort the natural happening of events. How can that be studied which study itself distorts?

Natural scientists have long been aware of the problem posed by the relationship of the researcher to his data. To be sure, in some of the natural sciences the presence of a researcher does not greatly affect the phenomena being studied. In others the phenomena must be shielded from, for example, the heat or electricity of an investigator's body. In biology and physiology the problems are quite different and often complex, even in simple experiments. Here also, thanks to the work of such investigators as Bernard, Cannon, and others, many of the obstacles have been overcome.

In the social sciences, the sensitiveness of the phenomena being studied to the presence of an investigator is especially great. This sensitiveness of human life to interaction with other human beings is familiar to all of us, and not only in research. It is demonstrated in every relationship. To clarify the point, let me take extreme examples.

Restrictive controls, short of the extinction of life itself, produce in those controlled diverse reactions, in all of which may be recognized attempts of the self to maintain its integrity. This seems to be true of parental, educational, administrative, military, and governmental controls. For example, this aspect of human behavior continually plagues the administrator who seeks to initiate change. In research, too, what we seek to control again and again resists the investigator and in often subtle ways upsets his plans. So, for many years, experiments in industry with rest pauses for workers were inconclusive: sometimes production increased following their introduction; sometimes it did not. Investigators cussed "human nature" until the researchers at Hawthorne began to understand the nature of their relationship to the workers in the test room.[3]

Impressive though reactions to violation of integrity are in human life, the positive effects of a relationship

[1] Expanded from remarks made at a discussion entitled "What the Social Scientist Would Like His Students to Know About the Natural Sciences," at the Harvard Summer School Conference on "The Place of Science in General Education," July, 1949. For the ideas behind these remarks, I am indebted to F. J. Roethlisberger for clarifying for me the importance of observation in scientific method, and to C. I. Barnard for crystallizing the concept of self-awareness.

[2] Claude Bernard. *An Introduction to the Study of Experimental Medicine.* New York: Henry Schuman, 1927, p. 38.

[3] F. J. Roethlisberger and W. J. Dickson. *Management and the Worker.* Cambridge: Harvard University Press, 1939, Chap. VIII.

with others can be even more startling. The capacities of human beings to respond to warmth and appreciation with adaptation and growth are tremendous, although these powers are often latent. An article by Vincent Sheean entitled "On Love," in the July, 1949, *Atlantic Monthly,* gives an instance in point. Philosophy, religion, medicine, several of the social sciences, practical men of affairs, and military leaders have all documented this phenomenon. Whether human beings welcome or resist a relationship, their active response to one is apparent. My point is that in the social sciences, as in all science, an investigator's skills in handling his relationship to his data are of great importance.

II

But, granted an investigator needs skills in relating himself to his data, he must still make relevant observations. Although some physical scientists have had truly exceptional capacity in this direction, they have seldom made explicit the processes by which they achieved their results. Often, I suspect, they are not aware that there have been processes. Often they don't have to be conscious of them: their work has progressed far enough so that frequently they can take for granted the observations of nature on which an experiment is based. "At some time and in some way not recorded,"[4] is a fairly typical description of the origin of an observation that led to fruitful experiment.

Not all records of observation are this incomplete. President Conant refers to Galileo and a pump that "was once called to his attention" (p. 33), and to Galvani, the frog's legs, and two people who are identified only as "one of the persons who were present" and "another one who was there." The fact that such careful observers as Galileo and Galvani failed to record the particulars of the situation in which their first observations occurred is indicative of the point I wish to make. Who was the person "who was present" who noticed the movement of the frog's legs? Who was "another one" who noticed that a spark seemed to excite the action? What was the background of their thinking that made them mention these observations to Galvani as possibly significant? Particularly, what in Galvani's thinking led him to seize at once on their remarks with "incredible zeal and eagerness," even though he "at the time had something else in mind and was deep in thought"?[5]

[4] James B. Conant. *On Understanding Science.* New Haven: Yale University Press, 1947, p. 37.

[5] James B. Conant. *Op. cit.,* p. 67. Cannon, without quoting sources, gives a slightly different account of these incidents, in which the same failure to record precisely the original observations is apparent. (Walter B. Cannon. *The Way of an Investigator.* New York: Norton, 1945, p. 69.)

Would that all of us when deep in thought could thus turn our minds into fruitful channels.

More detailed instances of how relevant observations have occurred can readily be found in Mach, Poincaré, Bernard, and others who have documented the progress of science. Cannon's *The Way of an Investigator* supplies us with valuable material. We also know something of the observations that led to the development of penicillin and radar. In all this material three phrases are used over and over again: "an accidental observation," "a hunch," and "chance." These words make me curious. Just what do they mean?

Two possibilities occur at once. The words hardly seem adequate as descriptive of a *process of thought.* On the other hand, they may reflect an *attitude of mind* that glories in the obviously brilliant results of the controlled experiment, to the neglect of the skilled observation. It is as if this attitude were saying, "What could be less worthy of attention than an accident, a hunch, or chance?" The choice of these words signifies how little the process is thought to deserve attention—and how little it receives. "It happened once; it was accidental; it will not happen again." "We made the most we could of it; why pay more attention to it?" A hunch: "A small thing; random; inexplicable. Now, when we can control the variables . . ."

Webster lists fourteen meanings for the word "chance." The fourteenth is: "The fortuitous . . . element in . . . existence; that which happens . . . in connection with events to which it bears no necessary relation." The first meaning is, simply, "The happening of events; the way in which things befall." I call to your attention the contrast of connotations in the fortuitous, the unrelated, and the inexplicable, on the one hand, and the happening of events, nature, on the other. Priestley redefines chance as "the observation of *events arising from unknown causes.*"[6] "Chance," with causes unknown, is surely distinct from chance without cause.

Please note, my claim is not that fortune plays no role in observation. Indeed it does; but when we have said that, have we said all there is to say? To me it seems not, though what else there is, is both difficult and complex to describe.

Certainly a skill of observation is something much more than what is involved when I say, "I see you." You are visible reality—at least, I find it fruitful for many purposes to assume that you are. What I mean by the process of observation is much more complex. To observe things in this other sense involves a way of thinking about things, as well as the data that are

[6] James B. Conant. *The Growth of the Experimental Sciences.* Cambridge: Harvard University Press, 1949, p. 53.

observed. Two psychologists, Snygg and Combs, have recently stated the dual nature of the process as follows:

> The progress of science . . . is in two directions. The first is toward the discovery of new facts. This unceasing search is continually turning up new facts inexplicable in the old frames of reference. In turn, the scientist is forced to develop new frames of reference. Once a more adequate frame of reference has been achieved, its effectiveness is soon demonstrated by the discovery of a great number of new facts and relations.[7]

A skill of observation is, then, a capacity to *discriminate between reality as it actually is and reality as any one of us sees it,* determined as it is for us by the frames of reference, the conceptual schemes, which we habitually use. Some psychologists speak of this difference as the difference between "reality" and "perceived reality." To learn to step outside the conceptual schemes one habitually uses in search of new and more fruitful ones is no mean accomplishment. Science and philosophy have long pondered the problem.

III

President Conant's book *On Understanding Science* is helpful in giving us examples of the difficulties in the way of this learning process. Swammerdam, who experimented with frogs' legs but failed to push the work as Galvani did; Rey, whose work on calcination of tin should have exposed the phlogiston theory of combustion; the need of a new concept to "fit the times" if it is to be useful; and the "power of an old concept" to prevail against contradictory evidence are all to the point. President Conant says, "The history of science . . . fails to demonstrate any uniform way in which new experimental facts and observations generate the fruitful notions in the minds of great investigators" (p. 17).

Bernard has this to say: "Apropos of a given observation, no rules can be given for bringing to birth in the brain a correct and fruitful idea that may be a sort of intuitive anticipation of successful research" (p. 33).

These difficulties sound ominous for my purpose, but they give us a clue, for our question need not be the rules for getting from a *given* observation to an experimental idea. Our question can be, rather, "Are there any conditions of the mind which seem to assist the making of new observations?"

Bernard discusses at some length "a few general principles for the guidance of minds applying themselves to research (in experimental medicine)." Cannon, among others, speaks of "hard labor" (p. 67) and "the prepared mind" (p. 79). Both Conant and Cannon quote Pasteur, "Chance favors the prepared mind." Henderson's statement of the "conditions [necessary] for understanding" is well known: "first, intimate, habitual, intuitive familiarity with things; secondly, systematic knowledge of things; and thirdly, an effective way of thinking about things."[8] His more precise description of "systematic knowledge" is by no means as familiar: *"Accurate observation of things and events,* selection, guided by judgment born of familiarity and experience, of the salient and recurrent phenomena, and their classification and methodical exploitation" [italics mine].[9]

Henderson's remarks describe usefully—at least, as he was wont to say, "to a first approximation"—the *outward* organization of training necessary to prepare a mind for fruitful observation. Since it is in the mind that an idea is generated, the process of creating one has an *inner* aspect as well. These outward conditions will not be productive unless they stimulate the growth of this inner capacity. A key to the ability to observe the difference between reality and reality as our existing conceptual schemes permit us to perceive it is awareness of our own frames of reference. If we know what they are, we are in a position to distinguish between them and reality. We can "see" that the world is round, not flat; that weights and feathers fall uniformly; that not all unions are "bad," and all managements "good," or vice versa.

In many of us, awareness of this sort remains low; in others it develops into an overriding—sometimes neurotic—conviction of sin that leads to crises of indecision and inaction. In still others, it achieves a balance that permits effective discrimination between reality and what we see as reality.

At this point I am faced with a difficult choice. The strict logic of my topic requires that I should describe as precisely as possible just what is the balance in the processes of the mind that leads to effective awareness. To do so would take me far into several theories of psychology, from which we would emerge convinced that the "gaps" in what is now known are more important than the "blocks" of what is known. Consequently, I propose to leap this hurdle by calling attention to two aspects of it: first, that the gap is there, and, second, that I am neglecting it.

Let me say only that a new idea worthy of attention seems always to spring from reflection. Consequently, balanced awareness involves an effective alternation between reflective thinking and concentrated attention. This fact is important in linking the general conditions of training of which I have been speaking with this

[7] Donald Snygg and A. W. Combs. *Individual Behavior.* New York: Harper, 1949, p. 5.

[8] L. J. Henderson. *Sociology 23, Introductory Lectures,* Harvard University. Rev. October, 1938, p. 6. Mimeographed.

[9] L. J. Henderson. "The Study of Man." *Science,* 1941, **94**, 1.

inner process of mind; for it follows that training must supply adequate material—that is, experience—for reflection, as well as an opportunity for the two kinds of thinking to develop in effective alternation with each other. The conditions Henderson laid down meet these requirements; but it is precisely at this point that we need to know much more about what learning is, and what the conditions are that favor it.

Let me repeat, the difficulty of acquiring an awareness of one's own frames of reference is great. It is especially so in the social sciences, where the investigator's own frames of reference, from which he draws the meaningfulness of his whole life, are called into question. Difficult and even painful as this learning process may be, it is nonetheless inevitable in the accumulation of knowledge; else the researcher fails to separate what he brings to the situation from the data he is studying.

IV

Skills in handling our relationship to the data we seek to study and skills in making relevant observations are related. Both require the inner quality of awareness of self of which I have been speaking. On the one hand, awareness of self increases our capacity for handling ourselves in relation to our data by forcing on us continuous and critical inner appraisal and reappraisal of what we are doing in relation to an external reality. On the other hand, it reinforces our capacity for accurate observation by making us conscious of the difference between that which we see (perceived reality) and reality. This awareness is as necessary in the training of social scientists as it is in general education for citizenship.

In the social sciences we often proceed as though we were unaware of the existence of the need. Our attempts to meet it have until recently been in one of two directions, both relatively sterile compared with progress in other sciences. On the one hand, we study situations far removed from what is familiar to us because we hope that the gross determinants of the behavior occurring in them will persist and be obvious to the investigator in spite of his presence. Studies of primitive tribes and cultures and of other groups at the fringe of our civilization have taken this direction. These studies are eminently worth while in their own right, and much of general value has been learned from them. Yet their methods leave us with a sense of something missing when we focus them on the problems of modern life. Too often, sensing "the shadow but not the substance" of our relationship to our data, we retreat into a pseudo-objectivity that defeats itself. By attempting to make our questionnaires, tests, and laboratory-type experiments completely objective, we arrive at a typical norm so far removed from the uniqueness of the particular instance that the knowledge gained is all but useless in application.

Why I believe the quality of awareness is necessary in the training of a social scientist will, I hope, be clear by now. That quality in him is the seed from which new understandings of the way things happen will grow.

I believe this quality is equally needed today in general education in training for citizenship. When a boy-girl relationship becomes that of husband and wife, a couple cannot assume that communication between them over mutually created problems of children, housekeeping, and career will be eased by the understanding that arises from a common background. Indeed, most of us sooner or later have to realize that no such community of background exists. Under these conditions understanding, if it is to be achieved, must be demonstrated in face-to-face interactions in the present. This means that each of us must be able to recognize and behave in terms of what is important in our relationships here and now. Distinguishing this present reality from the way in which our past experiences have taught us to see it is vital to securing, first, understanding; then, communication and active cooperation.

Difficulties of communication between people exist not only in family relationships. They are a common symptom of our times. In industry they exist at every level of organization, between worker and worker, between foreman and worker, between staff specialist and line executive. They are particularly important and difficult between representatives of different organizations—business and government, business and labor, labor and government, government and government.

Let me take brief examples from foreign affairs; the needs are only less dramatic, hardly less acute, in the domestic economy. An administrator of the Economic Cooperation Administration interested in improving the efficiency of manufacturing in Europe, or a nutrition expert of the United Nations Food and Agricultural Organization seeking to improve the diet of southeast Asia, must each be aware of the threat to existing customs that his methods present. Without this awareness, what he is doing will inevitably seem to be destroying established ways of doing things, rather than creating new freedoms. His relationship and the relationship of our country to those peoples then come to be hated and feared, instead of becoming relationships through which they can seek the help to help themselves.

Administrative skills in instances such as these go a long way toward making good intentions effective, but they are never wholly so without understanding and support in the wider community. Indeed, now

that destruction for one may mean destruction for all, whole nations are called on for an awareness of self in relation to others such as has never before been required. At these levels the problems are of an entirely different order than any I have discussed up to this point. Yet, in peace and in war, citizen awareness of the effects of national policy is imperative. For example, however disastrous bombing may be to lives and property, it may also arouse to action a will to resist. The stubborn "happening of events" will then bring it about that this living resistance will replace both lives and property. If this should happen, bombing becomes a boomerang of a kind no primitive ever wished to possess. Even the *threat* of bombing may arouse such resistance.

And the threat is today a reality in the lives of all of us. Surely general education's responsibility to address the problems of communication between peoples cannot neglect these aspects of understanding: understanding of how what I myself do, of how what we as a nation do, affects and is affected by, the social realities of the divided world in which we live.

Many noted students of the social scene—Toynbee, Fromm, Rogers, Liebman, Whitehead—point to something closely akin to what I have been calling a conscious awareness of self in relation to the external world, as the chief need of civilization today. Our ignorance of what is required at these more complex levels is appalling; yet conditions today make it necessary to face the problems of research and education that are involved.

V

At the simpler levels, useful leads for organizing training in awareness are available, though neglected. One does not need to be a skilled observer to recognize that education does an uneven job in providing would-be researchers and citizens with foundations for the development of these skills.

In both school and college the emphasis is on systems of knowledge, a quite different thing from "systematic knowledge." Our conceptual schemes are more often "theories of explanation"[10] than fruitful ways of helping us to new observations. We leave the acquisition of "intuitive familiarity" to chance, or neglect it entirely, in spite of good examples set us in engineering, and especially in medicine.

[10] L. J. Henderson. *Op. cit.*, pp. 8–10.

Beyond this, experience suggests that training organized under the burden of responsibility in connection with the handling of actual situations provides a favorable climate for self-awareness to mature into active skill. Henderson makes much of this point and refers both to medical training and to what I believe was once known as "Milner's Kindergarten" as a case in point in a quite different field, that of government administration.[11] Yet, everywhere in education, especially in the training of ourselves, the teachers, neglect and chance have captured the "burden of responsibility."

I could mention "self-directive" interviewing as a promising new tool of research for some fields of the social sciences. The recent suggestion of an "internal frame of reference" as an appropriate conceptual scheme for psychology may be most fruitful. Role-playing and several forms of group discussion, such as group therapy and group dynamics, are having some success in developing effective self-awareness. Semantics and psychoanalysis also have important contributions, as may the psychodrama and sociodrama. I would be overly self-aware indeed if I did not mention, too, our rather different use of case method instruction in human relations in General Education at Harvard College and in the Graduate School of Business Administration. We have plans for new, as yet untried, ways of training in social skills under the burden of responsibility.

I have now tried—I am sure, inadequately—to clarify two aspects of scientific method, the importance of which I wish students of human behavior could learn from the natural sciences. I have described them as skills of handling oneself in relation to one's data and as skills of making relevant observations of nature. An inner quality of the mind, which I have called self-awareness, seems to me a key to their acquisition. At this stage of the growth of knowledge in the social sciences, I give techniques of experimentation secondary emphasis. As social scientists learn to handle their relations with their data and to make relevant observations, I am confident that experimentation will reappear in ways that do not distort the happening of events. Our start is to learn to make accurate observations of nature.

[11] See also John Buchan. *Pilgrim's Way.* Boston: Houghton Mifflin, 1940, pp. 100 ff.