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Data Evaluation: A Critical Activity

Uncritical acceptance of bad scientific information can lead to social penalties, as recently emphasized by Comar.* A particularly pernicious aspect of this problem involves numerical data, which are essential in all branches of science and technology and are often needed to arrive at valid operational decisions. Unfortunately, the scientific literature contains many erroneous values. Few scientists or engineers seem to have given much thought to the magnitude of the problem, and some probably regard every numerical entry in a handbook as revealed truth. Yet anyone who has had to seek a particular number in the literature and searched out a dozen or more reports, only to end up with a set of widely disparate values, comes to realize that a substantial intellectual effort and a considerable background in the field are needed to arrive at reliable figures. A number of specialized data centers have grown up to pursue this task in systematic fashion. The largest single organization devoted to such activities is the Office of Standard Reference Data of the National Bureau of Standards (NBS).

Data evaluation in the United States has recently been assayed, with support from the National Science Foundation, by a special committee of the Numerical Data Advisory Board of the National Academy of Sciences (NAS). The committee's report, ably coordinated by Everett Johnson and Robert Marvin, describes the current level of activity, analyzes costs and benefits, and projects data needs of planned federal R & D programs.†

Costs of search and critical evaluation are small: less than 0.2 percent of that for the original research and about one-quarter of the cost of its initial publication. Benefits are often great and are not easily translated into monetary units. The time saved when a data center can use its files and experience rapidly to prepare special compilations can be extremely important when new regulations or legislation dealing with environment, health, or safety are under consideration. A graphic example is the 1976 report of the NAS Panel on Atmospheric Chemistry concerning the effects of halocarbons on stratospheric ozone. Mathematical models for this study required knowledge of the rates of about 100 known chemical reactions in the stratosphere. The Chemical Kinetics Information Center at NBS provided critically evaluated rate constants in a short time. Without them, according to panel member Frederick Kaufman, "we would have had to gather and evaluate a huge volume of data ourselves, and this large added task would have made it nearly impossible to complete the required reports within the allotted time. Many months' work by several senior investigators and many tens of thousands of dollars would likely have been involved."

Perhaps more important is the fact that the selected values had been thoroughly documented and recognized as the best available. Advocates and opponents of controversial proposals such as those to ban SST's or aerosol sprays, tend to select data supporting their position, so that without an authoritative and generally accepted set of data it can become politically impossible to reach any decision. Other benefits of organized evaluation include elimination of multiple efforts and reduction of waste in industrial plant design. This latter benefit is particularly evident today, when rising costs tend to eliminate traditional development stages in favor of mathematical modeling.

Data evaluation is an unglamorous activity, unlikely to win Nobel prizes for its practitioners. Moreover, the very modesty of its cost tends to obscure its importance. It is thus not surprising to learn in the committee's report that current U.S. activity is about one-third to one-half of that required to keep pace. If this situation is to change, a greater awareness of the need for and importance of data evaluation on the part of the scientific community seems essential.—WALTER H. STOCKMAYER, *Professor of Chemistry, Dartmouth College, Hanover, New Hampshire 03755*

*C. Comar, *Science*, 16 June 1978, page 1225. †Committee on Data Needs, Numerical Data Advisory Board, *National Needs for Critically Evaluated Physical and Chemical Data* (Washington, D.C., 1978).