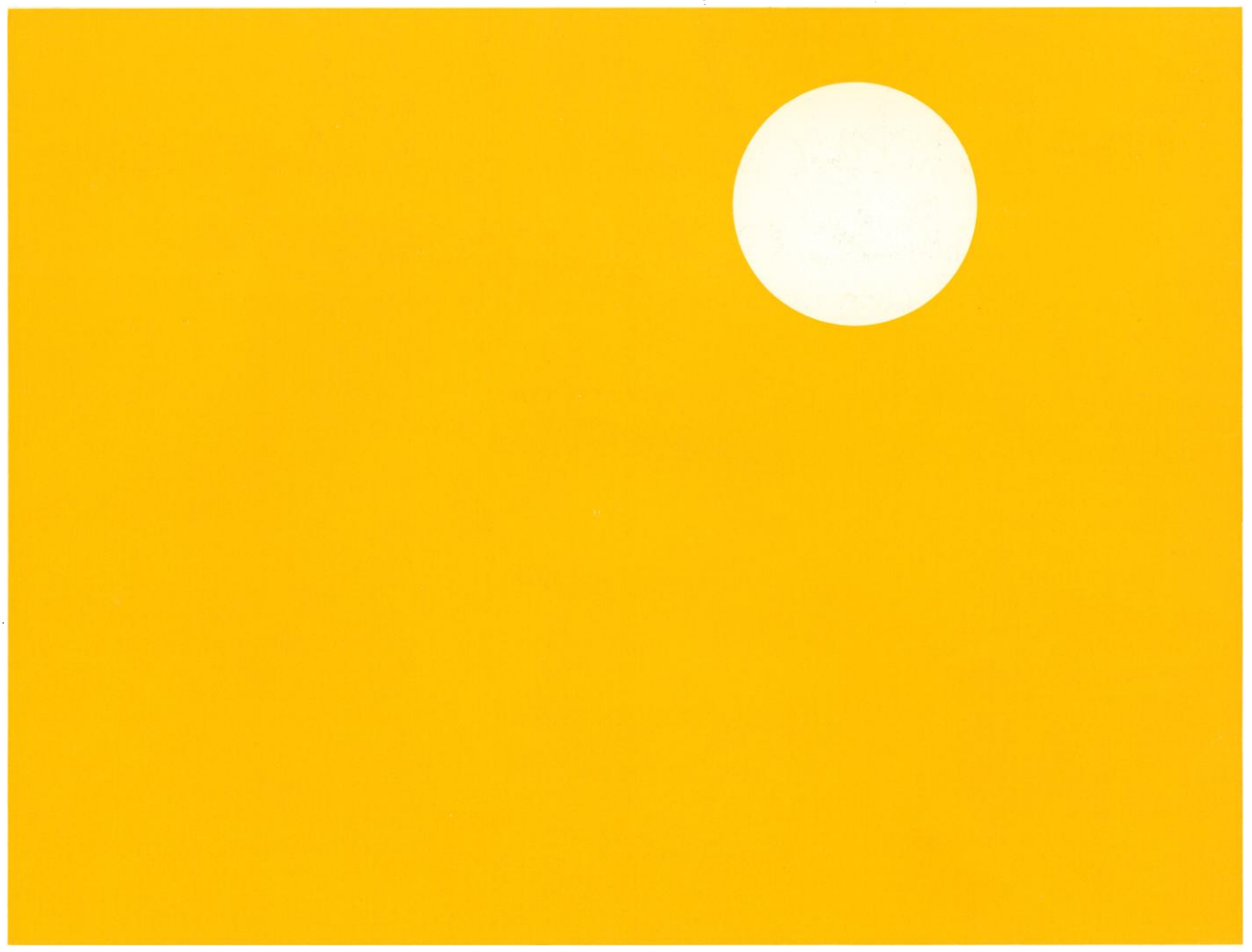
SCIENCE

4 April 1975

Vol. 188, No. 4183

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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4 April 1975

Volume 188, No. 4183

SCIENCE

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORTS

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.
Postmaster: Send Form 3547 to SCIENCE, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005.

COVER

Larva (left) and adult (right) of Douglas-fir tussock moth. The insect is a serious defoliator of fir forests of western North America. See page 63. [Wally Guy, U.S. Forest Service]

A new real-time computer system that expands to meet your needs.

You can capture real-time data from lab and process instruments, or perform complex computations, or develop new computer programs with our new 9640A computer system in its basic, simplest form.

As your load increases and you need additional power, you can build it up to a disc-based multiprogramming, multi-terminal, multi-lingual system that lets your engineers and scientists use it all at the same time for real-time data acquisition, processing and plotting data, and developing and debugging programs.

Should that not be enough, you can link several 9640A systems into a distributed multiprocessing network. Hardwired or linked by phone to each other and to a central 9640A, each satellite system dynamically shares workloads, programs, and the central data base. Each also has ready access to all central peripherals. And if you need large-scale number-crunching or data base management, you can link the 9640A network with a larger system such as an IBM 360/370 or HP 3000.

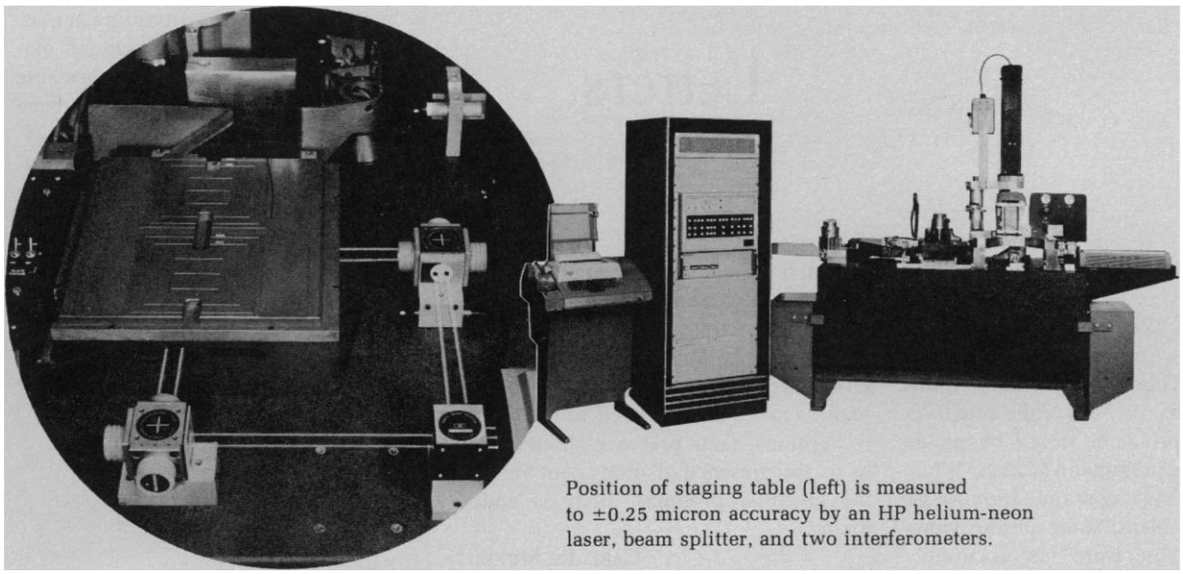
The key feature of the 9640A that makes all this possible is a new real-time operating system (RTE-II) that captures critical experimental events *whenever they occur*. With RTE-II, you can store programs in memory, assigning each a priority level. When a higher priority task shows up, RTE-II always executes it in real time, automatically exchanging programs between disc and memory, if necessary, to make room for it.

Other benefits include:

A microprogrammed floating point and extended arithmetic set that helps the 9640A keep up with its many tasks by speeding program execution from 2 to 20 times. Floating point multiplication, for example, requires a single microcoded instruction set compared to 50 in Assembly Language.

A spooling option for batch processing that also speeds system operation by allowing the computer to operate on priority tasks at top speed without having to wait for input/output peripherals to catch up. You can load programs on disc and the computer can output on disc—leaving the job unattended while the computer performs priority tasks. Later, when input/output resources become available, the computer executes the task.

With multiprogramming and distributed processing, the microprogrammed HP 9640A System gives you big computer benefits at a fraction of the cost. Prices start at $19,150*.



Position of staging table (left) is measured to ±0.25 micron accuracy by an HP helium-neon laser, beam splitter, and two interferometers.

An HP laser measurement system controls step-and-repeat photomasker within 0.25 micron.

When you're making photomasks for IC chips, there's not much room for error—perhaps a micron one way or the other. You can't hope to make consistently good masks unless you can position the camera's staging table to that kind of accuracy in the first place—and do it repeatedly without variation.

Electromask, Inc., a leading manufacturer of photomaskers, achieves a precision of ±0.25 micron (±10 microinches) over the full 5-inch stage travel in its new image repeater. By incorporating the HP 5501 Laser Transducer and HP 2100 Computer, coupled with a unique air-bearing system to transport the staging table, Electromask designers were able to build in positioning accuracy that does not degrade with repetition, since there is no friction or wear in either the air bearing or laser transducer.

HP's special electro-optical design allows one laser to measure both the X and Y positions of the staging table. It also simplifies design by allowing plane mirrors to replace cube corners or prisms as table position reflectors. The HP 2100 computer automatically controls and monitors all camera operations while giving the operator a choice of routines that greatly facilitate and speed the production of IC masks. The Electromask Image Repeater can produce a 3-inch photo master with an array of 200-mil chips in less than one minute on emulsion, and less than 8 minutes on photoresist.

The fourth part of a micron, one minute: there can be no doubt that Electromask has improved step-and-repeat photomasker operations—with an important assist from Hewlett-Packard.

For more information on the Electromask Image Repeater, write to Electromask, Inc., 6109 De Soto Avenue, Woodland Hills, California 91364. For more information on HP products write to us. Hewlett-Packard, 1507 Page Mill Road, Palo Alto, California 94304.

*Domestic USA prices only 00543

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A verbal montage of the state of science in the 70's

"Science is a constantly changing series of approximations," a scientist-philosopher pointed out.

Thus, each of the 36 interviews between scientists and journalists is a snapshot of a particular science at a particular time. But, summed up, these interviews offer a verbal montage of the state of science in the early seventies: progress in genetics, the difficulties of finding technological answers to natural disasters such as earthquakes, volcanoes, and hurricanes; the pulsating need to explore the worlds beyond—Mars, cosmic puzzles such as pulsars, the oceans. We continue to probe ourselves—the basis of our violent behavior, our evolution, the nurturing of our young . . .

Each of these interviews—like fragments of a jigsaw puzzle—tells little. Assembled, they give a panorama of science that is revealing of its depth, its breadth, and its dynamic state.

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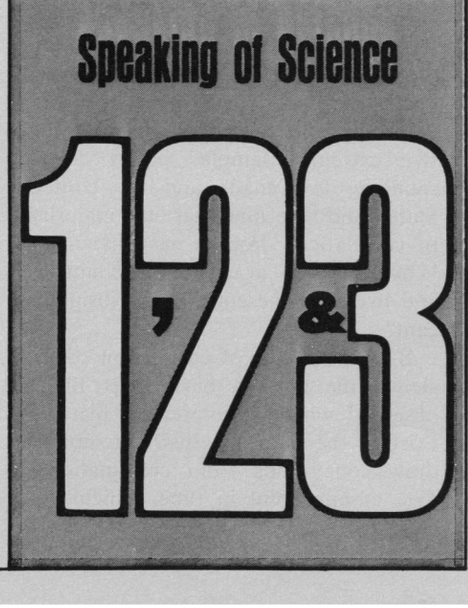
8. Patterns of Discovery
9. The Limits of Growth: A Debate
10. Tragedy of the Commons Revisited
11. Understanding Perception
12. Exploring the Universe



Volume 3

1. Eluding the Energy Trap
2. The Earth's Fire
3. Science, Development, and Human Values
4. Technological Shock
5. Population Policy and Human Development
6. Earthquakes: Managua and Beyond
7. Volcanoes
8. Hurricanes
9. Malnutrition: A Medical and Economic View
10. The Green Revolution: An Assessment
11. Legend and Science in the Early Americas
12. The Science of Violence

Each of the three Speaking of Science *volumes includes six one hour audiocassettes, packaged in an attractive album and accompanied by a booklet with background on each conversation. Cost of all three volumes, with slipcase, is $84.95 to AAAS members; $99.95 to nonmembers. Volume I, 1972, Volume II, 1973, and Volume III, 1973 are available separately at $34.95 each to AAAS members, and $39.95 to nonmembers. (Both prices plus $1.50 postage and handling.)*

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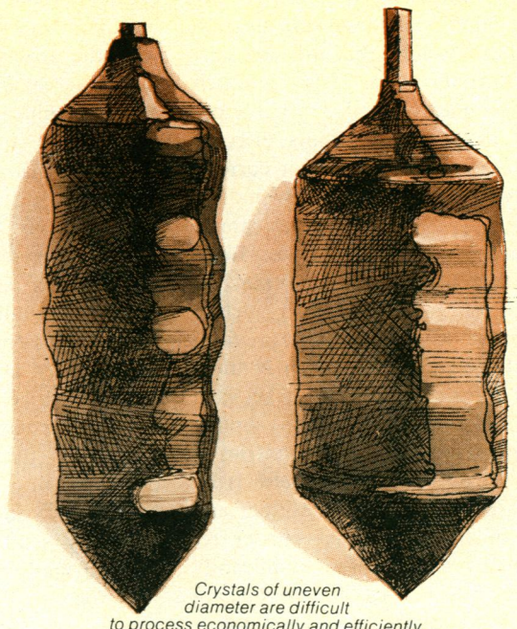
Western Electric Reports:

An inside look at crystal growth.



Crystals of uneven diameter are difficult to process economically and efficiently. X-ray imaging now yields crystals of a diameter within a tolerance of ± 1/16 inch.

Engineers at Western Electric's Engineering Research Center have developed an improved method for controlling the growth of the crystals used in light emitting diodes (LED's). The new technique represents one more step toward low-cost, mass produced LED's.

LED's have found many uses in telecommunications equipment as illuminators, indicator lamps and numeric displays. They consume very little power and last from 10 to 100 times longer than the devices they replace.

LED's used in the Bell System are made from gallium phosphide (GaP) single crystals. Economical processing using standard-sized fixtures requires crystals of uniform diameter. But because GaP single crystals must be grown inside a high pressure vessel, monitoring and controlling crystal growth has been a problem.

Previously, crystal growth could only be monitored visually. The halo surrounding the growing crystal was observed through closed circuit television. Since the halo would expand and contract with the diameter of the growing crystal, it provided some measure of control. But phosphorous vapors condensing on the viewing window partly obscured the halo, making precise control difficult.

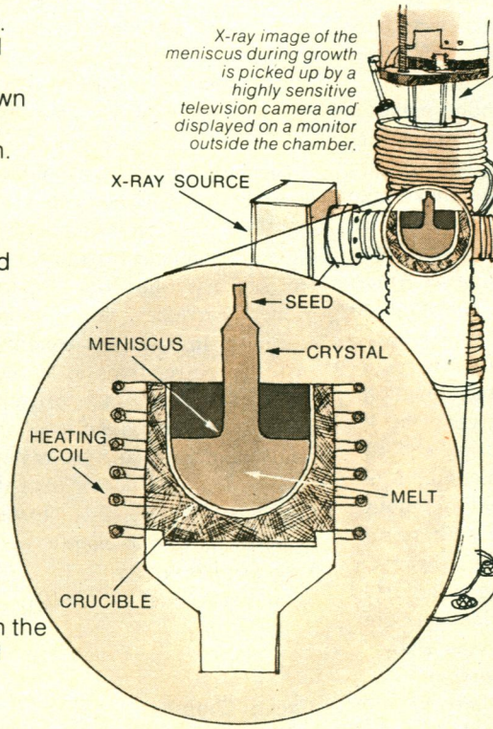
The new monitoring technique is similar to the use of a fluoroscope in medicine. X-ray imaging provides an unobstructed view of the meniscus formed where the solid crystal meets the liquid melt. Western Electric engineers have correlated the height and angle of this meniscus to the crystal's growth condition. This is useful because a change in the shape of the meniscus signals a change in the temperature of the melt *before* it is manifested as a change in the crystal's diameter.

A change of just 4° in the liquid-solid contact angle can be observed, allowing adjustments to be made in either temperature or pulling rate to maintain uniform growth.

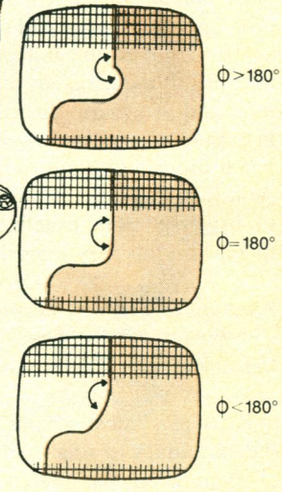
X-ray imaging is in production use at Western Electric's plant in Reading, Penn.

Benefit: X-ray imaging of the meniscus of a growing crystal has permitted a marked improvement in the monitoring and control of crystal growth. It helps insure high yields of uniform diameter crystal wafers for processing into LED's.

X-ray image of the meniscus during growth is picked up by a highly sensitive television camera and displayed on a monitor outside the chamber.



Growing crystals. seed is dipped into crucible of molten GaP, maintained just above melting temperature It is rotated and withdrawn at controlled rate, producing cylindrical crystal



THE LIQUID-SOLID CONTACT ANGLES

X-ray image of the meniscus at various temperatures. The smaller the angle, the lower the temperature. The larger the angle, the higher the temperature. An angle of 180° indicates the desired "steady state" growth condition

Western Electric

We make things that bring people closer.

4 April 1975, Volume 188, Number 4183

SCIENCE

Muddling Through: Government and Technology

Not everyone is sure that technology generates greater social benefits than costs. What is quite clear, however, is that a sick national economy is not going to create needed jobs, nor improve productivity so that we can afford to help others, if its technological capacities are not up to it.

Government tends to imagine that a mystery called the market system defines the level and quality of technological enterprise. It is true that private decision-makers balance opportunities against corporate risks in estimating returns from innovation. But the environment of private decisions is conditioned heavily by government's attitudes and behavior. There is scant evidence that the federal government has the policy machinery to guide its actions as they affect the environment for innovation.

For a time it looked as if government had caught on to the need for explicit public policies toward technological vitality. That was in 1972, when Michael Boretsky of the Department of Commerce showed that the United States was fast losing its lead in high technology exports. A presidential message went to Congress on science and technology, and whatever defects it had were redeemed by flashes of comprehension as to the need to encourage innovation. To test incentives for risk-taking, the National Science Foundation and the National Bureau of Standards were assigned new responsibilities. Thereupon, Carey's law became operative: that the half-life of a federal experimental program is about two and a half budget cycles. The NSF's program has been practically shelved. The Experimental Incentives Program in the Bureau of Standards has launched promising partnership experiments with regulatory and procurement agencies, yet its future is uncertain. So it goes, while the economic indicators fall and factions quarrel over the mix of fiscal antibodies.

The energy predicament has dramatized the fragility of a technology-dependent economy. A materials crisis would teach us an even more emphatic lesson. The success of our Free World partners in invading our domestic markets, thanks to our export of technological and managerial know-how, has begun to make us thoughtful. But when we hunt for a public policy framework within which technological vitality can be regenerated, we cannot find it. This is one place where presidential staff work in science and technology can stand strengthening.

Government may imagine that it is neutral toward the rate and quality of technological risk-taking, but it is not. The regulatory system alone is pervasive and here to stay, but regulatory policies aimed at the public interest rarely consider impacts on innovation. Standards-setting activities, important as they are, need not force distortions on technological compliance. Changes in tax treatment of industrial research and development, if approached narrowly, can choke off outlays for innovation and trigger even more exportation of R & D and know-how.

Government is not against technological innovation. But the habit of muddling through leaves American technology at increasing risk. Government should have policy machinery to align its industrial growth policies with its regulatory, taxing, R & D, and procurement policies so that discontinuities are refereed. With this goes a need for better governmental research on the dynamics and performance of the technological enterprise in the United States, aimed toward a baseline for good policy analysis.

We have found out that compulsive technological drive is not the right answer. But we need also to know whether unintended governmental constraints are inducing adverse choices in industrial risk analysis at the expense of innovation. Now that we are in deep economic trouble, the question is less academic than it might have seemed when the nation's economy had its seasons in the sun.—WILLIAM D. CAREY

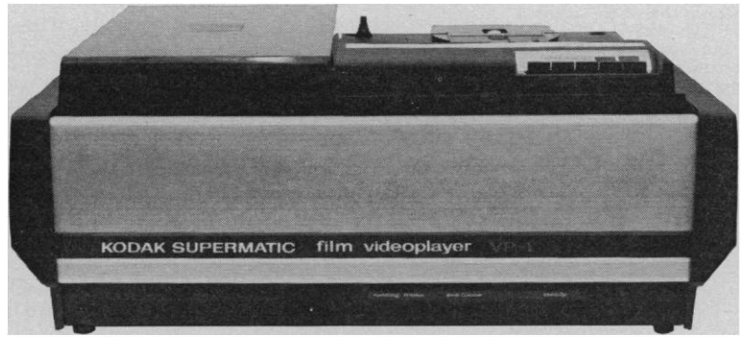
We want to be useful ...and even interesting

She moved on to another field

Marion Gleason came to Rochester in the early 20's as the wife of a musician employed by the founder of Kodak. After a bit, the company itself engaged her on the strength of her education in dramatic arts. We were in the process of introducing movie film only 16 millimeters wide. The movie industry, of course, ran on 35mm film. The lower cost would allow amateurs to make movies. Analogous to amateur dramatics. So the thinking ran. To show how it might be done, Marion Gleason wrote some scripts full of adventures such as the movie houses were showing. With large casts of friends she directed several productions.

As things turned out, large casts and thrilling airplane crashes proved unnecessary for enjoyment of home movies. With advances in emulsions, film width shrank to 8 millimeters, and 16mm became largely a professional medium. Later came super 8. Professionals in fields outside professional motion pictures have been turning to super 8.

As for Marion Gleason, she dropped out of dramatics altogether and turned to—of all things—toxicology. For many years she has been busy organizing increasingly voluminous editions of a standard compendium sometimes familiarly referred to in the world's poison control centers as, simply, the Gleason.



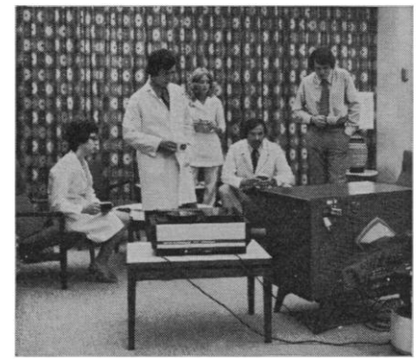
Keep your options open

This device takes super 8 film and puts out a good-quality color TV signal complete with sound, if any. You just connect its output cable to a TV receiver by the antenna terminal, or to a monitor, closed-circuit distribution system, broadcast station, or even videotape recorder. Compared with the alternatives for capturing action in color and sound, editing it, and showing it, super 8 film is simple, inexpensive, highly mobile. And it doesn't *have* to be shown on the film videoplayer if a common super 8 movie projector is available!

Further details from A. T. Brown, Dept. 640, Kodak, Rochester, N.Y. 14650.

The watching is easy

Perhaps a majority of all who are active today in science, teaching, technical marketing—persons who must communicate professionally and be communicated with—have been conditioned since childhood to regard the TV tube as just as reasonable an input to one's consciousness as ink on paper. That it takes a little less fuss to switch on TV than to set up a movie projector is hard to deny.



***Directory of KODAK Products and Services for the Health Sciences*, available from Dept. 55T, Kodak, Rochester, N.Y. 14650,** tells how to go about obtaining what we have to offer for the art of communication and other arts and sciences of biomedical interest.

Kodak

(*Continued from page 43*)

Science). Dr. Rieser of the AAAS will serve as acting chairman until installation of officers in July 1975 at Belo Horizonte, Brazil.

AAAS Fellows

The Council Committee on Fellows is now soliciting nominations for AAAS Fellows for consideration at its fall 1975 meeting. A Fellow of the AAAS is defined as one "who has produced a body of work on behalf of the advancement of science that is scientifically distinguished or socially highly significant, or both." Nomination forms may be obtained from the Executive Office, AAAS, 1776 Massachusetts Avenue, NW, Washington, D.C. 20036.

Forms completed by an individual member of the Association should be sent not later than 1 May to the secretary of the nominee's voting section for possible inclusion in the slate of nominees to be submitted by the section committee to the Council Committee on Fellows. Alternatively, nomination may be made by any three AAAS Fellows and the form sent directly to the Executive Officer for receipt not later than 15 October (see box on page 1122 of the 21 March issue).

Notes from Other Offices

Meetings: The theme of the 1976 Annual Meeting in Boston, 18–24 February, will be "Science and Our Expectations: The Bicentennial and Beyond." Symposia are being developed around interdisciplinary research and public interest policy questions in which science can make a contribution. Suitable events relating to the Bicentennial are also being planned. Members interested in arranging symposia are reminded that all ideas must be submitted to the Meetings Office no later than the end of April.

* * *

Opportunities in Science: Arrangers for Annual Meeting symposia are reminded that it is the policy of the AAAS to increase the participation of minorities and women in all Association activities, including the Annual Meeting. If arrangers need assistance in identifying women and minority scientists, they should contact the Office of Opportunities in Science.