BECOMING HUMAN: FIRST STEPS FOR HOMINIDS AND *HOMO SAPIENS*

Science

15 February 2002

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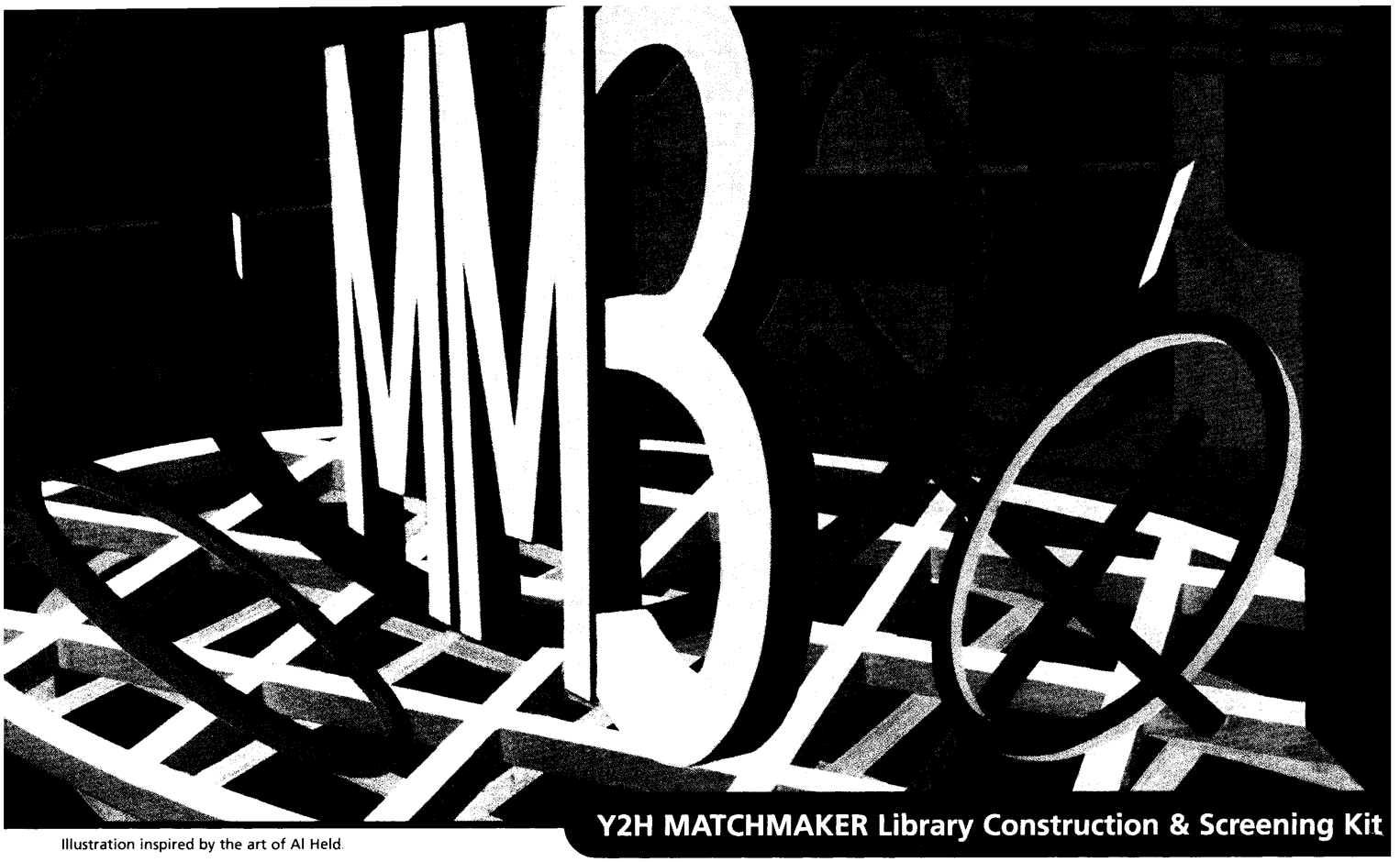
Pages 1181–1412 $9

Gordon Research Conferences

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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NEWS

NEWS OF THE WEEK

NEWS FOCUS

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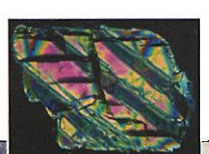

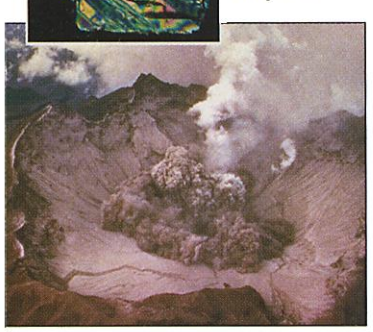

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BOOKS *ET AL.*

PERSPECTIVES

REVIEW

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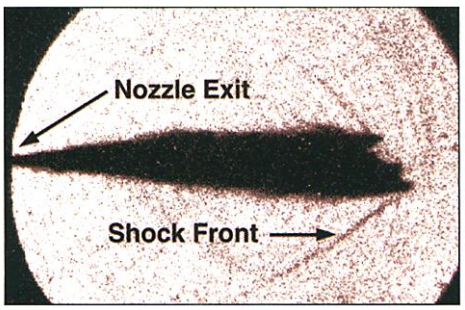
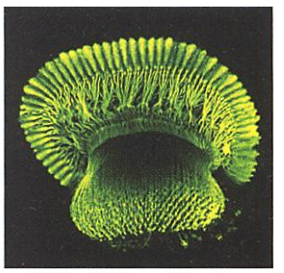


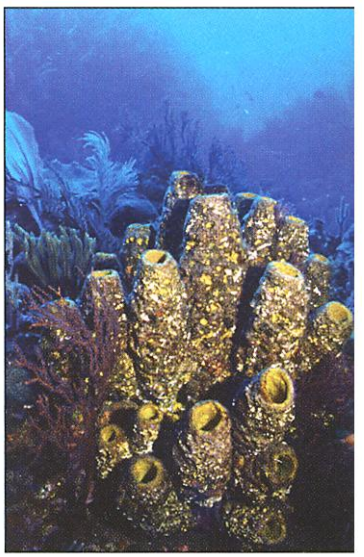
1261
Spray waves

REPORTS



COVER 1327

A mosaic of confocal images of the entire visual system of the fruit fly *Drosophila* labeled with an antibody to a photoreceptor-specific protein, Chaoptin. The Gordon Research Conferences on Visual System Development will be held 9 to 14 June 2002 at Salve Regina College, Newport, RI. The schedules for the 2002 Gordon Conferences begin on p. 1327. [Image: Franck Pichaud and Claude Desplan, New York University]



1280
Hotspots for coral conservation

New on *Science* Express Signals in response to infection

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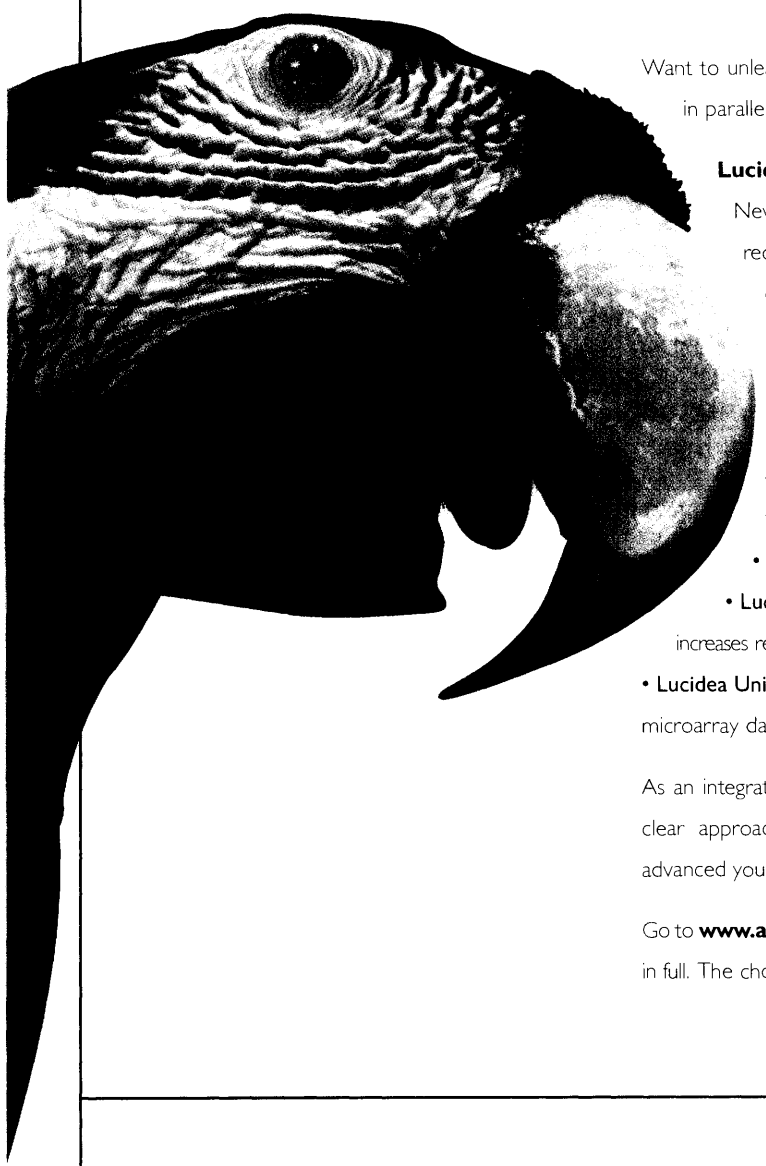

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SCIENCE EXPRESS www.sciencexpress.org

Regulatory Role of *SGT1* in Early *R* Gene–Mediated Plant Defenses M. J. Austin *et al.*

The RAR1 Interactor SGT1, an Essential Component of *R* Gene–Triggered Disease Resistance
C. Azevedo *et al.*

Ubiquitin-targeted protein degradation mediates plant responses to pathogen attack.

Regulation of Corepressor Function by Nuclear NADH Q. Zhang, D. W. Piston, R. H. Goodman

The interaction of the mammalian transcriptional corepressor CtBP and repressors responds to metabolic redox level for the regulation of gene expression.

science's next wave www.nextwave.org

career resources for scientists

Singapore: From News Journalism to Freelance Editing L. S. Wong

Continuing Next Wave's month-long focus on careers in editing, we hear from a science graduate who has many years of experience in the publishing world.

Germany: The European Union Made Easy B. Holst

The author, a Danish native now at a Max Planck institute in Göttingen, describes her experiences in a 3-day course designed to train women to write high-quality EU proposals.

UK: Your First "First Author" Paper, Part 1—The Writing P. H. Dee

Just because it's a lot shorter than a thesis doesn't mean that writing a paper takes 5 minutes. Our columnist tells it like it is.

Canada: The Bottom Line—Ontario's Universities Need More Funding L. McKarney

Student protesters across Canada demanded tuition freezes last week, but there is no relief in sight for Ontario's cash-strapped universities.

US: The Joys and Struggles of Women of Color in Academia L. Harrison

Learn from those who have gone before: A report on an interactive forum featuring women professors of color discussing their strategies for success.

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Diversity Comes of Age F. L. Bellino

NIA supports minority investigators and research that addresses health disparities between minority and nonminority elderly populations.

Passing the BRCA1 Baton R. J. Davenport

Possible target of anticancer protein identified.

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Protocol: Infrared-Guided Laser Stimulation of Neurons in Brain Slices H.-U. Dodt, M. Eder, A. Schierloh, W. Zieglgänsberger

Methods for stimulating neurons with high spatial resolution.

Perspective: The SAP Family—A New Class of Adaptor-Like Molecules That Regulates Immune Cell Functions A. Veillette

The proteins SAP and EAT-2 consist of little more than a single Src homology 2 domain, yet both appear to be essential for proper signaling.

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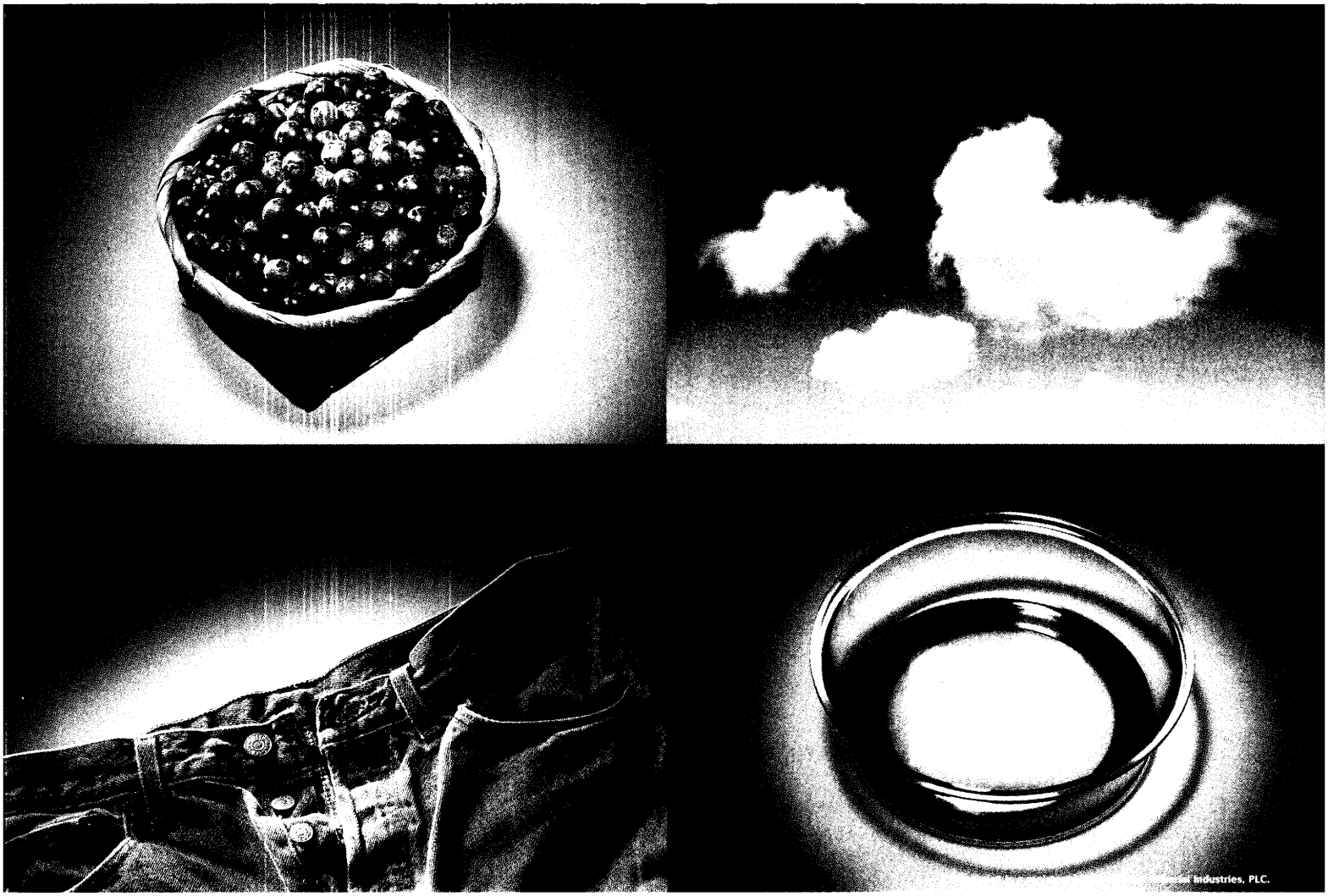

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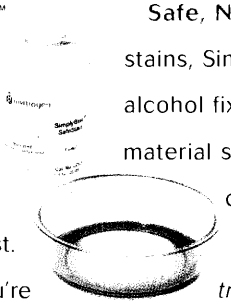

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THIS WEEK IN Science

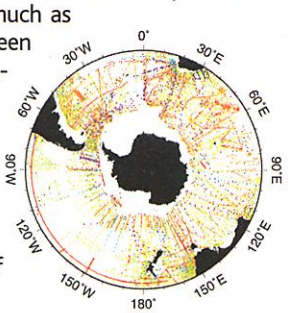
edited by Phil Szuromi

Early Rise of Human Behavior

Anatomically modern human specimens have been found in sub-Saharan Africa as far back as 100,000 years. When behaviorally modern humans developed, as evidenced by abstract or symbolic art, has remained controversial. Some archaeologists have argued for a late and rapid development of behavior about 40,000 to 50,000 years ago in the European Upper Paleolithic and sub-Saharan African Late Stone Age, but others argue for an earlier and more gradual development starting in the African Middle Stone Age. Henshilwood *et al.* (p. 1278: see the news section on human evolution and the 11 January news story by Balter) discovered two pieces of ochre with geometric patterns, which they interpret as symbolic artwork, in Blombos Cave, South Africa. Thermoluminescence dating of the rock deposits and associated burnt lithic fragments indicates the ochre pieces are about 77,000 years old, belonging to the Middle Stone Age and supporting an earlier and gradual rise of human behavior in sub-Saharan Africa.

Southern Warmth

The Southern Ocean mixes water from the Pacific, Atlantic, and Indian Oceans in the fast-flowing Antarctic Circumpolar Current, and thus is considered to be a good integrator of conditions in the world's oceans. Gille (p. 1275) compared temperature measurements for Southern Ocean waters at depths of 700 to 1100 meters in the period between 1930 and 2000. They found that water temperatures in this region increased nearly twice as much as that of the average global ocean between 1950 and 1990. This increase is comparable to the amount atmospheric warming in the Southern Hemisphere during that period and is more precisely defined than average surface air temperature. Measurements of mid-depth of Southern Ocean water could be useful for tracking the progress of warming south of the equator.



CREDIT: GILLE

Mantle Flow: Old or New?

The overall flow of mantle material in a preferred direction tends to align the olivine grains along one axis that can be revealed as an anisotropy in electrical conductivity. Bahr and Simpson (p. 1270) measured the anisotropy of electrical conductivity beneath Australia and the fast-moving Australian plate and beneath Fennoscandia and the slower-moving Eurasian plate. They found a greater degree of olivine grain alignment in the mantle beneath Fennoscandia, which indicates that the flow is dominated by mantle convection independent of plate motion or that the flow is a fossil remnant of older and faster Eurasian plate motion. Either mechanism provides useful estimates of mantle dynamics, such as relaxation times and convective flow patterns.

1261 Shocking Images

In most gasoline or diesel engines, fuel is pressurized and sprayed into the engine so it is rapidly dispersed with the oxidant. Optimizing this process is critical for fuel and engine efficiency, yet it has been difficult to examine the dynamics of such sprays in sufficient detail to optimize designs rationally. MacPhee *et al.* (p. 1261) now show that synchrotron x-radiography can reveal the high-speed dynamics of high-pressure sprays. Their analysis shows that for conditions typical of many engines, a shock wave develops and propagates in the spray.

And in Brevia ...

Data from miniaturized Global Position Satellite tracking devices, attached to wandering albatrosses residing on an island in the southern Indian Ocean in a study by Weimerskirch *et al.* (p. 1259), reveal their flight patterns and foraging behavior.

High Humidity

Increases in stratospheric water vapor may contribute to global temperature trends and also interfere with the recovery of polar ozone by strengthening destruction mechanisms. The concentration of water vapor in the stratosphere has approximately doubled in the last 50 years and the only known mechanism (the oxidation of methane) for producing water accounts for only half of this increase. Sherwood (p. 1272) examined nearly two decades of recent satellite data and found that stratospheric moisture variations can be traced back to relative humidity changes near or below the tropical tropopause. These changes appear to be influenced by the size distribution of ice crystals lofted in deep convective updrafts. A contributing factor could be the accelerating rates of tropical biomass burning, which produces the small aerosols required for this proposed mechanism.

Conservation by Land and by Sea

A quarter of the world's coral reefs are now seriously degraded by human activity, and many more are highly threatened. Using data on the distribution of 3235 reef species, Roberts *et al.* (p. 1280) pinpoint the hotspots of reef degradation and biodiversity and investigate how conservation action might be targeted to where it is most needed. A striking concordance is seen among terrestrial and marine biodiversity hotspots: Many marine hotspots are adjacent to or overlap terrestrial biodiversity hotspots, indicating an opportunity for developing integrated terrestrial and marine conservation strategies.

Chirality Enhancement on Films

A key question for those interested in the origins of life is whether a racemic mixture of molecules can react to form chiral polymers. Zepik *et al.* (p. 1266) studied three analogs of lysine and glutamic acid that were modified to give them an amphiphilic nature and then deposited as racemic monolayers onto a water surface. Disordered monolayers formed oligomers with random or binomial distributions. However, for ordered monolayers, a racemate in which nearest neighbors were of opposite configuration favored alternat-

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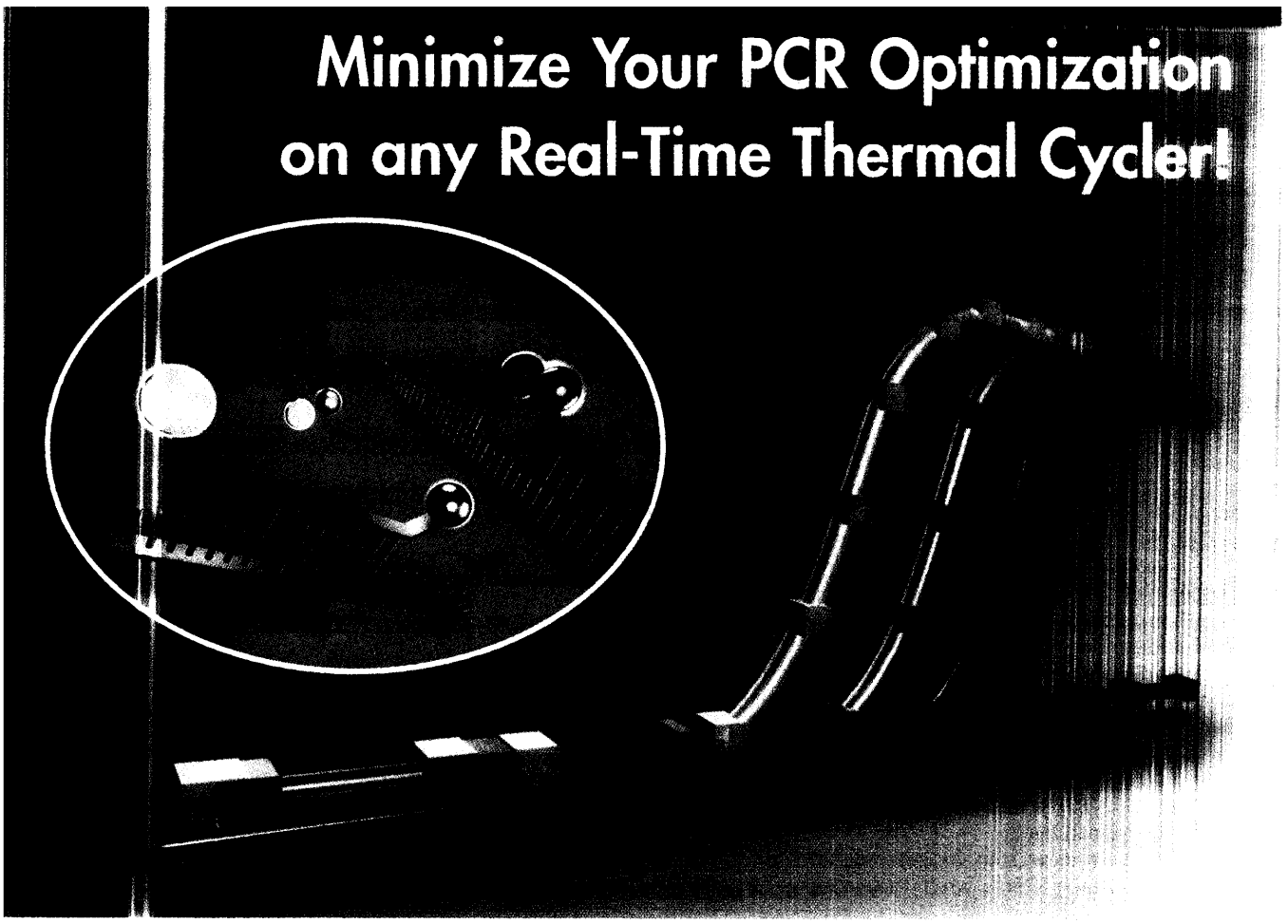
CONTINUED ON PAGE 1191



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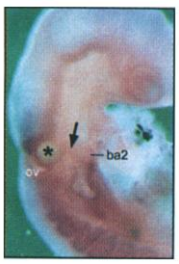
ing oligomers, and racemates in which nearest neighbors were of the same configuration favored homochiral oligomers. This finding is somewhat surprising given the slow diffusion of molecules within the monolayer surface and the need for the growing oligomer to fit within the crystalline structure of the monolayer.



CREDIT: TRAINOR *ET AL.*

Programmed or Plastic?

In vertebrates, cranial neural crest cells specify the bone and connective tissues of the head. In classical experiments involving the chick embryo, portions of the chick hindbrain, which specified the first arch skeletal derivative, were transplanted to posterior locations in the hindbrain. This transplanted material continued to give rise to duplications of the first arch, despite its new location, which suggested that the neural crest is pre-programmed to make specific head structures. However, subsequent analyses have indicated that the neural crest is more plastic. Trainor *et al.* (p. 1288) now show that the inclusion of the midbrain/hindbrain junction in the grafts is sufficient to account for duplication of first arch structures and that fibroblast growth factor 8 from the isthmus results in this duplication.

Maintaining Even Distributions

Distributing adhesive contacts evenly around the cell periphery may require a signaling pathway that depends on the small guanosine triphosphatase (GTPase) Rap1. Knox and Brown (p. 1285) reveal that loss of Rap1 function in *Drosophila* epithelial tissue caused unequal distribution of adherens junctions and disrupted normal cell migration. Rap1 was also enriched at the junction between newly divided sister cells. The GTPase may link junctional complex proteins to signaling pathways that regulate cell-cell contacts and possibly changes in cytoskeletal tension that are critical to cell mobility and division.

Doing Double Duty

Regulation of the cell cycle involves the nedd8 ubiquitin-like modification of key proteins. Kurz *et al.* (p. 1294) now find that these modifications are also important in controlling the cytoskeleton in *Caenorhabditis elegans* embryos. Nedd 8 conjugation inhibits microfilament contraction in the cell cortex during pronuclear migration and again during cytokinesis. In addition, katanin, a microtubule-severing complex, is degraded after neddylation at the end of meiosis.

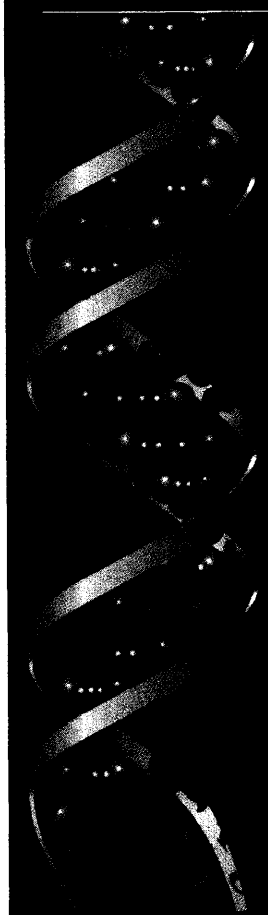
AIDing Immunological Diversity

The phenomenal diversity of the antigen receptor genes arises in part from their assembly by V(D)J recombination, and three distinct processes generate still further diversity of the rearranged immunoglobulins. The rearranged V segments are subject to somatic hypermutation and gene conversion, and class switching changes the effector function of the immunoglobulins. Activation-induced deaminase (AID), a protein predicted to be involved in RNA editing, has been shown to regulate the activity of both somatic hypermutation and switch recombination. Arakawa *et al.* (p. 1301; see the Perspective by Fugmann and Schatz) now show that immunoglobulin gene conversion is also regulated by AID, indicating that somatic hypermutation and gene conversion are likely initiated by the same event. Thus, AID appears to be a master regulator of all three processes.

Potent Antimalarial Agent

Within human beings infected with malaria, the asexual stages of *Plasmodium falciparum* reside in red blood cells. Unlike their host cells, the parasites synthesize large amounts of membrane, probably to assist nutrient uptake. Wengelnik *et al.* (p. 1311; see the news story by Taubes) have been working on ways to inhibit parasite phospholipid biosynthesis that have focused on using structural mimics of choline. The lead compound, G25, was tested in monkeys with heavy infections of *P. falciparum* and *P. vivax* (5 to 14% parasitized erythrocytes). They were able to cure the monkeys after intramuscular treatment without recrudescence up to 60 days later. G25 cures monkeys of malaria at doses far below those used for current antimalarials and is effective in mice infected with parasites that are resistant to the drugs currently in use.

Setting the Standard



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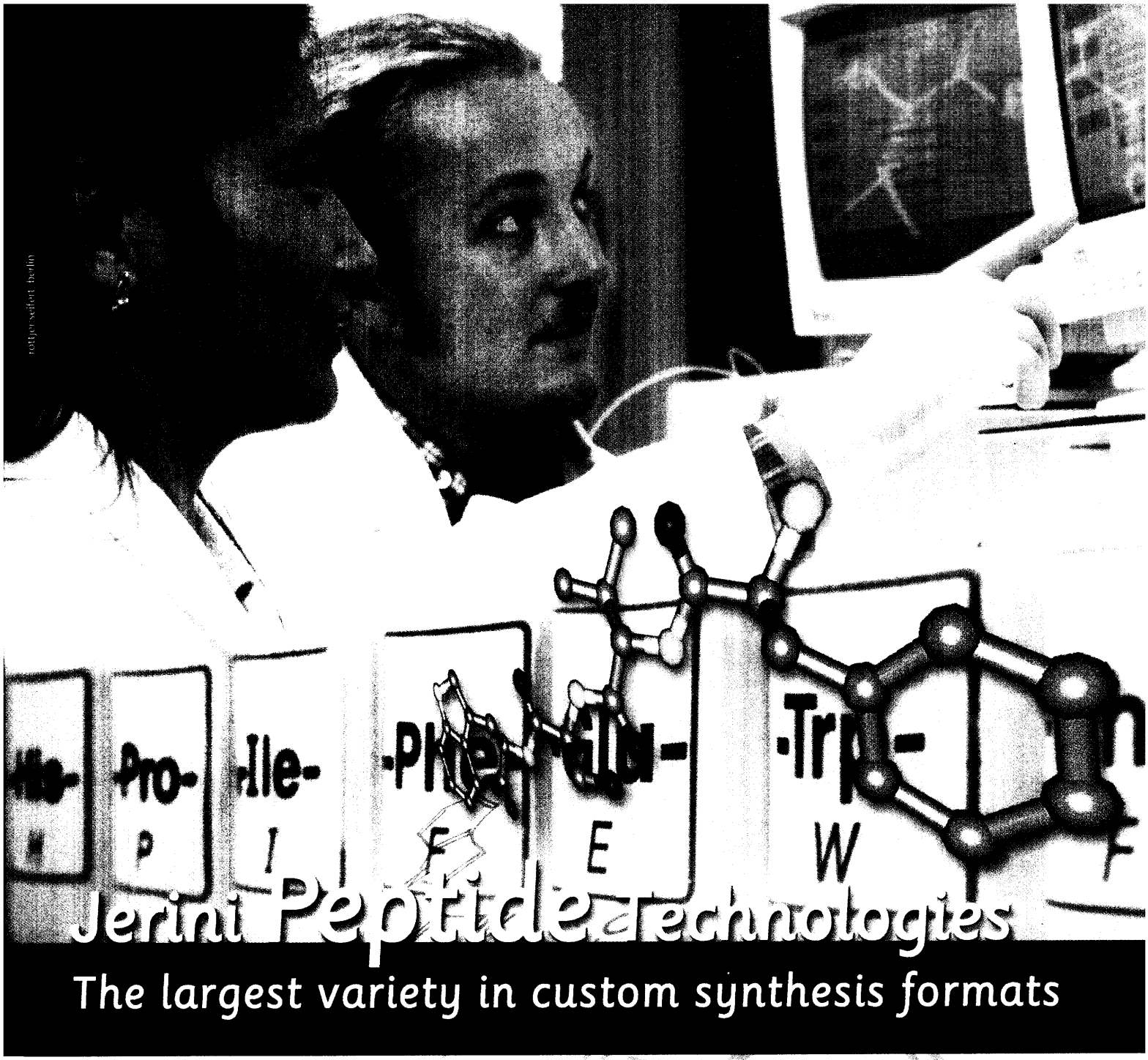

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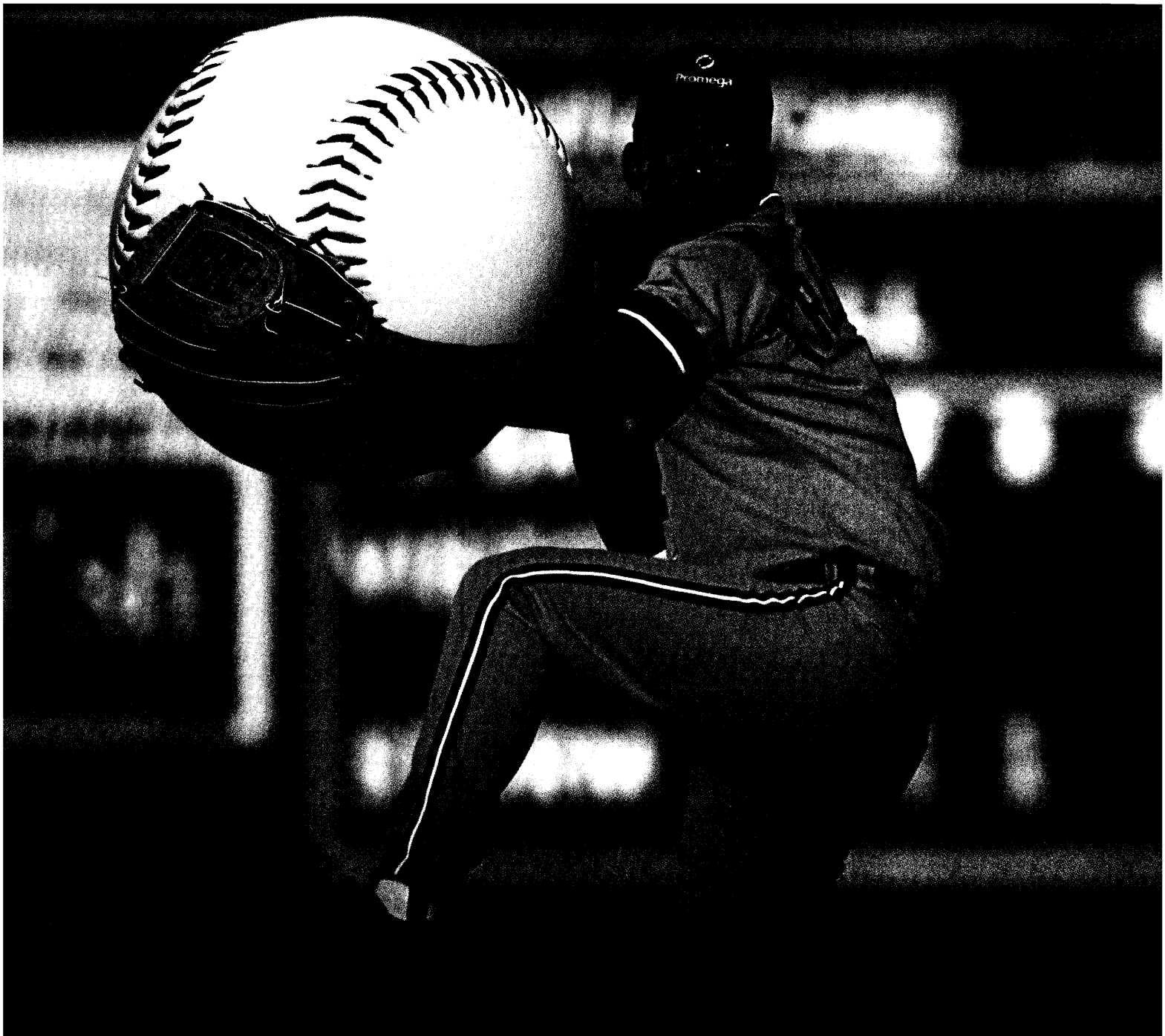

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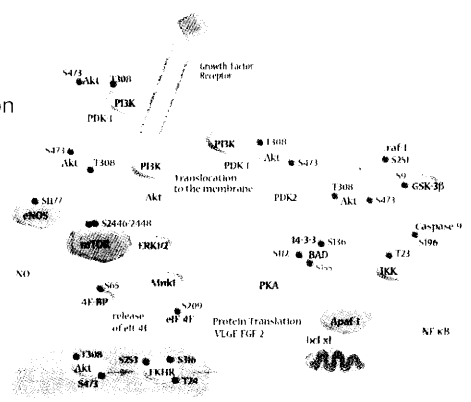

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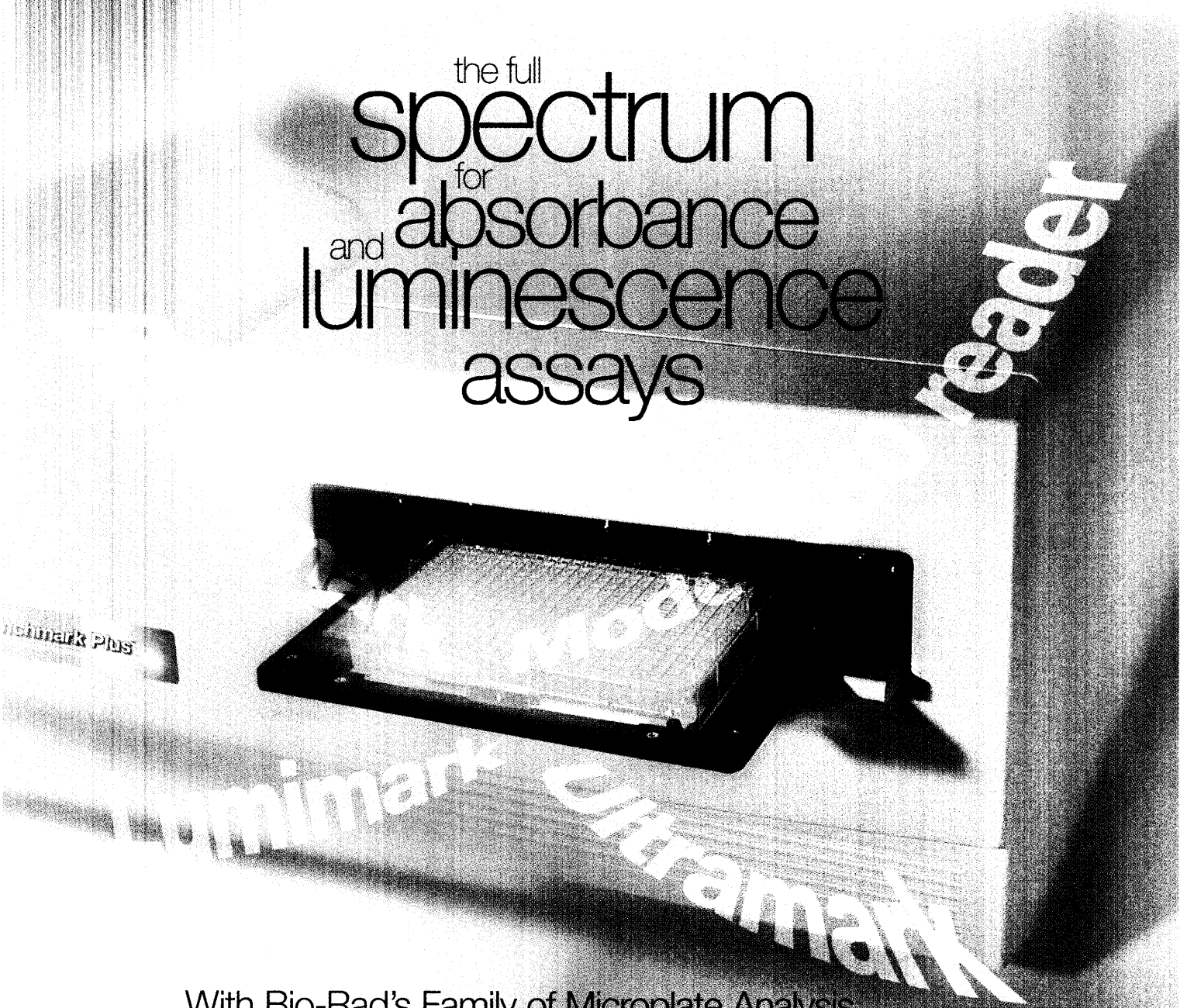

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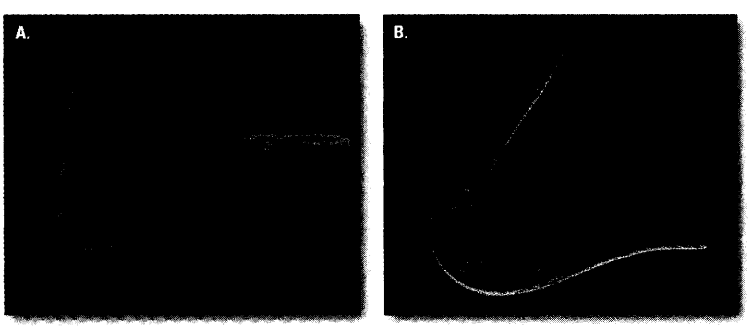

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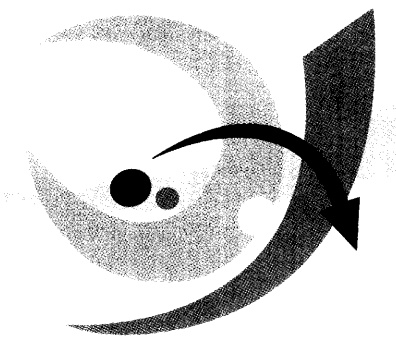

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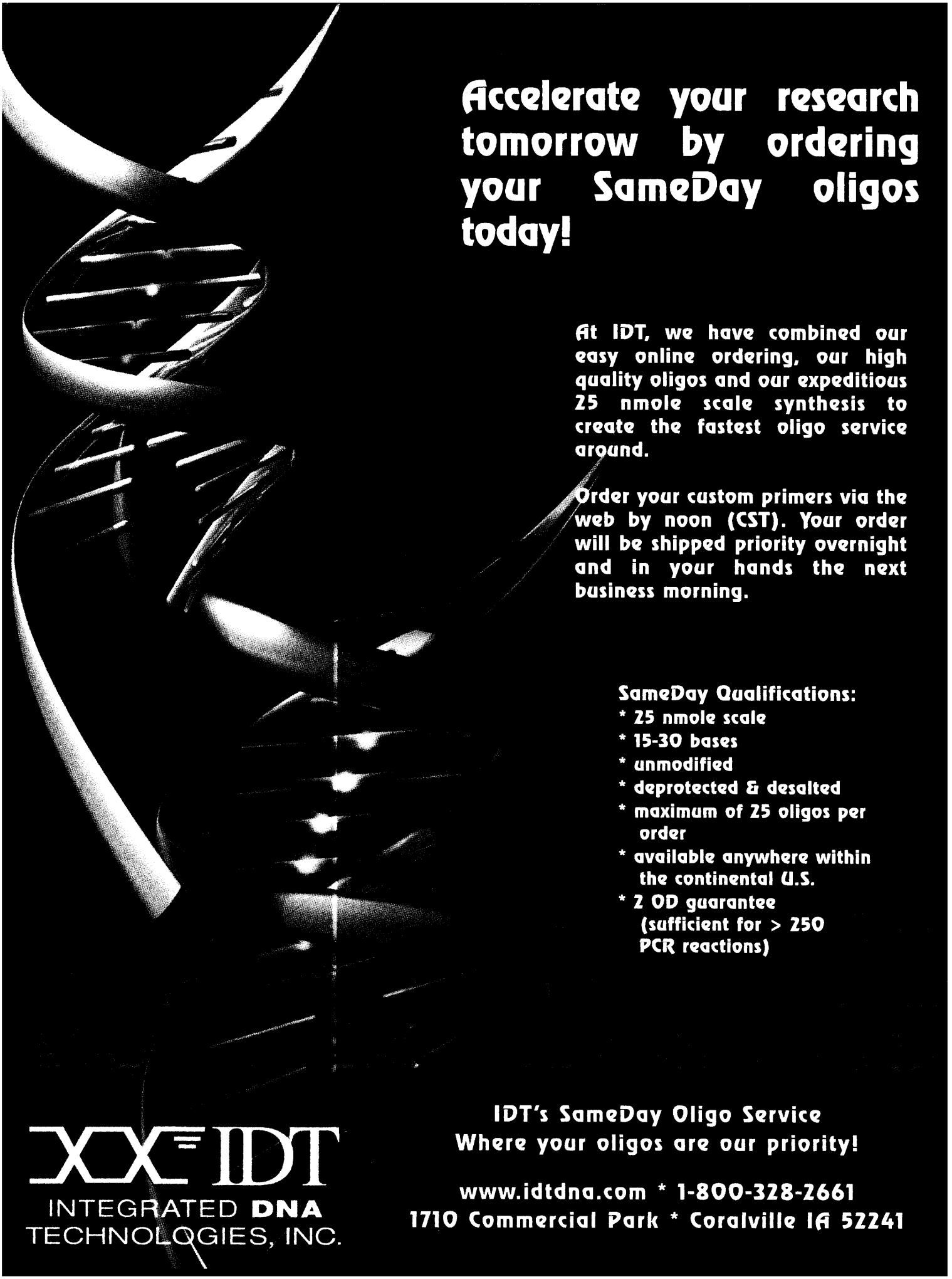
For more detailed information please visit the Eppendorf Homepage at **www.eppendorf.com/award2002** or visit Science Online at **www.eppendorfscienceprize.org**



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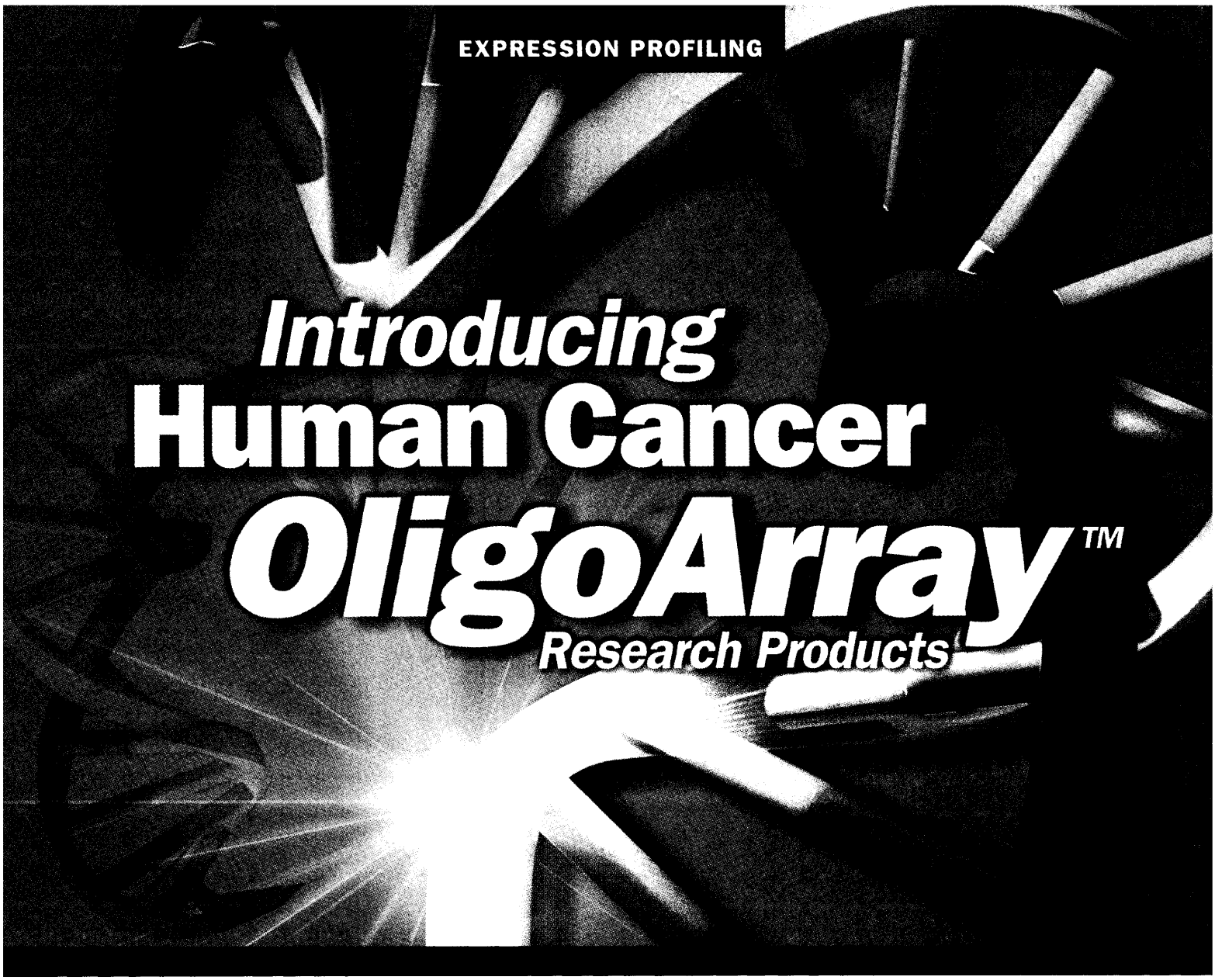

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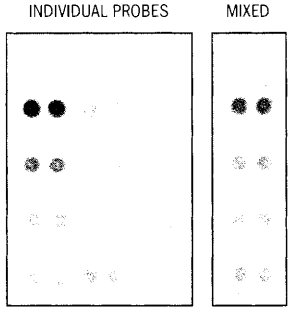

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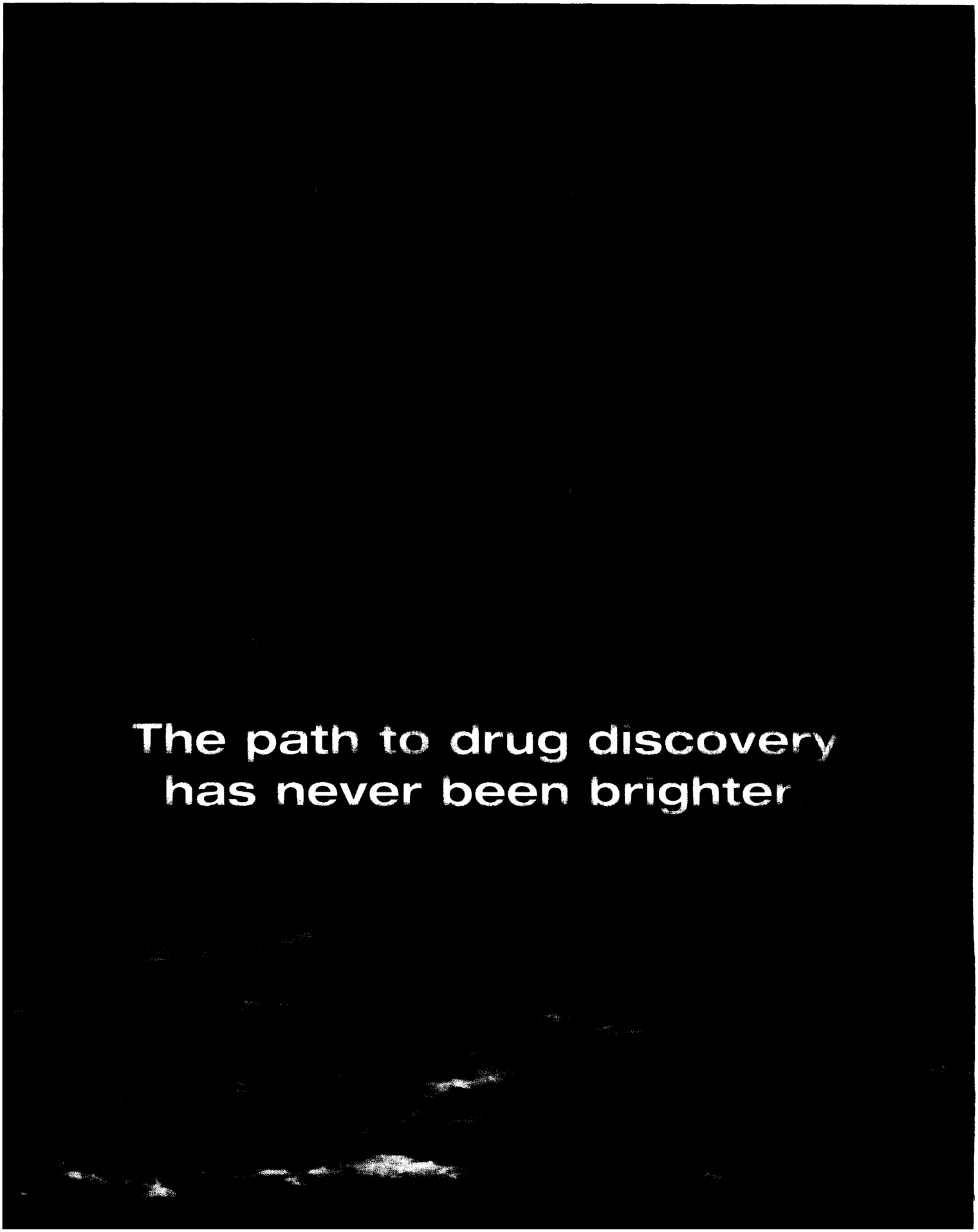
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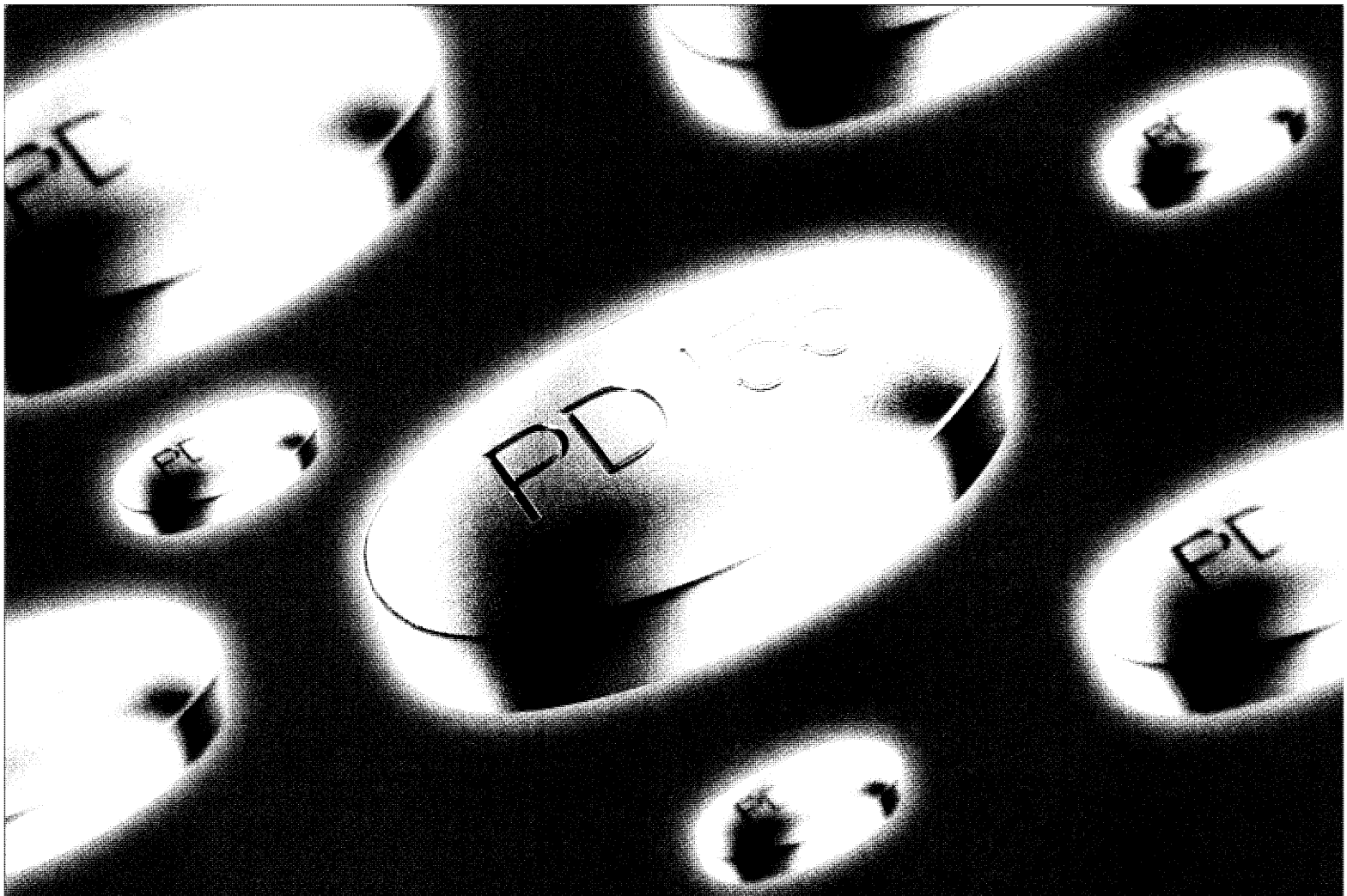

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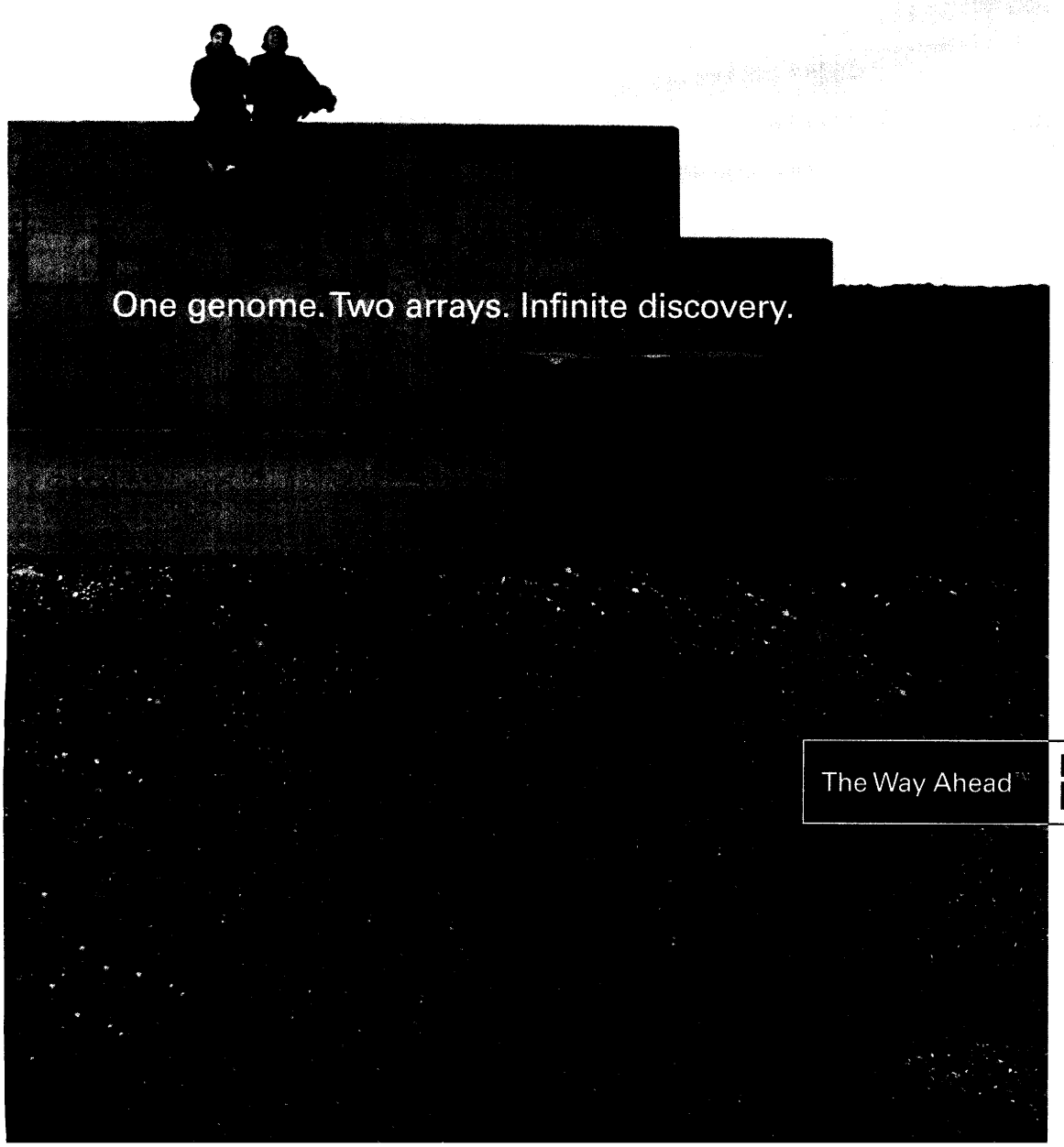

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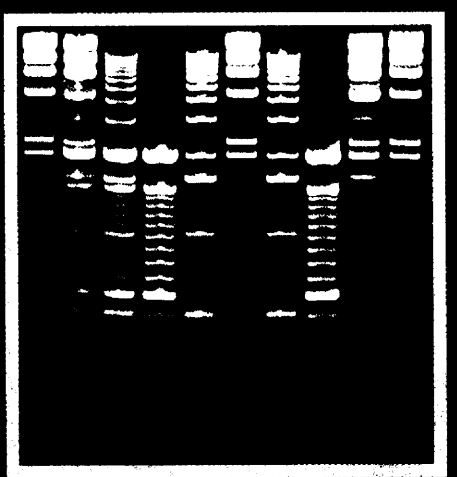

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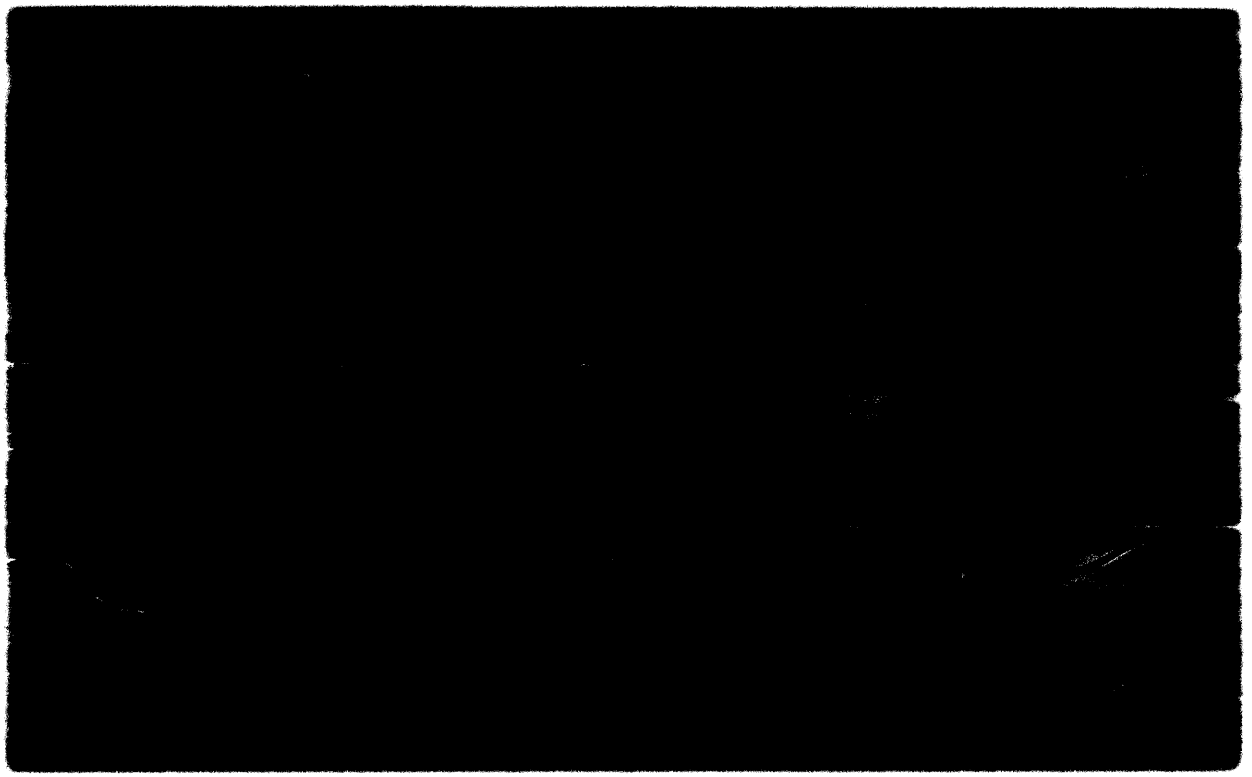

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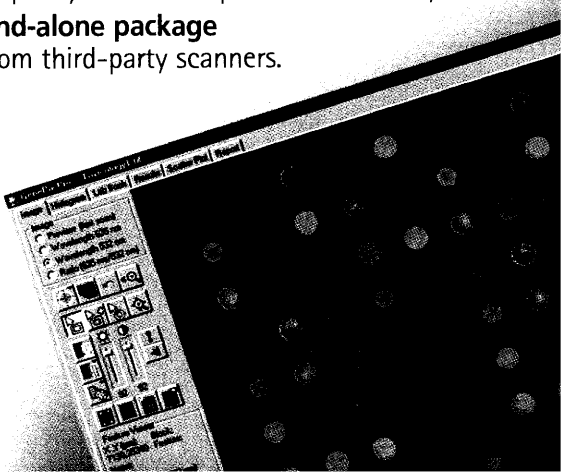

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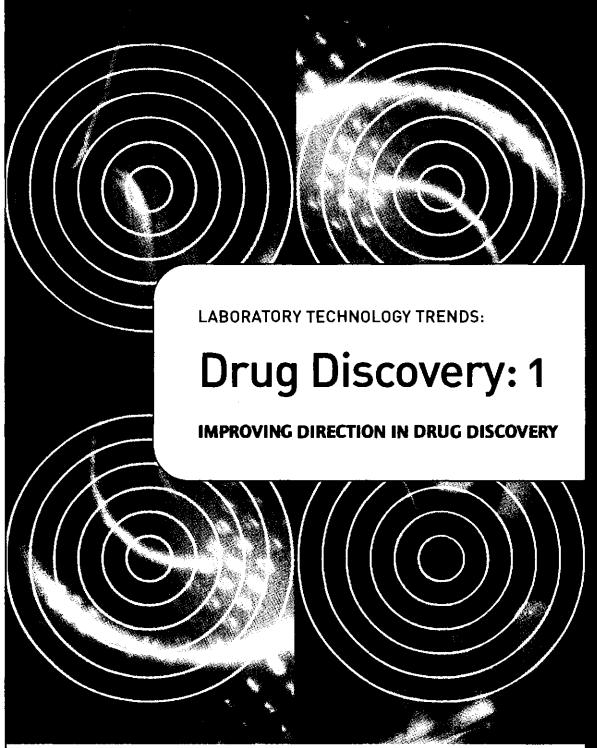

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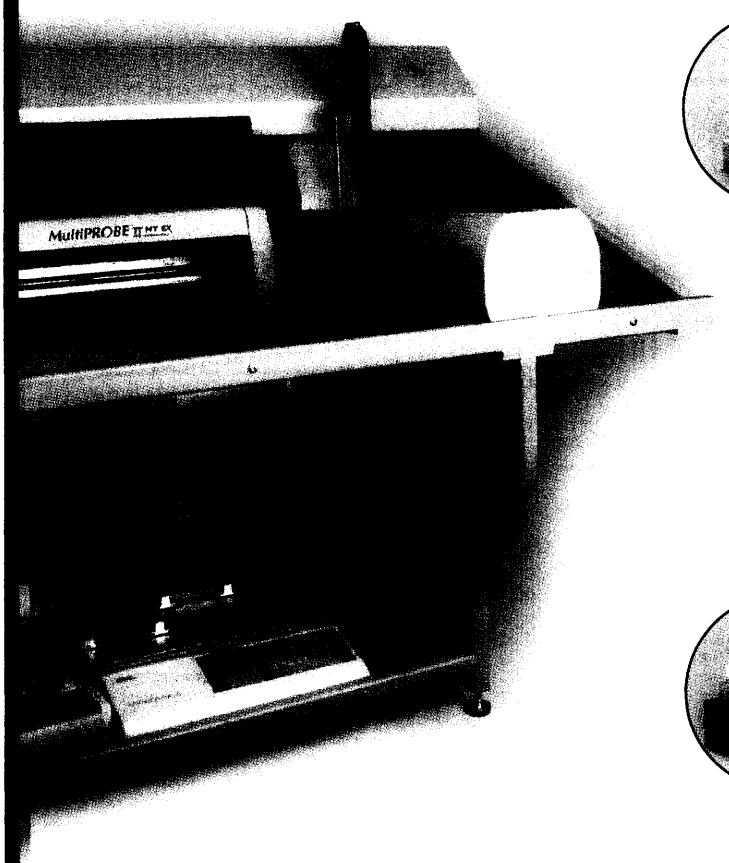

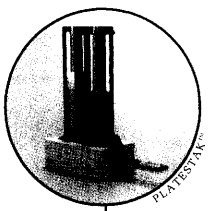

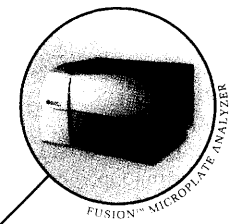

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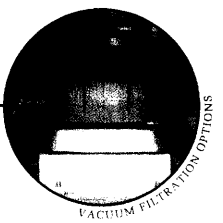

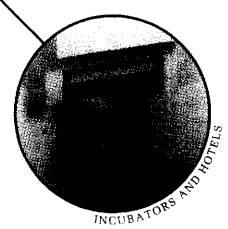

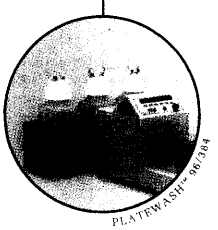

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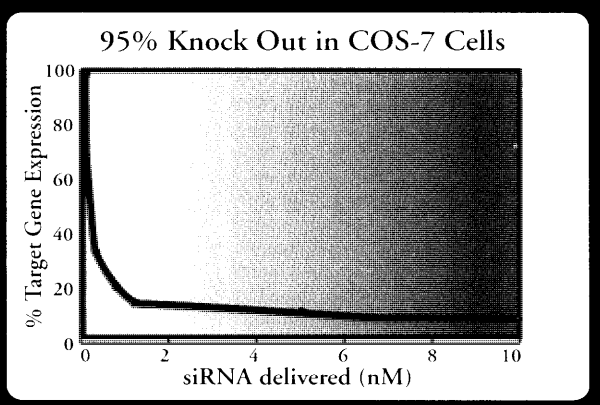

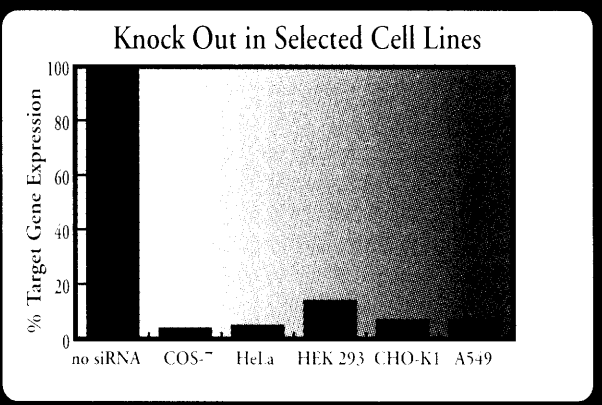

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