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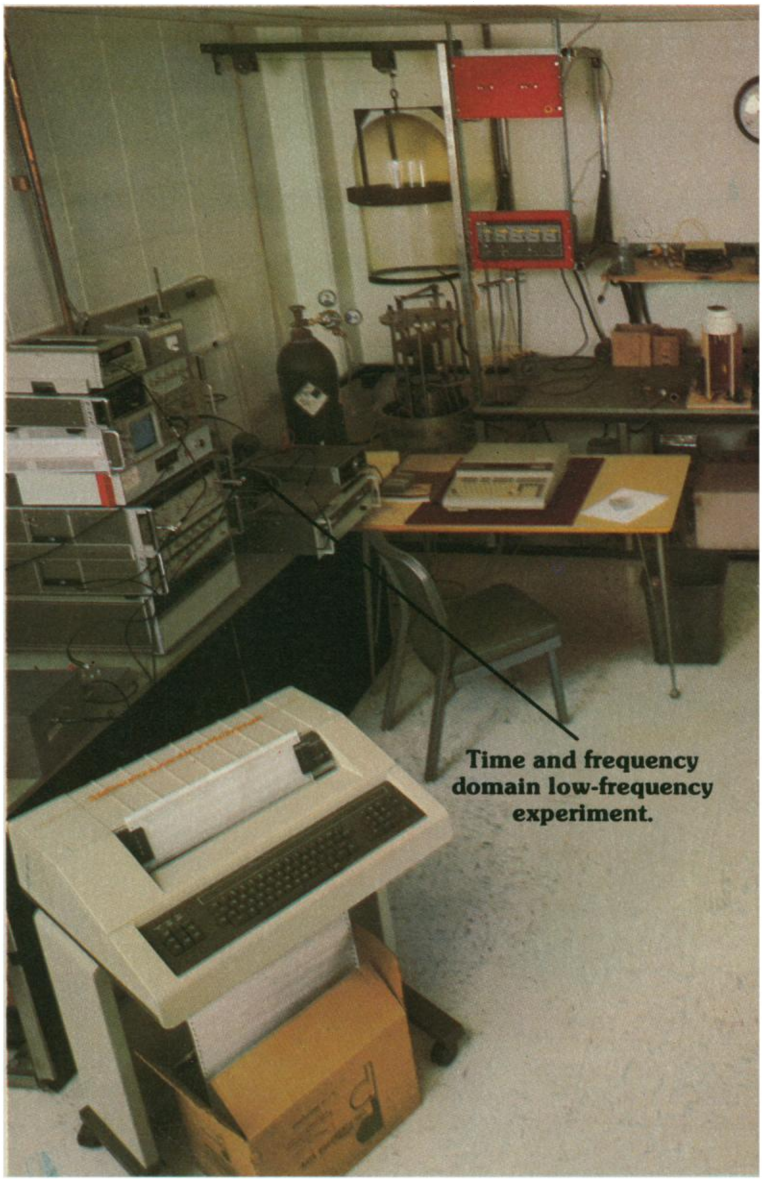
COVER

London Fever Hospital, mid-1800's. The disappearance of fever hospitals in developed countries is but one of the changes brought about by the development of antimicrobial drugs. See page 240. [National Library of Medicine, Bethesda, Maryland]

An HP-IB system helped generate— in three months. . .



For Colorado State University's Department of Electrical Engineering, contracts and grants are a hectic game. The competition is stiff, funds must be utilized to the maximum, and contracts unfailingly completed on time.

Professor Joel DuBow, head of the Department's Energy and Materials Group, recommended the use of an HP-IB system for experimental programs involving fossil fuels, because "we have enough problems understanding the measurements without having to worry about interfacing. By using HP-IB compatible instruments and computers, we were able to get right to the data analysis, without first having to do research on research."

Processing the unseen.

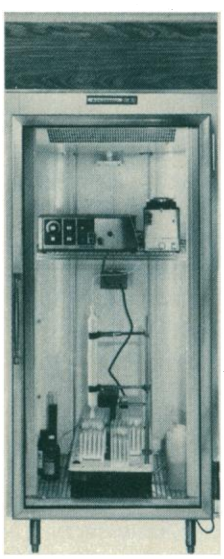
The in situ oil shale processing, now considered the most promising oil extraction technique, utilizes underground processing. Since the material cannot be seen, it is critical that the process be monitored and diagnosed accurately. CSU's HP-IB system has permitted Professor DuBow and his colleagues to devise — and test — conceptual schemes for accomplishing this. For example, when oil shale is heated, it goes through three structural changes: from an "as is" state to a transition zone, to a retorting zone, and, finally, to a combustion zone. By using the HP-IB system to monitor temperature coefficients of the shale properties, Prof. DuBow has been able to delineate the location of these zone boundaries. Process engineers can then use this data to detect the position and velocity of these reaction zones, and to determine the shape of each zone. In turn, this tells them whether or not the desired process is being followed. If not, corrective action can be immediately taken.

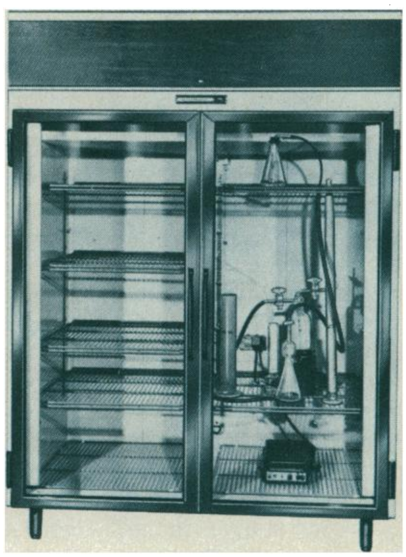
A hierarchy of machines.

Another reason why Prof. DuBow chose HP-IB is because of the flexibility provided. "We use three HP 9825s, in conjunction with an HP 1000," Prof. DuBow says. "That way, we end up with a hierarchy of machines. The 9825s have the capacity to analyze most of our data, while the HP 1000, with floppy disc drive, is faster for graphics and hard copy output. The HP 1000 also gives us the ability to store data permanently, and to compare new data against data that was generated six months ago. On the other hand, if the 1000 is busy, the 9825s can provide us with a lot of our essential data. And, since software is compatible, if one 9825 is unavailable the other two can keep the lab running."

Flexibility for data quantity and quality.

In short, this HP-IB system made it possible for CSU engineers to assemble a system configuration quickly, so they could begin looking at data months faster than might have been possible had conventional components been used. It also permits them to analyze oil shale samples faster and obtain more data from the tests. In fact, in one three-month period, CSU has generated more oil shale test data than had ever before existed in published form.



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do the elected representatives or the public servants. Furthermore, the technologists do not understand the even more complex legal, social, and political issues in our rapidly changing world. Yet, it is the technologists who are asked to answer the final questions. It is they who are often blamed when things to wrong, as they sometimes do. And lately it is they and their producers who are threatened with legal punishment for failures.

The genie of technology has given us many benefits that we all share. We all should also share its failures. It is past time for schools of liberal education, including those that educate jurists, to *require* in their curricula courses which help nontechnical students to understand at least the general nature of the technologies of our modern world. Most engineering curricula now *require* a substantial portion of their studies to include liberal education. In both cases it is suggested that entirely new approaches be developed that will better acquaint the students with the overall nature of our technically based society with its ever more compelling human needs.

They who will make, govern, and judge in the future will then be better prepared to enhance humankind with decisions that are at once technical and human-value bearing. They will be more tolerant of the other person's dilemmas, and they will more willingly share responsibility.

JAMES R. JOHNSON
Institute of Technology,
University of Minnesota,
Minneapolis 55455

"Risky" Investments

I am the chairman of a task group established by the Advisory Council of the National Science Foundation to look into the adequacy of the process of funding of research proposals that are highly innovative but that also have a relatively high risk of failure. There seems to be a perception in some parts of the scientific community that highly imaginative proposals for research which are "off the beaten track" sometimes have difficulty in obtaining funding because scientific reviewers and agency officials are unduly conservative and tend to "play it safe."

We would very much appreciate having comments and views of the scientific community, including any knowledge of significant creative proposals for research that experienced difficulty in finding funding from federal agencies, as well as suggestions for improving the mechanism by which such proposals are handled. We are also concerned about the possibility that some worthy proposals may experience difficulty because they fall between different disciplines or divisions of a discipline.

The task group is in no sense an appeal mechanism, nor does it have any possibility of determining the merits of individual proposals, but is involved in suggesting ways in which the procedures and policies of the National Science Foundation can be most effective in fostering highly creative science in our laboratories and universities.

HALSEY ROYDEN
Department of Mathematics,
Stanford University,
Stanford, California 94305

Erratum: In the note describing the photograph that appeared on the cover of the 16 May issue of *Science*, and in H. Massey's *Atomic and Molecular Collisions*, from which the photograph was taken, the library represented in the photograph was misidentified. The library shown is that of the Royal Institution, London.

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The Bridge Between University and Industry

University-industry relations in science and technology have long been characterized by curious mixtures of respect and condescension, of affection and irritation, of strong mutual interactions and barriers, planned or philosophical. Yet these intellectual, economic, and social interactions form the core of a complex network that most of us consider to be the basis for civilization's present progress and future hope.

The massive growth of federal support for R & D from World War II through the 1960's had an unintended impact on this network, proving it to be both more sensitive and more durable than might have been predicted. Federal funds for university research from 1950 to 1970, so lush and available seen through the rosy haze of nostalgia, did strengthen our foundation of science, our university research capabilities, the training of graduates, and hence the infrastructure for future industrial growth. But the bridge between university and industry, although neither completely broken nor abandoned, fell into disuse. Research subjects evolved from government goals and funding, and career objectives of graduates were geared to the glamor and growth of space, nucleonics, and the new age of materials science. While industrial research became stronger internally, the university research community leaned toward its new and generous patron.

The bridge with industry was rediscovered by universities around 1970, with the slowing of federal support, cutbacks in aerospace research, and narrowing of federal support following the Mansfield Amendment. Initial approaches were made by universities with overtones of "with your money and our brains"—not an endearing note, and surely not the best one on which to begin a relationship. But through the 1970's a maturing sense of mutual benefits and interdependence has emerged. Universities and industry are now building toward long-term relations that take into account each other's needs and contributions, the functions that each serves in our society. There is, in short, a sound base for a sensible working partnership.

There are signs today that federal funds for university R & D may increase in some areas such as defense, energy, and basic research. Coupled with industrial belt tightening, this could tend to divert university researchers away from industrial cooperation.

Nevertheless, there are clues to future growth. The National Science Foundation program for stimulating joint research proposals from university-industry partners is an excellent start, but must be nurtured with a clear understanding of the broad societal functions to be served. The Monsanto-Harvard and Exxon-MIT programs, with sizable funds committed to basic areas of mutual interest, are perhaps unusual examples, but partial government support might encourage others on a somewhat smaller scale. Strong industry participation in mission-oriented research institutes at universities and long-term joint projects between university research teams and single companies can provide opportunities for combining university research careers with economic growth of the private sector.

The bridge in science and technology between university and industry—sometimes strong, occasionally ignored, always important—has a unique role in current industrial societies. The difficult lessons of the 1970's have given us a base for using this bridge as a means of strengthening our national technical community. The challenge for all is to preserve this base despite future changes in federal funding.—HERBERT I. FUSFELD, *Director, Center for Science and Technology Policy, New York University, New York 10003; past president, Industrial Research Institute*

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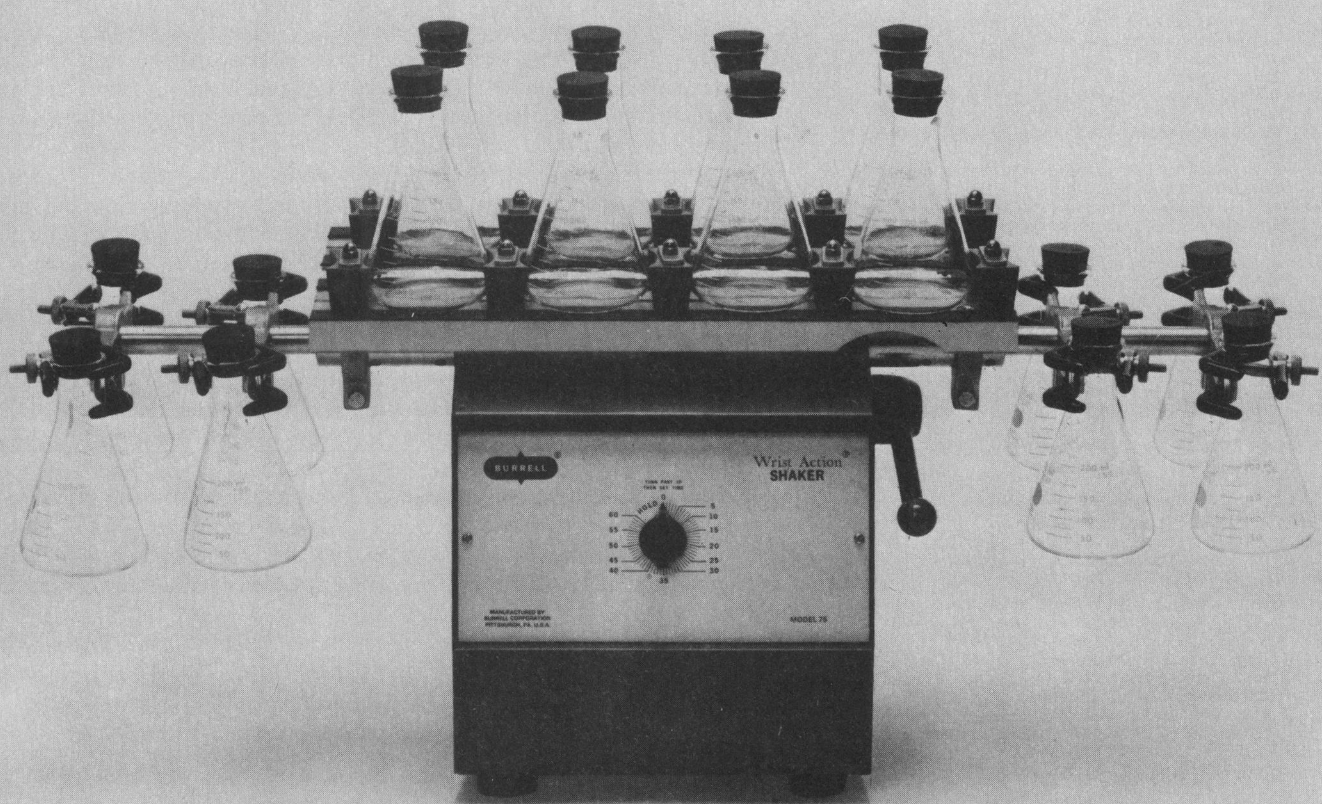

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