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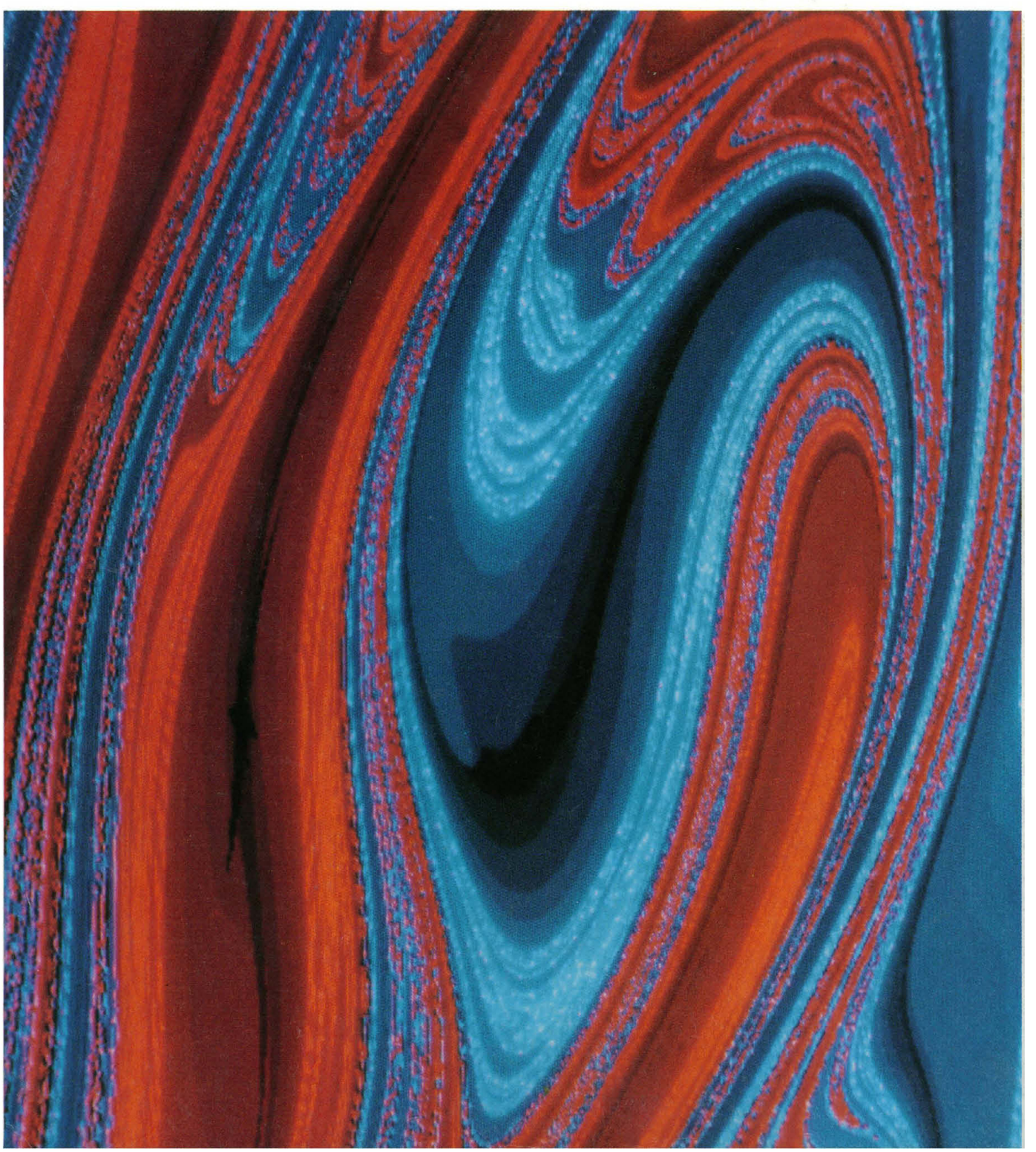


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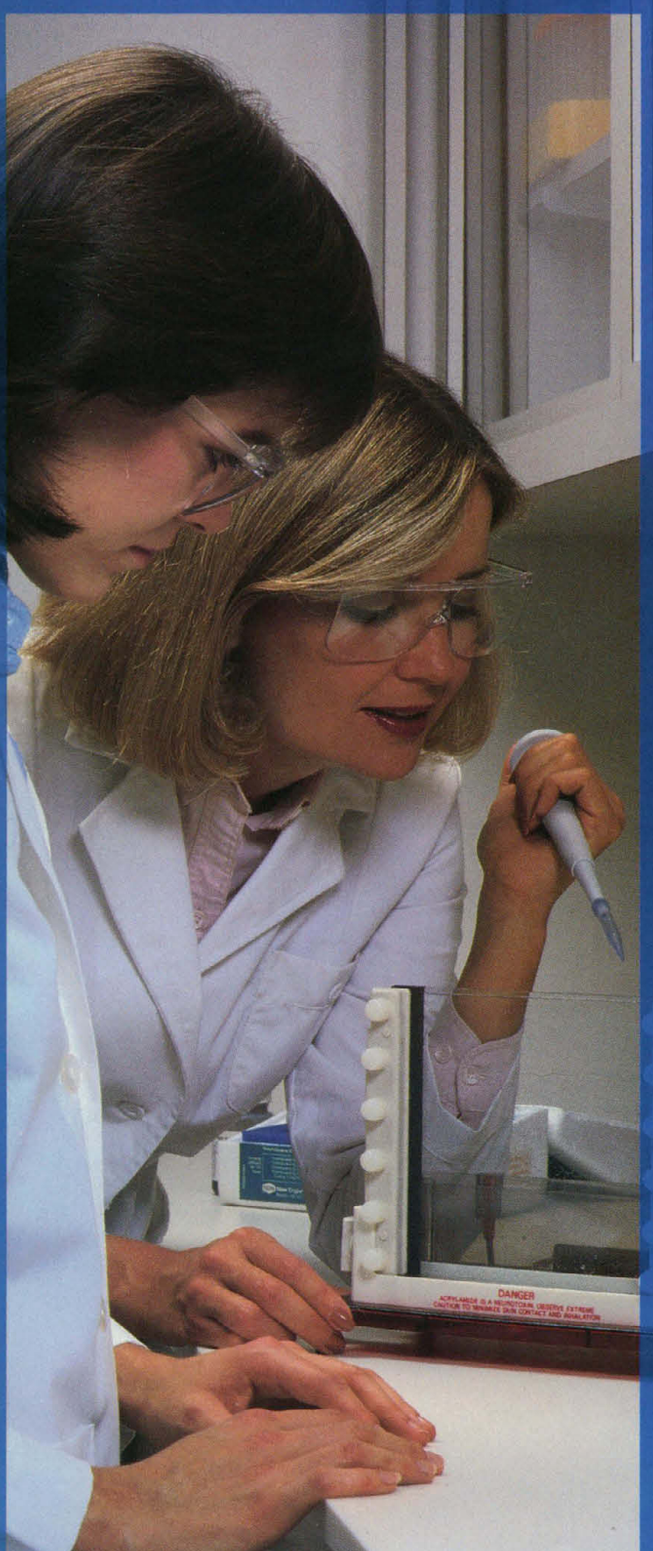

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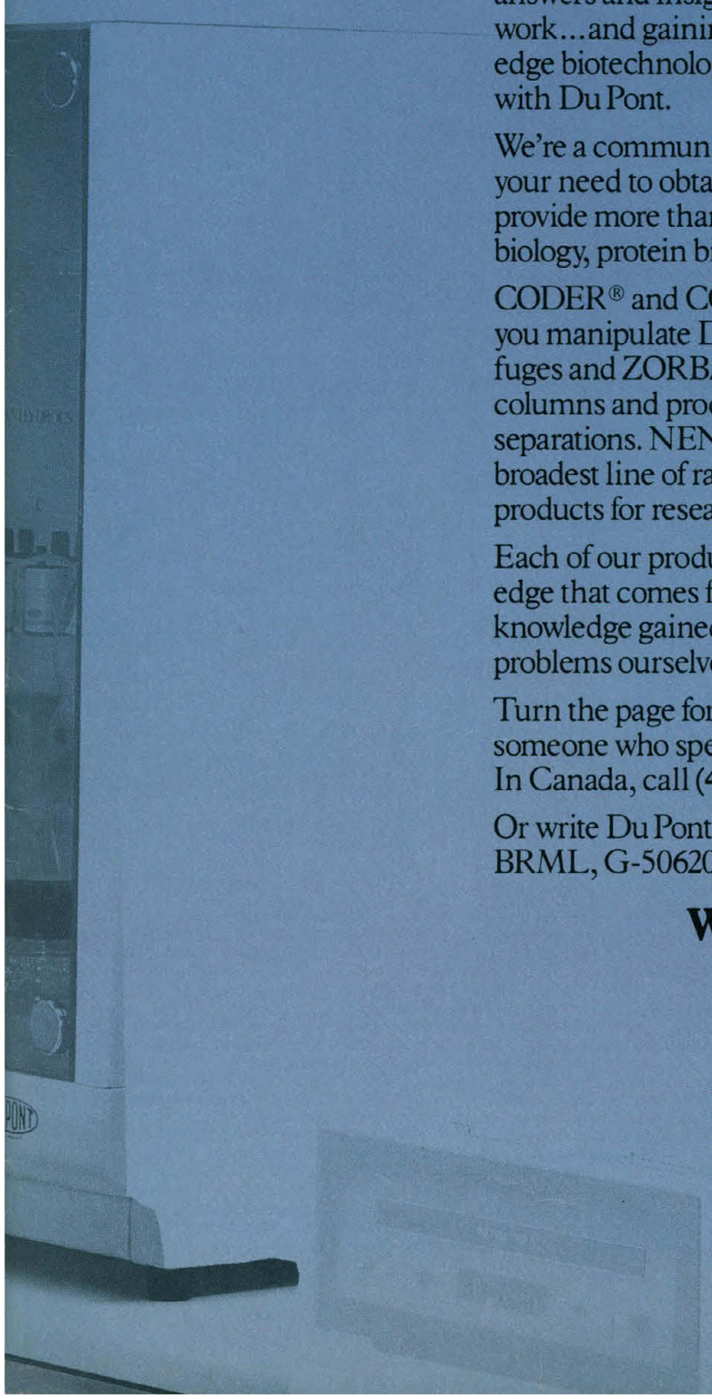

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COVER Even systems as simple as a periodically forced damped pendulum can have complex behavior. This computer-generated plot shows initial pendulum velocities (measured horizontally) and positions (measured vertically). Orbits starting at points in the red region eventually settle into one type of periodic motion, while orbits starting in the blue region yield a different type of periodic motion. The boundary between these regions is fractal. The lighter the shade of red or blue, the longer it takes to settle into the corresponding motion. See page 632. [Photo courtesy of C. Grebogi, E. Ott, and J. A. Yorke, University of Maryland, College Park, MD 20742]

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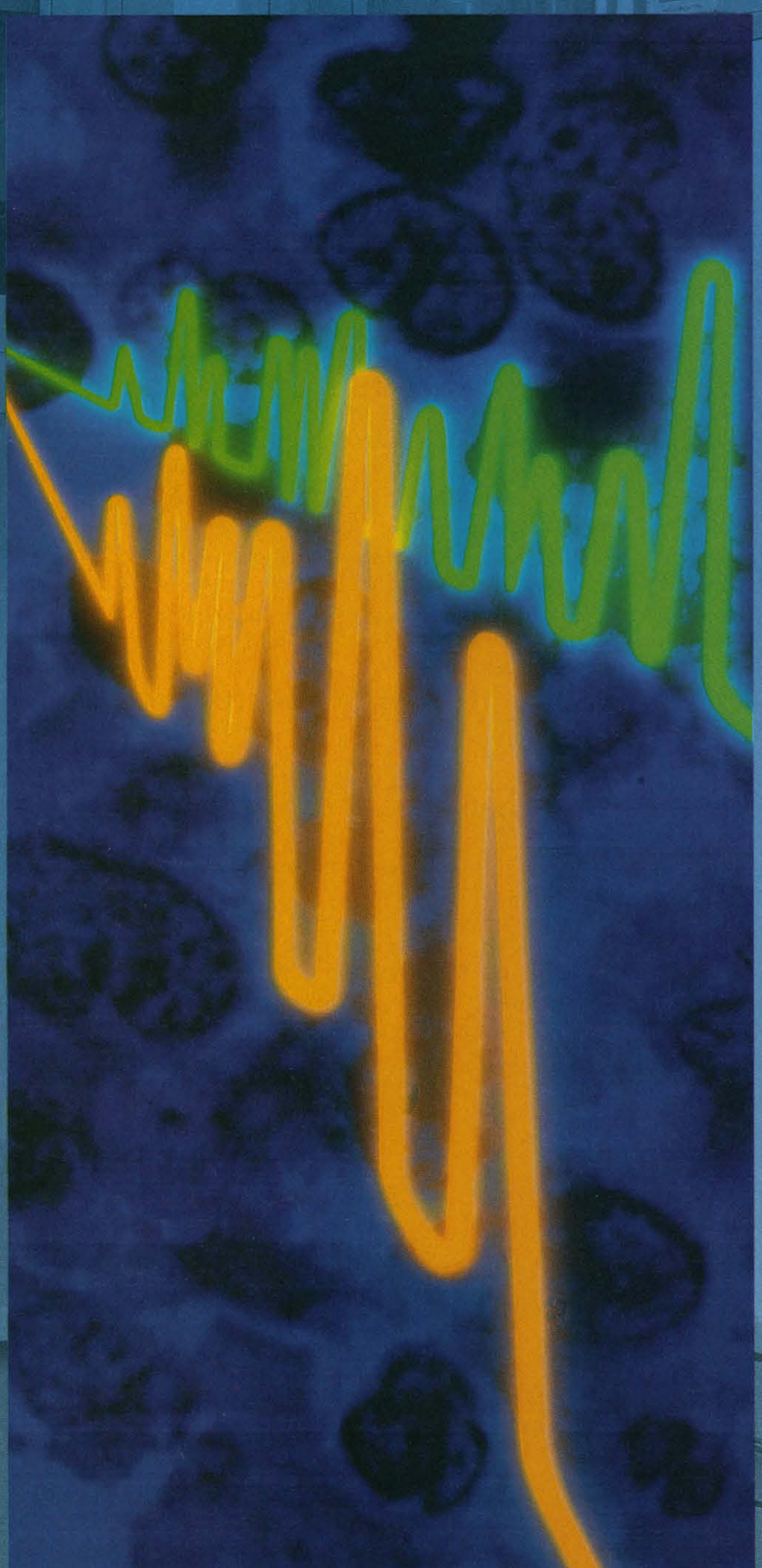

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This Week in
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Space-astronomy planning

ENORMOUS advances in our knowledge and understanding of the cosmos have come from space-based observations because these observations are free from the absorption, distortion, and background interference caused by the earth's atmosphere (page 617). Space-astronomy programs drafted in the 1970s for the 1980s and beyond called for a combination of ground-based and space-based systems; now, however, the schedule for putting into operation and maintaining space-based equipment—such as the "Great Observatories"—cannot be met because of the deficiencies and failure of the shuttle. Brown and Giacconi propose reorienting the space-astronomy program, disengaging from the use of manned launchers after some existing telescopes such as the Hubble Space Telescope are launched, and turning to unmanned launchers for putting other equipment into orbit. The program would go forward, and, by the 21st century, technologic advances might be such that shuttles and astronauts would again be available for carrying out some fraction of the launches and essential maintenance activities.

Chaotic systems

CHAOS is a phenomenon common to ecology, economics, physics, chemistry, engineering, fluid mechanics, and other disciplines (page 632). It is why short- but not long-range weather forecasting is possible and why economic forecasts are unreliable. Initially well-defined ordered phenomena that appear to obey certain physical laws can undergo transitions to chaotic states; the chaos ensues because tiny errors in the initial definition of parameters that characterize the phenomenon grow exponentially, ultimately preventing the system from achieving a steady state. Although the future then becomes unpredictable, there may be order to how the chaos develops (cover). Grebogi *et al.* discuss some basic features of nonlinear dissipative systems and some of the mathematical formulations (many of which have been confirmed by experimental demonstrations) and concepts that help explain chaotic dynamics and the interrelations of chaotic and orderly states.

DNA cleavers

REAGENTS that cleave large DNA molecules at specific sites are important tools for gene mapping and for other investigations of gene structure and function (page 645). A group of synthetic oligonucleotides, homopyrimidines, equipped with a DNA-cleaving moiety are described by Moser and Dervan; the reagents bind specifically to double helical DNA (parallel to homologous homopurines on one strand and antiparallel to homopyrimidines of the other strand) and then, in the presence of Fe(II) and dithiothreitol, cleave one or both strands at the binding site. Reagents with 11 to 15 deoxyribonucleotides were synthesized; these probes formed triple helices with target DNA molecules. They matched with and cleaved a limited number of sites on large DNA molecules, fewer than do naturally occurring cleaving enzymes that must match with only four to eight base pairs. The precision of a match between probe and target was illustrated with two 15-nucleotide probes: the cleavage ability of a probe having a single base mismatched with the target sequence was reduced tenfold compared to that of a probe that was a perfect match.

T cell receptor δ gene

SURFACE receptors for antigen on some subpopulations of T cells in the blood, thymus, and tumors consist of a gamma polypeptide chain and a delta polypeptide chain (instead of the more commonly occurring alpha and beta chains) in association with the standard CD3 polypeptides (pages 678 and 682). The gene for the γ chain was previously cloned; now information is available on the gene for and the expression of the δ chain. Hata *et al.* describe the isolation and characterization of complementary DNA clones encoding the δ protein. In cell lines expressing γδ receptors, the δ region of DNA was rearranged (a prerequisite to expression) and transcribed. Band *et al.* confirm with a monoclonal antibody specific for the δ polypeptide that molecules synthesized by the complementary DNA clones are authentic δ molecules. These two probes, complementary DNA and monoclonal antibody, will be useful for clarifying how and when in development the γδ antigen receptor is expressed on cell surfaces, how broad is the range of the antigen-binding repertoire of γδ molecules, and what other characteristics distinguish T cell subpopulations that express γδ antigen receptors.

Oncogene and developmental gene

A gene that is important in the normal embryonic development of fruitflies (the *dorsal* gene) encodes a protein that is similar to proteins associated with human and turkey proto-oncogenes and a related viral oncogene (the *rel* genes) (page 692). The observed similarities of *dorsal* and *rel* support the concept that oncogenes are normal genes that have somehow gone awry. *Dorsal* is a maternal effect gene for which RNA is supplied to the maturing fertilized egg by the mother. Steward determined the sequence for the complementary DNA of the fruitfly's *dorsal* gene (so called because it plays a role in how embryonic cells are positioned along the dorsal-ventral axis of the embryo). From the sequence of the complementary DNA, the protein sequence was deduced; this predicted sequence showed significant homology with sequences of the *rel* genes. As the control of expression of dorsal and the gene's influence on growth regulation of fruitfly embryos are better understood, insight may also be gained into the functioning (or malfunctioning) of the *rel* genes in tumor cells.

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Brittle Books and Journals

One of the stimuli for scholarly publication is the belief by scientists and other authors that their work will add enduring values to the human heritage. But, as librarians have known for decades, most books and journals are perishable. Efforts to minimize degradation and its consequences will require the cooperation of scientists and engineers with librarians, archivists, and others.

The extent of the problem is typified by an inventory of the 13.5 million volumes at the Library of Congress. Of these, 3 million are too brittle to handle, and each year about 70,000 more volumes are added to this group. Science and technology represent 25 percent of the class collections of the Library of Congress.

The major source of the degradation is a defect in the manufacture of most paper. To prevent running of the printing ink on the paper, a sizing or filler is used that has an acid reaction. The sizing is a combination of alum and resin that results in a *p*H of about 4.8. Paper contains adsorbed water to the extent of 4 to 6 percent of the weight of the cellulose. The hydrogen ions catalyze hydrolysis of the cellulose, destroying its strength and suppleness. When the *p*H is 7 or slightly above, paper can remain strong and supple for many hundreds of years. Satisfactory paper need not be acid. A sizing containing magnesium or calcium carbonate maintains the *p*H at a safe level. Cost of such paper is about the same as the acid type. Problems of future degradation would be lessened if editors and publishers insisted on the use of acid-free paper.

It seems likely that practical processes will be capable of halting degradation of existing acidic books. One process, which has been tested in a pilot plant, involves neutralization of the acid and incorporation of an alkaline reserve into the pages of the books and journals. In a full-scale plant, now under construction, 7500 to 9000 volumes will be loaded into a tank capable of sustaining a high vacuum. When the vacuum is established, most of the water in the books (on the order of 50 gallons or more) will be pumped out, reducing the content in the books to 1 percent or less. A volatile compound, diethyl zinc, will then be introduced. It will diffuse into the volumes, neutralize any acid present, and react with moisture to form zinc oxide, which is mildly alkaline. Subsequently, excess diethyl zinc will be removed, and the books rehydrated. The total process will be complete in 3 to 5 days, with a cost per volume estimated at about $3. The process leaves no odor or toxic substances and does not affect the ink or the binding. However, the process must be conducted carefully; diethyl zinc bursts into flame when exposed to air.

The big problem for libraries is what to do about the books that have become brittle. The pages of the volumes can be photographed, resulting in master copies of microfilm or microfiche. However, costs per volume range up to $100. For the collection at the Library of Congress, the expenditures needed to save 3 million volumes have been estimated at $258 million. The Library of Congress has our greatest collection, but other institutions have many items not catalogued there. To avoid unnecessary costs and duplication, it will be desirable to have a nationwide accessible bibliographic data file. In addition, in science and technology, some books and journals are far more valuable than others. Priorities need to be established. A useful model is that used at the National Library of Medicine, where committees of physicians, scientists, and librarians have selected the most important literature for inclusion in the library's bibliographic system. In consequence, the biomedical literature is well provided for. The National Agricultural Library will probably serve the needs of agriculture. However, much of the remainder of science and technology is not specifically covered. The Library of Congress will need cooperation in its selection of scientific and technical literature. Another focal point for preservation activities is a newly created Commission on Preservation and Access formed under the sponsorship of the Council on Library Resources located in Washington, DC.

Ultimately, much of the scientific literature will be available in machine-readable and searchable form. But that is some time away, and most scientists will wish to retain the convenience of hard copies of journals.—PHILIP H. ABELSON

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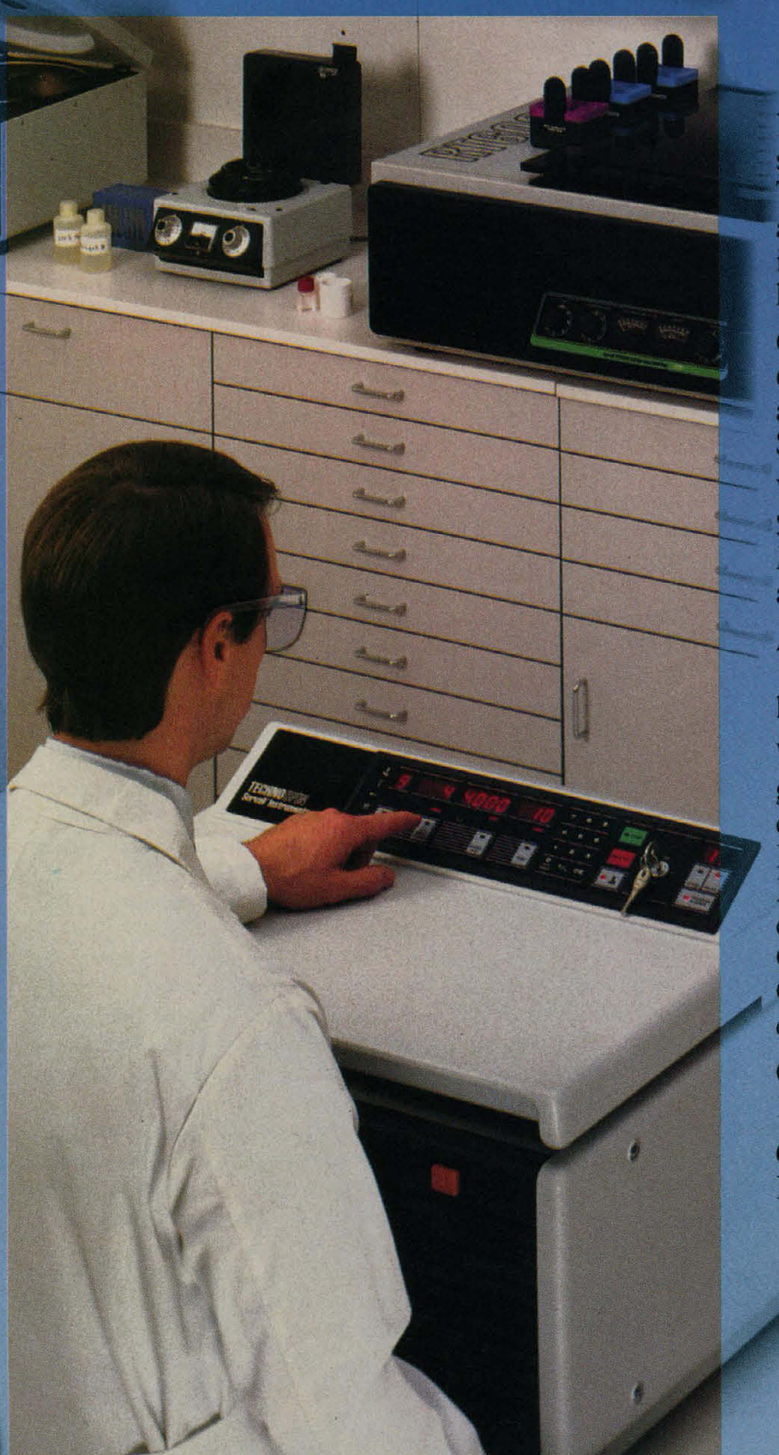

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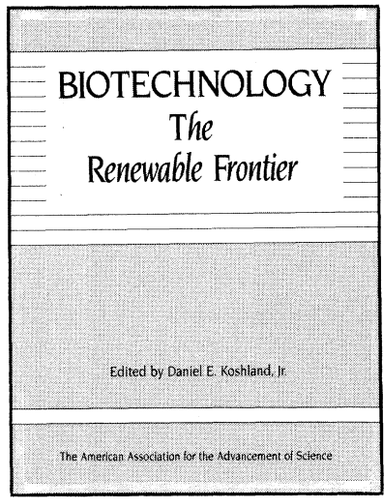

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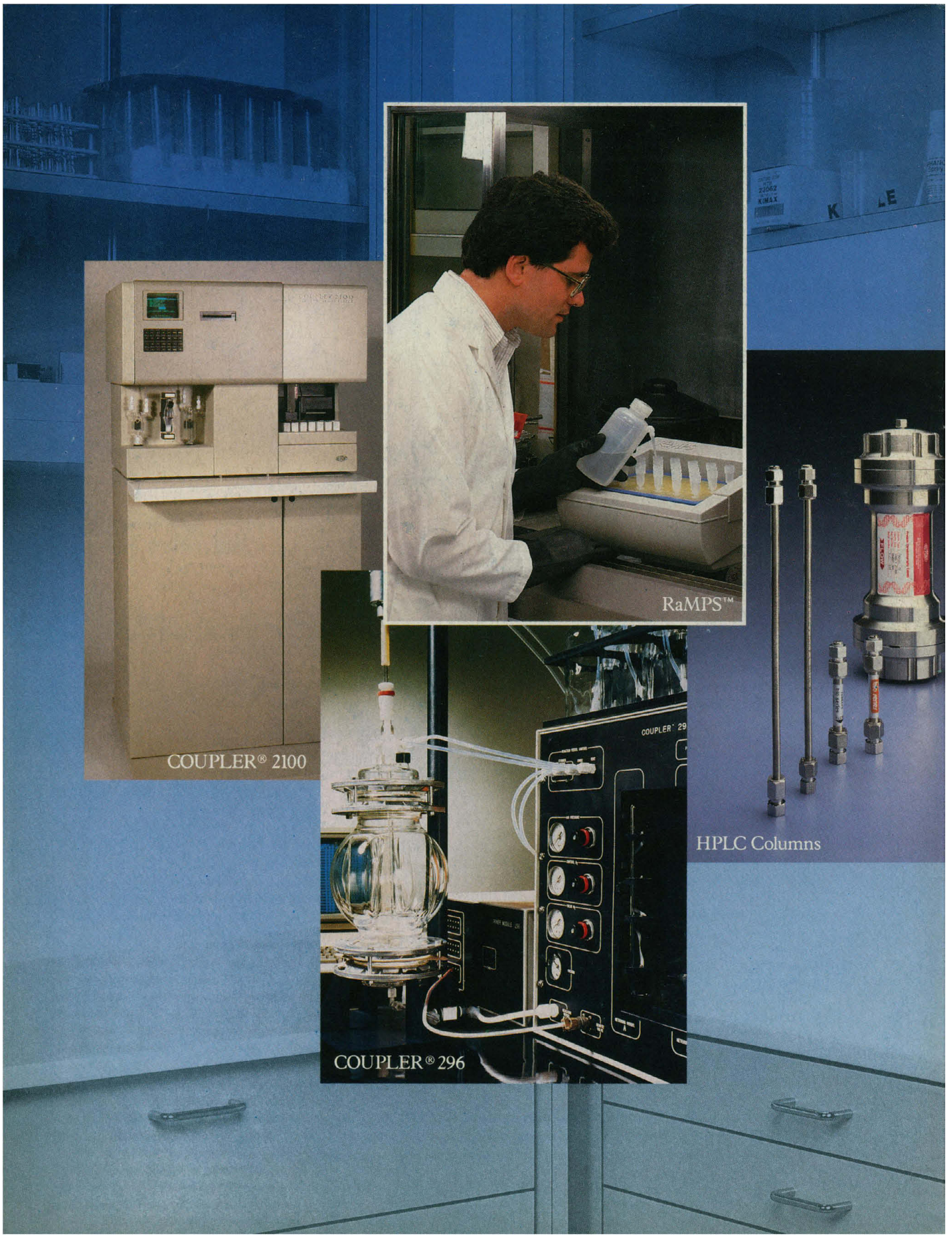
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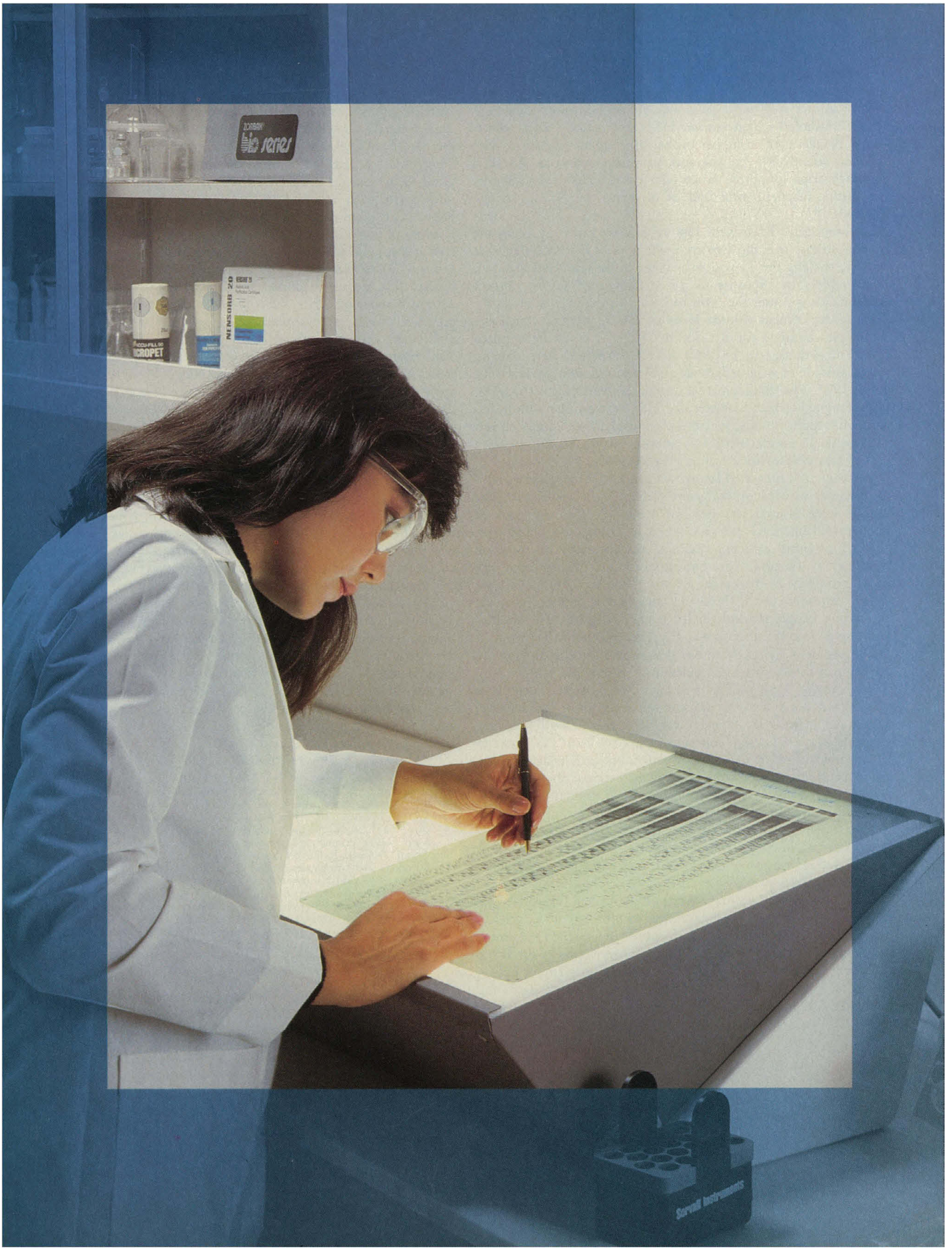
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Nuclear Arms Control:

Can the U.S. and Soviet Union Trust Each Other?

This question is explored in a new videotape, ***Fear of Cheating, Fear of Spying,*** produced by the American Association for the Advancement of Science. The 40-minute program illustrates the wide spectrum of views of leading arms control experts, scientists, and administration officials on the important issue of verification and alleged Soviet cheating.

Some of the issues and arguments presented are: verifiability of arms control agreements, acceptable risks, trust and negotiation, a history of U.S. and Soviet compliance, the current controversy over alleged Soviet violations, the adequacy of technologies for verification, and arms control challenges for the future. Participants include such well known experts as Sidney Drell, Herbert Scoville, Jr., Sidney Graybeal, Colin Gray, and Condoleezza Rice.

The tape is accompanied by a discussion guide containing introductory readings, suggested group discussion questions, and a bibliography. A transcript and glossary are also included.

Fear of Cheating, Fear of Spying is a valuable learning tool for college classes, high school audiences, and *any* groups interested in promoting citizen awareness and public discussion of nuclear arms control issues. To order this informative program for your institution, just complete and mail the form below.

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