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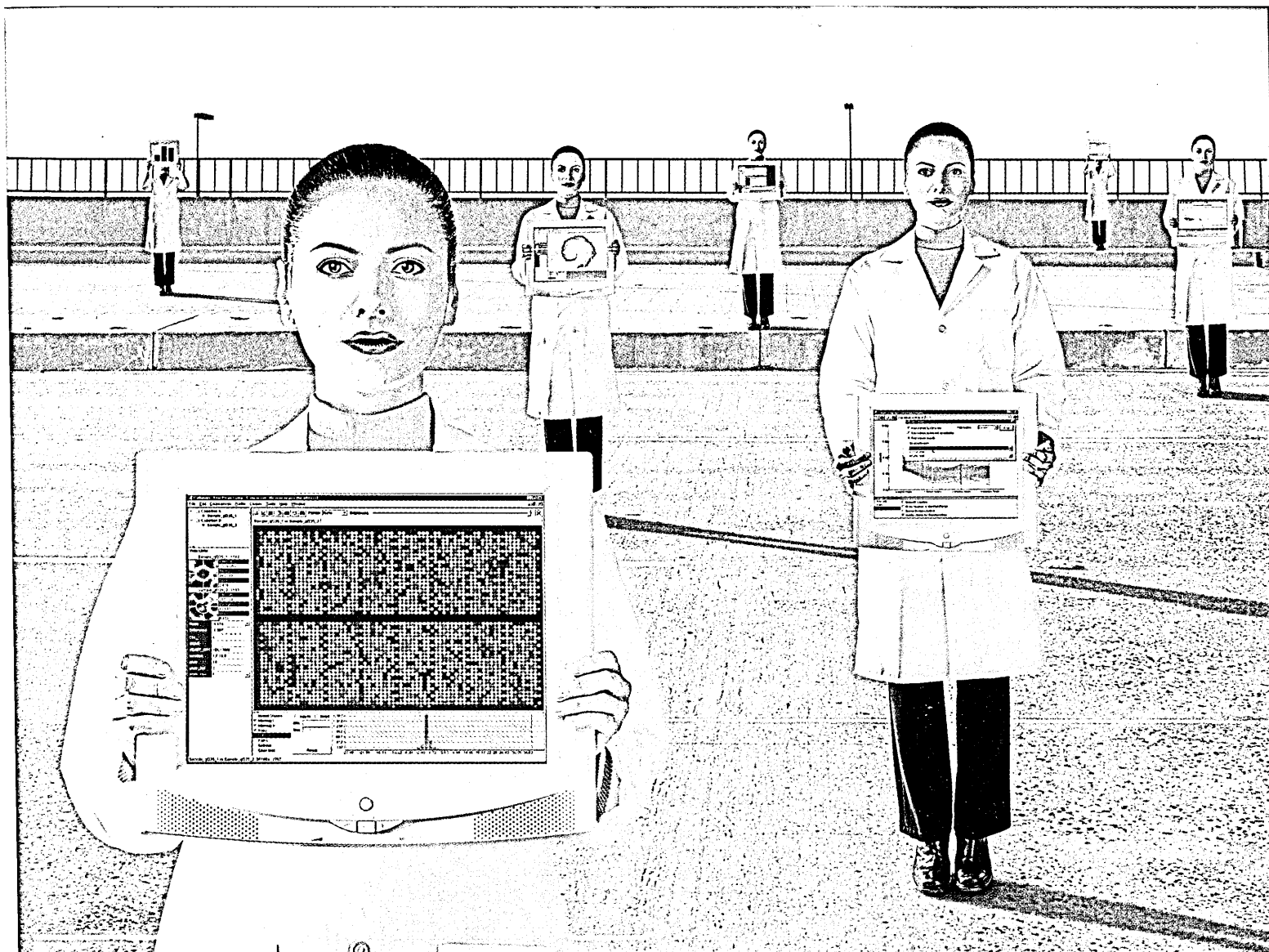
30 November 2001

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Pages 1777-2040 \$9

*Lipid
Biology*



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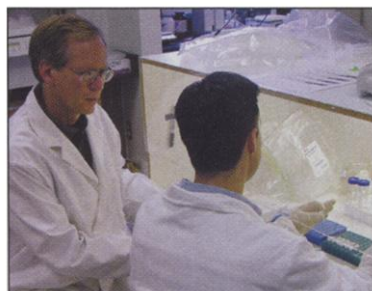
Science

Volume 294 30 November 2001 Number 5548

1783 **SCIENCE ONLINE**
1785 **THIS WEEK IN SCIENCE**
1789 **EDITORIAL**
Jonathan Lash
*Dealing with the Tinder As
Well As the Flint*

1791 **EDITORS' CHOICE**
1795 **NETWATCH**
1798 **CONTACT SCIENCE**
1959 **NEW PRODUCTS**
1967 **AAAS NEWS & NOTES**

NEWS



1810

Anthrax forensics

NEWS OF THE WEEK

- 1802 **BIOETHICS: Cloning Announcement Sparks Debate and Scientific Skepticism**
- ▼1803 **MOLECULAR IMAGING: Virus Infects Cell: Live and Uncut**
1929
- 1803 **RESEARCH COLLABORATIONS: Asian Astronomers Build Closer Ties**
- 1805 **ULTRAFast LASERS: Photoelectrons Show How Quick a Flash Is**
- 1805 **SCIENCESCOPE**
- 1806 **CONSERVATION BIOLOGY: When Is a Coho Salmon Not a Coho Salmon?**
- ▼1807 **MARINE CONSERVATION: Reserves Found to Aid Fisheries**
1920
- 1809 **GENETICS: Fragile X's Missing Partners Identified**

NEWS FOCUS

ANTHRAX

- 1810 **DISEASE DETECTIVES: Taking Anthrax's Genetic Fingerprints**
Can Lab Sleuths Clinch the Case?
A Second Anthrax Genome Project
- 1813 **AN OLD ENEMY REVISITED: A 'Sure Killer' Yields to Medicine**
- 1815 **PALEONTOLOGY: TV Dinosaur Team Treads Tricky Mammalian Terrain**
- 1816 **GAMMA RAY BURSTS: Cosmic Mystery Objects Start to Yield Secrets**
HETE-2, in Business at Last
Short-Lived Mysteries
- 1819 **COMPUTING RESEARCH: Microsoft Settles Down Amongst the Dons**
- 1820 **GEOLOGICAL SOCIETY OF AMERICA: Life—Potential, Slow, or Long Dead**
- 1823 **RANDOM SAMPLES**

SCIENCE'S COMPASS

1831 LETTERS

Assessing the Reviewers of Animal Research H. Klemfuss, N. K. Dess, S. E. Brandon, H. H. Garrison, M. Pitts, B. E. Rollin, F. M. Loew. **Response** S. Plous, H. Herzog. **WHO Ranking of Health Systems** A. Robbins. **Counting All Species** C. Samper. **But Maybe Counting Is the Easiest Part** R. Husted. **Research on Resistance to Cancer Drug Gleevec** C. L. Sawyers

POLICY FORUM

- 1835 **CLIMATE CHANGE: Recent Reductions in China's Greenhouse Gas Emissions**
D. G. Streets, K. Jiang, X. Hu, J. E. Sinton, X.-Q. Zhang, D. Xu, M. Z. Jacobson, J. E. Hansen

BOOKS ET AL.

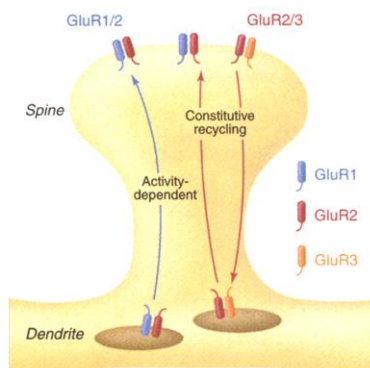
- 1838 **COMPUTING: *The Unfinished Revolution Human-Centered Computers and What They Can Do For Us*** M. Dertouzos, reviewed by M. Greenberger
- 1838 **APPLIED PHYSICS: *The Physics of Information Technology*** N. Gershenfeld, reviewed by D. G. Goodwin

PERSPECTIVES

- ▼1841 **CELL BIOLOGY: TAPping into mRNA Export**
1895 M. J. Moore and M. Rosbash
- ▼1842 **NATURAL PRODUCT SYNTHESIS: The Art of Total Synthesis** I. E. Markó
1904
- ▼1843 **PLANETARY SCIENCE: Clues to the Martian Atmosphere** D. M. Hunten
1914
- ▼1844 **PALEOCLIMATE: Dating—Vive la Différence**
1917 J. Adkins
- ▼1845 **SIGNAL TRANSDUCTION: A New Thread in an Intricate Web** M. von Zastrow and K. Mostov
1861
1939
- ▼1847 **ECOLOGY: Dammed Experiments!** J. Diamond
1923
- ▼1848 **IMMUNOLOGY: A Molecular Gut Reaction**
1936 F. Lambolez and B. Rocha
- 1849 **NETWORK ANALYSIS: The Structure of the Web** J. Kleinberg and S. Lawrence

PRIZE ESSAY

- 1851 **AMERSHAM BIOSCIENCES & SCIENCE PRIZE: AMPA Receptor Dynamics and Synaptic Plasticity** S.-H. Shi
2001 Grand Prize Winner



1851

Grand prize essay

LIPID BIOLOGY

1861 Lipids in the Limelight

NEWS

1862 Caveolae: A Once-Elusive Structure Gets Some Respect
Caveolin-3 Helps Build Muscles

REVIEWS AND VIEWPOINTS

1866 Nuclear Receptors and Lipid Physiology: Opening the X-Files A. Chawla *et al.*

1871 Prostaglandins and Leukotrienes: Advances in Eicosanoid Biology
C. D. Funk

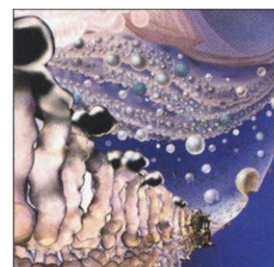
1875 Lysophospholipids—Receptor Revelations T. Hla *et al.*

1879 Hedgehog Signaling: A Tale of Two Lipids
P. W. Ingham

1881 Location, Location, Location: Membrane Targeting Directed by PX Domains
T. K. Sato *et al.*

See also Perspective on p. 1845, Reports on pp. 1939 and 1942, and by Baron and Malhotra published online in *Science this week* (www.sciencexpress.org), and content in *Science's STKE* (stke.sciencemag.org; see p. 1783).

Lipids are the fundamental structural components of cellular membranes, but they also have roles in signal transduction, intracellular transport, and gene transcription. The special section in this issue focuses on lipid biology, an area that has become a fertile meeting ground for diverse scientific fields. [Image: C. Slayden]



COVER 1861

RESEARCH

NEW FEATURE

BREVIA

Science's newest section features short, peer-reviewed papers of particularly broad general interest.

- 1893 Cloned Cattle Can Be Healthy and Normal R. P. Lanza, J. B. Cibelli, D. Faber, R. W. Sweeney, B. Henderson, W. Nevala, M. D. West, P. J. Wettstein
- 1894 Endangered Right Whales on the Southeastern Bering Sea Shelf
C. T. Tynan, D. P. DeMaster, W. T. Peterson

RESEARCH ARTICLE

- ▼1895 Delineation of mRNA Export Pathways by the Use of Cell-Permeable Peptides
1841 I. E. Gallouzi and J. A. Steitz

REPORTS

- 1901 Photoinduced Conversion of Silver Nanospheres to Nanoprisms R. Jin, Y. W. Cao, C. A. Mirkin, K. L. Kelly, G. C. Schatz, J. G. Zheng
- ▼1904 Total Synthesis of Ciguatera Toxin CTX3C
1842 M. Hirama, T. Oishi, H. Uehara, M. Inoue, M. Maruyama, H. Oguri, M. Satake
- 1907 Engineering Crystal Symmetry and Polar Order in Molecular Host Frameworks
K. T. Holman, A. M. Pivovar, M. D. Ward
- 1911 Seismic Detection of Rigid Zones at the Top of the Core S. Rost and J. Revenaugh
- ▼1914 Detection of Molecular Hydrogen in the Atmosphere of Mars V. A. Krasnopolsky and
1843 P. D. Feldman

- ▼1917 Mediterranean Sea Surface Radiocarbon Reservoir Age Changes Since the Last Glacial Maximum G. Siani, M. Paterne, E. Michel, R. Sulpizio, A. Sbrana, M. Arnold, G. Haddad
1844

- ▼1920 Effects of Marine Reserves on Adjacent Fisheries C. M. Roberts, J. A. Bohnsack, F. Gell, J. P. Hawkins, R. Goodridge
1807

- ▼1923 Ecological Meltdown in Predator-Free Forest Fragments J. Terborgh *et al.*
1847

- 1926 Matching Spiracle Opening to Metabolic Need During Flight in *Drosophila*
F.-O. Lehmann

- ▼1929 Real-Time Single-Molecule Imaging of the Infection Pathway of an Adeno-Associated Virus G. Seisenberger, M. U. Ried, T. Endreß, H. Büning, M. Hallek, C. Bräuchle
1803

- 1933 Physiological Migration of Hematopoietic Stem and Progenitor Cells D. E. Wright, A. J. Wagers, A. P. Gulati, F. L. Johnson, I. L. Weissman

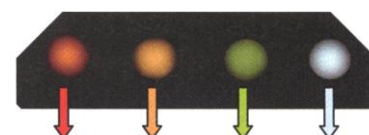
- ▼1936 T Cell Responses Modulated Through Interaction Between CD8 $\alpha\alpha$ and the Nonclassical MHC Class I Molecule, TL A. J. Leishman *et al.*
1848

- ▼1939 RGS-PX1, a GAP for G α_q and Sorting Nexin in Vesicular Trafficking B. Zheng *et al.*
1845

- ▼1942 Phosphatidic Acid-Mediated Mitogenic Activation of mTOR Signaling Y. Fang, M. Vilella-Bach, R. Bachmann, A. Flanagan, J. Chen
1861

- 1945 Regulation of Cell Survival by Secreted Proneurotrophins R. Lee, P. Kermani, K. K. Teng, B. L. Hempstead

- 1948 Lobster Sniffing: Antennule Design and Hydrodynamic Filtering of Information in an Odor Plume M. A. R. Koehl *et al.*



1901

Red scattering from triangular silver particles

1948

Lobster antenna smells odor plume



New on *Science Express*

Watery martian gullies: slippery when wet



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Formation of Recent Martian Debris Flows by Melting of Near-Surface Ground Ice at High Obliquity F. Costard, F. Forget, N. Mangold, J. P. Peulvast

Terrestrial analogs and global climate models suggest that the gullies on Mars form by the melting of water ice.

Earthquake Recurrence and Rupture Dynamics of Himalayan Frontal Thrust, India S. Kumar *et al.*

Paleoseismic data show evidence for three large earthquakes along the Himalayan Frontal Thrust in India, reinforcing concerns regarding seismic hazard.

Role of Diacylglycerol in PKD Recruitment to the TGN and Protein Transport to the Plasma Membrane C. L. Baron and V. Malhotra

1861 It is demonstrated that the lipid diacylglycerol plays a key role in recruitment of protein kinase D to the trans-Golgi network, thereby allowing intracellular transport from the trans-Golgi network to the cell surface.

TECHNICAL COMMENTS

Role of Apoptosis in *Pseudomonas aeruginosa* Pneumonia

Grassmé *et al.* (Reports, 20 Oct. 2000, p. 527) found that *P. aeruginosa*, a bacterium responsible for pneumonia and sepsis in susceptible individuals, induces extensive apoptosis of lung epithelial cells through interaction with the CD95/CD95 ligand system—and that the epithelial cell death conferred a survival benefit on infected mice. Hotchkiss *et al.* comment that the TUNEL method used in the study to demonstrate epithelial cell apoptosis “may yield false positives,” and that they were unable to confirm epithelial cell apoptosis in pneumonia using alternative methods. They also found that “extensive lymphocyte apoptosis ... occurred in lung, spleen, and thymus during pneumonia”—a pattern that suggests, according to Hotchkiss *et al.*, that “extensive lymphocyte apoptosis may ... contribute to the accompanying immune suppression and mortality” of bacterial sepsis, irrespective of infection site. Grassmé *et al.* respond with results of additional, non-TUNEL tests that “confirm induction of apoptosis in lung epithelial cells by *P. aeruginosa*.” The difference between their results and those of Hotchkiss *et al.*, they suggest, may lie in the fact that the two groups used bacteria in different growth phases.

The full text of these comments can be seen at
www.sciencemag.org/cgi/content/full/294/5548/1783a

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Singapore: On Being a Responsible Scientist J. Wong

Some of the more common ethical issues encountered by young scientists—and suggestions on how to deal with them.

UK: Chemists Storm Parliament C. Sansom

A special event at the Palace of Westminster gave young scientists the opportunity to show MPs the relevance of their work.

Germany: German Ph.D. Students—Free But Lonely
S. von Aichberger

Too much freedom can be a bad thing when it comes to preparing your Ph.D., as Germany's doctoral students attest.

Canada: Under One Roof, Part 4—Biotech in the Prairies
L. McCarney

This week, we head west to look at the flourishing biotech industry in Saskatchewan and Alberta.

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Cortical Basal Ganglionic Degeneration: A Case Study
N. Scarmeas, S. S. Chin, K. Marder

This rare neurodegenerative disease is categorized under both parkinsonian syndromes and frontal lobe dementias.

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signal transduction knowledge environment

Perspective: Phospholipid Signaling in Plants—Holding on to Phospholipase D T. Munnik and A. Musgrave

Does phospholipase D link membranes and microtubules? Lessons from the plant.

Review: The Complex and Intriguing Lives of PIP₂ with Ion Channels and Transporters D. W. Hilgemann, S. Feng, C. Nasuhoglu

Highlighting the role of PIP₂ in regulating and organizing transmembrane proteins.

Forum: Lipid Rafts—Real or Artifact?

An open discussion about membrane microdomains with an Opening Statement by Michael Edidin.

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THIS WEEK IN Science

edited by Phil Szuromi

Rigidity in the Liquid Core

Earth's outer core is composed of an iron-rich liquid, but differences in its chemistry and structure could have effects on core convection and nutation (the slight nodding of Earth toward the Sun as the Earth precesses on its axis). Rost and Revenaugh (p. 1911) have detected thin (about 0.2 kilometer) rigid zones at the top of the outer core and infer that these zones are mixtures of liquid iron alloys and solid grains of iron alloys and iron oxides.

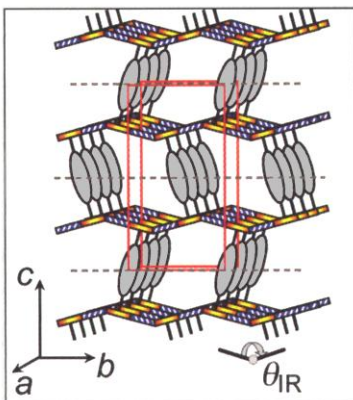
Tackling Ciguatoxin Synthesis

Many marine fish are vectors for ciguatera neurotoxins produced by the dinoflagellate *Gambierdiscus toxicus*, which produce more than 20,000 cases of seafood poisoning in subtropical and tropical regions.

The development of antibodies to these toxins has been hampered by the extremely low content of these poisons in fish. Hiram et al. (p. 1904; see the Perspective by Markó) now report the total synthesis of one ciguatoxin, CTX3C, through the convergent assembly of two comparably complex fragments.

Polarizing Organic Frameworks

Polar crystals, in which molecular dipoles align in one direction, should exhibit useful properties such as ferroelectricity and frequency doubling of light. Organic crystals offer the opportunity for the more rational design of bonding in the solid, but the dipoles of organic molecules tend to cancel in crystals and create nonpolar structures. Holman et al. (p. 1907) show that an organic host structure for the inclusion of guest molecules can be modified by using achiral banana-shaped bridging molecules to create a structure with an overall polarity. By properly choosing guest molecules, they can create crystals that exhibit second-harmonic generation of light.



1901 Photogenerating Triangular Silver Nanoprisms

An important challenge in the solution-phase synthesis of nanoparticles is to control particle size and shape while maintaining a high overall yield of product. Jin et al. (p. 1901) show that spherical silver particles can be almost completely converted by visible light into thin triangular prisms with edge lengths of 100 ± 15 nanometers. The triangular shape of these nanoparticles leads to unusual optical properties, such as the presence of two distinct quadrupole plasmon resonances and Rayleigh scattering in the red, rather than in the blue as is typical for spherical particles.

And in Brevia ...

The highly endangered North Pacific right whale (*Eubalaena japonica*) has changed both its habitat and prey during the last 50 years, according to Tynan et al. (p. 1894), and remains poised on the brink of extinction.

Careful records kept on cloned cattle by Lanza et al. (p. 1893) reveal that the 24 adult cattle that survived from 110 pregnancies appear to be completely healthy, in spite of a higher-than-usual mortality rate during gestation and at birth.



Hydrogen on Mars

Molecular hydrogen on Mars, although a relatively minor species in the CO₂-dominated atmosphere, stabilizes the chemistry of the atmosphere and soil and provides estimates of past water abundance. Krasnopolsky and Feldman (p. 1914; see the Perspective by Hunten) measured the H₂ abundance of Mars' upper atmosphere using the Far Ultraviolet Spectroscopic Explorer (FUSE). They found that there is enough H₂ to prevent the buildup of CO and O₂ in the atmosphere, to explain the presence of hydrogen-based oxidants in the soil, and to suggest that Mars may have initially had more water (as a proportion of the planet's mass) than Earth.

Revising CD8 Function

Intestinal intraepithelial lymphocytes (IELs) reside at epithelial surface along the gut, and many members of this class of T cells express a homotypic form of the CD8 α molecule whose role has been unexplained in the context of IEL biology. Leishman et al. (p. 1936; see the Perspective by Lambolez and Rocha) show that CD8 α homodimers interact specifically with a major histocompatibility complex-like molecule, termed TL, expressed on intestinal epithelial cells. When CD8 α engaged TL, cell division and cytokine production of antigen-specific IEL were increased, and other effector functions, such as cytotoxic activity, were inhibited. Thus, CD8 α may not act as a typical coreceptor but rather as a regulatory molecule that modulates that activity of intestinal T cells.

Managing Messenger RNA Traffic

Two classes of proteins, receptors and adapters, recognize properly processed messenger RNAs (mRNAs), and facilitate their export through pores in the nuclear membrane in the cytoplasm. The adapters bind directly to the mRNAs, and the receptors interact with the nuclear pore complex (NPC) and the adapters. The multiplicity of potential protein-protein interactions has hindered efforts at assigning pairwise combinations of adapters and receptors, both of which must also be recycled through the NPC for repeated use (see the Perspective by Moore and Rosbash). Gallouzi and Steitz (p. 1895) have now developed cell-permeable peptides that inhibit pair-wise interactions between receptors and adapters selectively without perturbing the overall movement of mRNAs into the cell.

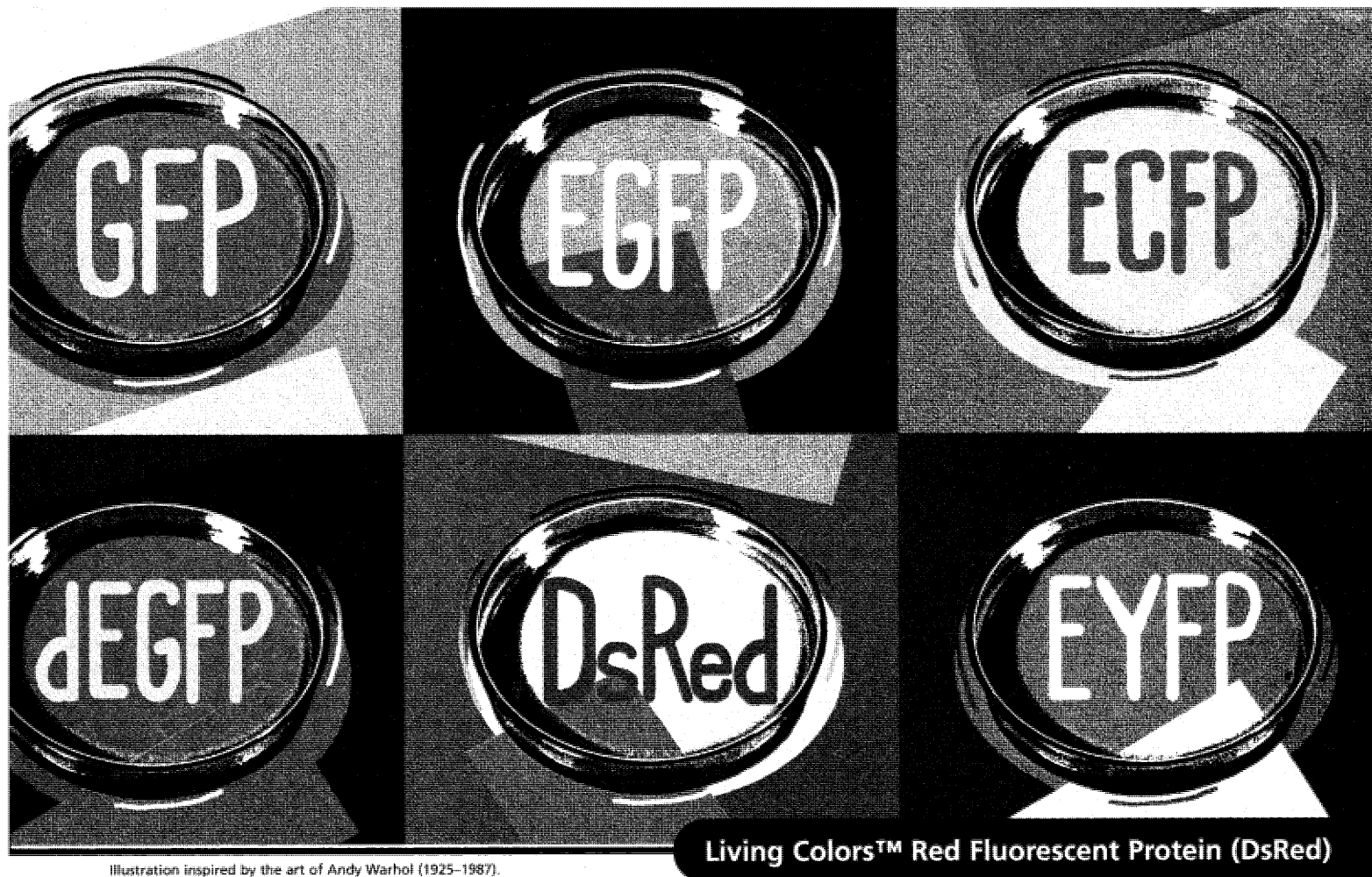


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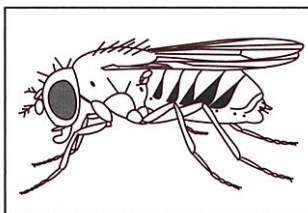


Losses Coming from the Top Down

Fragmentation of a natural habitat has been shown to create a community-level trophic cascade caused by the absence of predators. Terborgh *et al.* (p. 1923; see the Perspective by Diamond) show that for fragments of tropical forest created by the Guri dam project in central Venezuela, predator populations become unsustainable. Herbivores then become hyperabundant and severely suppress the recruitment of canopy trees, presaging wholesale degradation of the vegetation and loss of species diversity.

Controlling Air Intake During Flight

The tiny fruit fly, which has a diffusion-based respiratory system, must avoid excessive water loss during flight while maintaining sufficient gas exchange to fuel intense respiration. Is the opening of spiracles, which mediate gas exchange, tuned to match the intensity of force generation? To find out, Lehmann (p. 1926) glued individual female *Drosophila* to a support in a gas-tight chamber and indirectly measured spiracle opening by monitoring the release of water and CO₂. The author interprets the results to indicate that the flies do not hold their spiracles open during flight as previously suggested, but somehow adjust the size of the spiracle opening to correspond to the fly's metabolic requirements.



Watch a Virus Make Its Moves

For many of us, early instruction in microbiology included watching a movie of *Paramecia* engulfing their prey. Seisenberger *et al.* (p. 1929; see the news story by Beckman) now provide us with a real-time fluorescence video recording of a single virus particle adhering to a cell, being taken inward via endocytosis, breaking through into the cytoplasm, and reaching the nucleus where the wholesale takeover of host functions begins. The unexpectedly rapid transit time is of special interest because this invader, adenovirus, is a prime candidate for virus-based gene therapy approaches.

G Proteins and Vesicle Trafficking

Attenuating a cellular signal is just as critical as inducing it. For example, regulator of G protein signaling (RGS) proteins modulate the signaling output from receptor-coupled heterotrimeric G proteins. Zheng *et al.* (p. 1939; see the Perspective by von Zastrow and Mostov) have identified what has been an elusive RGS for the G α_s class of G proteins. Named RGS-PX1, it also contains a membrane-interacting Phox domain whose presence suggests a link between G protein signaling and vesicle trafficking in cells.

Lipids and Immunosuppression

Mitogens and other stimuli to cells cause generation of the lipid phosphatidic acid (PA), which acts as a second messenger to promote various cellular responses. Fang *et al.* (p. 1942) identify a new target regulated by PA binding that appears to account for the mitogenic effects of the lipid. In cells treated with PA, the mTOR protein (so named because it is mammalian target of the immunosuppressant rapamycin), which is a phosphatidylinositol kinase-like enzyme, becomes activated. Stimulation of human cells with mitogens increased accumulation of PA and inhibitors of PA production inhibited signaling through mTOR. The results indicate that PA mediates the effects of mitogens to activate mTOR and that rapamycin may interfere with mTOR function by blocking binding of PA.

How to Catch a Smell

Lobsters capture odors with small hairy arrays in their antennules. Does the movement of these antennules disrupt the spatial pattern of odors? Koehl *et al.* (p. 1948) used laser light and high-speed video imaging to visualize fluorescent dye flow through these antennules and found that small spatial patterns of dye enter the receptor area with little initial disturbance during the fast downstroke of the antennule. The spatial patterns only get blurred during the return stroke and the subsequent pause.

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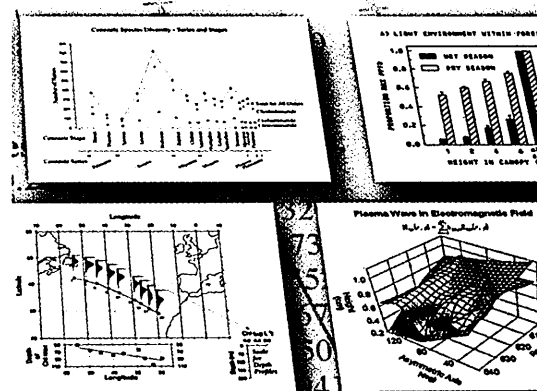
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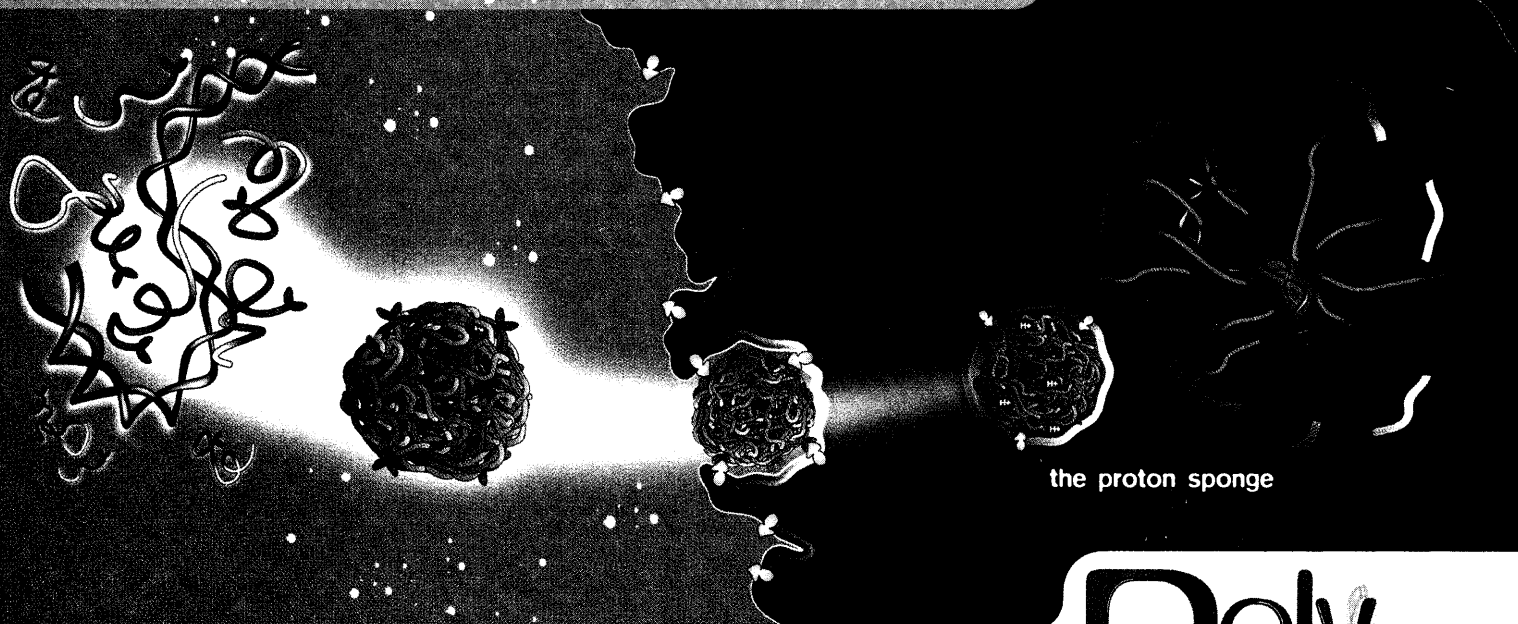
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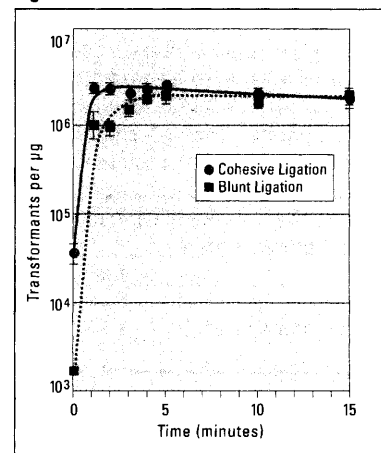
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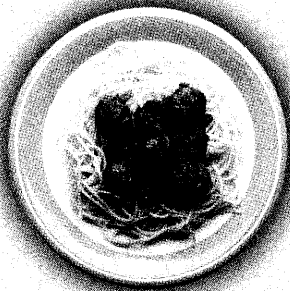
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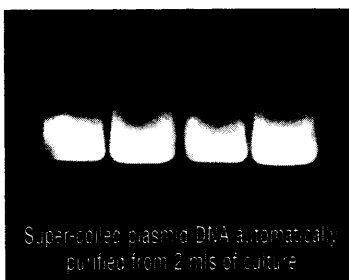
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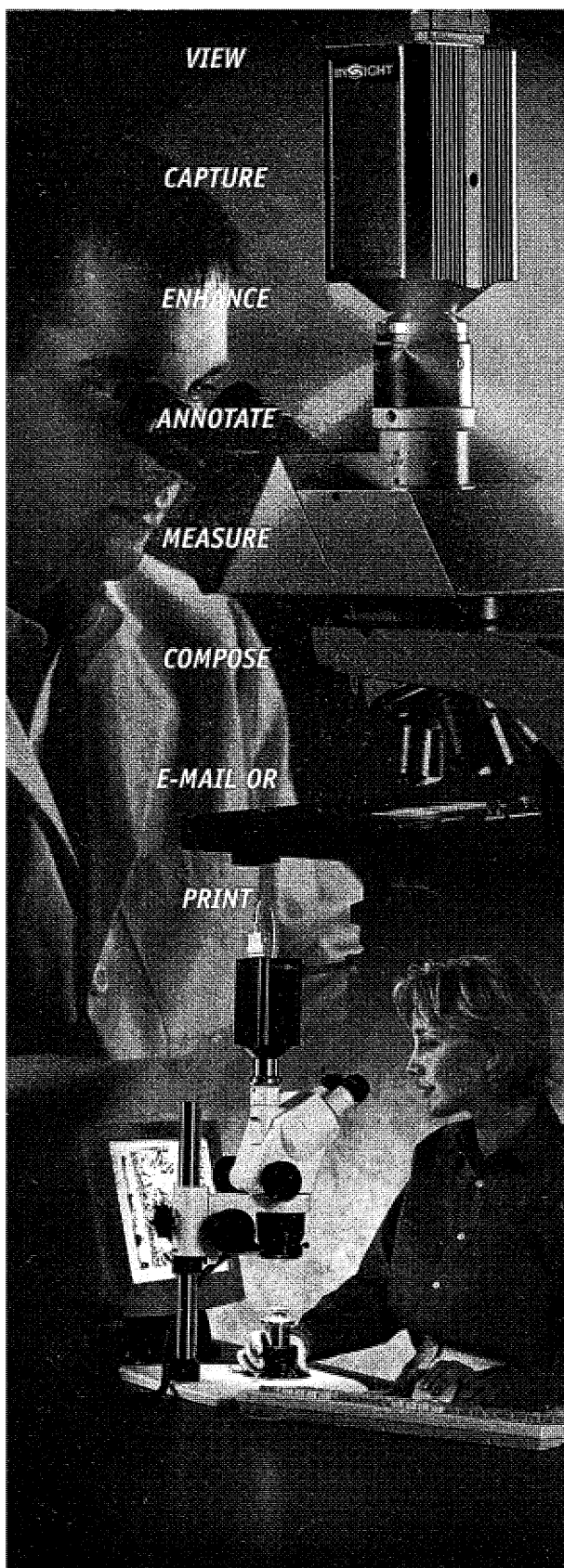
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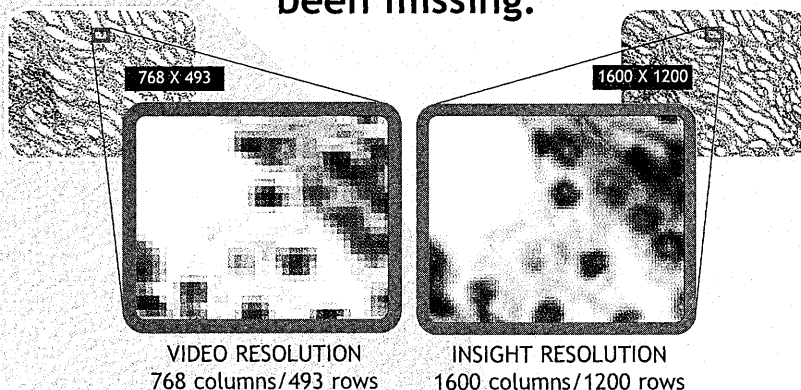
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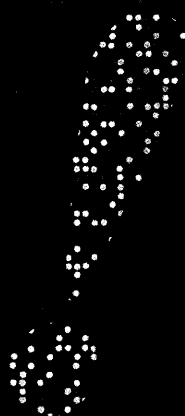


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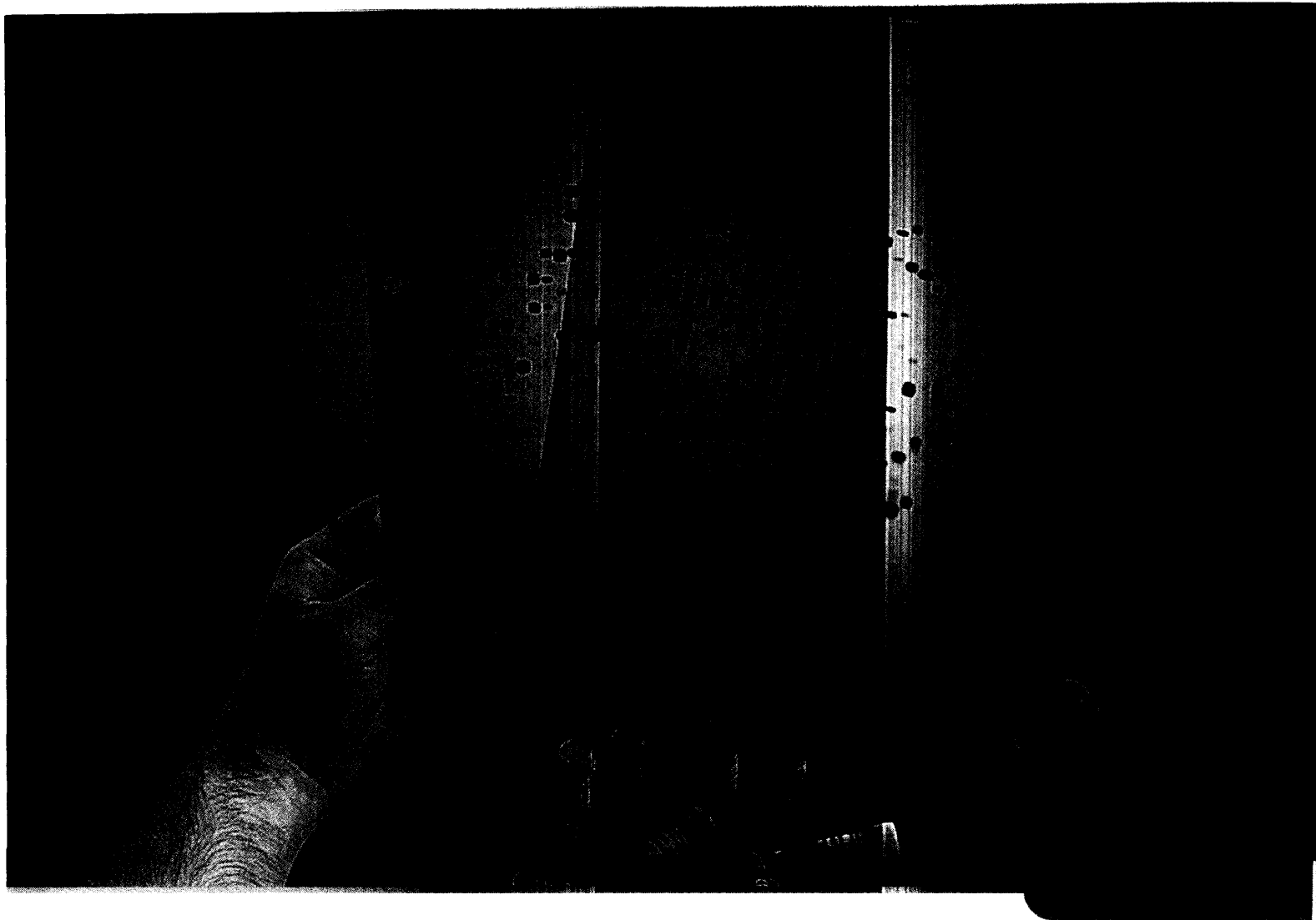
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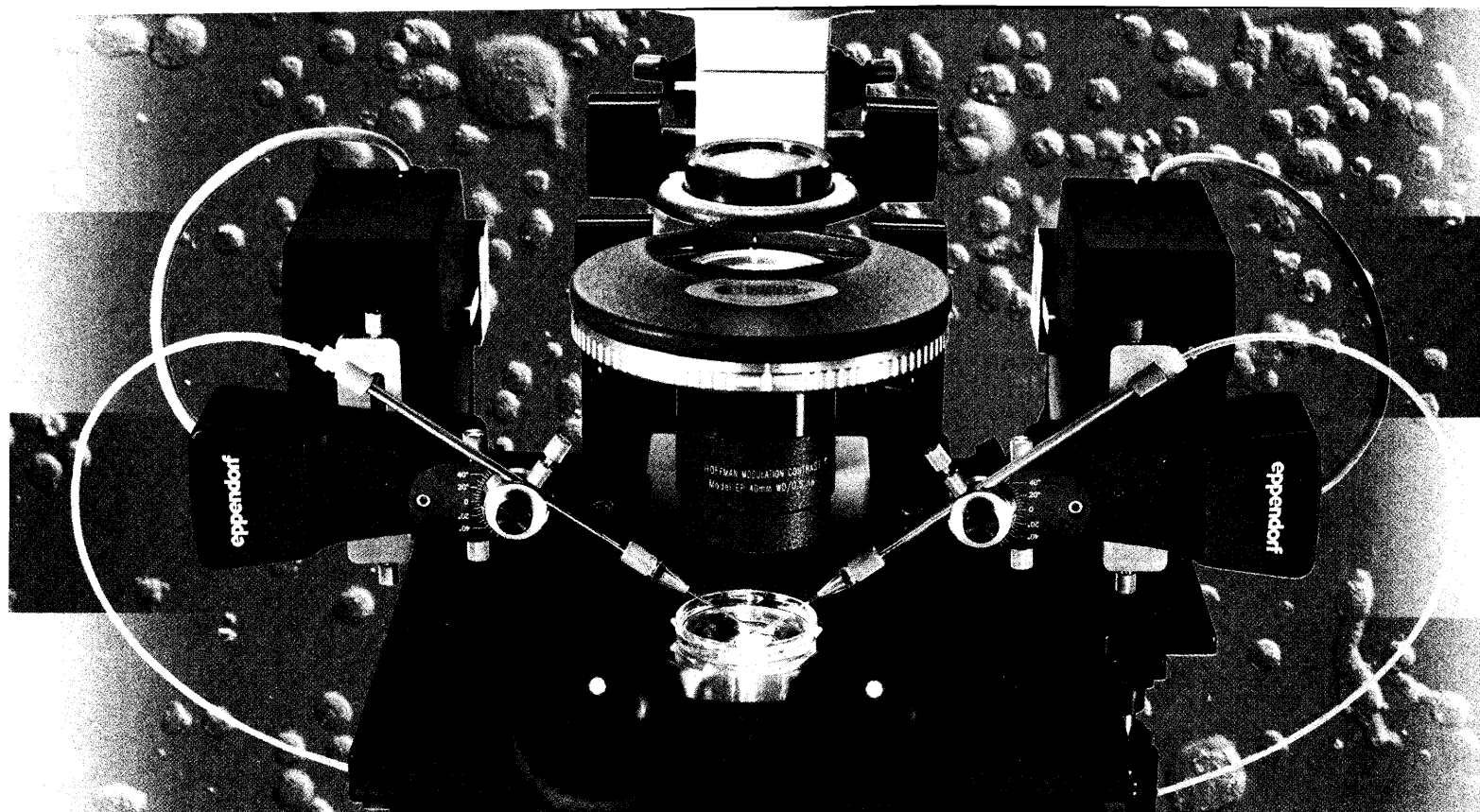
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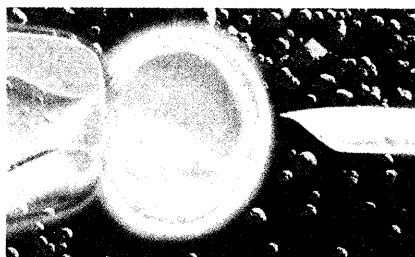


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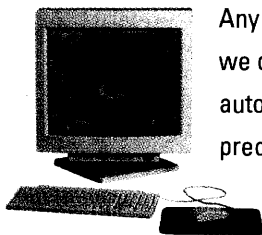
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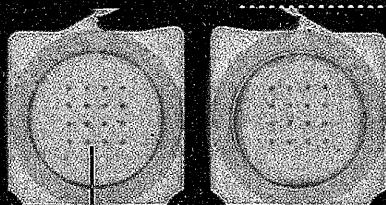
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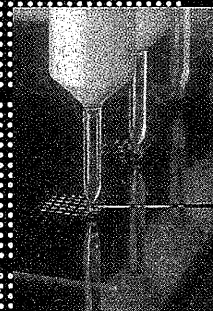
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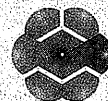
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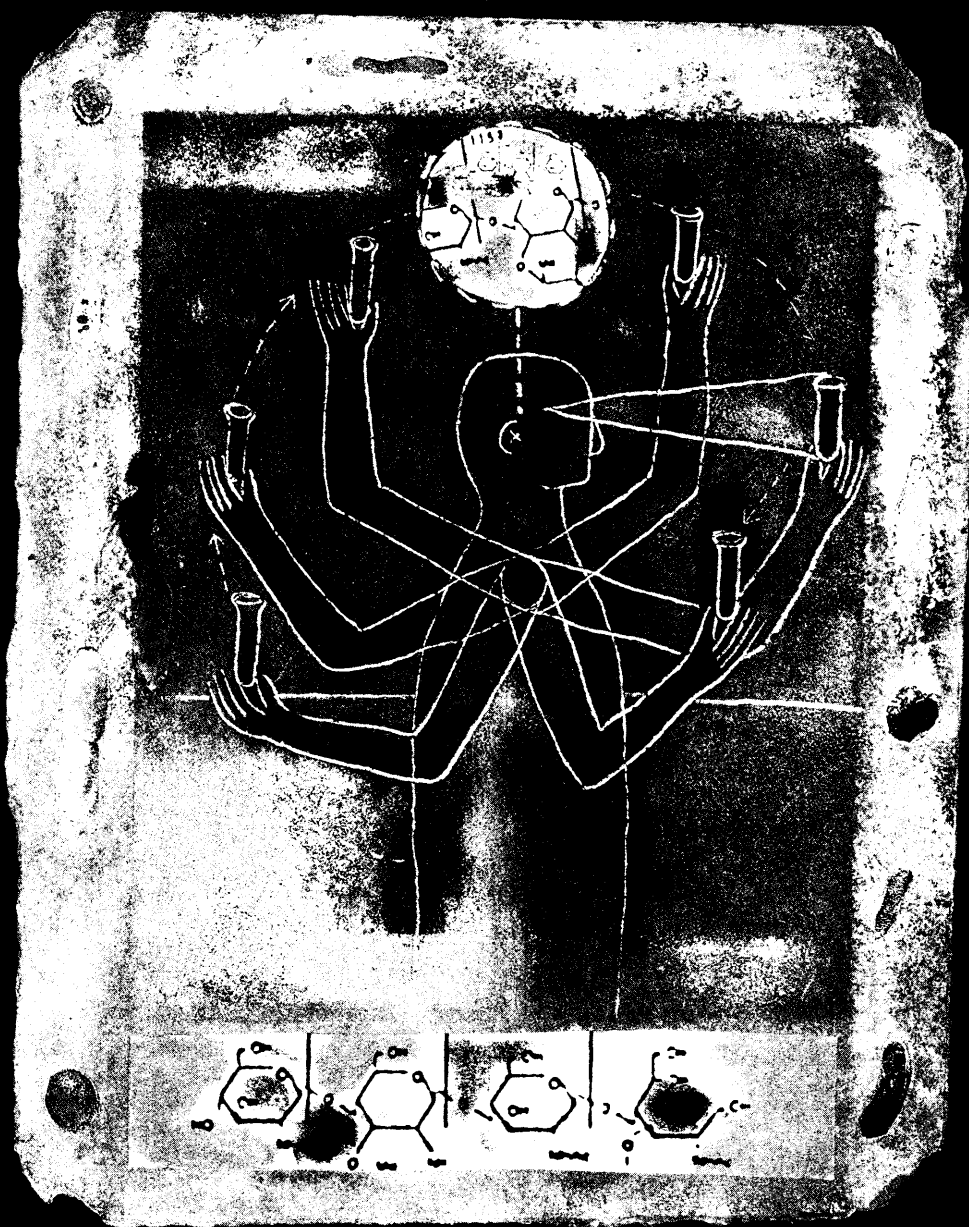
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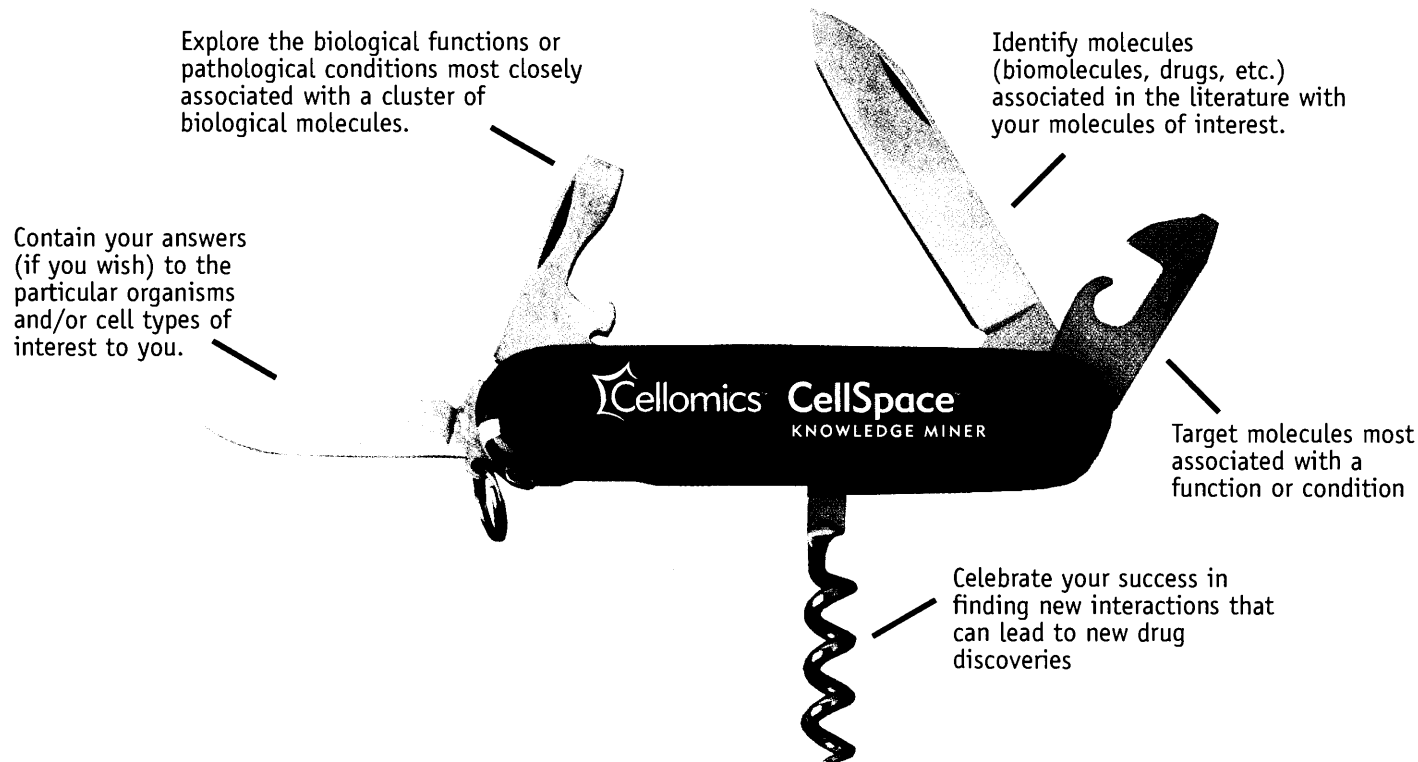


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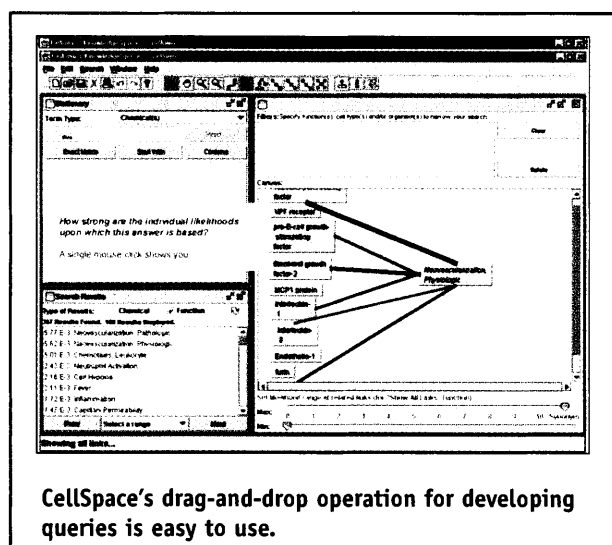


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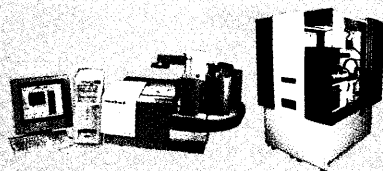
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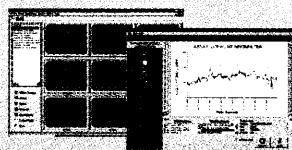
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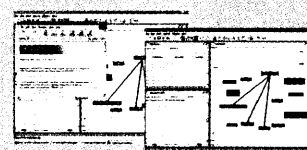
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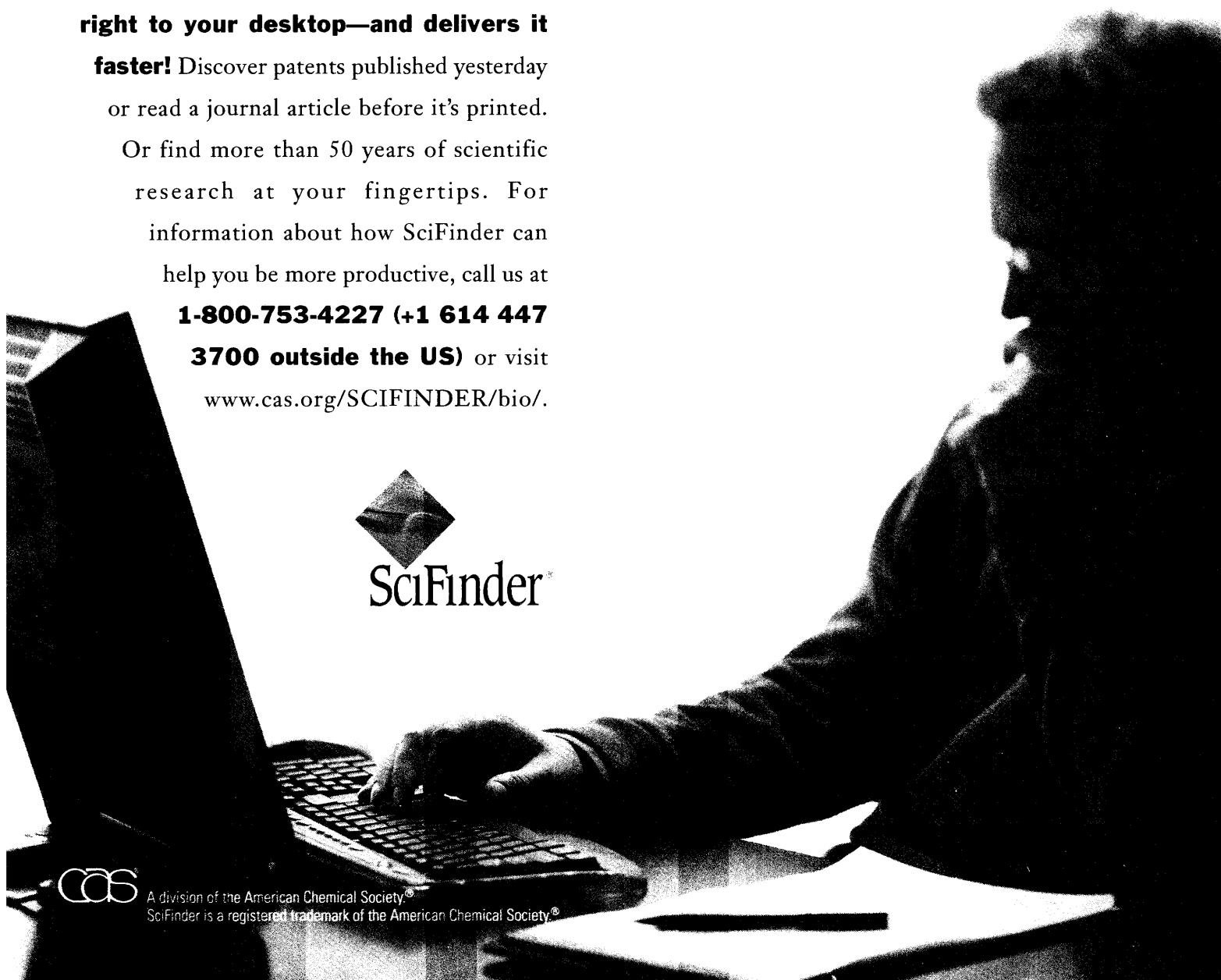
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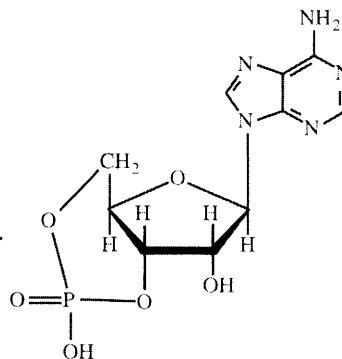


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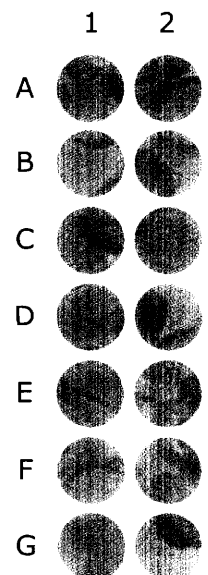
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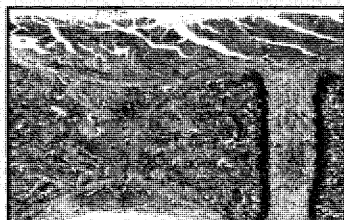
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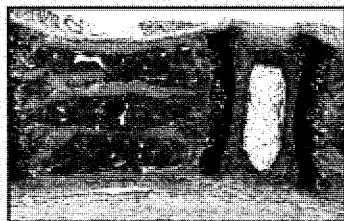
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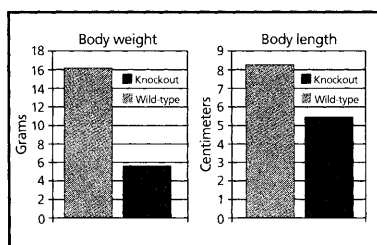
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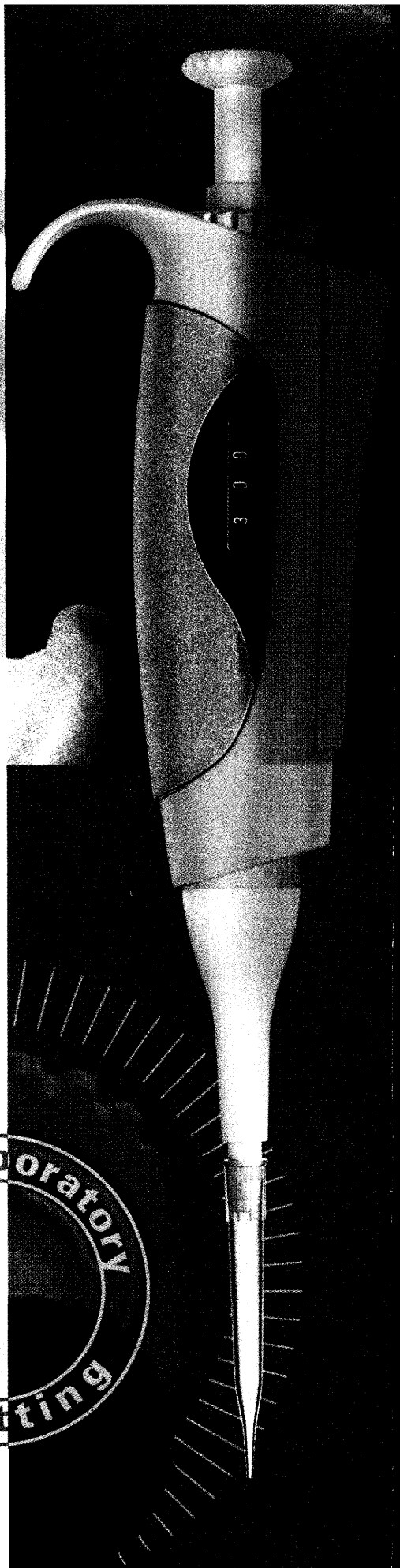
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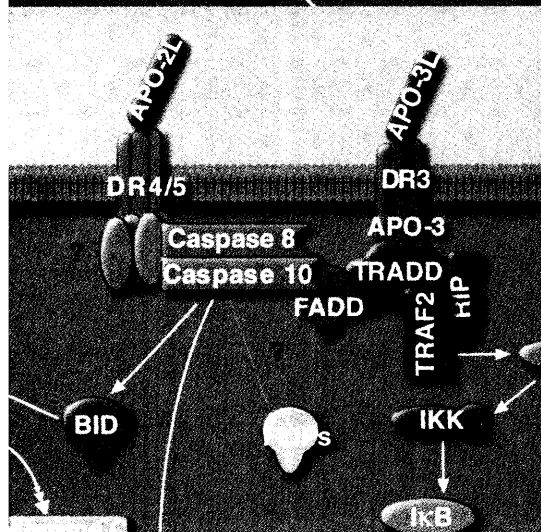
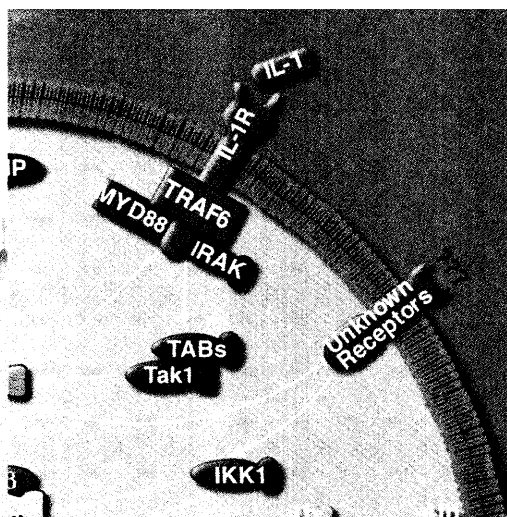
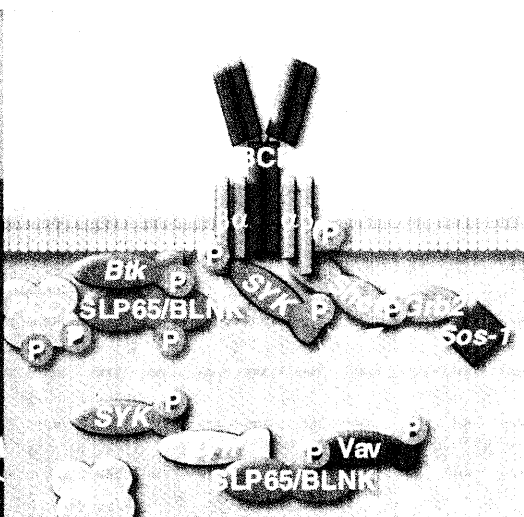
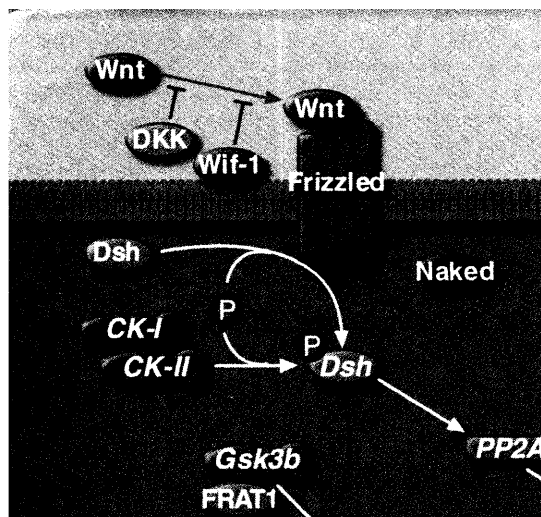
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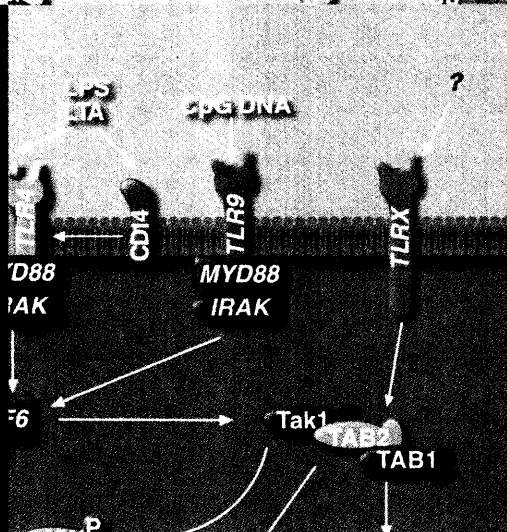
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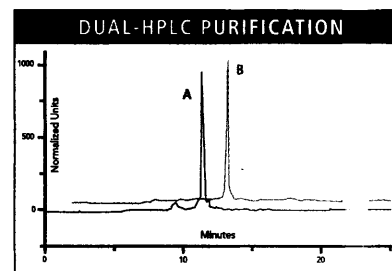
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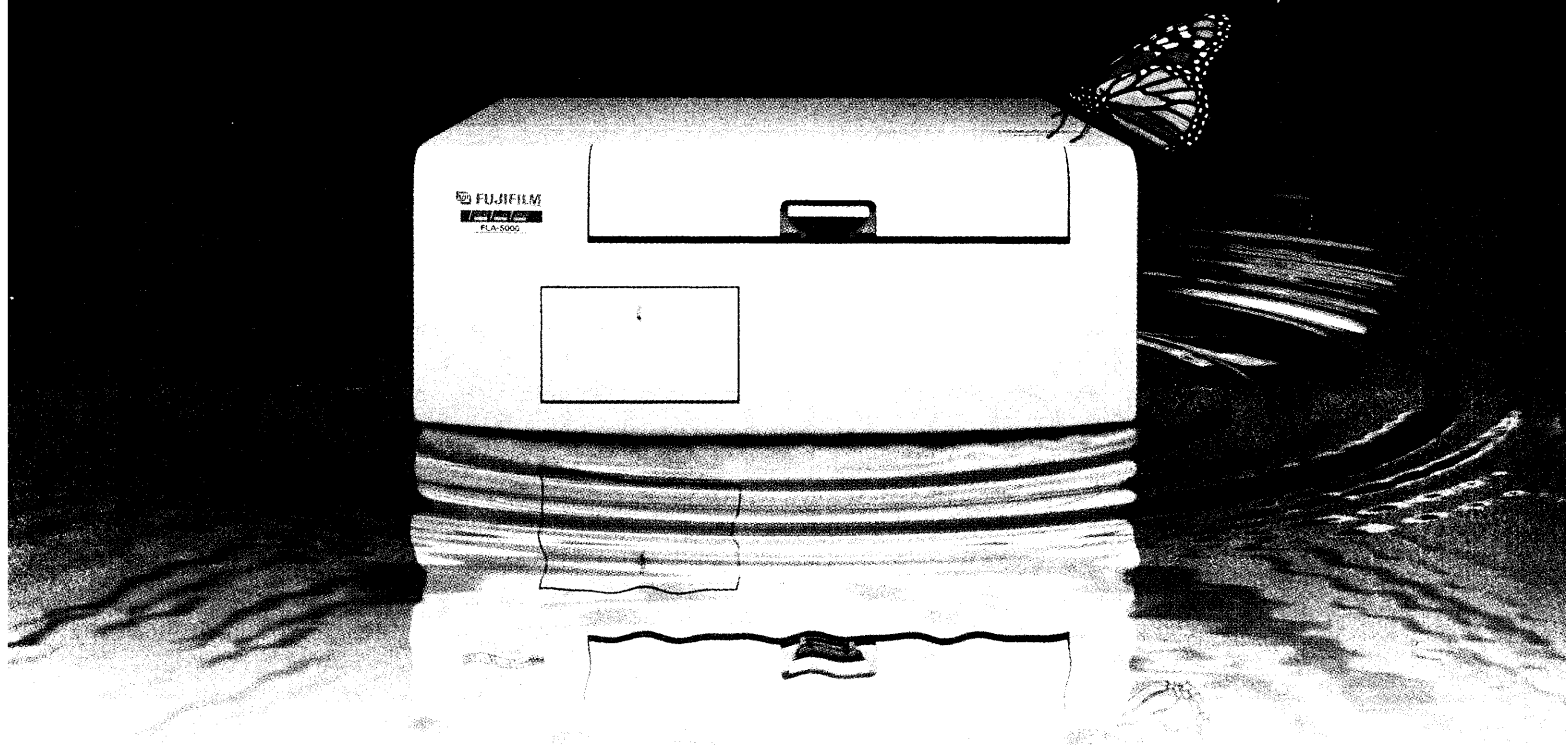


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Takagi, Masahito, et al, *Applied and Environmental Microbiology* (1997), 63: 4504-4510

† Fidelity was measured by the authors as mutation frequency in PCR products using a sensitive blue/white phenotypic assay using a 5.2 kbp *lacZ* plasmid as template



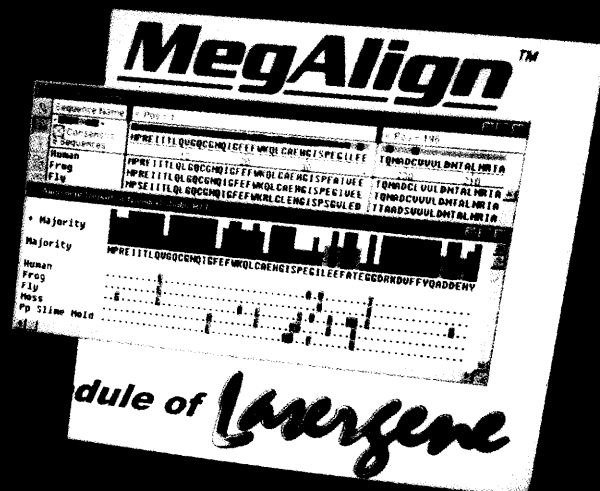
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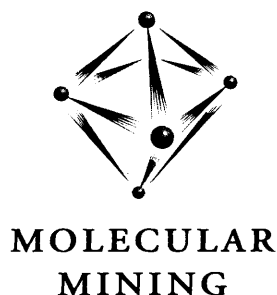
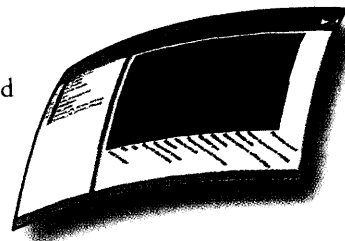
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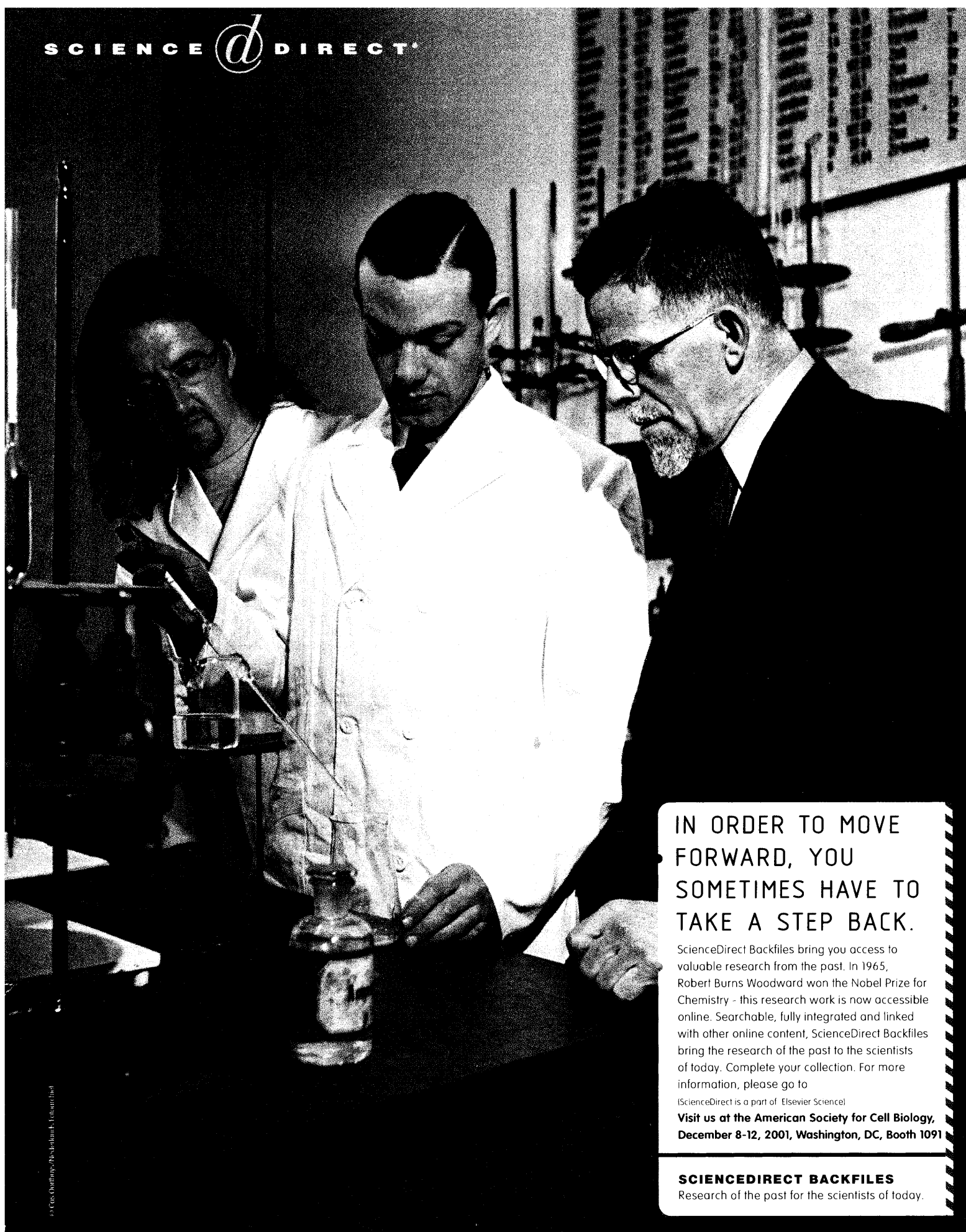
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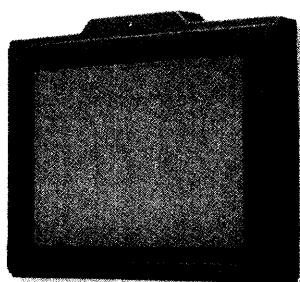
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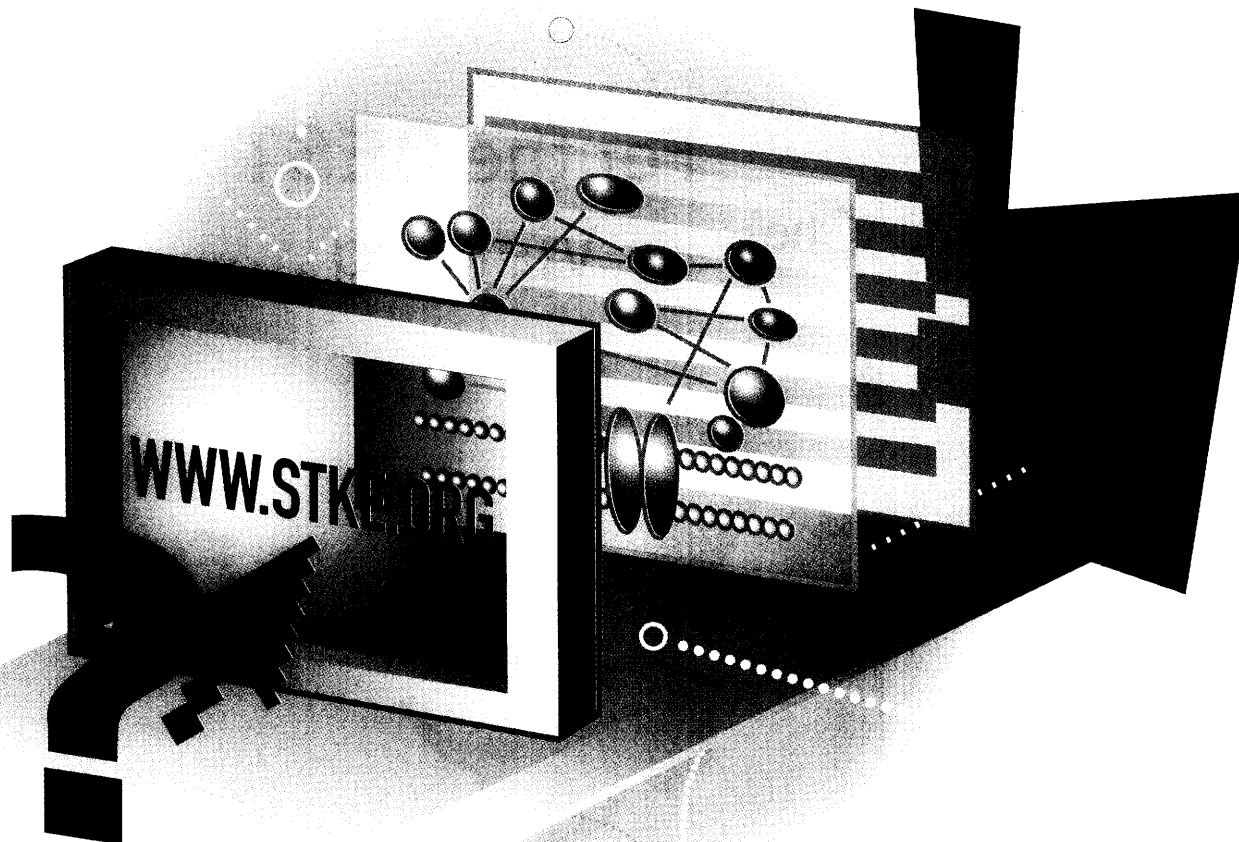


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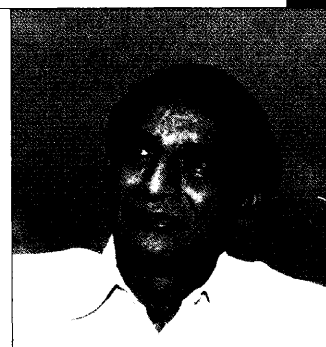
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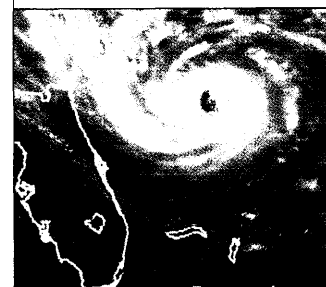


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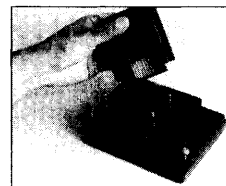
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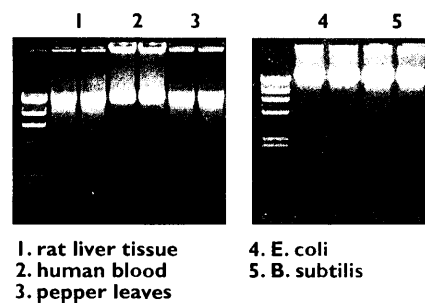
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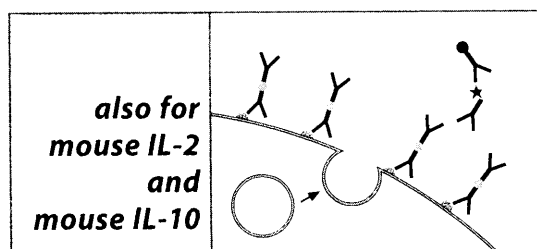
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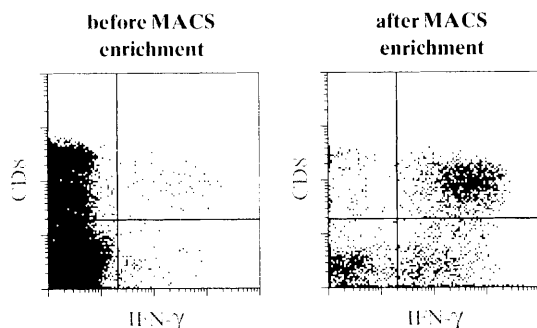
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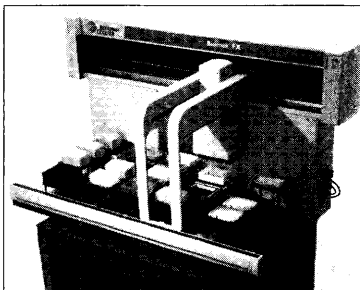
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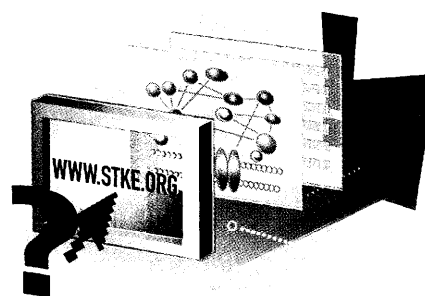
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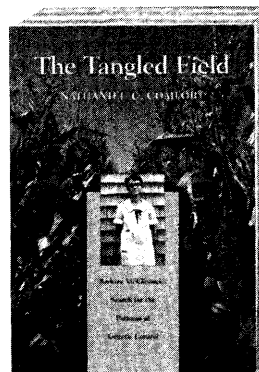
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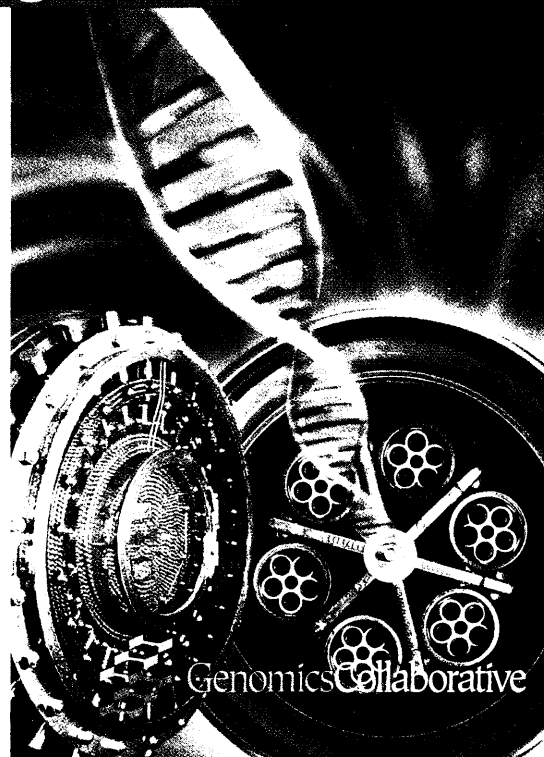
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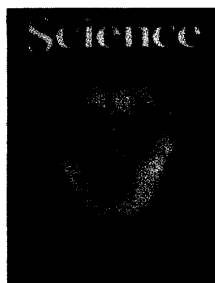
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