

Weinberg A M. Criteria for scientific choice. *Minerva* 1:159-71, 1963.  
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I suggest a set of criteria according to which the merit of a proposed scientific enterprise might be judged. The criteria are classified as *internal*, arising from within the relevant science, or *external*, arising from outside the science that is being judged. Internal criteria include competence of the investigators and ripeness of the field for exploitation—i.e., the likelihood that the proposed research will reach its goal. External criteria include relevance to engineering and other applications, relevance to achievement of social goals, and relevance to the basic scientific fields in which the proposed undertaking is embedded. [This paper has been cited in more than 85 publications.]

## Origins of Criteria for Scientific Choice

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"Criteria for scientific choice" was first given in 1961 as an invited lecture, entitled "An Agenda for Science," at a meeting of the honorary society Phi Kappa Phi, at the University of Tennessee. The title "Criteria for scientific choice" was suggested to me by Edward Shils, editor of *Minerva*. At the time, I was a member of the President's Science Advisory Committee, as well as director, Oak Ridge National Laboratory. The paper was my attempt to come to grips with the central problem of scientific administration: the allocation of resources among competing scientific claimants, all of whose proposals are meritorious and are, epistemologically speaking, equally true. Thus, "Criteria" attempts to analyze the meaning of "value" in science. Traditionally, the philosophy of science is mostly concerned with epistemology—how do we decide that a given science is "true." Here I propose an "axiology" of science—how do we decide that a given scientific enterprise is valuable, more valuable than a competing scientific enterprise.

The proposed internal and external criteria are, with one exception, hardly original. The exception is my criterion of "scientific" merit. The scientific merit of a piece of basic science is to be judged by the influence that it has and the illumination it sheds on the neighboring fields of science in which it is embedded. This criterion of embeddedness represents an extension to empirical science of John von Neumann's criteria of merit for a purely mathematical discipline—the bearing it has on the surrounding mathematical discipline.<sup>1</sup> I am grateful to my late colleague, Eugene Guth, for calling my attention to von Neumann's idea.

"Criteria" appeared at the time that budgets for science were being increasingly squeezed. Administrators in government were hungry for advice as to how to allocate the scientific pie, and "Criteria" seemed to offer a rationale, if not a recipe, for making such judgments. A sort of cottage industry devoted to criticizing and improving the criteria has since sprung up among policy analysts.<sup>2,3</sup> Perhaps the main influence of "Criteria" was in the National Science Foundation's (NSF) *Information for Reviewers*: The four NSF criteria derive rather directly from the criteria set forth in the original *Minerva* article.

The organization of the scientific enterprise implicit in "Criteria" is a pyramid in which allocations are made at the top by government administrators.<sup>4</sup> In this sense, science is seen as being organized, more or less, by an intrusive government. This "socialist" view of science contrasts with Polanyi's *Republic of Science*, in which the course of science is determined by myriad independent scientific practitioners. The *Republic of Science* is free market and decentralized. My scientific enterprise is much more socialist and centralized. Actually, I would say that where Polanyi's democratic republic is a good model for Little Science, my socialistic republic applies more to Big Science.<sup>5,6</sup>

1. von Neumann J. The mathematician. (Heywood R B, ed.) *The works of the mind*. Chicago, IL: University of Chicago Press, 1947. p. 196.

2. de Konink W. *Farady en Weinberg, stichting voor fundamenteel onderzoek der materia*. Utrecht, The Netherlands, December 1971.

3. Weinberg A M. Response to Burns and Studer's reflections on Alvin M. Weinberg. *Res. Policy* 5:197-200, 1976.

4. Rottenberg S. The economy of science: the proper role of government in the growth of science. *Minerva* 19:43-71, 1981.

5. Weinberg A M. Values in science: unity as a criterion of scientific choice. *Minerva* 13:1-12, 1984.

6. . . . . Criteria for evaluation, a generation later. *CIBA Foundation Symp.* 142:3-15, 1988.

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