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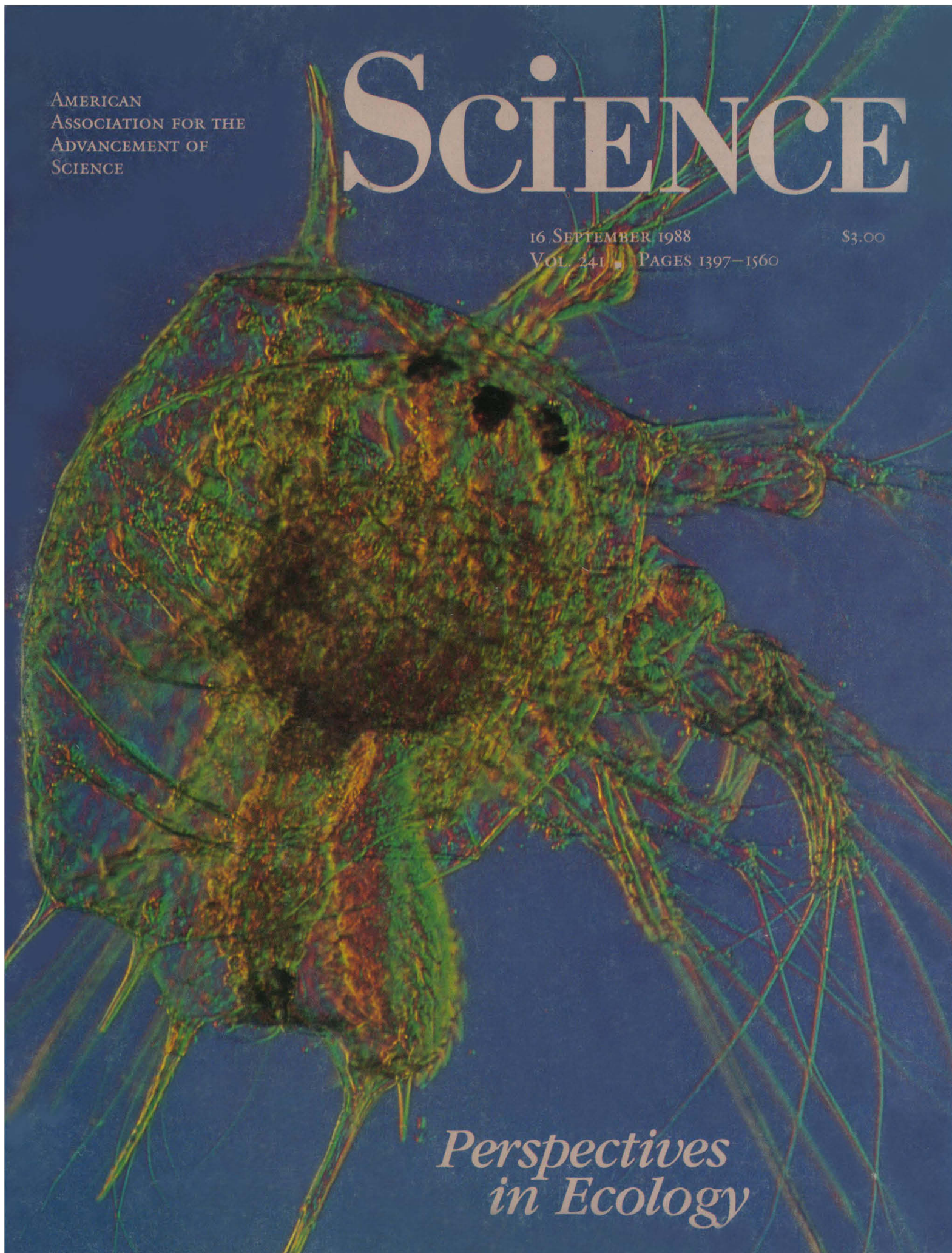
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*Perspectives
in Ecology*



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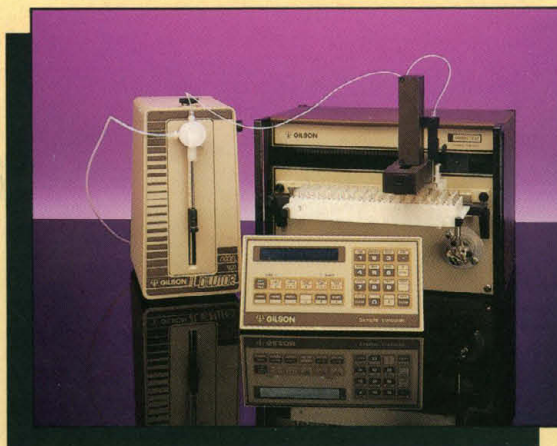
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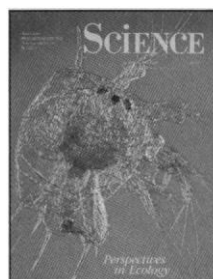
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COVER Nauplius larva (stage VI) of the intertidal barnacle *Balanus glandula* photographed with Nomarski interference contrast illumination. Upwelling in the California Current prevents these ocean-going larvae from returning to shore and thereby greatly affects the abundance of barnacles in the rocky intertidal zone. See page 1460. [Photo by K. Miller, Stanford University, Stanford, CA 94305]

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This Week in SCIENCE

Chemoattractant receptor structure

DICTYOSTELIUM *discoideum* is a slime mold that exists in single cell form until starvation induces aggregation; then the cells assemble into a multicellular spore-producing organism. The aggregation is coordinated by a signaling system involving the cyclic AMP receptor. The structure and activity of this receptor have been studied by Klein *et al.*: complementary DNA for the receptor was isolated and cloned and normal expression of the gene was shown to be essential for *Dictyostelium* development (page 1467). Significant homologies link the cyclic AMP receptor protein and several other proteins (such as rhodopsin) that are crucial to sensory processes in higher organisms: all of the proteins have seven discrete domains, large hydrophobic stretches of amino acids, immunologic cross-reactivities, and other shared features. These findings support the possibility that this relatively simple eukaryotic chemotactic signaling system and various vertebrate signaling systems could have evolved from a common ancestor.

Urban ozone sources

THERE are currently more than 60 cities in the United States that still do not meet national air quality standards for ozone despite control efforts that have been attempted over the almost 20 years since the enactment of the Clean Air Act (page 1473). In many urban areas, the current (national) strategies to reduce ozone pollution may never succeed, because these programs do not take into account natural hydrocarbons (primarily isoprene and α -pinene) that are emitted by trees. Chameides *et al.* use Atlanta, Georgia, as a model. Both natural and anthropogenic hydrocarbons are photooxidized in the presence of nitrogen oxides to produce ozone, but the chemical reactions of natural hydrocarbons are much faster than are those of the anthropogenic forms; thus, even if the natural hydrocarbons were only a fraction of the total hydrocarbon burden, they

would contribute significantly to ozone generation. Simulations of ozone formation in the air column over Atlanta suggest that, to keep ozone levels below the recommended level of 0.12 part per million by volume, the plan of attack must not rely exclusively on reducing anthropogenic hydrocarbon emissions but should also include other strategies, such as the reduction of nitrogen oxide emissions.

New ferromagnetic chemical complex

GETTING all the magnetic spins inside a molecular complex to point one way is hard: the spins usually end up being paired, with anti-ferromagnetism the result. Bino *et al.* describe the preparation of a new high-spin chromium-sulfur complex and provide details of its chemical structure and of its unusual magnetic properties (page 1479). In the complex, ferromagnetic coupling occurs among four tetrahedrally arranged chromium atoms; these surround a central sulfur atom. In the ion $[\text{Cr}_4\text{S}(\text{O}_2\text{CCH}_3)_8(\text{H}_2\text{O})_4]^{2+}$, the complex has 12 unpaired electrons and water ligands that are probably labile. These features make this complex a potentially useful reagent for nuclear magnetic resonance imaging and as a spin label tag for proteins and other macromolecules. The complex might be useful for making very low temperature thermometers, and, because the complex may absorb microwaves selectively, it might have a role in facilitating local specific heating in living or inanimate structures.

Hands-on study of zinc fingers

ZINC fingers consist of short segments of 30 amino acids that were thought to fold into finger-like loops; in each finger, one zinc atom is tetrahedrally coordinated between cysteine and histidine residues. Zinc fingers have been found as structural "motifs" in a number of proteins that bind to DNA and that participate in the

regulation of the DNA transcription process. Párraga *et al.* synthesized zinc finger peptides; then, with various spectroscopic techniques, including two-dimensional nuclear magnetic resonance, they determined the conformation changes that occur when a zinc atom attaches to the peptide (page 1489). A model more like a ribbon than a finger is proposed; in it, about 10 of the 30 amino acids of each zinc finger peptide participate in α -helix formation. Zinc binding is needed to drive the folding of the peptide. These data will help explain where and how DNA binds to a zinc finger or to several of them.

New World bone disease

BONES from skeletons of six adults who lived 3000 to 5000 years ago show signs of an erosive polyarthritis that, in modern bones, can be characteristic of rheumatoid arthritis (page 1498). The skeletons were collected along with 78 other well-preserved skeletons in northwestern Alabama. The similarities with rheumatoid arthritis included the distinctive types of lesions that were and were not found, the way in which the lesions were distributed throughout the skeletons, and both the gross characteristics and the radiologic profiles of the affected bones. Rothschild *et al.* speculate that rheumatoid arthritis may be a disease that originated in the New World: no Old World bones as old as these with rheumatoid arthritis-like lesions have been found so far. Native Americans may have suffered from this disease long before commerce between the Old World and the New World provided a means for the disease to be carried to Europe.

The bottom lines

This is a special issue on ecology. Four articles and the editorial focus on the diversity of living species on Earth and on factors that affect how these organisms interact and evolve (and sometimes die out) in the contexts of their habitats (pages 1405 and 1441 to 1466).



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For Whom the Bell Tolls

Illegal entry, sting operations, deception, aggression, bloodsucking, and territorial greed are what the articles in this issue of *Science* are about. They are also about cost-effectiveness, altruism, fertility, resource allocation, and adaptive behavior. The ecology world is one in which there is only one standard of ethics: survival. Species that can put together the smartest programs are going to survive, often at the expense of others. Ivory-tower critics may talk about animal rights or plant rights, but the mosquito is not worried about infiltrating across a border, nor does the malaria parasite have fits of conscience because it may be a stowaway in the illegal action. Nor is the swatter of the mosquito particularly distressed by intruding on the reproductive cycle of this interesting species.

Understanding the behavior of species and the survival strategies that they have developed is essential for understanding the survival of all species including humans. For evolution has finally succeeded in producing a species, *Homo sapiens*, whose physical features are not that impressive but whose brain has made its proliferation incredibly more efficient than it is in other species. As a result, the population of the globe has lost proportion, and the number of human beings is threatening all other species. Estimates of global species numbers range from 5 million to 50 million in the world today (May, page 1441), but their numbers appear to be dwindling rapidly. Efforts to protect a few endangered species such as the red-cockaded woodpecker or the northern spotted owl can only succeed at great expense and with knowledge of their habitat needs (Lande, page 1455). Specialized programs do not solve the problem of the relentless expansion of man, with his consequent destruction of tropical forests, his defiling of wilderness areas, and his pollution of the oceans. Ecology, the study of the delicate balance between species in the environment (Partridge and Harvey, page 1449, and Roughgarden *et al.*, page 1460), shows that evolution has developed clever strategies, not all of them following the Marquis of Queensberry rules, to use resources to maximum effectiveness. Those strategies sometimes involve symbiosis, sometimes tacit agreements on territory, and sometimes murderous aggression, but all are based on the assumption that resources are limited so that the clever and the parsimonious will gain relative to the inefficient and wasteful.

Our ability to speak and write has tilted that equation so that we humans are reproducing profligately while other species die. Are we likely to stop in deference to other species? Curiously the animal rightists and anti-evolutionists think in parallel in regard to the exalted status of man. Animal rightists suggest that we have no right to attack other species. Anti-evolutionists say that we are so different that we cannot learn from the behavior of lower species. Both are partly wrong and partly right. Evolution makes no case for gifts of rights to other species, and we have learned much about human behavior from studies of less complex species. But ecological studies also reveal that species adapt to threats to their own survival, and symbiosis is one of nature's prize stratagems.

Our great brains have allowed us to reproduce somewhat unchecked, but they should also allow us to modify behavior more than other species. The relentless extinction of species by destruction of their habitats is no longer a triumph for our species but a decisive warning to change our ways. Whether the greenhouse warming has really begun or is still hundreds of years in the future is almost irrelevant. It is bound to come, as has the destruction of arable soil by pollutants, and the drop in the quality of the air we breathe; these will worsen if we do not learn more respect for the ecosystem.

This issue of *Science* has a few articles, assembled with the help of Martha Coleman and Roger Lewin, on the forefront of one aspect of the vast subject of ecology. They emphasize the importance of understanding the value of species diversity, species interdependence, and species reproductive efficiency. Most species struggle to overcome poverty of resources and occupy niches that allow a critical number to survive in competition with other species. Modern civilization has upset that process so that many (although certainly not all) humans are living far beyond a survival level. The brain that allowed that situation needs now to curb a primordial instinct to increased replication of our own species at the expense of others because the global ecology is threatened. So ask not whether the bell tolls for the owl or the whale or the rhinoceros; it tolls for us.—DANIEL E. KOSHLAND, JR.

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Left to right: 31, 41, 65,
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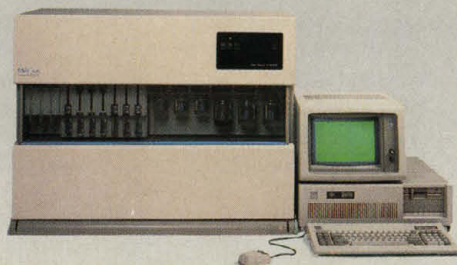
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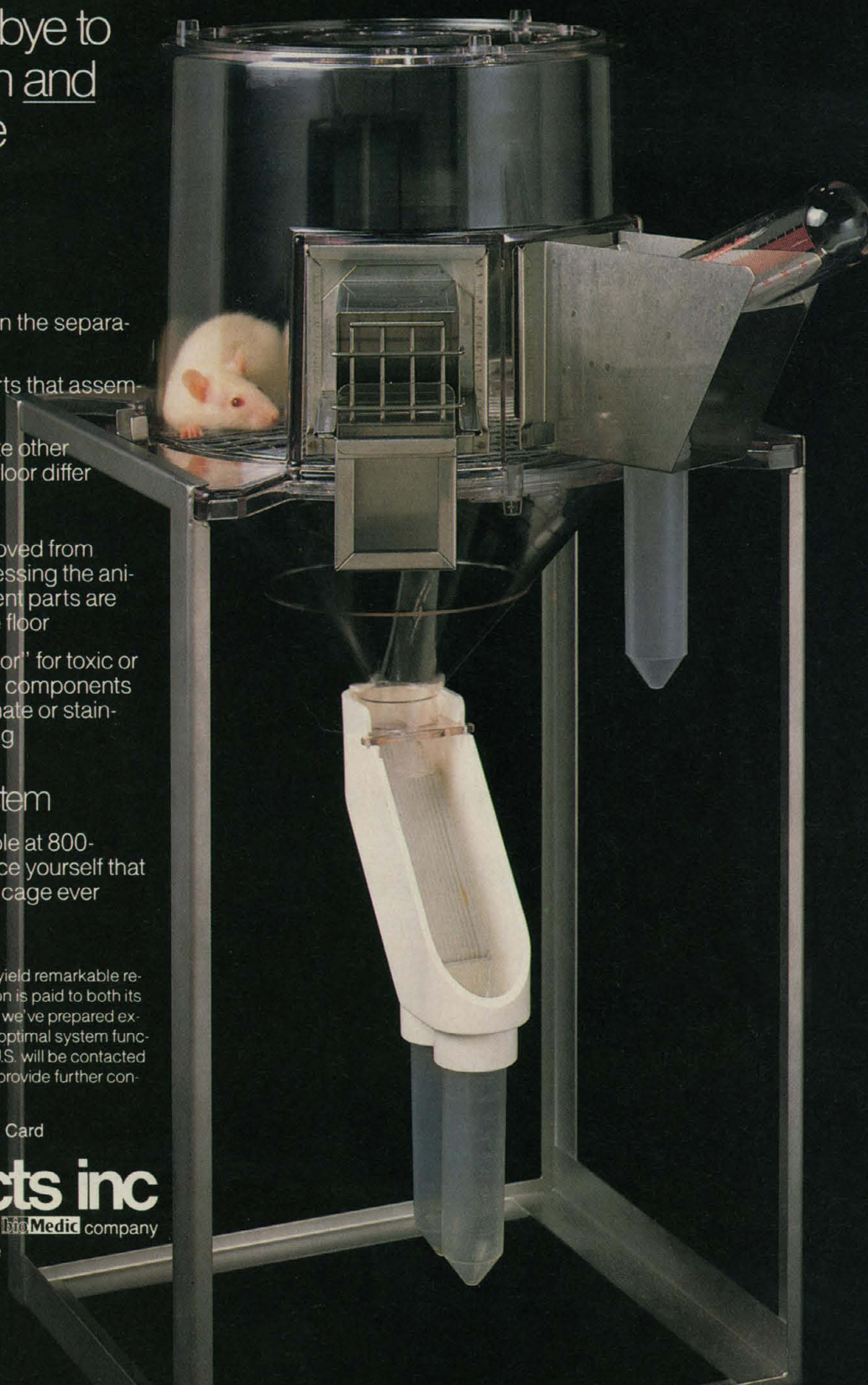
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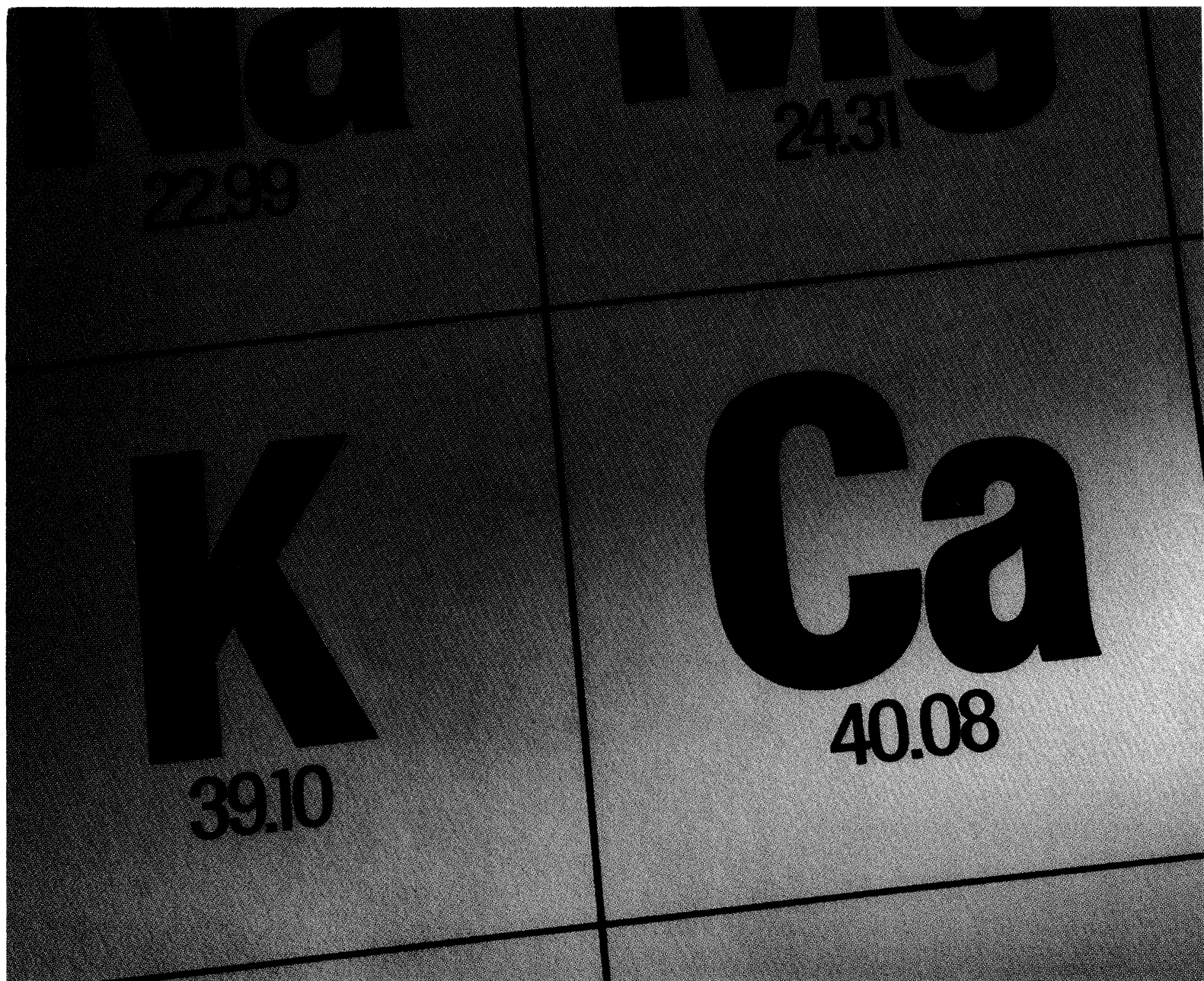
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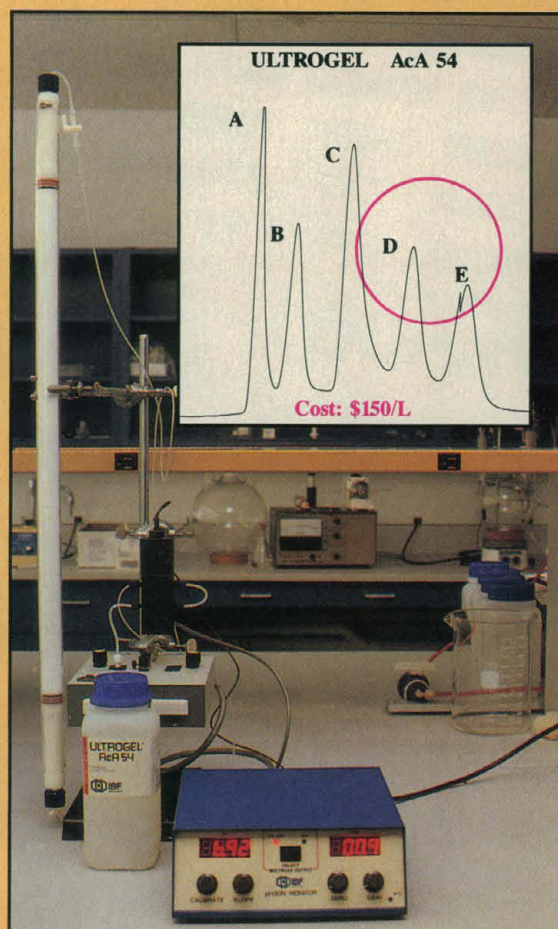
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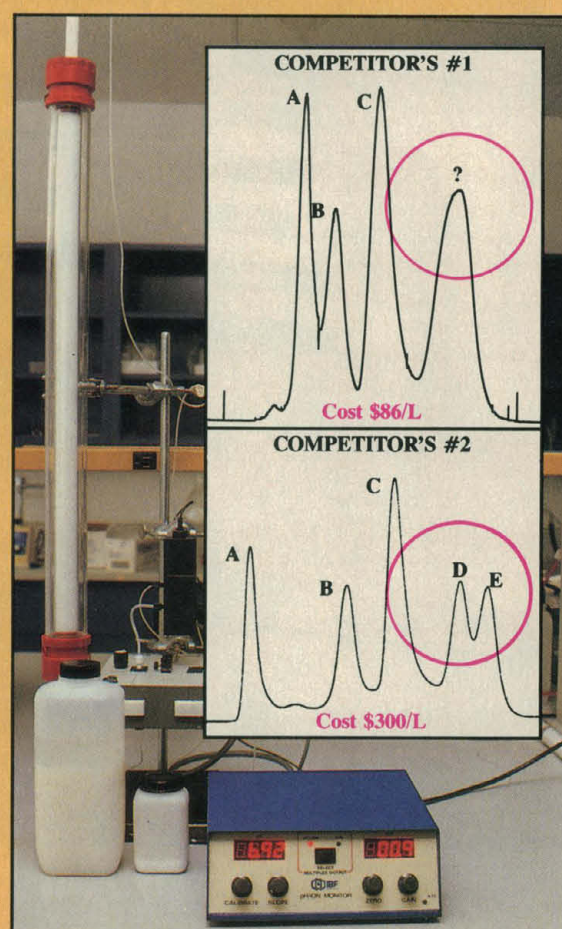
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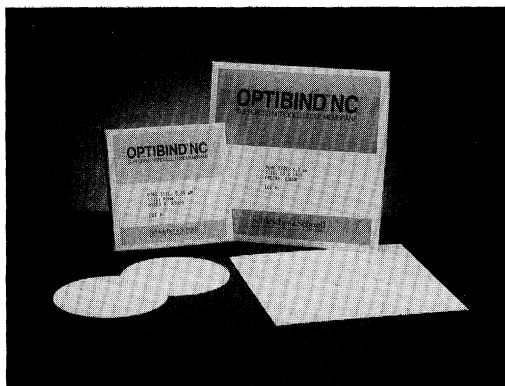
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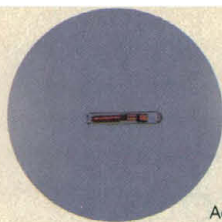
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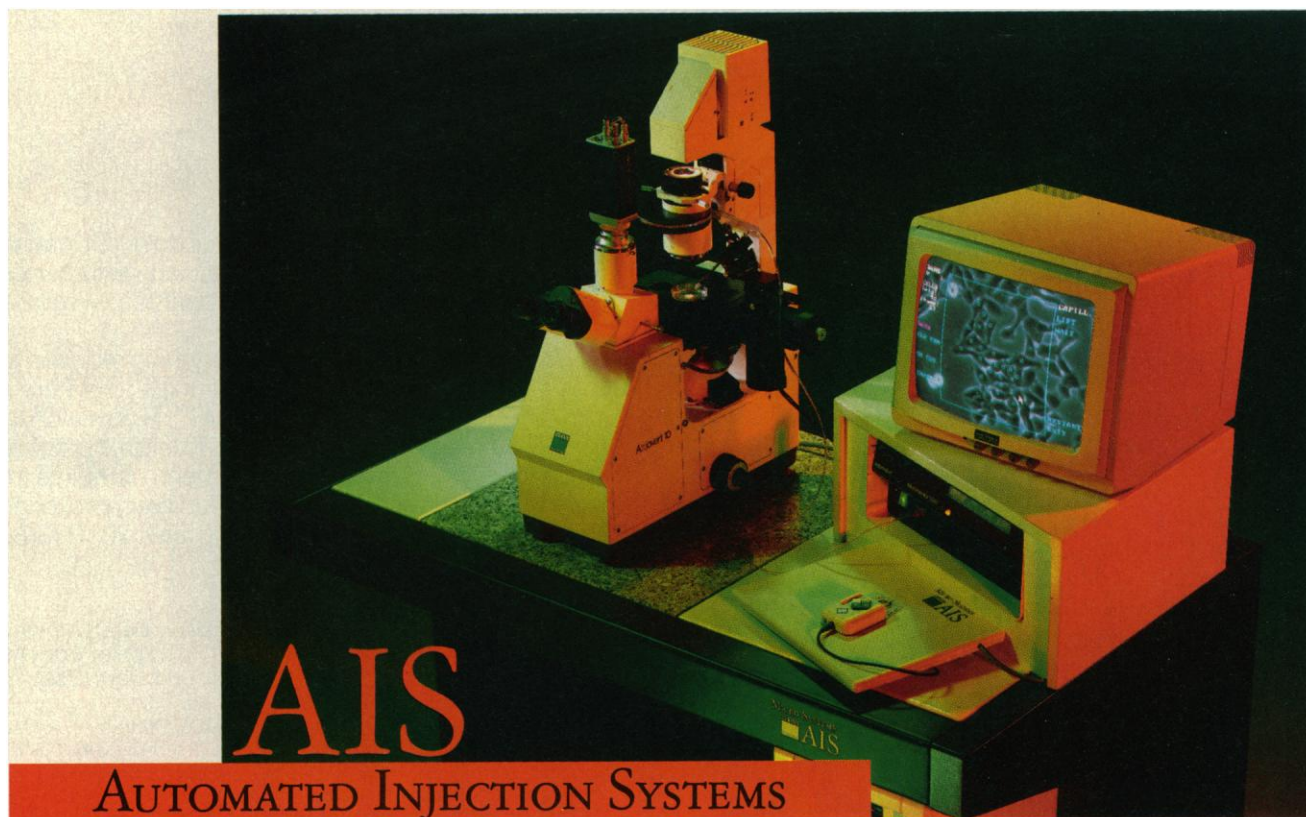
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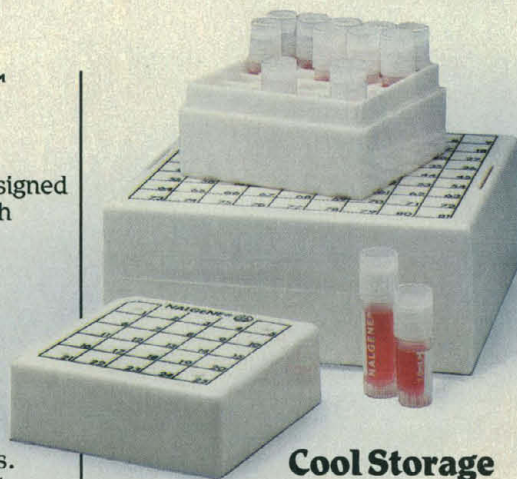
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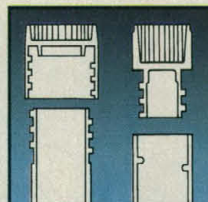
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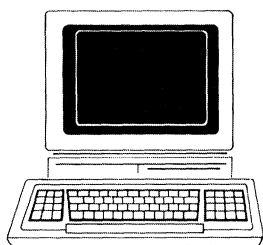


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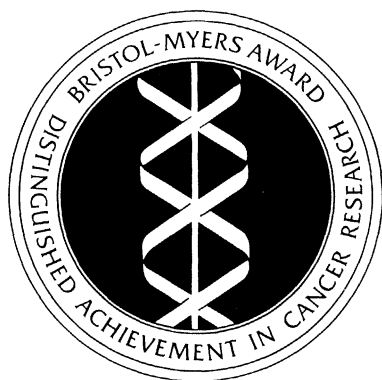
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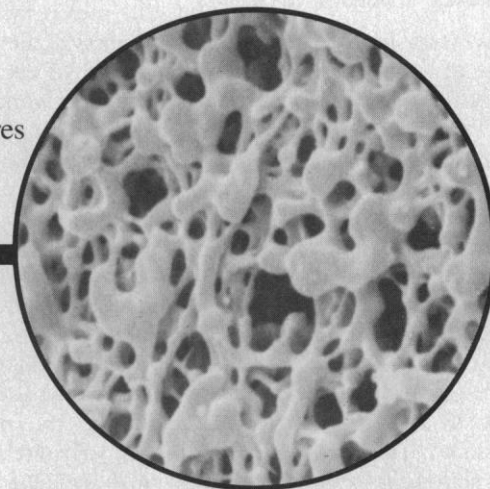
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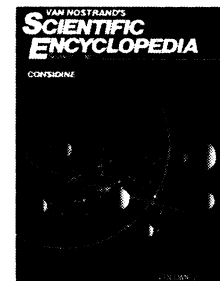
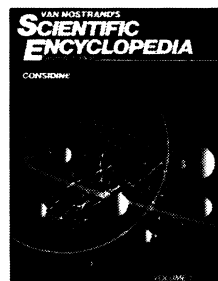
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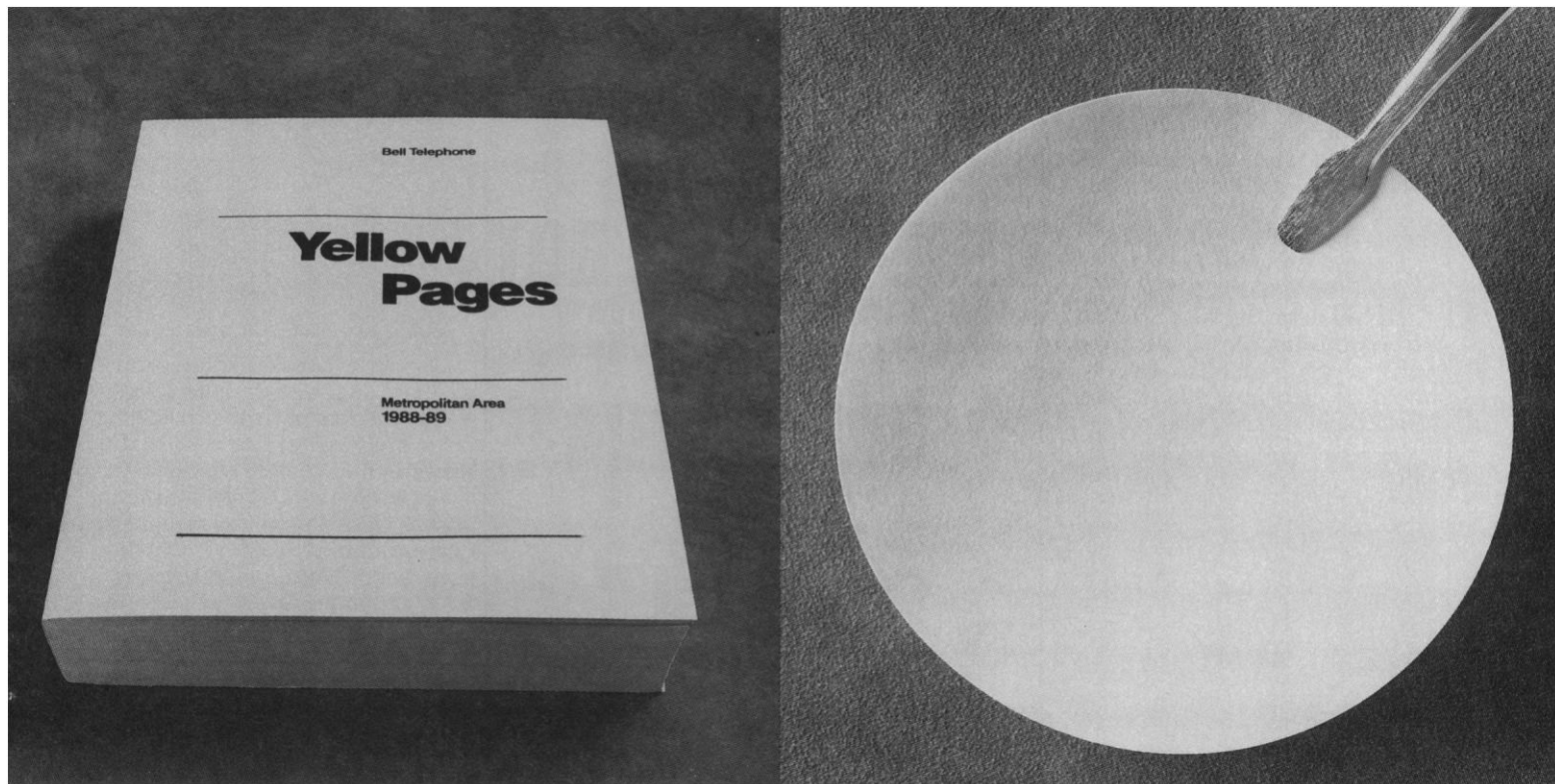
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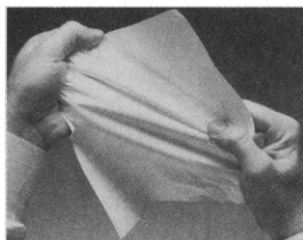
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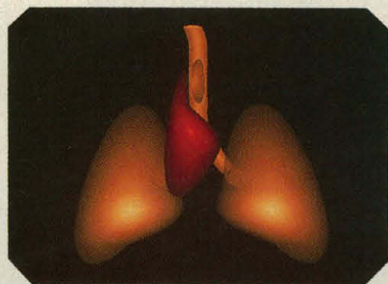
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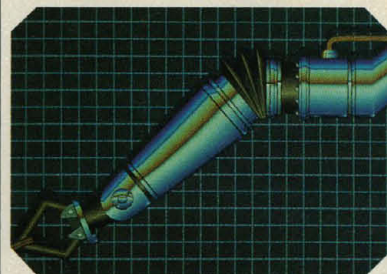


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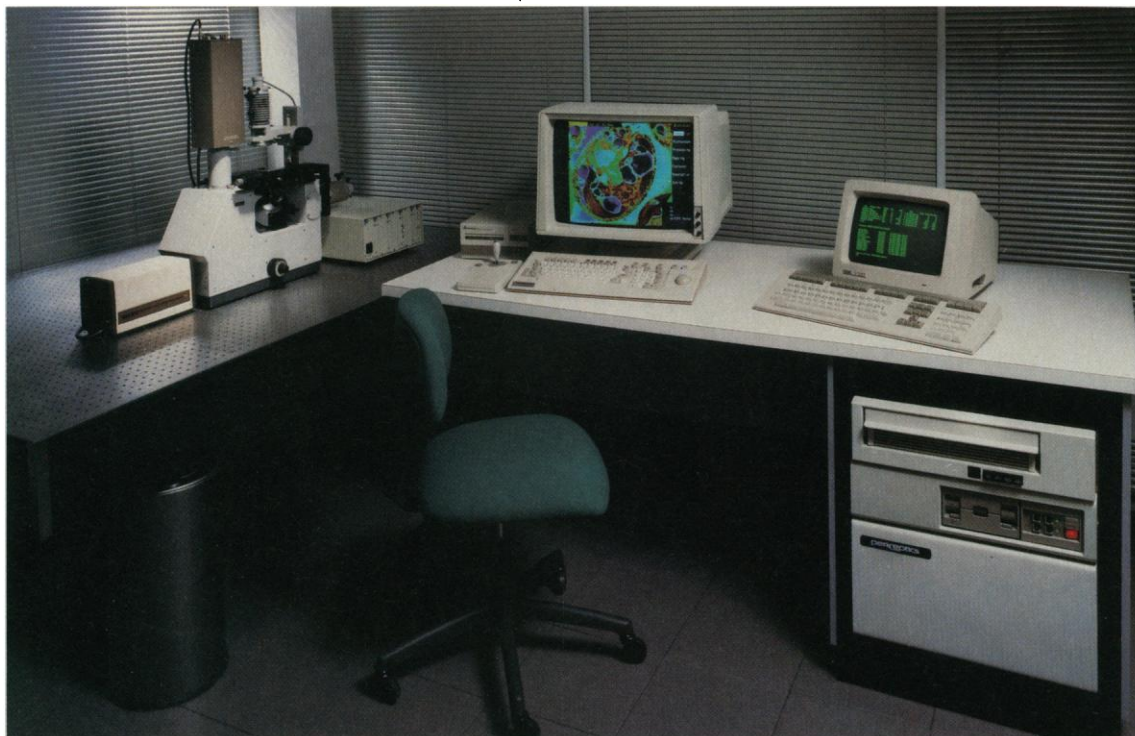
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cial Security payroll tax payments. Boskin and Puffert's study also indicates that changes in the performance of the economy, the policies affecting the accumulation of trust fund reserves, and the rules of the program will have an impact (as one would expect) on who gains or loses the most in terms of future benefits relative to tax contributions.

What we know as retirement today is a relatively new social experience. Unlike the pension plans (both public and private) that emerged after World War II, early plans were not designed to allow aging workers to "retire"—that is, to withdraw from the labor market in advance of physiological decline. Rather, they focused on providing "survival" benefits if and when old age began to take its toll on an individual's earning capacity and sought to respond to the needs of government and business. From these early beginnings evolved a new view of old age and pensions, however, in which benefits were based upon years of service, rather than on need per se, and were designed to replace pre-retirement earnings. Pensions became an "earned right" and (as was pointed out by Eugene Friedman and Harold Orbach in their now classic article in *The Foundations of*

Psychiatry, vol. 1) became "instrumental in defining a retirement status as appropriate for the older worker."

In contrast, as is suggested in the papers by Kingsley Davis, Uhlenberg, and Malcolm Morrison, there currently seems to be a growing interest in employing older workers longer. In my opinion, Kotlikoff gets at the heart of the issues we now face when he says at the beginning of his paper:

The success of the new public policy toward employment of the elderly is predicated on two ifs. The first is that the elderly will choose to remain employed, the second is that they will remain employable. There is little evidence at the moment that the trend toward increasingly earlier retirement has slowed, let alone reversed. Although much of the postwar increase in early retirement may reflect a response to Social Security and private retirement incentives, much appears to reflect a strong desire of the elderly for significant leisure. But, even if the often substantial retirement incentives were eliminated and preferences shifted in the direction of more old-age labor supply, the question of the productivity of the elderly would remain.

I couldn't agree more. The biggest "retirement issue" of the next century will be whether both workers and employers see the need and are willing to modify the retirement "right" to include what each group

sees as viable work options in later life to complement the retirement life everyone now expects and almost all enjoy.

JAMES H. SCHULZ
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International Relations

U.S.-Soviet Security Cooperation. Achievements, Failures, Lessons. ALEXANDER L. GEORGE, PHILIP J. FARLEY, and ALEXANDER DALLIN, Eds. Oxford University Press, New York, 1988. xii, 746 pp. \$42; paper, \$18.95.

The editors of this book set themselves the task of providing "the first comprehensive and systematic study" of efforts by the United States and the Soviet Union since World War II to develop cooperative arrangements to enhance security. They express the hope that the study will "stimulate serious discussion, reflection, and additional research" on the subject (p. vii). This is an ambitious undertaking, but the book well justifies the effort. It is an analysis based on what is now termed "cooperation theory" in

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