great need for the bill's enactment, Senator Smith apparently regards the measure as a political "hot potato" and hopes to avoid political pressure from the small-numbered but extremely militant antivisisectionists by keeping the bill in committee. Senator J. Howard McGrath of Rhode Island, another subcommitee member, who introduced S. 1703, has also been subjected to antivivisectionist political pressure.

Scientists and their friends should write to Senator McGrath supporting S. 1703 and to Senator Smith urging the subcommittee to recommend the bill.

As Dr. Ivy said, "The preposterous and dangerous situation which the antivivisection movement has produced is really the scientist's fault. Our lack of effort in the past has enabled the antivivisectionists to achieve their present restrictions on research and teaching. It would be more than a tragedy if further inertia were to continue and this important legislation suffer a defeat."

BRUCE SHELLY

National Society for Medical Research, Chicago

On the Application of Scientific Procedure to the Social Sciences

In a letter published in *Science* (March 18, 1949) Edgar G. Miller, Jr., says "Science is not any particular method or set of techniques. It is a way of reasoning. The standards are intellectual rather than procedural." These statements are part of an argument showing that it is wrong to criticize the social sciences on the ground that they do not use the "procedural" methods of natural science. The writer says further that "the validity of the scientific method is not confined to any one procedure."

I believe this is a misapprehension. Natural scientists have discovered, rather late in history, that science can progress only if it is made impersonal and objective. Observations of facts in nature have to be independent of the observer—of his language, race, religion, intellectual power, and above all his motives. The "procedure" for ensuring this is simply to require that any fact be observable or demonstrable at all times to anyone, before it is admitted as a part of science. Only since enforcement of this procedure has science truly grown; and, conversely, if it were relaxed science would retrogress to the days of alchemy and astrology. This applies to descriptive sciences like geology as well as to laboratory sciences like chemistry. The facts of descriptive science must be demonstrable. Any hypothesis which may be constructed must be labeled as such; it must be held plausible only as it codifies observations, and useful only as it leads to further observations. Until it is rigorously—procedurally—checked, it may not be used in demonstrations, simply because that would be assuming what is to be proved. It is only thus that science can purge itself of errors—especially errors stemming from the desire to prove something preconceived rather than to ascertain the truth.

It does not follow that the intellectual tools of science—hypothesis before the fact, and logic after it—are unimportant. It is just that they are not sufficient. Logic and hypothesis existed long before science made any serious progress. The theologies and philosophical schools that flourished in the predemonstration days were the work of men whose intellect and imagination were as good as our own. Their hypotheses were brilliant, their logic profound and subtle. Their common defect was simply that they did not check their premises by observation. The consequence was that their systems of thought were generally of low usefulness as descriptions of nature or as bases for scientific advance. The writings of Aristotle furnish plenty of classical examples in illustration. What is proved by thinking depends on the premises, and if the premises are arbitrary or unrelated to nature the conclusions will be the same. Such pursuits as chess playing and theology have intellectual standards as exacting as those of natural science, but they are not science, because they have nothing to do with nature, and may exist purely in the mind. It was not until thinkers applied the criterion—procedure—of checking their teachings one by one against observation, and excluding from science anything that could not be so checked, that the success and prestige of present-day science could begin to grow.

All this does not mean that further effort in the social sciences is useless unless they confine themselves to the observational method. In history, for example, it is impossible to use the critical procedure of physics or chemistry. That does not prove that history is not a useful or rewarding study; a thorough knowledge of history on the part of today's citizens might benefit humanity more than the know-how of rockets and atom bombs. It does prove that history is not a natural science, and that a prediction of future events, or even a recital of past ones, is and remains an opinion judicially based on limited evidence, instead of an objective fact to be built on with confidence. The modern social sciences are in a somewhat different position; many of their teachings are objective and demonstrable. But many others are not, and perhaps never will be; and failure to differentiate between fact and hypothesis can serve only to debase future work in the field. The consensus of scientific thought will be, I think, that social science may best advance by checking as many of its teachings as possible against experiment and observation, and rigidly separating these from the teachings that are as yet unconfirmed by critical procedure and are therefore still hypotheses or assumptions—to be regarded as *useful* instead of *true*, and above all to be treated with the impersonal skepticism of the scientist instead of the interested faith of the prophet.

FREDERICK ROMBERG

Austin, Texas