

# Priorities in Science

Bill R. Appleton

There has been much discussion recently concerning the need and advisability of assigning priorities in science. To the scientist or engineer this is an uncomfortable trend because it requires value judgments across complex disciplines, and the choices often hinge more on social or economic policy than technical considerations.

This process is equally difficult for the policymakers and supporters of science, who are forced to allocate limited funds without sufficient guidance. Nevertheless, many of science's top advisers are acknowledging the need for the science community to participate in making some of the hard choices. Both Frank Press, president of the National Academy of Sciences, and D. Allan Bromley, adviser to the President for science and technology and director of the Office of Science and Technology Policy (OSTP), have called on the science community to respond. In the May issue of *Science*, a letter from Congressman George Brown, chairman of the House Committee on Science, Space and Technology, concludes that "Congress must, in consultation with the Administration and the scientific community, set broad cross-cutting federal R&D goals. Moreover, it must develop criteria for evaluating whether these goals are being achieved in a timely and cost-effective manner."

Some of the issues driving the need to make choices in the allocation of research funding were reviewed in a recent Office of Technology Assessment (OTA) document, *Federally Funded Research: Decisions for a Decade*. \* This report shows that federal funding for basic and applied research rose significantly from 1960 to 1990—and with it the number of scientists and engineers performing this research. The current budget climate has forced Congress to take control measures to reduce the deficit and balance the budget. This has led to the situation where there are too few dollars to support our existing scientific infrastructure and too many worthy projects to fund. And this is why policymakers and funding agencies are pushing us for guidance.

\***Editor's Note:** See related article in the June 1991 *MRS Bulletin*, p. 13.

## MS&E Response to the Call for Self-Assessment

The materials science and engineering (MS&E) community has, in my opinion, responded to this call for self-assessment in an unprecedented manner that few would have predicted possible for such a diverse field. Astronomers recently received considerable attention for their efforts to forge a consensus on major new projects in their report, *A Decade of Discovery in Astronomy and Astrophysics*. However, unlike astronomy, which is a comparatively uniform discipline, not only does MS&E encompass many disciplines (physics, chemistry, engineering, etc.), but its practitioners reside in a broad spectrum of society (industry, universities, government laboratories, etc.). The latest effort from the MS&E community is contained in *A National Agenda in Materials Science and Engineering*. Not only does this report successfully focus the broad opportunities in MS&E, it also recommends some innovative approaches to making choices for the future, choices which I think have relevance for the rest of science as well.

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In many respects the MS&E community anticipated the current interest in self-assessment. Self-examination in MS&E actually began with the National Research Council's (NRC's) 1975 COSMAT report, *Materials and Man's Needs*, where the concept of MS&E as a coherent, interdependent field was first enunciated. By 1984 the MS&E community had succeeded in assigning priorities to its future major facilities in the NRC's Seitz-Eastman report, *Major Facilities for Materials Research and Re-*

*lated Disciplines*; and those priorities continue to be adhered to even today.

However, the intense current interest in MS&E as a unified field was reinitiated by the NRC's report, *Materials Science and Engineering for the 1990s*. This study began in 1985 and was made public at the Solid State Sciences Committee Forum in 1989. The report not only presented a comprehensive evaluation of the needs and opportunities in MS&E but was also a tremendous unifying force that involved hundreds of materials scientists and engineers from industry, universities, and government laboratories in its assessments and conclusions.

Further efforts to focus and implement the broad opportunities identified in the MS&E report led to the organization of four regional meetings held in the Eastern, Southeastern, Midwestern, and Western regions of the United States from March through September 1990. These regional meetings involved over 400 scientists and engineers and produced four regional reports. These regional reports were further condensed by representatives from the four meetings into *A National Agenda In Materials Science and Engineering*.\*\*

It is interesting that the need for this recent in-depth assessment was driven from the beginning by enlightened concern at the national level that more needed to be done to focus our MS&E efforts for the good of the nation. The NRC's MS&E report was initiated in October 1984 by a letter from Don Fuqua, then chairman of the House Committee on Science and Technology, to the presidents of the National Academy of Sciences and the National Academy of Engineering. In his letter, Fuqua noted the growing importance of materials to the nation's economy and called for a comprehensive materials research and technology assessment.

The regional meetings were also driven by national recognition and concern. Following the release of the MS&E report, many public forums were held; the community looked at how far we had progressed and what was still needed. The MS&E community continued to respond to the policymakers' message that because MS&E is such a diverse field with such enormous potential, they would like us to focus on a few outstanding opportunities and to tie them to national needs. In several speeches, Allan Bromley identified materials as a vitally important R&D area

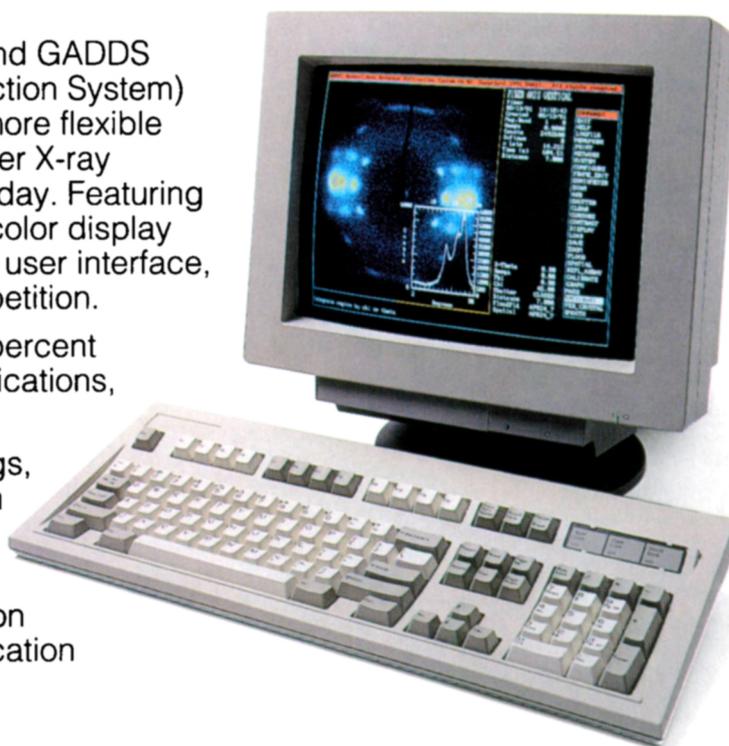
\*\***Editor's Note:** See the April 1991 *MRS Bulletin*, p. 22-25, for more information and also excerpts from the *National Agenda*.

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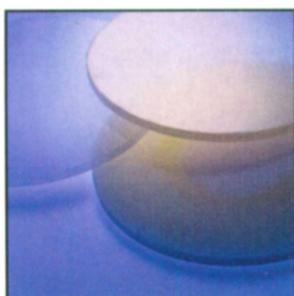
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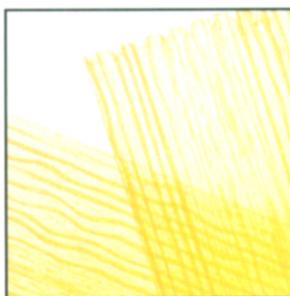
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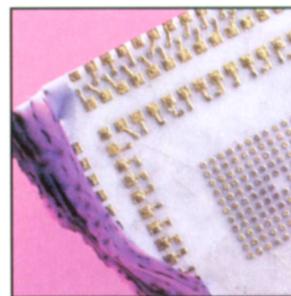
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spread among many disciplines and needing coordination. These considerations led to the call for a series of regional meetings to focus the opportunities identified in the MS&E report and to develop an implementation plan. In January 1990, in letters to the heads of the major funding agencies and the national academies, Bromley endorsed the regional meetings as a follow-up to the MS&E study for the purpose of building the materials infrastructure and suggesting potential initiatives for OSTP consideration. This interest provided the motivation for the regional meetings process and the reports that followed.

### Results of the Regional Meetings Process

A number of important directions emerged from the regional meeting process and the resulting report, *A National Agenda in Materials Science and Engineering*. They have the potential to significantly improve the future well-being of the MS&E community, and are as follows:

- The regional meetings, like the original MS&E study, were a grassroots effort that involved all facets of the MS&E community. This led to a heightened sense of unity and purpose for the participants.
- A strong case was made for the importance of increased cooperation among industry, universities, and government laboratories; and the regional meeting participants identified with this mode of operation as a synergistic way to increase individual research as well as advanced projects.
- Educational initiatives in MS&E were recognized as essential complements to achieving the recommended goals.
- The importance of diversity in MS&E was recognized not only as a necessity but also as a strength that should be enhanced.
- Analysis of the technical opportunities identified at the regional meetings underscored the importance of synthesis and processing, and reinforced the conclusion of the MS&E study that this area of weakness in the U.S. system needed increased emphasis.
- The report specified six areas of emphasis in MS&E that would yield significant benefit to society now if incremental funds were to be provided. Each of these specific initiatives was cast within a broad area of national need such as environment, health, and energy to underscore the continuing dominant importance of MS&E to the economic competitiveness of the nation and the well-being of our society.
- It was estimated that incremental funds,

above what is now being spent on MS&E R&D, on the order of \$1.25 billion would be needed to implement the identified initiatives.

Perhaps the most innovative recommendation in the *National Agenda* was to establish a living mechanism for identifying future MS&E initiatives and the appropriate participants for carrying them out. Opportunities in MS&E arise quickly, as evidenced by the rapid emergence of the high transition temperature superconducting materials, and we need an established mechanism for identifying and responding to such opportunities.

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### If we are to reverse the negative trend in the competitive posture of the United States, MS&E must be the cornerstone.

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A major recommendation of the *National Agenda* was the establishment of a strategic, goal-oriented planning process that intimately involves participants from the three major sectors in MS&E—industry, universities, and government laboratories—in selecting and implementing new initiatives and in establishing clear national goals. It would be the role of OSTP and the funding agencies to convene the MS&E community for strategic planning and for monitoring the implementation of selected initiatives. It would be the joint responsibility of these agencies and the convened MS&E community to identify the participants most appropriate to carry out the selected projects and to select the most appropriate modes of support. The advantages to this approach to planning are numerous, but it is particularly important for the diverse MS&E community and the nation that a participatory planning process be institutionalized. If we are to set goals, we must have a mechanism that involves the entire field.

### A National Agenda for MS&E

The intent of the combined regional meetings report, *A National Agenda in Materials Science and Engineering*, was to provide input to the OSTP for planning a national, coordinated program in MS&E. The unquestionable importance of MS&E to the economic well-being of the United States

has been established in far too many reports to cite here. It is difficult to think of any advanced technology that does not depend, often pivotally, on the development of new materials or materials systems. Thus, if we are to reverse the negative trend in the competitive posture of the United States, MS&E must be the cornerstone.

The importance of having MS&E go forward as a national initiative cannot be overemphasized. The reason science is being asked to set goals and assist the policymakers in making difficult choices is because the current budget constraints dictate flat federal budgets in coming years. Consequently, those areas perceived to have the largest benefit for society will be selected for increased funding. I believe the case for MS&E is overwhelming in this regard.

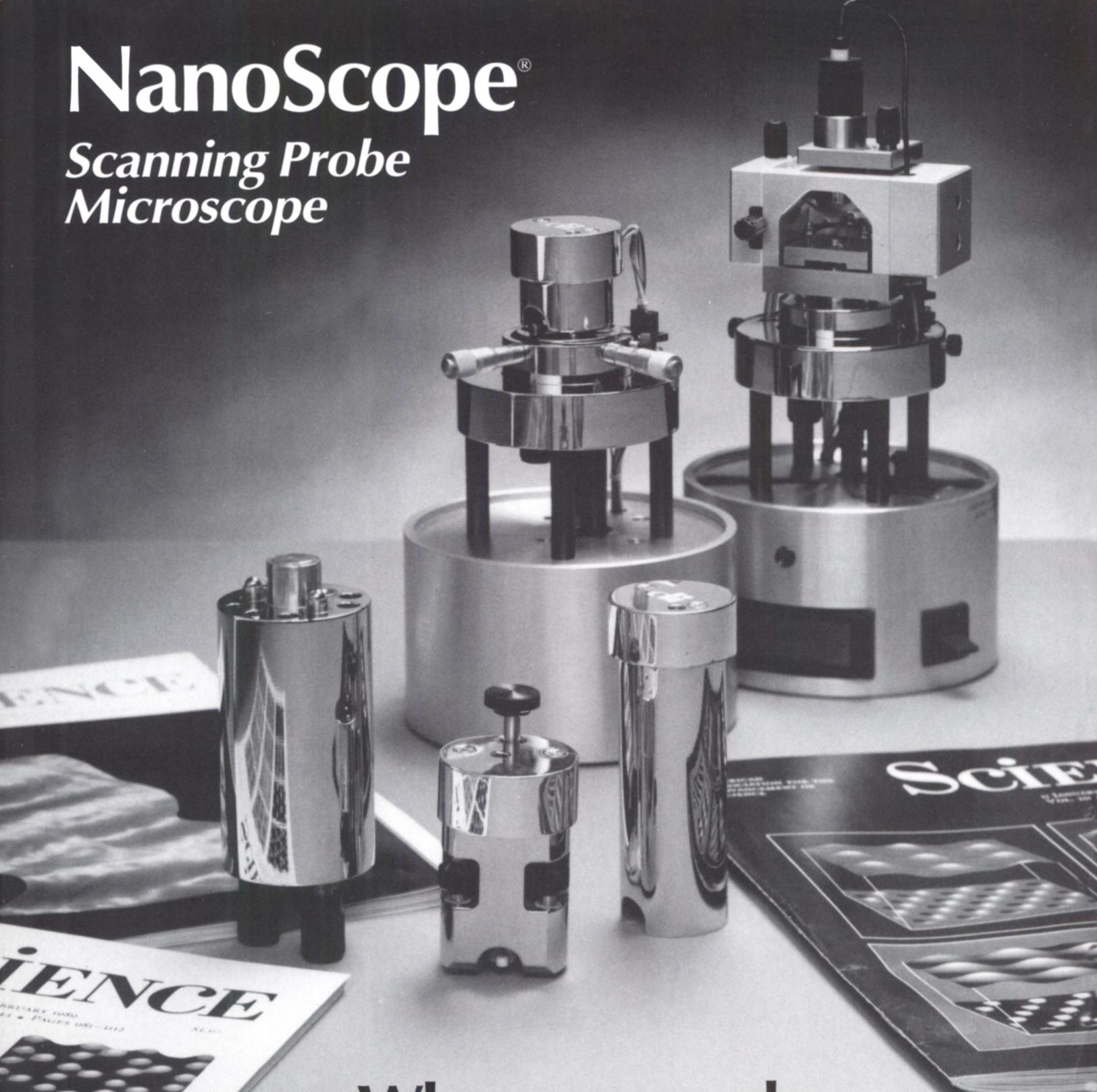
In addition to being essential, MS&E also appears deserving. The same OTA report, *Federally Funded Research: Decisions for a Decade*, that shows that federal funding for basic and applied research rose significantly from 1960 to 1990 also shows that areas such as engineering and physical sciences have been relatively flat. When considering MS&E specifically, as was done in the MS&E report, one sees that the effective level of support for nondefense expenditures in MS&E has decreased 21% since 1976. If any significant benefit to the economic competitiveness of the United States is expected from MS&E, substantial incremental funds must be part of any national plan.

Essential ingredients for having MS&E go forward as a national initiative are the establishment of a national agenda that is acceptable and exciting to the administration, the various funding agencies, and Congress. This process has been set in motion by OSTP, and the MS&E community can feel good about its contribution. We must continue to push for the completion of the national agenda and monitor its progress to assure that it becomes more than just a planning exercise. This effort can truly make a difference to the United States and the MS&E community; it is an essential component for any future success.

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