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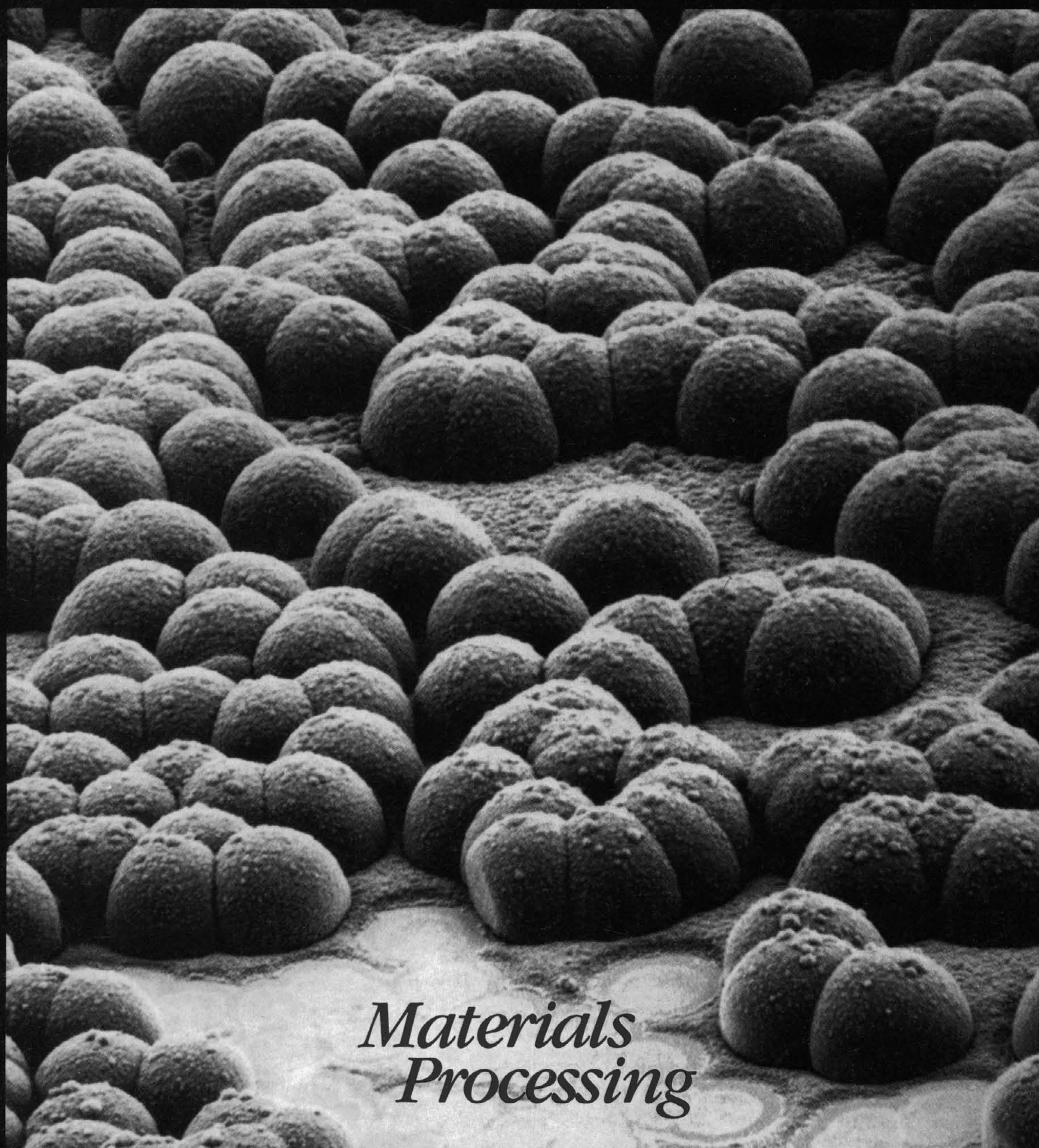

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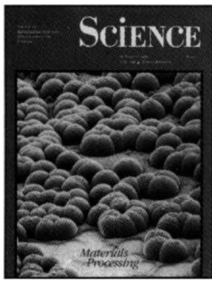
■ The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.



COVER Polycrystalline diamond balls grown at high supersaturation using combined hot filament and microwave plasma-assisted deposition. The source gas was 1.5% methane in hydrogen at 10 torr. The diameter of the balls is approximately 18 micrometers. See page 913. [Scanning electron microphoto is courtesy of Thomas Anthony, General Electric Corp., Schenectady, NY]

AAAS Meetings

Book Reviews

Products & Materials

This Week in SCIENCE

Possible source of missing ozone

CURRENT models of ozone photochemistry do not completely explain the distribution of ozone in the upper atmosphere in the region from 50 to 80 kilometers because more ozone is present than the models can account for. The models are low by a factor of 1.5 to 2. Slanger *et al.* (page 945) have experimental results from laboratory work that may explain the source of excess ozone. Unfocused 248-nanometer KrF excimer laser irradiation of pure oxygen was used to generate large densities of ozone by an unexpected mechanism. Initially, the radiation produces a small amount of O_3, which then strongly absorbs the 248-nm irradiation, dissociates, and yields vibrationally excited O_2. The excited O_2 species absorbs more photons and dissociates for a total yield of three oxygen atoms for each O_3 molecule initially destroyed. Recombination of this atomic oxygen yields ozone in an autocatalytic process. A preliminary analysis indicates that such a mechanism might operate in the upper atmosphere, but more data are needed to evaluate this possibility. Users of KrF lasers also need to know that O_3 is produced at 248 nm, a wavelength not previously known to generate ozone from oxygen.

Enhancing nitrogen fixation

A species of *Pseudomonas* produces a toxin, tabtoxinine-β-lactam, that inhibits glutamine synthetase; infection by this pathogen kills many species of nonleguminous plants. Infestation of alfalfa roots and nodules by this *Pseudomonas* does not kill the alfalfa plant but significantly increases plant growth, nitrogen fixation, total assimilated nitrogen, and nodulation (page 951). Nitrogen-fixing nodules form on roots of alfalfa plants after infection with the legume symbiont *Rhizobium melilota*. These nitrogen-fixing bacteria reduce N_2 to ammonia, which is assimilated by the plant in a reaction catalyzed by glutamine synthetase. Knight and Langston-Unkefer found that infestation of nodules by the pseudomonad and subsequent release of tabtoxinine-β-lactam reduced glutamine synthetase activity of the plant fraction of the nodule by half, but the *Rhizobium* fraction of synthetase activity in the nodule remained intact.

Incommensurate superconducting structures

UNDERSTANDING the superconducting properties of the 2212 phase of the Bi-Sr-Ca-Cu-O system has been slowed by the complexity of its structure. The x-ray diffraction pattern of crystals of this superconductor shows satellite reflections, indicating either that positions of atoms in unit cells vary (modulate) along crystallographic directions or that substitution of atoms occurs. The structure is known to consist of a series of layers perpendicular to the *c*-axis including four Cu-O layers per unit cell. A mixed Sr-Ca layer is sandwiched between each pair of Cu-O layers. Gao *et al.* (page 954) have determined that the positions of Bi and Sr are modulated along both the *c*-axis and the *a*-axis; Cu is modulated along only the *c*-axis. For all modulations the modulation is incommensurate, that is, the structure cannot be described on a unit cell that is a multiple of the basic unit cell. The large displacements of Cu atoms found might be related to the superconducting properties of the compound, because the Cu-O-Cu angles are of importance in determining the strength of the antiferromagnetic superexchange coupling between certain Cu electrons. A decrease in this angle reduces the coupling and would increase the transition temperature T_c, according to some explanations of the superconducting mechanism.

Cofactors for neurotoxicity

THE Chamorro people of Guam have a high incidence of amyotrophic lateral sclerosis (ALS) with features of parkinsonism and Alzheimer-type dementia. The uncommon amino acid β-*N*-methylamino-L-alanine (BMAA) present in an indigenous food plant has been implicated in the pathogenesis of this disease. Just how BMAA exerts its neurotoxicity is not clear, because it lacks the terminal acidic or electronegative moiety characteristic of other excitatory amino acids. Weiss and Choi (page 973) found that BMAA requires physiological concentrations of bicarbonate ions to exert its toxic effects in cultured neurons. They propose that bicarbonate ions interact with BMAA to produce a structure suitable for glutamate receptor activation, perhaps by an interaction between a positively charged β-amino group of BMAA and the bicarbonate. This structure may approximate the active acidic or electronegative group of other glutamate agonists. The findings may have implications for sporadic forms of ALS and Parkinson's disease, as well as in the search for factors that may not be structurally recognizable as glutamate agonists but that nevertheless have neurotoxic effects.

Building a folding protein

IF it were known how the primary amino acid sequence of a protein determines its three-dimensional structure, macromolecules could be designed with any desired structure or property. Regan and DeGrado have taken a step toward this goal by designing an amino acid sequence that forms a helical protein in solution (page 976). The protein consists of four identical helices that are connected by three identical hairpin loops. The structure is related to naturally occurring four-helix proteins such as myohemerythrin, cytochrome c′, and growth hormone. The artifical gene encoding the designed protein was assembled from DNA oligonucleotides, inserted into a plasmid, and expressed in a bacterial system. The purified product was, in fact, compact, globular, monomeric, and alpha-helical. The folded conformation of the protein was extraordinarily stable toward denaturation.

The solid favorite.

Photomicrographs courtesy of Buehler Ltd.

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SCIENCE

19 AUGUST 1988
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High-Tech Materials Processing

The pace of research and development of high-tech materials continues to be impressive. Four articles in this issue provide a glimpse of the progress being achieved in microelectronic devices, artificial diamonds, and high-temperature superconductors. All of the articles deal with technologies having potential for large economic impacts. This is particularly true of the microelectronics involved in the $400-billion information-processing industry.

In the past, advances in microelectronics were a major contributor to the 20 to 30 percent annual reduction in the cost of computing that has characterized the last three decades. During that time, the number of circuits per chip increased from 1 to 100,000. Today chips contain as many as 10^6 memory bits. A group of authors from IBM tell us that straight ahead progress is expected for at least the next decade. Their article suggests how the trend to more circuits per chip will be achieved. For the immediate future, new additional photon beam–controlled processes will be used with more process steps and ever more finely patterned lateral dimensions and smaller vertical dimensions. The optical lithography currently practiced with resolutions down to about 1 micrometer will be extended to about 1/3-micrometer resolution, which the authors state will be sufficient to fabricate 100-megabit DRAM memory chips (5000 typewritten pages of text per chip).

Means of producing much more finely structured chips have already been explored. They involve use of electron beams that can be focused into spots a few angstroms in diameter. A chip has been produced containing circuits of field effect transistors with gates as short as 70 nanometers. The dimensions correspond to densities that will allow 1 billion memory bits per chip in the future. Improvements arising from tinier lateral dimensions will be supplemented by shortening vertical dimensions through epitaxial growth of thin layers. Excellent equipment for monitoring the structure of such chips is available in the form of the scanning electron microscope and the scanning tunneling microscope.

The other three articles on processing describe developments that are in early stages. Using ion beams 10^5 times more intense than those employed in doping semiconductors, White and Short have demonstrated the feasibility of creating mesotaxial growth of conducting layers within silicon semiconductors. When a beam of 200–kiloelectron volt cobalt ions strikes silicon crystals, the cobalt atoms come to rest at a range of distances from the surface. However, annealing the chip at 1000°C results in a migration of cobalt atoms against the concentration gradient to form a thin, single-crystal layer of $CoSi_2$ within both (111) and (100) silicon. An insulating layer of SiO_2 within silicon has been formed by a similar technique employing a beam of oxygen ions.

The formation of diamonds and diamondlike hydrocarbons at ambient pressure is described by Angus and Hayman. Because of the superior properties of diamonds, these products will have substantial practical applications. Diamonds grown on a substrate held at about 900°C from a vapor containing active small hydrocarbons and atomic hydrogen show the hardness and thermal conductivity of natural diamonds. Diamondlike hydrocarbons are formed when 50– to 200–electron volt hydrocarbon ions hit a substrate. The films formed, which can have a hardness approaching that of diamonds, may contain 20 to 30 atomic percent hydrogen and may be deposited on large areas at rates as high as 80 micrometers per hour. Their permeability to organic solvents and inorganic acids is extremely low. When the films are annealed at 400°C, they become more diamondlike in their electrical conductivity.

The fourth article, by Murphy and colleagues, reviews processing techniques for the $Ba_2YCu_3O_7$ high-temperature superconductor. The authors point out that attaining a high critical temperature is only one requirement. It is relatively easy to produce material that exhibits some magnetic field exclusion and zero resistance at temperatures above the boiling point of liquid nitrogen (77 K). But no one has yet produced material that has a large critical current and is in a form suitable for most desirable applications. The authors describe various synthetic processes and progress in producing desired shapes such as films and wires. However, they concluded, "The eventual use of the new superconductors may require new processing techniques as innovative as the discovery of the materials themselves."

—PHILIP H. ABELSON

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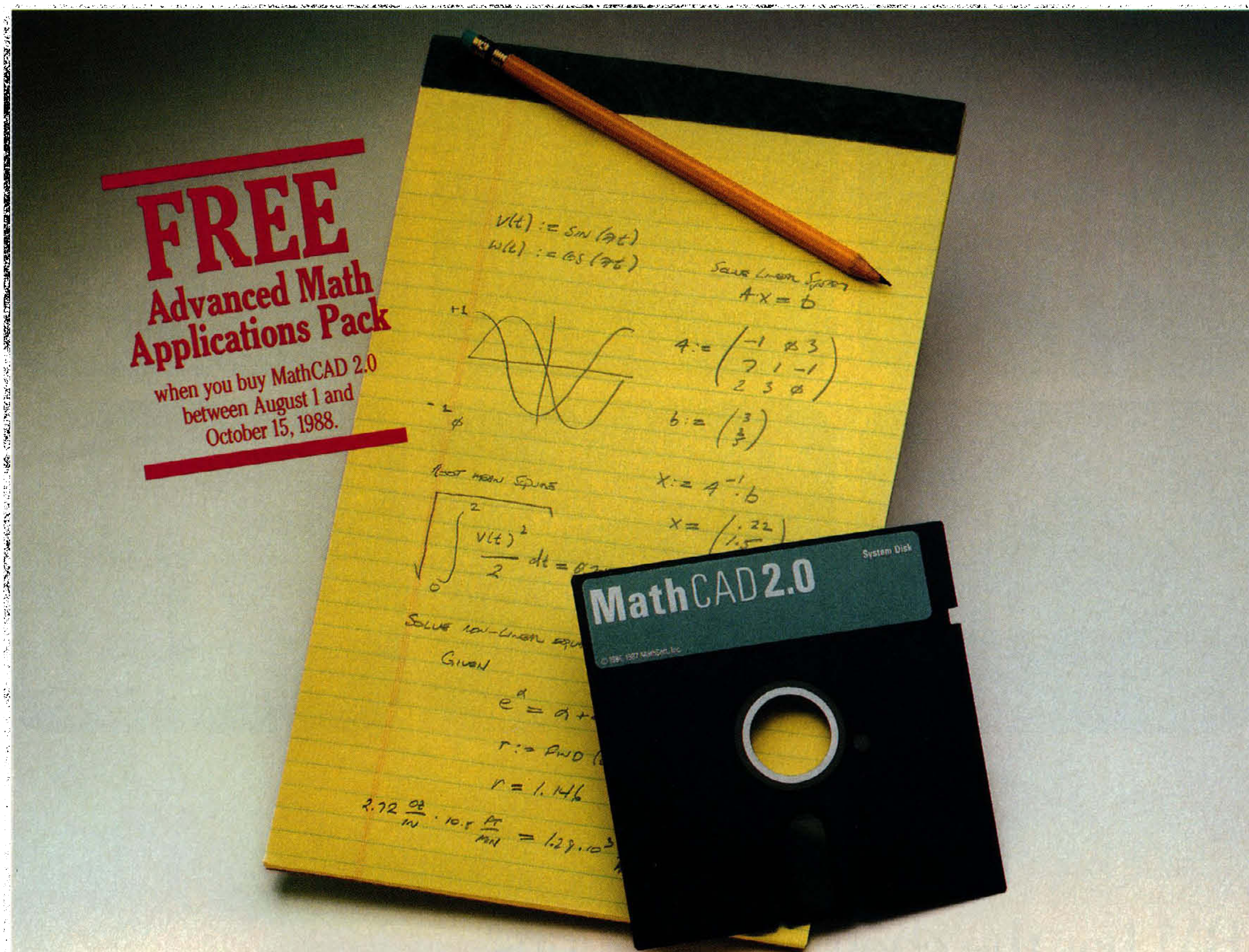
No nomination form is required, but all nominations should be typed and should include the following information: nominee's name, address, institutional affiliation and title; a brief biographical resume; and a statement of justification for the nomination. Organizational nominations should include information about the nature, form and work of the organization. All nominations must include the name, address and telephone number of the individual making the nomination.

Nominations, as well as questions about the award, should be addressed to Dr. Albert H. Teich, Head, Office of Public Sector Programs, AAAS, 1333 H Street, N.W., Washington, D.C. 20005. (Telephone 202/326-6600)

Deadline for receipt of nominations is *November 15, 1988.*



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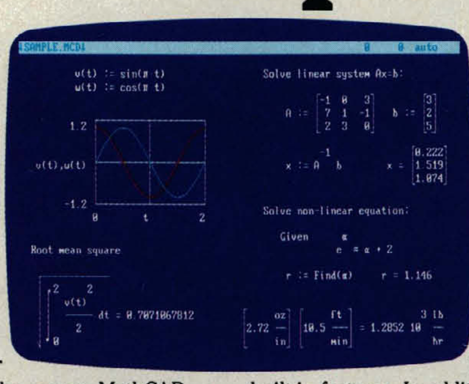

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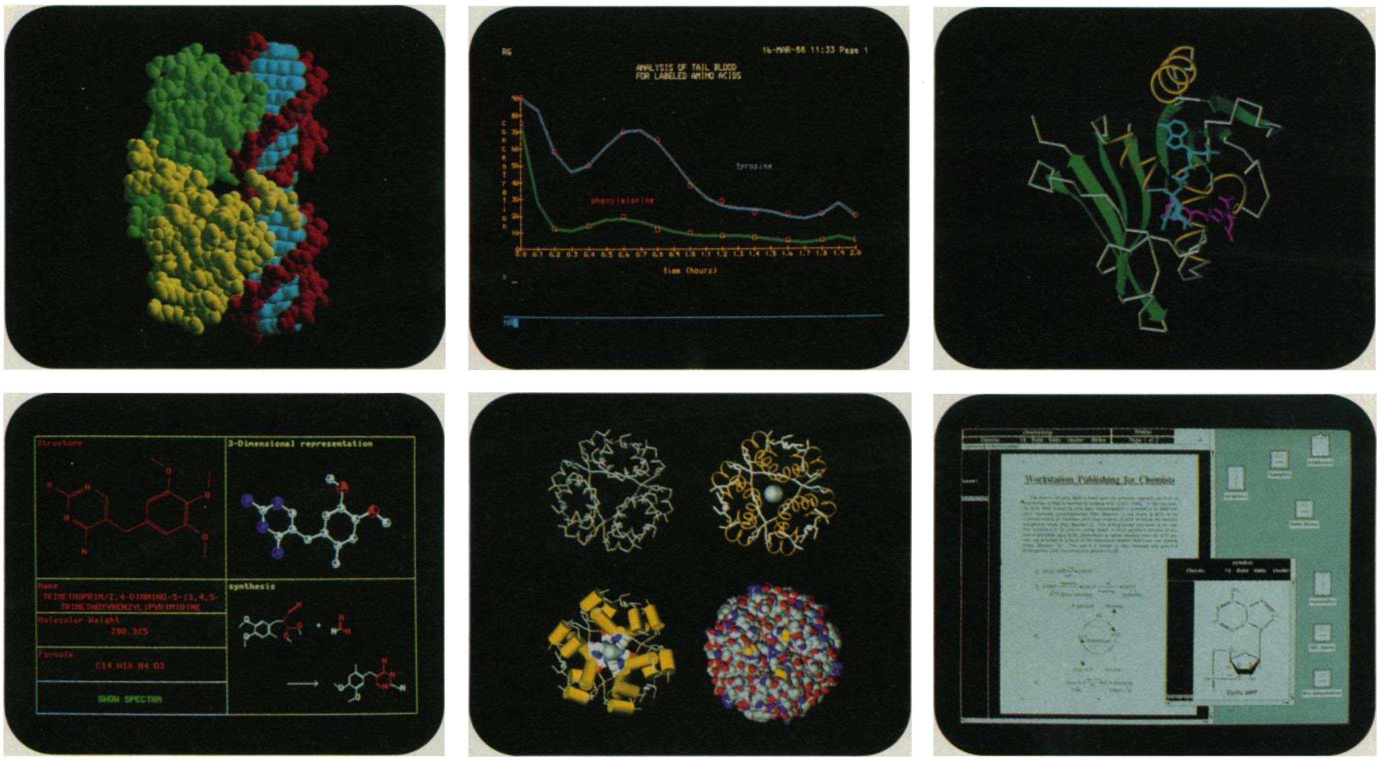

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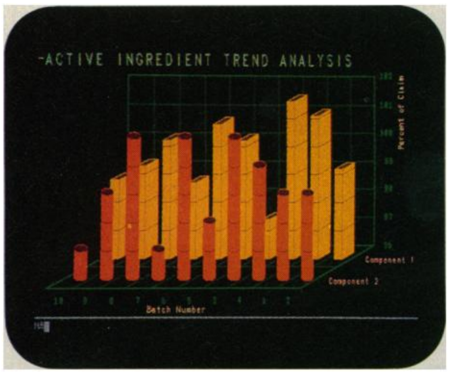
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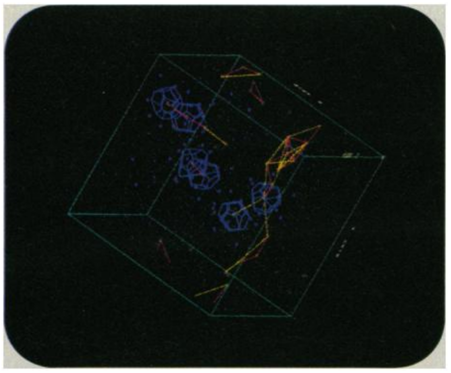
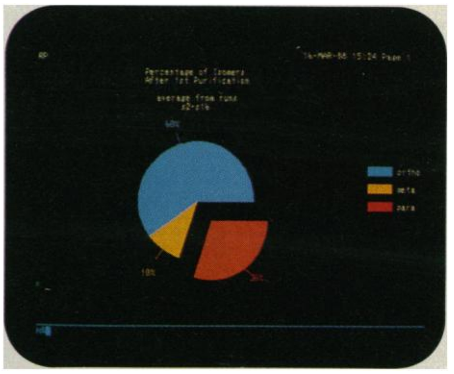
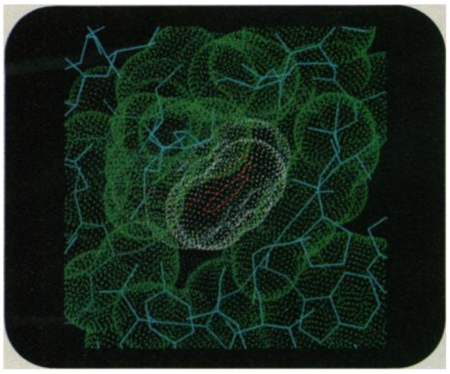
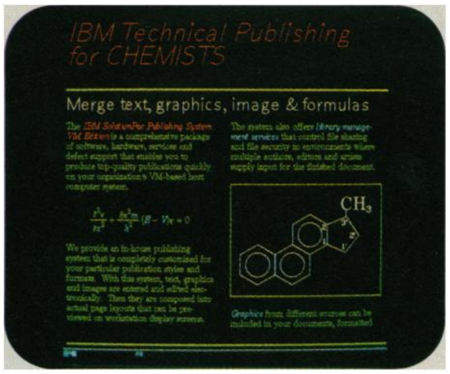
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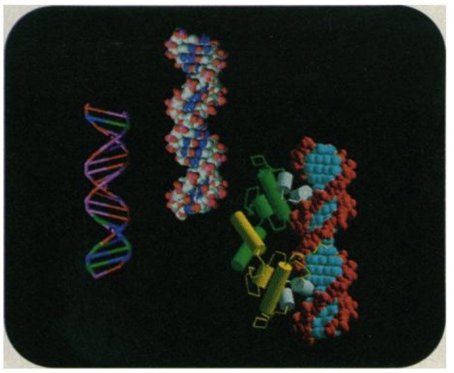

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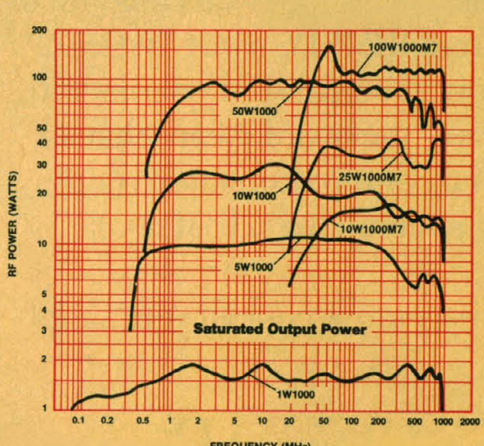

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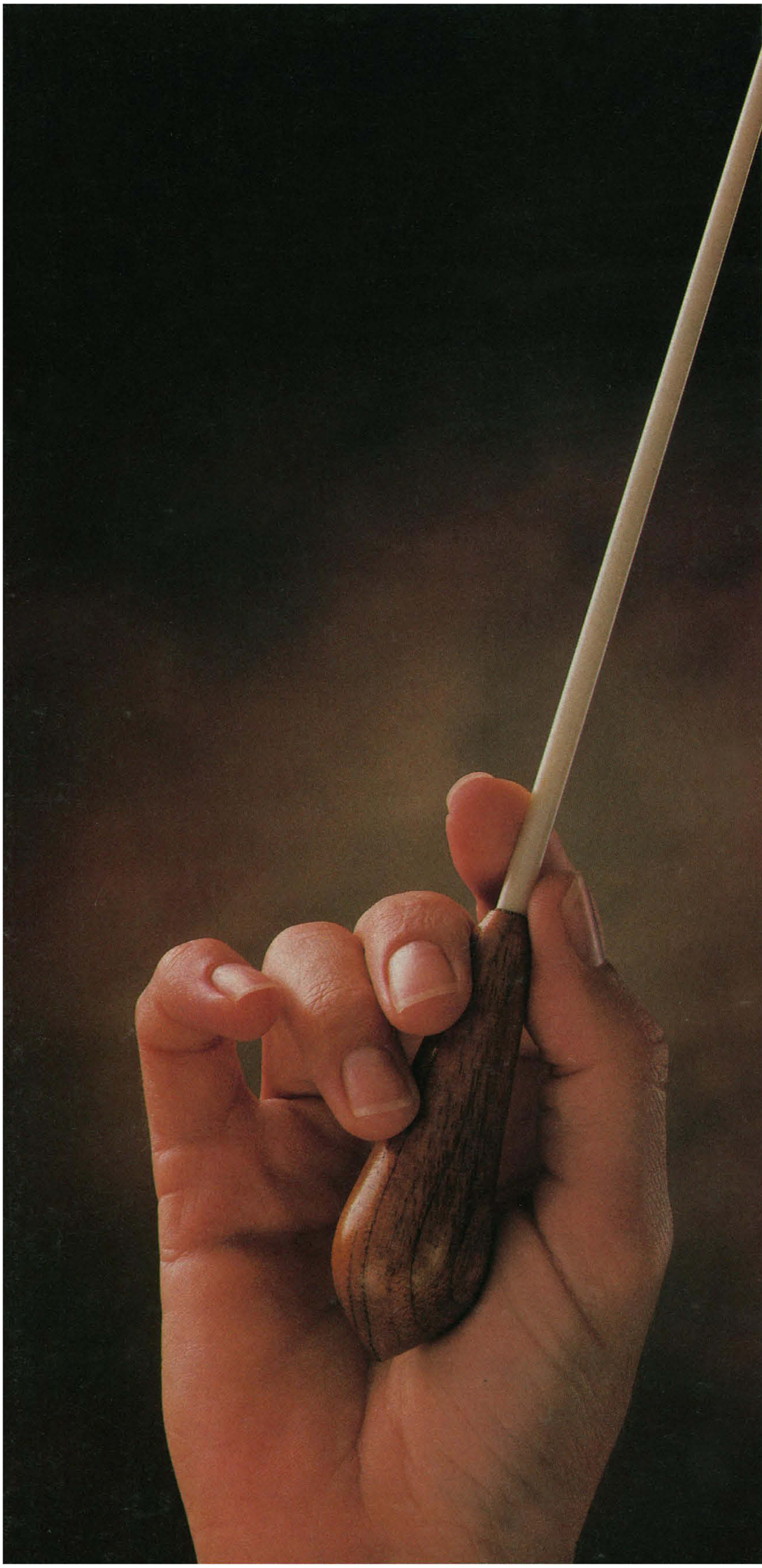

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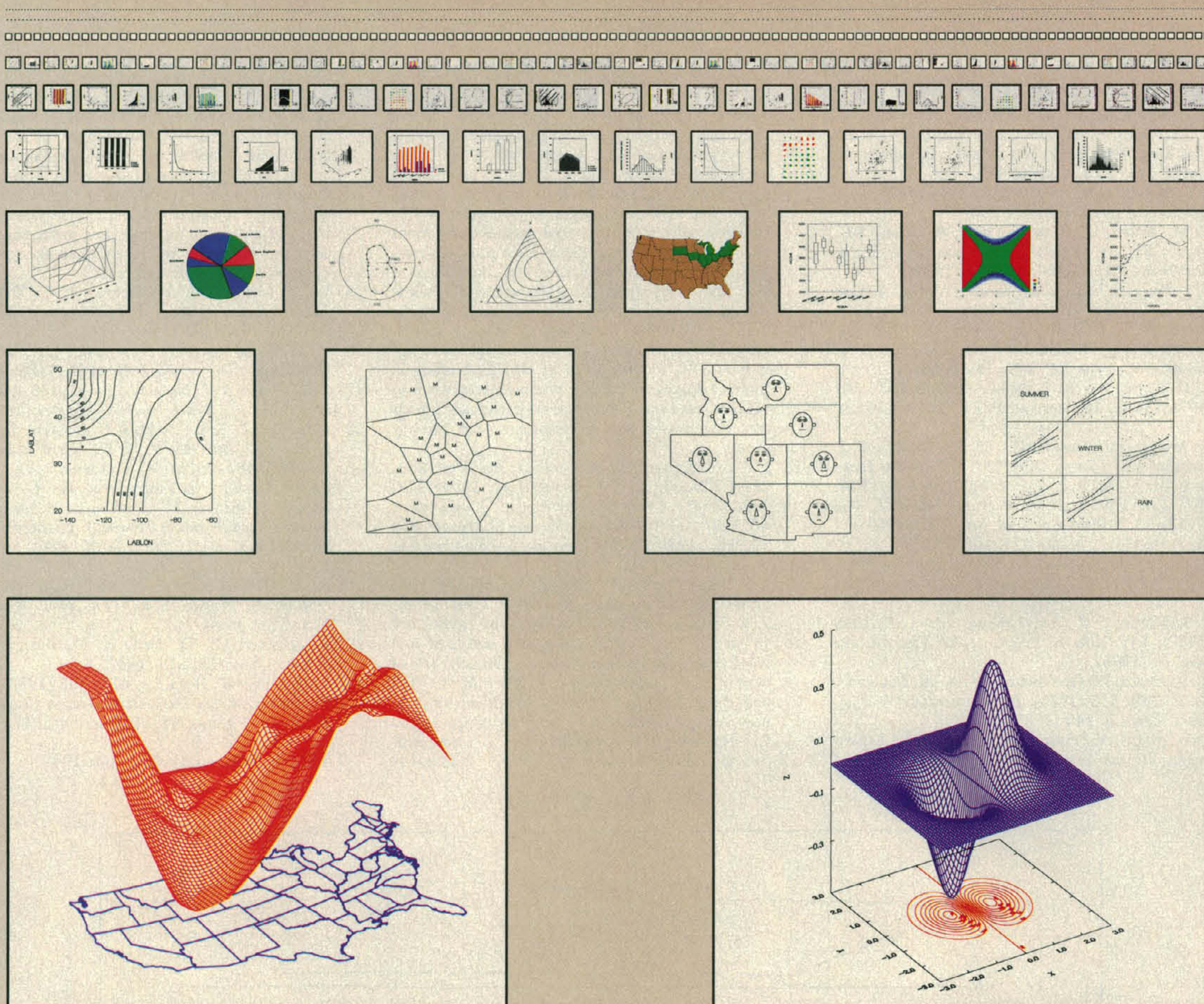

4th Annual AAAS Forum for School Science

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Program

Friday, 7 October

7:30 AM Registration

8:30 AM Welcome and Introduction

Walter E. Massey, *Vice President for Research and for Argonne National Laboratory, University of Chicago; President, AAAS*

Audrey B. Champagne, *Senior Program Director, AAAS Forum for School Science*

8:45 AM The Economic Connection

Sidney Topol, *Chairman of the Board, Scientific Atlanta Incorporated; Member, Executive Committee, Council on Competitiveness*

9:30 AM Educating Teachers

Franklyn Jenifer, *Chancellor, Massachusetts Board of Regents of Higher Education*

10:15 AM Break

10:45 AM The Role of the State Legislature

David Wright, *Majority Policy Chairman, Pennsylvania House of Representatives*

11:30 AM Science Teacher Supply and Demand

Linda Darling-Hammond, *Director, Center for the Study of the Teaching Profession, RAND Corporation*

12:15 PM Luncheon

2:30 PM The Role of State Education Agencies in Restructuring Education

Frank Newman, *President, Education Commission of the States*

Continued on next page.

Continued from previous page.

Advance Registration Form

4th Annual AAAS Forum for School Science

7–8 October 1988 ✦ Twin Bridges Marriott, Arlington, VA

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No refunds will be made for cancellations received after 22 September.

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AAAS Forum '88 ✦ 7–8 October 1988

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Other occupants of room: Name ______________ Name ______________

Special housing needs due to handicap: ______________

Room: ☐ Single ($70)* ☐ Double ($70)* ☐ Twin ($70)* *Add 4.5% VA sales tax and 5% occupancy tax.

Arrival: Date ______ Time ______ **Departure:** Date ______ Time ______

Please list definite arrival and departure dates and times. Check-in time is 4:00 p.m.; check-out time is 1:00 p.m. Reservations will be held until 6 p.m. only unless guaranteed by one of the credit cards below or one night's deposit is received. Failure to cancel 24 hrs. prior will result in one night's charges.

☐ American Express ☐ Diner's Club Card number ______________ Expiration date ______

☐ VISA ☐ MasterCard Cardholder's signature ______________

☐ Deposit (check) for $ ______ enclosed. Make check payable to Twin Bridges Marriott Hotel.

Mail bottom half (hotel reservation form) to: Reservations, Twin Bridges Marriott
333 Jefferson Davis Hwy., Arlington, VA 22202