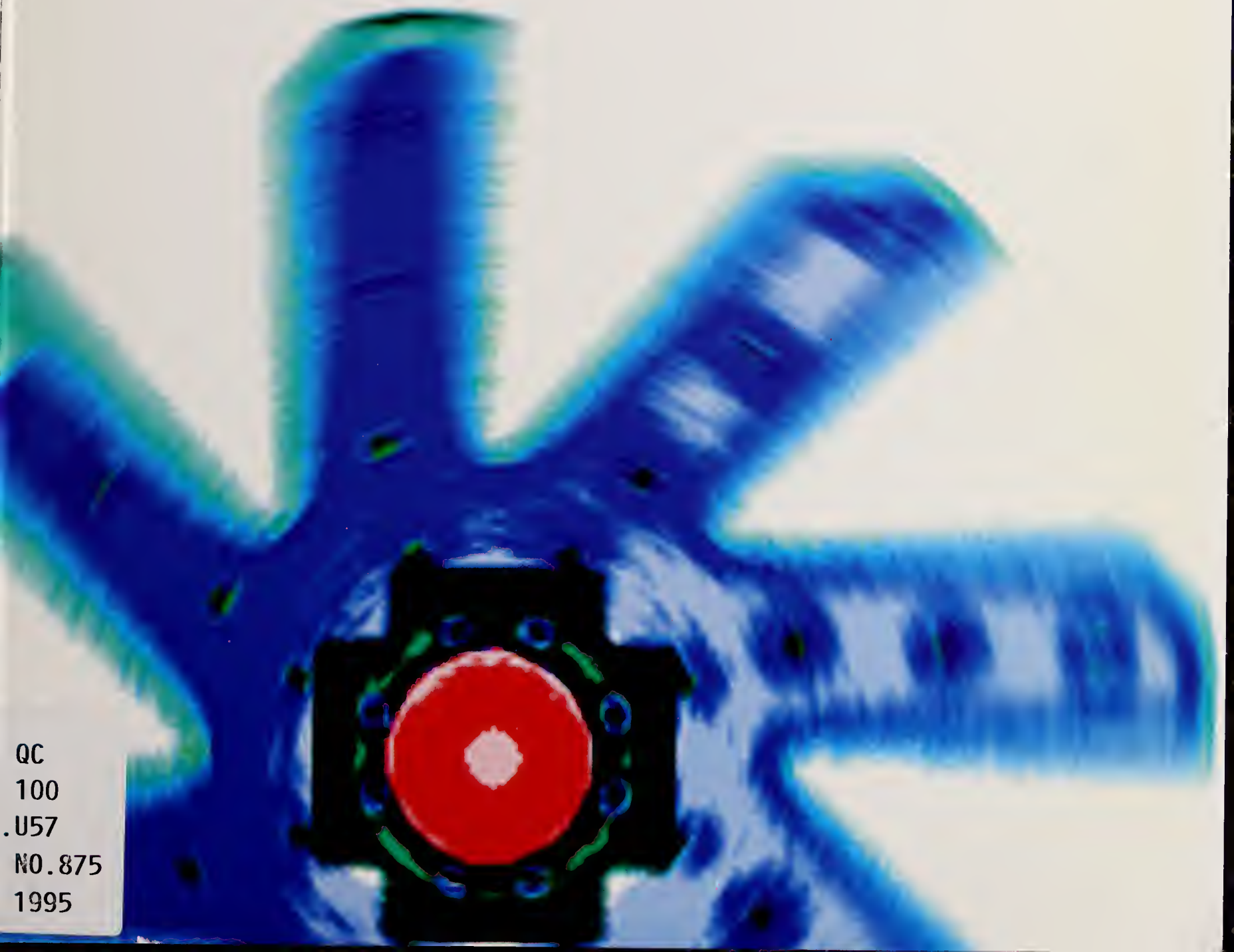
U.S. Department of Commerce
Technology Administration

**National Institute of
Standards and Technology**

n i s t



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The National Institute of Standards and Technology (NIST) is a non-regulatory federal agency within the Commerce Department's Technology Administration. NIST's primary mission is to promote economic growth by working with industry to develop and apply technology, measurements, and standards. Established by the U.S. Congress in 1901 as the National Bureau of Standards, the Institute was renamed and assigned new responsibilities in 1988.

NIST carries out its mission through a portfolio of four major programs:

- **the Advanced Technology Program—cost-shared, competitive awards to industry for development of high-risk, preproduct, enabling technologies;**
- **the Manufacturing Extension Partnership—a nationwide network of extension centers and experts co-funded by states and local governments that provides hands-on technical assistance to smaller manufacturers;**
- **laboratory research and services—planned and conducted in cooperation with industry and focused on infrastructural technologies such as measurement and test methods and evaluated data; and**
- **a quality outreach program associated with the Malcolm Baldrige National Quality Award—recognizing quality improvement by U.S. manufacturing and service companies.**

Budget: $1 billion (estimated fiscal year 1995 from all sources)

Staff: About 3,200 scientists, engineers, technicians, and support personnel, plus some 1,200 visiting researchers each year

Sites: Gaithersburg, Md. (headquarters), 234-hectare campus; Boulder, Colo., 84-hectare campus

Facilities: Major facilities include a 20-megawatt research reactor, metals processing facility, synchrotron radiation source, linear accelerator, and computer networking and security laboratories

Front cover: This colorized micrograph shows a microrotor, similar to those in a miniature motor operated by an integrated circuit. NIST is working to develop reliable ways for the semiconductor industry to measure stress, strain, and other mechanical properties to optimize the operation of such MicroElectro-Mechanical Systems or MEMS.

To Our Customers:

Satisfying customers. Continuously improving products and processes. These mandates for the business world are also a way of life at the National Institute of Standards and Technology.

Here at NIST our customers are U.S. businesses, large and small. Unlike any other federal agency involved in science and technology, NIST's *primary* mission is to support U.S. industry. The Institute works with industry to address economically important technology jobs not covered by private investments.

NIST's Advanced Technology Program helps accelerate progress on preproduct technologies that are too risky or too long term to be adequately supported with private funds alone. The Manufacturing Extension Partnership helps smaller manufacturers with limited resources find the technical advice they need to stay competitive. Institute laboratory researchers work side by side with industry researchers to develop infrastructural technologies like measurement methods and process controls that benefit whole industrial sectors. And the Malcolm Baldrige National Quality Award program provides quality management guidance to help companies focus on their customers' and their employees' needs.

To ensure that our programs are meeting industry needs, NIST sponsors workshops, hosts industry guest researchers, participates in cooperative research and development projects, attends manufacturing conferences and trade shows, conducts industry surveys, and assesses the economic impact of its programs. The feedback provided through all these channels is invaluable in streamlining our processes and keeping our programs in step with industry.

This brief brochure is designed as an introduction for corporate managers and others interested in finding out how NIST programs may help meet their organization's needs. We invite you—our customers—to join with us in making sure that our investments in technologies, measurements, and standards strengthen industry and promote U.S. economic growth. Together we can succeed in a uniquely American approach to federal investment in civilian technology that will yield tremendous economic benefits to our nation.

Arati Prabhakar

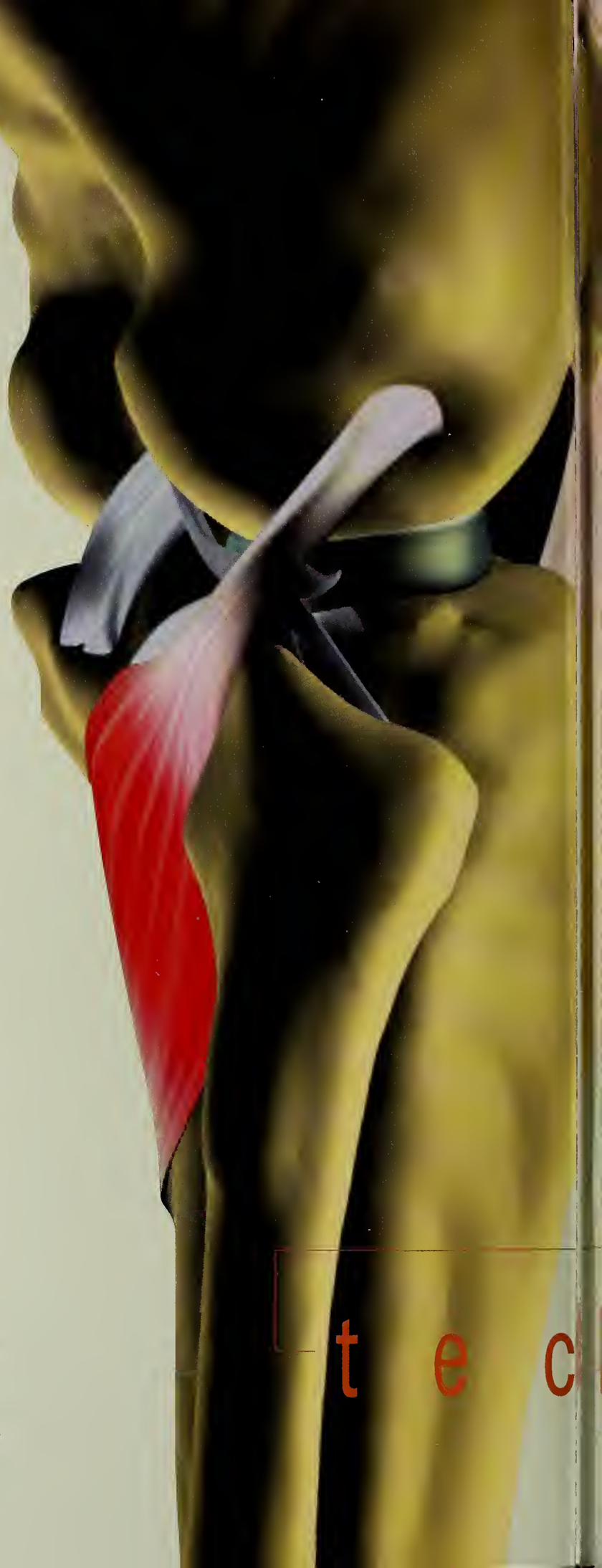
Arati Prabhakar
Director

The Advanced Technology Program (ATP) invests directly in the nation's economic growth by working with industry to develop innovative preproduct technologies that have significant commercial potential but are too risky to be developed quickly without a partnership between industry and government.

Begun in 1990, the program provides cost-shared awards, through a rigorously competitive process, to both individual companies and industry-led joint ventures. It accelerates research progress on promising, but high-risk, enabling technologies that allow important improvements in products, processes, or services. ATP does not fund product development.

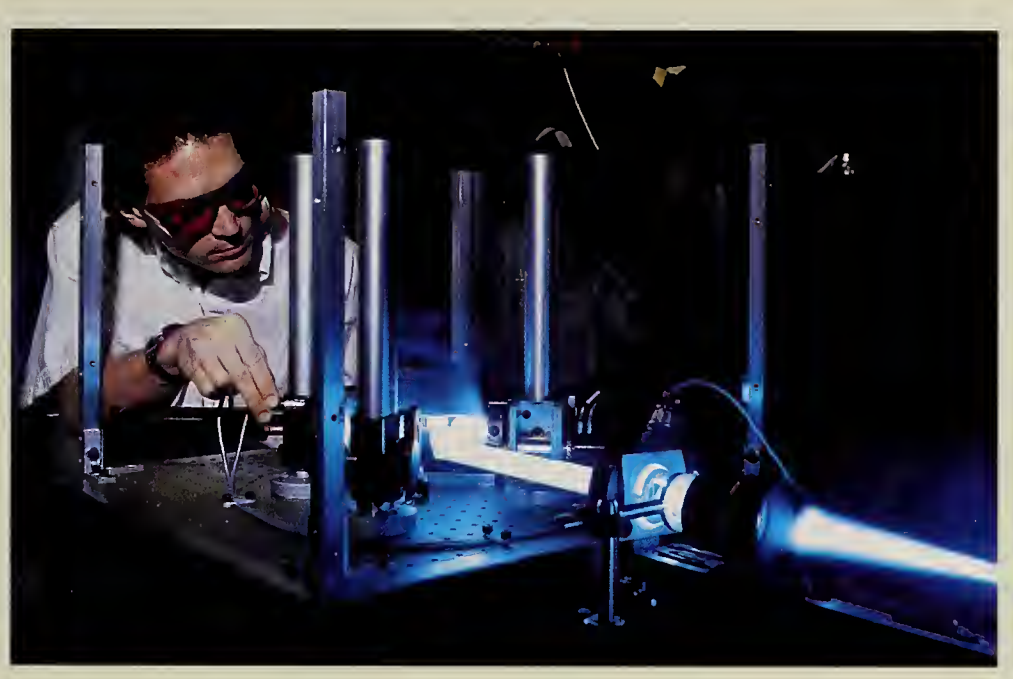
The program builds bridges between basic research and product development through two types of funding mechanisms: general competitions open to all technologies and focused program competitions in which proposals are sought in specific technology areas defined through input from industry. Examples of current focused program areas include: tools for DNA diagnostics, information infrastructure for healthcare, manufacturing of composite structures, component-based software, catalysis and biocatalysis technologies, motor vehicle manufacturing technologies, and digital video in information networks.

The ATP relies on ideas supplied, co-funded, and carried out by industry. Successful ATP project sponsors range in size from start-up companies with a handful of employees to major industrial firms with international scope. Awards to individual companies are limited to $2 million over three years and can be used only for direct R&D costs. Awards to joint ventures can be for up to five years, and joint ventures must provide more than 50 percent of the project's funding. During fiscal year 1995, the ATP expects to sponsor more than 200 projects with appropriations totaling $431 million.



Right. Engineering Animation Inc., Ames, Iowa, is using its ATP award to develop the technology for a "virtual human." The company hopes to use three-dimensional images like this knee graphic and high-speed computer systems to realistically visualize every aspect of human physiology.

Right. Accuwave, Santa Monica, Calif., has used ATP co-funding to apply holographic technology to fiber-optic communications. The company is developing ways to use holograms as filters so that many "channels" of optical signals can share a single optical fiber simultaneously.



Two heads are better than one and teams can be even better. A three-year ATP project co-funded with the Auto Body Consortium proves the point. ABC, eight small manufacturers that supply the auto industry with assembly processes, has worked in cooperation with General Motors, Chrysler, and two universities to make major improvements in how well auto body parts fit together. "I can't say enough about the wisdom of whoever put together the ATP," says Dwight Carlson of Perceptron, an ABC member. "I would not change anything."

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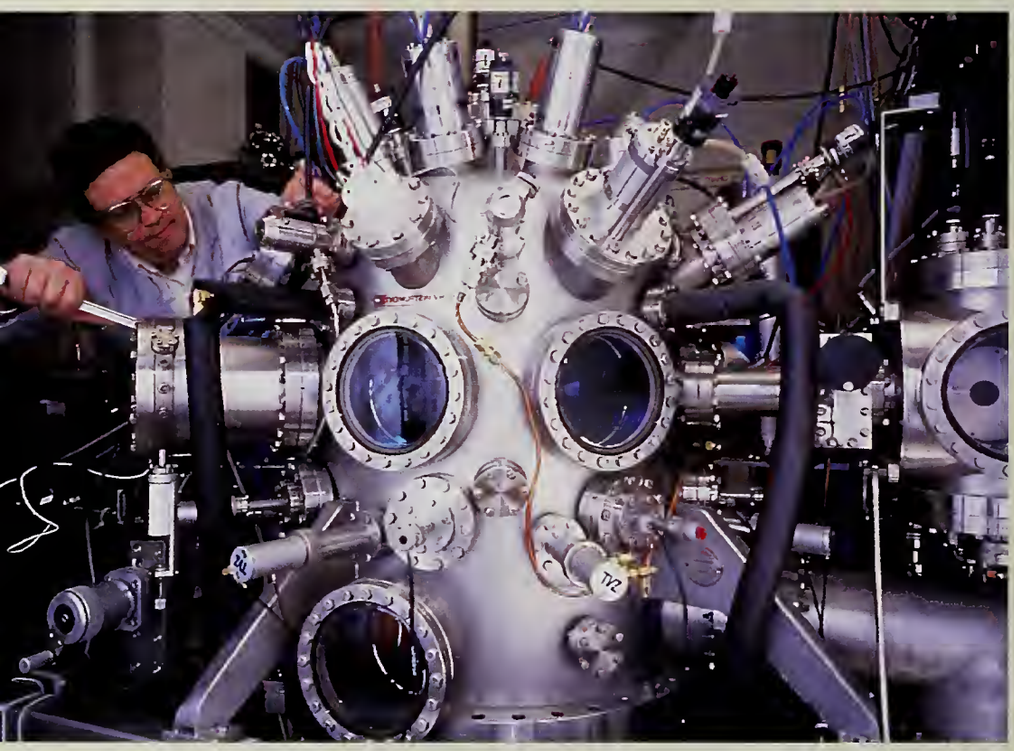

Above. The National Storage Industry Consortium—with about 40 industry members, including Digital Equipment Corp., Eastman Kodak Co., and IBM—won an ATP award to develop multilayer, magnetic read heads that may greatly increase the storage capacity of computer disks. NIST research chemist Bill Egelhoff has helped the consortium better understand how factors such as surface topography affect the materials' performance.

Just as Eagle-Picher Research Laboratory, Miami, Okla., was making major headway in developing a durable, true green light-emitting diode, the company lost a major funding source. Despite a wealth of potential commercial applications for such devices, the company was unable to fund the work on its own. A three-year ATP award helped the company stick with the high-risk project. Soon they hope to be selling the world's brightest, most durable green LEDs.

Engineering Animation Inc., Ames, Iowa, is a small company with big ambitions. It is applying its expertise in computer simulation to create a "virtual human," a three-dimensional, animated computer visualization that can walk, breathe, grasp objects, pump blood, sustain injury, and undergo surgery. According to company president and CEO Matthew Rizai, winning an ATP award was the turning point that helped the company attract additional revenue and grow from five employees to 96 employees. "Today we are a growing company adding high-paying, highly skilled jobs," he says.

Left. The Kopin Corp. is the coordinator of The American Scaled-Electronics Consortium, an ATP award recipient working to apply thin-film integrated circuits to flat-panel displays and multilayered microelectronic devices.

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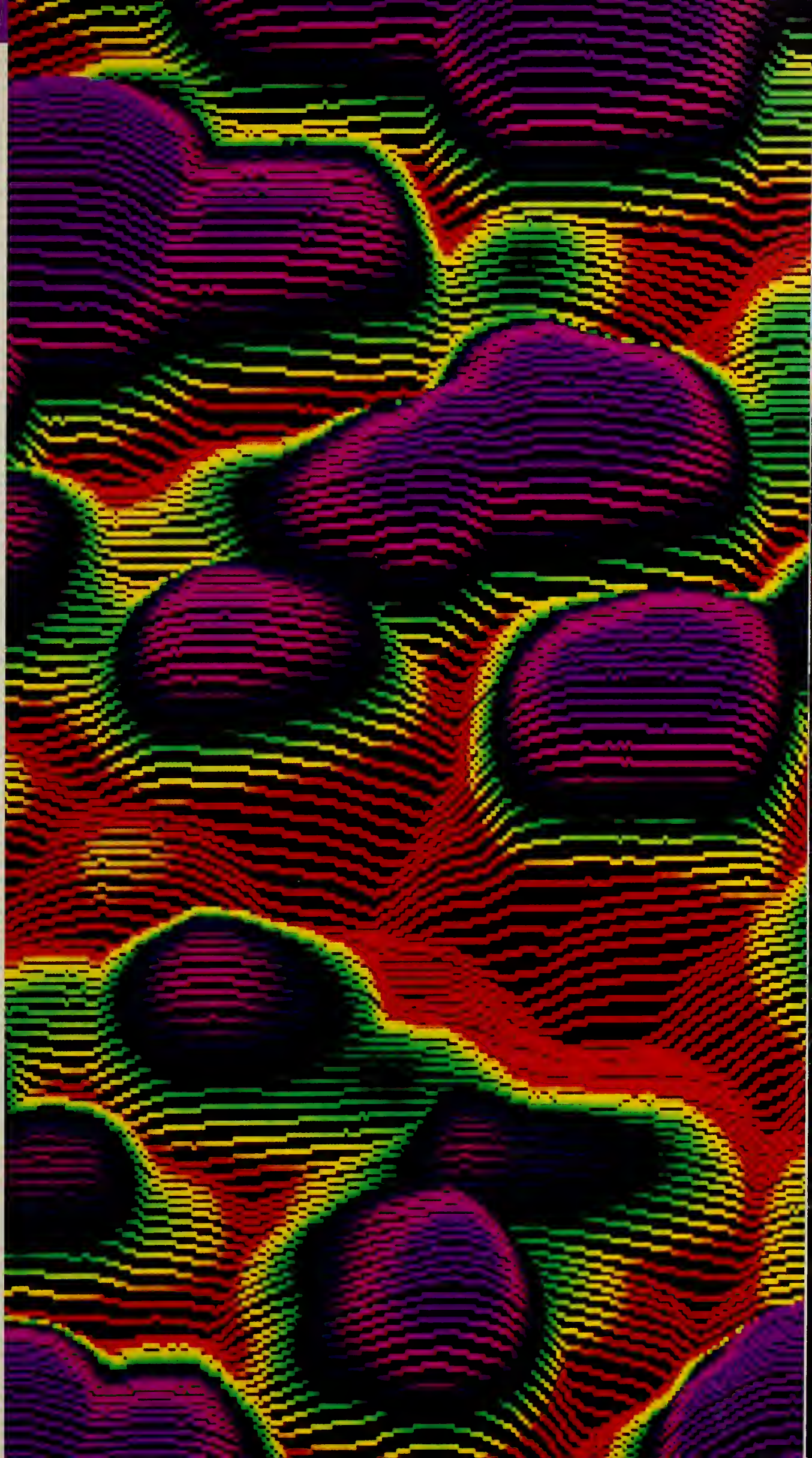
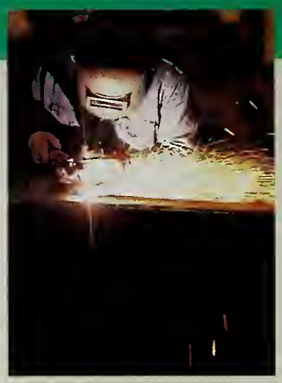
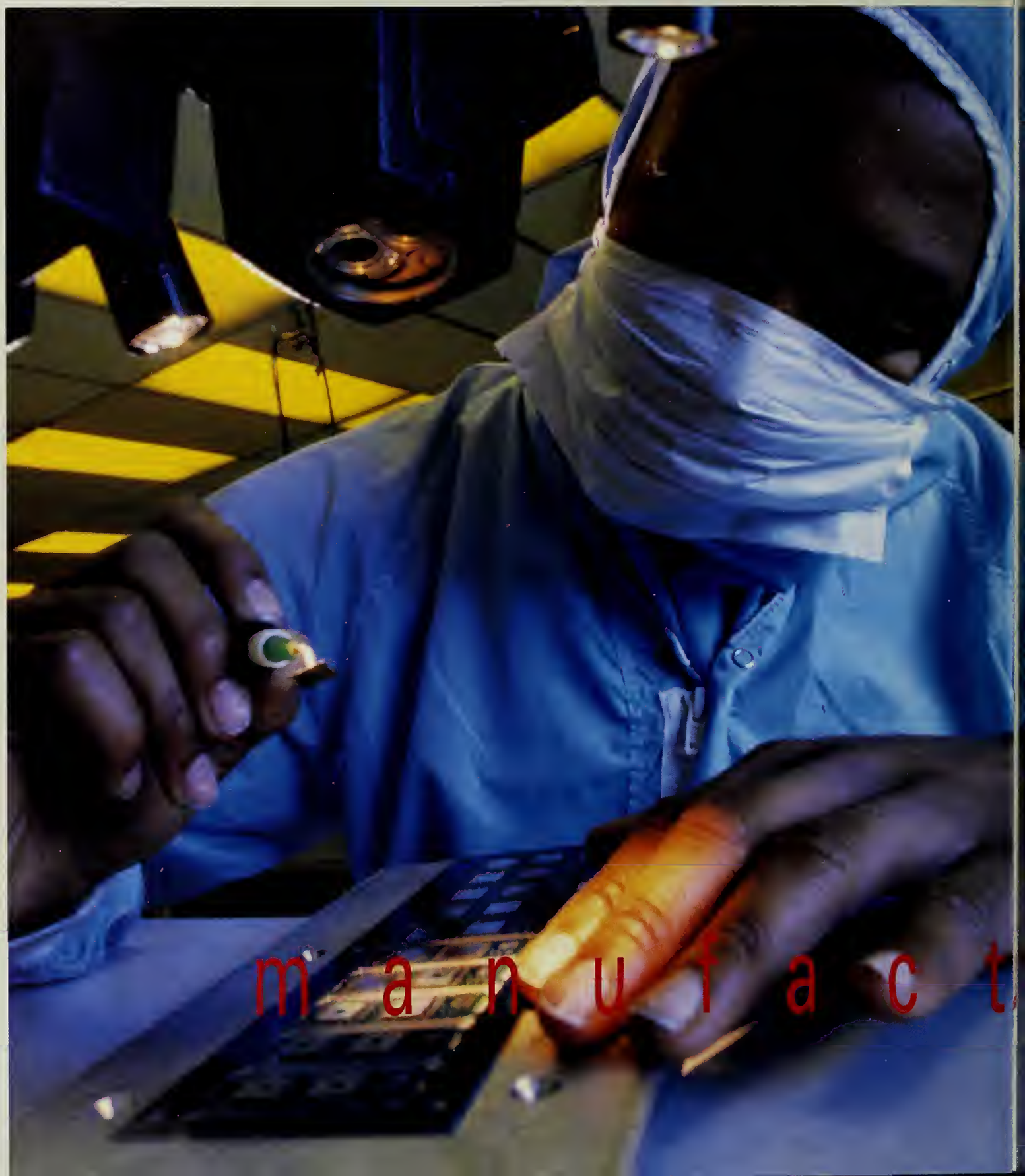
Right. This atomic-force micrograph shows the surface topography of a new type of information storage material under development by Optex Communications Corp., Rockville, Md., with ATP co-funding. The erasable, luminescent material is an enabling technology that allows 18 hours of video to be stored on a single CD-sized disk.





Left. Fairmont Tamper, Columbia, S.C., manufactures heavy-duty railroad maintenance equipment. NIST's extension center in Columbia analyzed a redesigned track lifting and aligning machine and confirmed that the new design met the company's performance goals.

Below. Valtronic Inc., Solon, Ohio, assembles miniaturized electronic circuit boards. The company sought help from the NIST affiliated center in Cleveland, Ohio, while developing a new high-precision machine tool.



There are more than 370,000 U.S. manufacturers with fewer than 500 employees. These small and medium-sized companies account for about 95 percent of all U.S. manufacturing plants and about half of the nation's manufacturing capacity.

The Manufacturing Extension Partnership (MEP) is a nationwide network of affiliated manufacturing extension centers dedicated to helping smaller manufacturers improve their competitiveness by adopting modern technologies and production techniques. Each center is a partnership typically involving federal, state, and local governments; industry; educational institutions; and other sources of expertise, information, and funding support.

Since the MEP's creation in 1989, the number of non-profit extension centers providing smaller manufacturers with hands-on technical assistance has grown rapidly. By the end of 1994, 44 centers were either in operation or getting under way. Most were initiated with funding from the Defense Department's Technology Reinvestment Project. By 1997, plans call for NIST to have established a truly national network with approximately 100 extension centers across the country.

Smaller manufacturers face some unique barriers that hinder their ability to successfully modernize their operations. The MEP links these companies with information and experienced manufacturing experts to help the companies improve their ability to compete. The centers sponsor seminars, training programs, and forums and serve as a conduit for these manufacturers to private consultants, vendors, universities, federal agencies, and other sources of technical help.

The MEP also works with states in the planning and development of coordinated manufacturing extension and modernization programs to serve the needs of smaller businesses. In addition, the MEP supports other projects to bring information, services, and resources to the affiliated MEP centers and to individual companies.

Clipper Diamond Tool Co. Inc., Long Island City, N.Y., was losing customers to Japan and Europe and badly needed modernization. The NIST manufacturing extension center in New York City helped the company get the advice it needed to relocate within the city and to automate its manufacturing and office operations. "Our company has been revitalized," says President Joseph Klipper. "We are once again able to compete both here in the United States and around the world."

Above. Horsburgh & Scott, Cleveland, Ohio, manufactures industrial gears and speed reducers. The company has worked with the NIST extension center in Cleveland on numerous projects to improve its operations.

u r i n g

c o m p e

Left. Working at the NIST affiliated center in Troy, N.Y., Manufacturing Extension Partnership staff members demonstrate the capabilities of a computer-controlled machine tool as it shapes a prototype wax part. NIST extension centers have helped many smaller manufacturers get the advice they need to automate their operations with computer-controlled equipment or computer-aided design and manufacturing systems.

Accuspray Inc., Cleveland, Ohio, manufactures commercial and industrial paint spraying equipment. When the company needed help refining a paint sprayer design, it turned to the NIST extension center in Cleveland. The center put the company in touch with university researchers who helped make the sprayer 50 percent more efficient. The center also recommended changes in plant layout that saved $500,000 in construction costs and shortened lead times for manufacturing the sprayers from 10 days to two.

t i t i v e n e s s

Under its new management, Thomson Berry Farms, Duluth, Minn., was looking for a makeover. The NIST extension center affiliate in Virginia, Minn., helped the company hire an engineering consultant who redesigned the firm's plant layout and suggested other changes that turned the company—in one year—into a profitable enterprise. "Our changes allowed us to cut our labor costs in half," without eliminating any jobs, says CEO Paul Leonidas. "They also helped us go out and seek more business. We have almost quadrupled the production capabilities of the plant."

Above. Located in Canton, Ga., Evenflo makes plastic baby bottles by injection molding. The company receives advice from the NIST extension center in Atlanta, Ga. MEP centers can offer hands-on advice to help smaller companies improve their productivity and competitiveness.

Above. Physical scientist Tinh Nguyen places a sample into an infrared microscope to study factors affecting the failure of plastics used to protect structural steel from corrosion.

NIST laboratory research and services provide the infrastructural technologies, such as measurements, standards, reference materials, evaluated data, and test methods, that U.S. industry needs to continually improve its products and services.

NIST plans and implements its laboratory program in conjunction with U.S. industry through workshops, discussion forums, consortia, and extensive formal and informal cooperative research efforts. It measures the results of its work through feedback from industry about tangible economic benefits. The Institute has participated in more than 500 Cooperative Research and Development Agreements since 1988. Ninety-five percent of NIST CRADA partners are businesses, with about equal numbers of large and small companies participating.

Specific areas of NIST research expertise include electronics and electrical engineering, manufacturing engineering, chemical science and technology, physics, materials science and engineering, building and fire research, and information technology. NIST also provides industry with a wide range of technology services. These include Standard Reference Materials and Data, information on national and international standards, laboratory accreditation, and equipment calibration.

Fiscal year 1995 appropriations for NIST laboratory research and services total $265 million. In addition, NIST has begun receiving appropriations for construction of the advanced laboratory facilities needed to bring the Institute's facilities up to the 21st-century needs of industry.

Above. NIST engineering technician Daniel Sawyer IV calibrates an articulating arm coordinate measuring machine, a tool widely used in the automotive and aircraft industries. NIST is working with industry to develop national standards for evaluating the performance of such machines.

Precise control of fiber diameters is a critical factor in the quality of connections for the $2 billion optical fiber industry. A recently issued NIST Standard Reference Material has helped the industry reduce uncertainty in its measurements of fiber diameters by a factor of 10. "The opportunity to work with NIST on this project," says Jan Suwinski, executive vice president of Corning Inc., Corning, N.Y., "gave Corning and other American fiber manufacturers a clear competitive advantage."

Left. Research chemists Angela Hight Walker and Richard Suenram use a NIST-developed microwave spectrometry system to identify trace gases commonly found in automotive emissions. The spectrometer is much faster and easier to use than current emission analysis methods.

Left. Reliable "pocket chemistry" is the goal of NIST work to develop miniaturized environmental and medical sensors. Research chemist Brigitte Ramos transfers a holographic grating onto a glass wave guide.

Background. This DNA profile was made using the polymerase chain reaction (PCR) method, a technique that allows analysis of a suspect's DNA even if only a few cells are available. NIST has developed a Standard Reference Material to help ensure the quality of PCR laboratory tests.

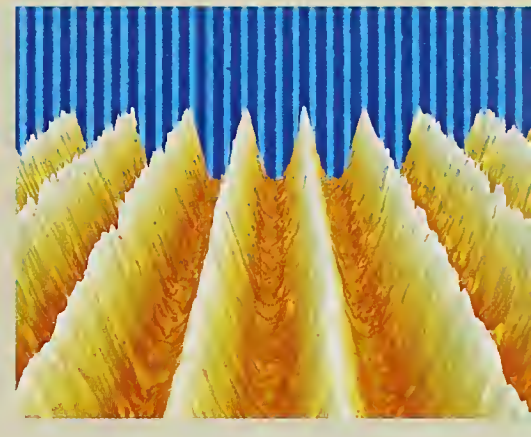
s u r e m e n t

Internal jet engine parts must perform flawlessly while exposed to hot, corrosive gases and rotating hundreds or thousands of times per minute. In 1987, NIST joined forces with a consortium of companies to improve understanding of the metal powders used in making these and other high-performance parts. A computer model developed during the project helped consortium member companies optimize their powder metallurgy processes. One company, Crucible Compaction Metals, improved its percentage of usable powder produced by over 40 percent while reducing operating costs.

r e s e a r c

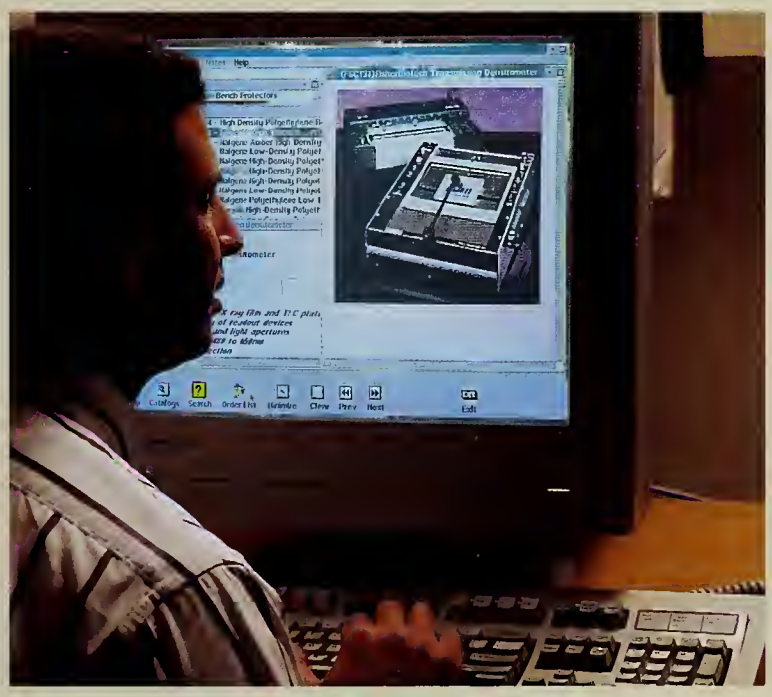
Left inset. Research engineer Rob Gettings studies the effect of machining on the strength of a ceramic test sample. NIST is working with a 20-member consortium of companies and universities to optimize the machining process for different ceramic materials.

Left. The NIST Cold Neutron Research Facility is among the best places in the world to study materials properties using neutrons. These multiple images were made looking down polished nickel guide tubes that direct the "cold" or slowed down neutrons from the NIST reactor core to a wide variety of scientific instruments.



Above. Using a laser-based technique called atom optics, NIST physicists laid these narrow rows of chromium atoms (only one-thousandth the width of a human hair) on a silicon surface. The technique opens new avenues for creating smaller, faster microelectronic devices.

Left. Measurements of light intensity, color spectra, and other variables provide objective indicators for judging the performance of video displays. NIST physicist George Jones positions a flat-panel television set within a 2-meter-wide hemisphere used in making such measurements.



Left. NIST is working with more than 25 vendors to implement paperless systems to streamline government procurement. Computer scientist John Garguilo demonstrates use of an electronic catalog. Additional applications for electronic commerce include transfer of health-care records and of manufacturing specifications.

Below. A 1993 Malcolm Baldrige award winner, Eastman Chemical Co. of Kingsport, Tenn., employs more than 17,000 people and produces more than 400 different chemicals, fibers, and plastics. Quality management principles—such as a strong focus on customers' needs—are woven throughout the company's business activities.

quality

The Malcolm Baldrige National Quality Award has quickly become both the U.S. standard of quality achievement and a comprehensive guide to quality improvement. Congress established the award in 1987 to promote quality awareness, to recognize the quality achievements of U.S. companies, and to publicize successful quality strategies. In conjunction with the private sector, NIST developed and manages the award program. Two awards may be given annually in each of three categories: manufacturing, service, and small business. Planning is under way to extend the benefits of the Baldrige award to the health-care and education communities.

Applicants for the award undergo an extensive evaluation by an independent review board of private- and public-sector quality experts. Examiners rate applicants on seven key criteria: leadership, information and analysis, strategic planning, human resource development and management, process management, business results, and customer focus and satisfaction. Facts, not flash, are needed to make it through the tough screening process.

A General Accounting Office report calls the award criteria, "the most widely accepted formal definition of what constitutes a total quality management company." About 1 million copies of the criteria have been distributed worldwide, and thousands of organizations are using the criteria as a quality improvement road map.

Above. Ames Rubber Corp., Hamburg, N.J., also won the Baldrige award in 1993 and employs about 500 people. Ames manufactures rubber rollers for office copiers and specialized parts for front-wheel-drive vehicles. Its quality management efforts resulted in dramatic improvements in reducing defect rates, increasing productivity, and improving profitability.

Wainwright Industries manufactures stamped and machined parts for the automotive, aerospace, home security, and information-processing industries. A 1994 Baldrige award winner, the company credits its quality management efforts with streamlining of its requisition procedures, a 35 percent reduction in product cost, a tenfold reduction in defect rates, and an improvement in on-time delivery to nearly 100 percent.

Left. The NIST Biomonitoring Specimen Bank stores thousands of tissue samples (e.g., human liver, oysters, and whale blubber) for monitoring long-term pollution and health trends. Here, biologist Barbara Koster removes a container of samples for analysis.

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Organizational Contacts

General Inquiries
(301) 975-3058
inquiries@enh.nist.gov

Advanced Technology Program
(800) ATP-FUND
atp@micf.nist.gov

Manufacturing Extension Partnership
(301) 975-3593
mepinfo@micf.nist.gov

Malcolm Baldrige National Quality Award
(301) 975-2036
oqp@micf.nist.gov

Laboratory Programs

Electronics and Electrical Engineering
(301) 975-2220

Manufacturing Engineering
(301) 975-3400

Chemical Science and Technology
(301) 975-3145

Physics
(301) 975-4200

Materials Science and Engineering
(301) 975-5658

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Technology Services:

Standards Information Center
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Additional Information on NIST Programs

The following free publications are available by sending a self-addressed mailing label to: Public Affairs, Administration A903, NIST, Gaithersburg, Md. 20899-0001 or by faxing your request with your name and address to (301) 926-1630.

Guide to NIST, 116 pgs.—a comprehensive catalog providing details and contact information on more than 250 separate program activities.

NIST Industrial Impacts: A Sampling of Successful Partnerships, 80 pgs.—a compilation of 32 brief case studies describing NIST/industry cooperative efforts.

Setting Priorities and Measuring Results at the National Institute of Standards and Technology, 38 pgs.—a description of how NIST matches its programs to industrial needs and evaluates impact.

Technology at a Glance, quarterly, 4 pgs.—a lay-language newsletter providing updates about NIST award programs, extension services, and research results.

NIST also provides extensive information on its programs through the Internet Gopher and World Wide Web systems.

Gopher system access: telnet to **gopher.nist.gov**. At the log in prompt type **gopher**. (Gopher clients may use the NIST server: **gopher-server.nist.gov**.)

World Wide Web access: http://www.nist.gov/item/NIST_GUIDE.html.

f o r m a t i o n

U.S. Department of Commerce
Ronald H. Brown, Secretary
Mary L. Good, Under Secretary
for Technology

National Institute of Standards and Technology
Arati Prabhakar, Director

National Institute of Standards
and Technology
Gaithersburg, Md. 20899-0001
(301) 975-2000
Boulder, Colo. 80303-3328
(303) 497-3000

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SP 875 Staff
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Writer/Editor: Gail Porter
Graphic Design: Beverige Seay
Production: Virginia M. Covahey
Printing Coordination: Warren
Overman

Public Affairs Division
A903 Administration Bldg.
National Institute of Standards
and Technology
Gaithersburg, Md. 20899-0001
(301) 975-2758

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Above. Electronics engineer Katherine MacReynolds readies an antenna for near-field measurements. Developed by NIST, the indoor technique allows accurate characterization of the performance of large antennas.

NIST

National Institute of Standards and Technology

Gaithersburg, Maryland
20899-0001

(301)975-2000

Boulder, Colorado
80303-3328

(303)497-3000