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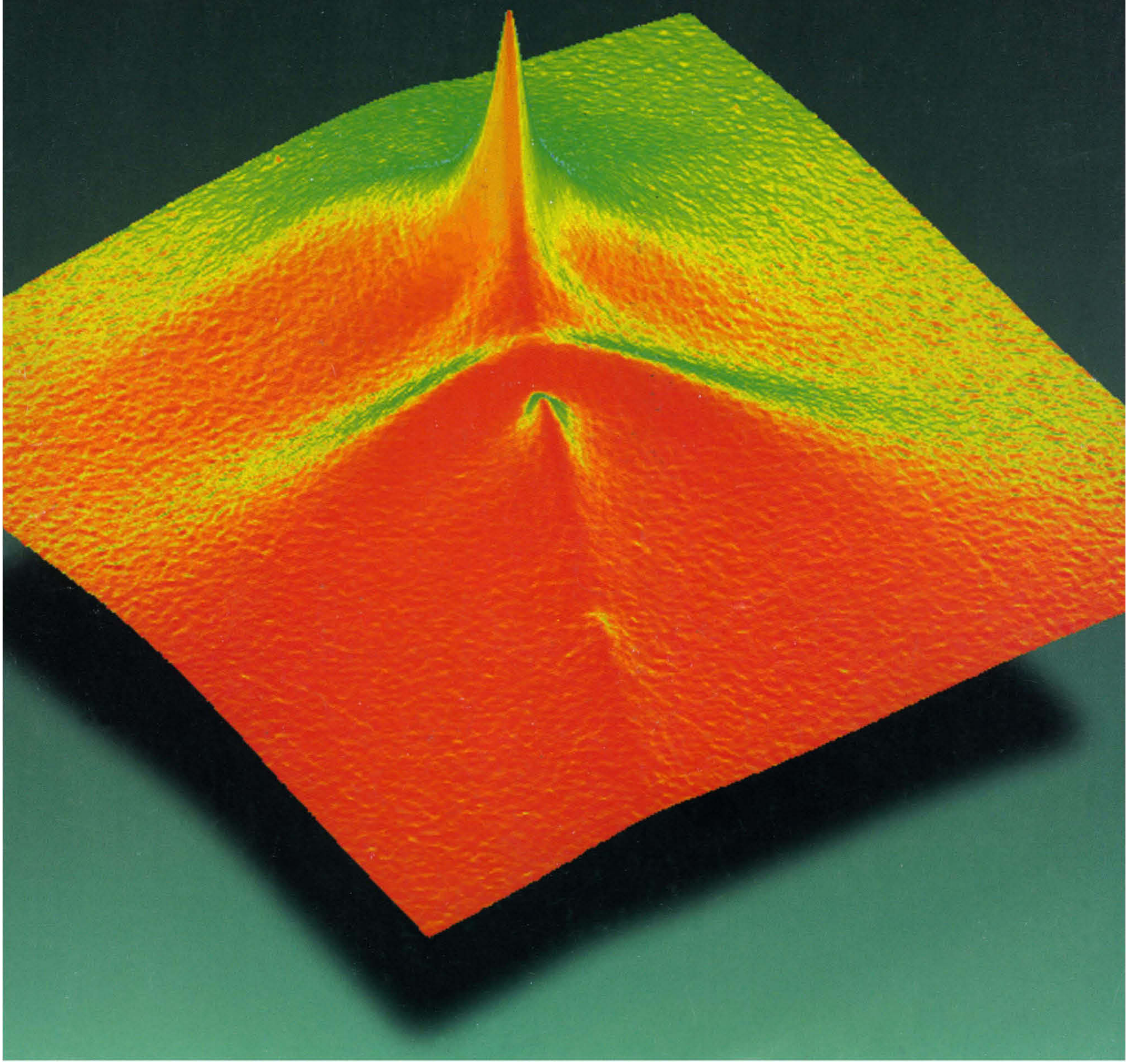
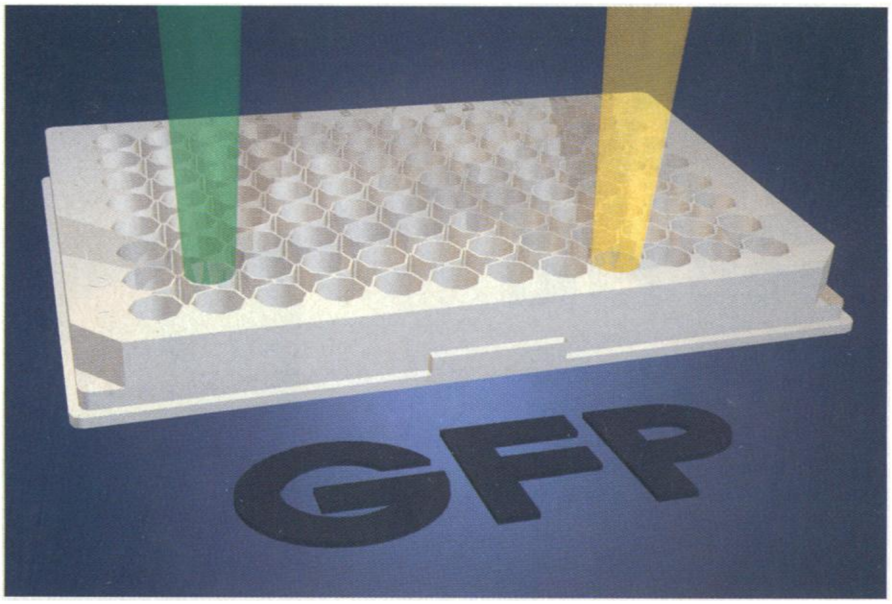


Green, Gold and Glorious



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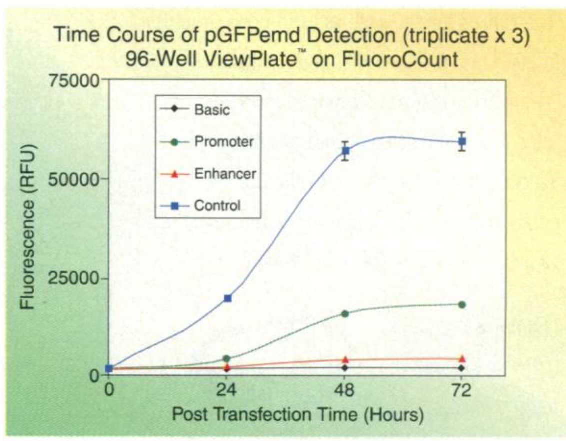

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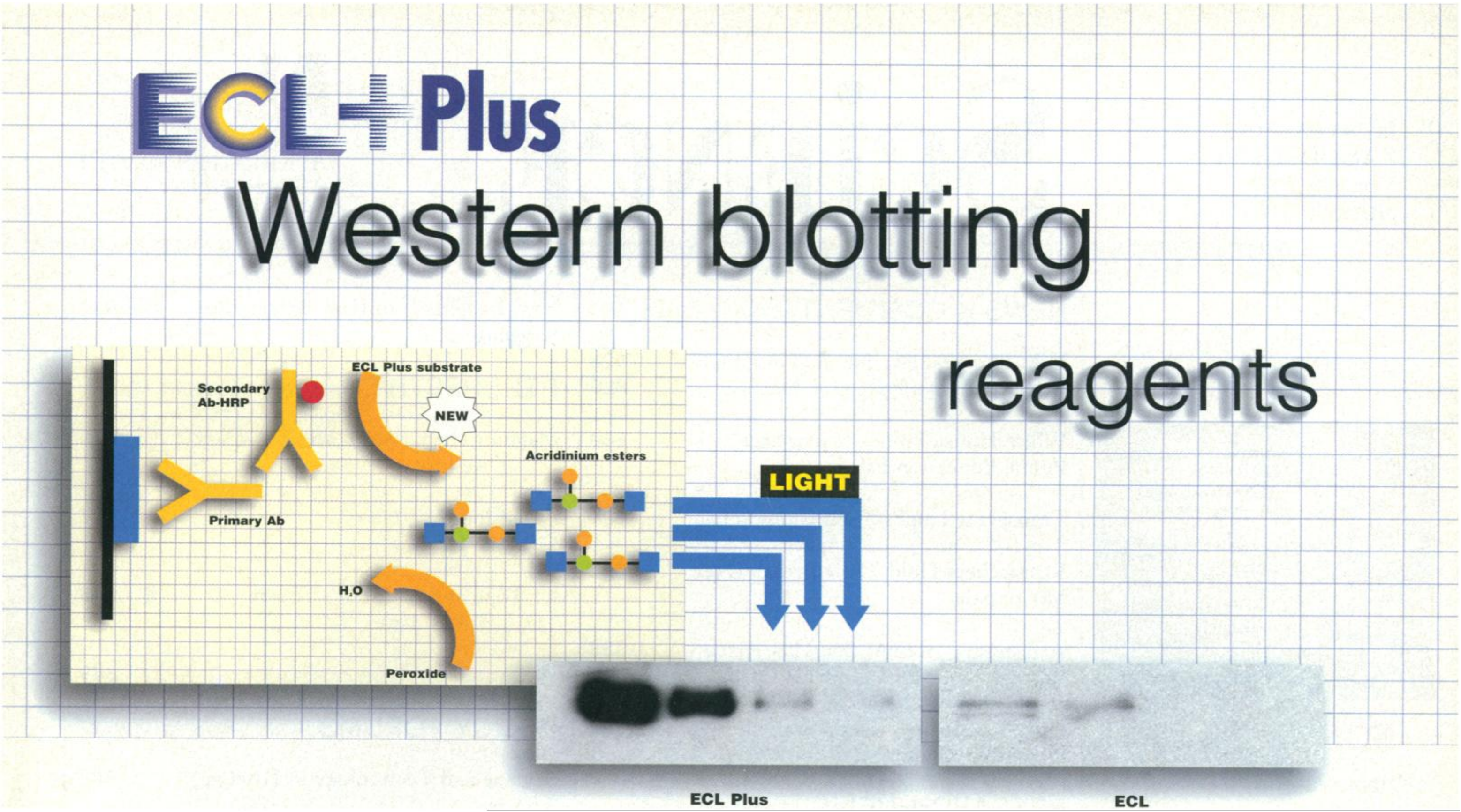

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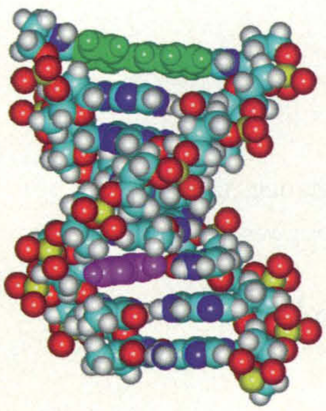

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For Self-Starting Scientists a "Model" Career Awaits

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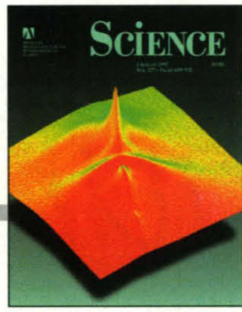
COVER



Plot of the structure in comet Hyakutake. The nucleus is the bright peak, and the dust coma (green area at top) is visible toward the sun. Trailing the nucleus is an arc of cyanogen (CN) emission (green arc) and two dust condensations (below the green arc). Simulations imply that the CN arc resulted from interaction between the gas coma and a secondary source, possibly the inner dust condensation. Field of view, 8100 kilometers. See page 676. [WIYN Observatory image, by Walter Harris, University of Wisconsin, Madison]

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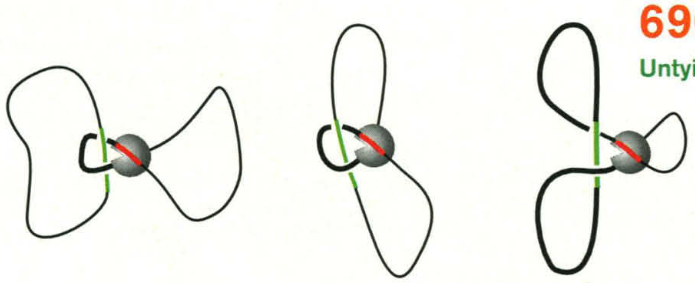
Delayed delivery



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Untying knots

◩ **Indicates accompanying feature**

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THIS WEEK IN SCIENCE

edited by BROOKS HANSON

Electrons through vibrations

Electron transfer (ET) plays an important role in many chemical and biochemical reactions, but because ET is usually very fast, it is difficult to study. Ito *et al.* (p. 660) synthesized a series of model compounds that allow tuning the rate at which ET occurs in an intramolecular transfer reaction over a wide range of times. The system allows them to correlate vibrational absorption line shapes with the ET dynamics.

DNA in knots

At thermodynamic equilibrium, a distribution of isoforms of closed circular DNA (superhelical coils, knots, and catenanes) is formed from linear DNA. DNA topoisomerases can catalyze strand passage between two DNA segments, thereby affecting DNA topology. Isoforms formed with type I DNA topoisomerase approach that which is observed at equilibrium. However, Rybenkov *et al.* (p. 690) show that with topoisomerase II the distribution of isoforms is below the equilibrium values. Type II topoisomerases use the energy of adenosine triphosphate hydrolysis to reduce the number of knots and catenanes and simplify the topology. These findings have implications in DNA replication and chromosome segregation, as highlighted in a Perspective by Pulleyblank (p. 648).

Chemical plants

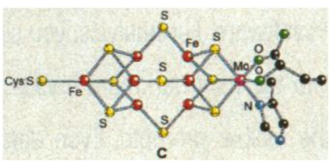
The secondary metabolites of plants, which contribute to their interesting flavors, have other functions, including warding off insects and microbial pathogens. Frey *et al.* (p. 696) found that in maize a series of five enzymes is sufficient to synthesize one of these defense compounds, DIBOA, from a common precursor. The first of the enzymes resembles a subunit of tryptophan synthase but represents a branchpoint in the pathway that leads away from tryptophan synthesis. The other enzymes are cytochrome P-450–dependent monooxygenases. Together these five genes confer on transgenic yeast the ability to synthesize DIBOA from indole-3-glycerol phosphate.

Electrons through hairpins

Electron transfer (ET) through DNA has been controversial; some results suggest that DNA is an efficient "molecular wire" and others suggest that it acts as a more protein-like insulating state. Lewis *et al.* (p. 673) measured photoinduced ET rates in DNA hairpins in which a stilbene dicarboxamide group bridges two connecting DNA arms. No ET was seen in a six AT base pair hairpin, but introducing a single GC pair led to distance-dependent fluorescence quenching. Although not a molecular wire, ET is more efficient than in proteins.

Clusters in proteins

Many proteins contain iron-sulfur clusters, which facilitate electron transfer reactions and can act as catalytic centers and as sensors for iron or oxygen.



Beinert *et al.* (p. 653) review our understanding of the various structures and properties of these prosthetic groups, including results on studies of model compounds and on the incorporation of the clusters into proteins.

Inducing labor

Observations that aspirin-like drugs could delay childbirth led to speculation that prostaglandins might be involved in the regulation of labor. However, oxytocin seemed more effective. Sugimoto *et al.* (p. 681) have now sorted out these observations. They used a knockout mouse lacking a prostaglandin receptor to show that prostaglandin $F_{2\alpha}$ is required to inactivate the corpora lutea. This inactivation in turn leads to a decline of serum progesterone levels and induction of oxytocin receptor, followed shortly by labor and delivery.

Boundary effects

The thin boundary between Earth's core and mantle may play a key role in convection in the mantle as well as in the origin and structure of Earth's magnetic field (see the Perspective by Kellogg, p. 646). Two reports provide information on the character of this boundary. Earle and Shearer (p. 667) measured scattering of seismic waves propagating through the layer. The scattering may be explained by topography on the boundary of about 300 meters over wavelengths of about 8 kilometers. Revenaugh and Meyer (p. 670) examined seismic waves reflected from just above the boundary. They were able to map several regions along the boundary where the seismic waves were slowed considerably. These data suggest that much of the boundary contains a thin, <15-km-thick boundary of melt.

Snowball fights

Comet Hyakutake recently passed within about 0.1 AU of Earth. Harris *et al.* (p. 676; cover) used narrow band filters on the WIYN telescope at Kitt Peak to image the structure of the inner coma for a 7-hour period during Hyakutake's closest approach. They found that there was an extended region of icy particles that is separated from the gas and forms arcs and extended clumps well beyond the comet nucleus. They conclude that there is another local source of icy grains behind (away from the sun) the nucleus of the comet that produced some of the volatiles detected from Hyakutake.

Baby talk

Why do mothers speak differently when talking to their infants than when talking to their husbands? Kuhl *et al.* (p. 684) report the results of a cross-cultural study using 30 mothers fluent in English, Russian, or Swedish. The data reveal that vowels are exaggerated when speech is directed toward infants. Because infants appear to be able to discriminate normally pronounced vowels, the authors suggest that mothers are emphasizing the parameters that infants must learn in order to speak themselves. See also the news story by Barinaga (p. 641).

Right place and time

The El Nino–Southern Oscillation (ENSO) phenomenon dominates tropical Pacific climate and influences global climate, but the exact mechanism of the oscillation is not yet fully understood. Picaut *et al.* (p. 663) used recent data on the eastward or westward advection of surface waters and the resulting convergence of water in the central Pacific to modify the classical delayed action oscillator model. When these features are included in a simple model of ENSO, observations and simulation match well, indicating that these features are central to the ENSO mechanism.

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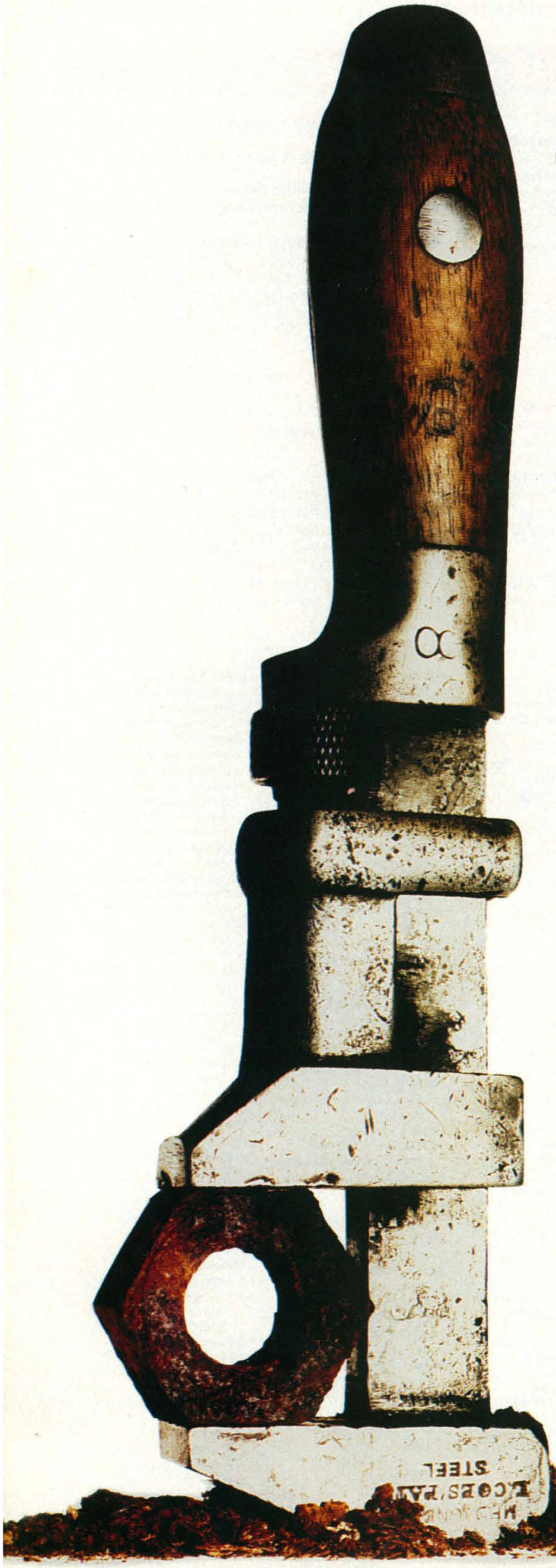

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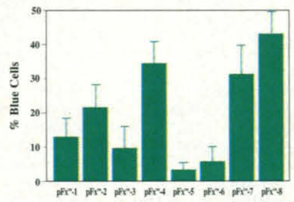

Figure 1: Percent blue cells produced by transfection of CHO cells with a lacZ control vector using PerFect Lipids™ (pFx™1 - pFx™8).

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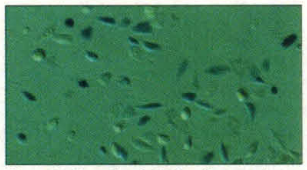

Figure 2: Transfected CHO cells expressing β-galactosidase, stained with X-gal.

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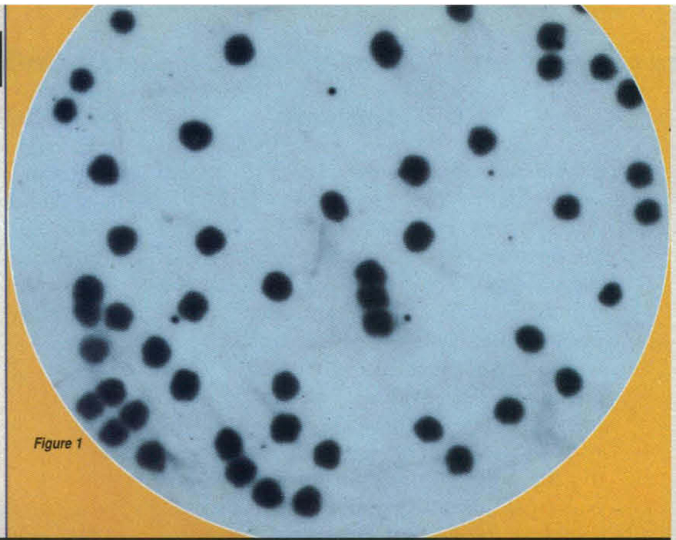

Figure 1

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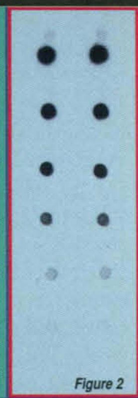

Figure 2

Figure 1. Colonies were screened for the TGF- ß1 gene with a fluorescein-labeled oligonucleotide probe and Enhanced Luminol. *This film demonstrates results obtained using the Renaissance 3'- End Labeling Fluorescein Kit with Antifluorescein-HRP (NEL823) and the detection substrate Enhanced Luminol (NEL201). Discs were exposed to Reflection film for 15 minutes.*

Figure 2. Mouse ß-actin was detected using a fluorescein-labeled ssRNA probe and ready-to-use CDP-Star. *This film demonstrates results obtained using Renaissance RNA Fluorescein Labeling Kit with Antifluorescein-AP (NEL633) in conjunction with ready-to-use CDP-Star (NEL601). Blots were exposed to Reflection film for 5 minutes.*

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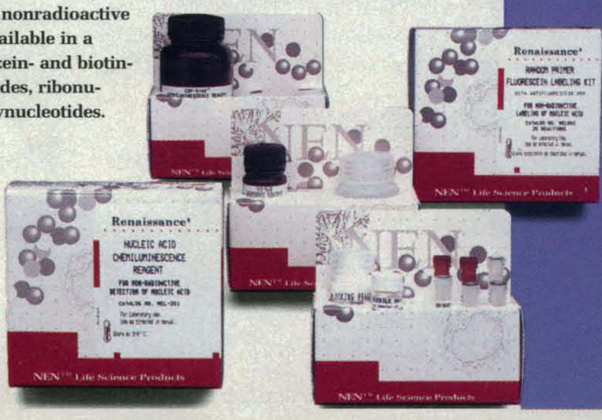
Figure 3

Figure 3. The v-Fos gene was detected in 125 ng of blotted mouse genomic DNA in less than 5 minutes using CDP-Star. *This film demonstrates results obtained using the Renaissance Random Primer Biotin Labeling Kit with Streptavidin-AP (NEL604) in conjunction with ready-to-use CDP-Star (NEL601). Blots were exposed to Reflection film for 5 minutes.*



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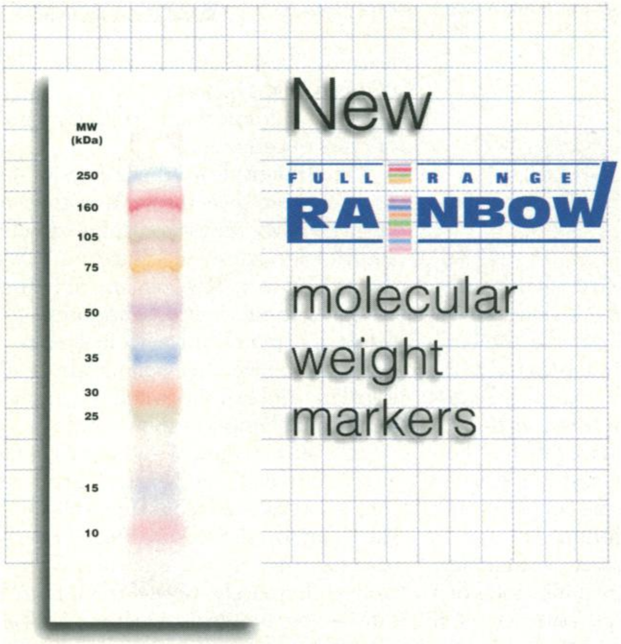

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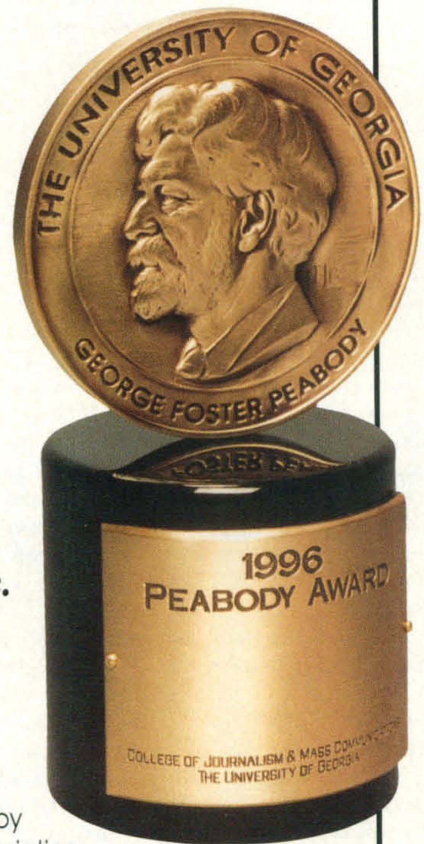

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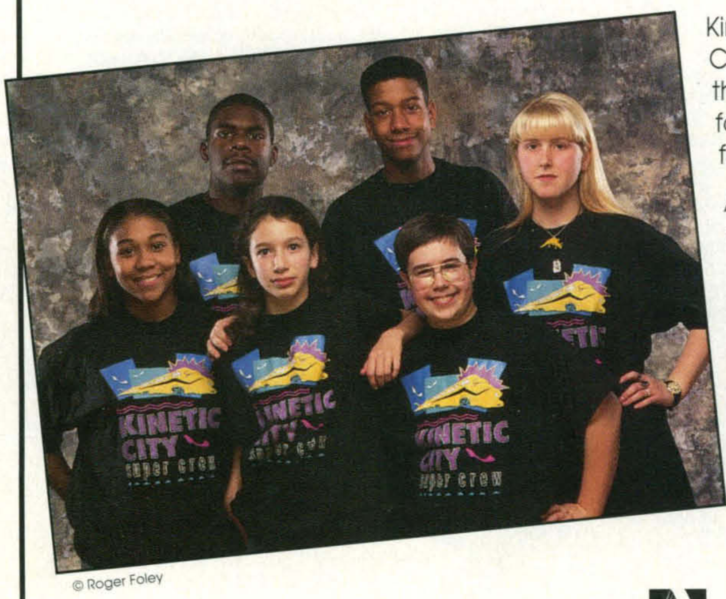

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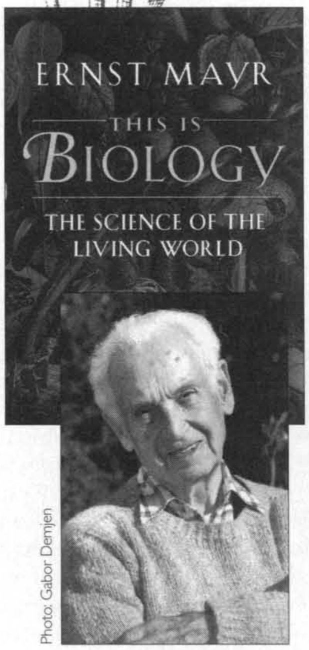

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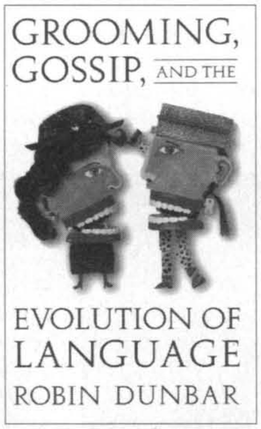

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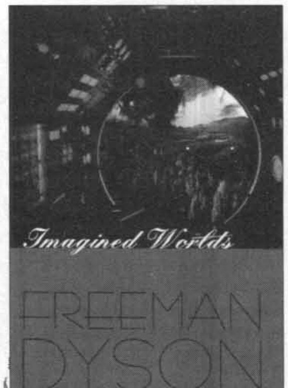

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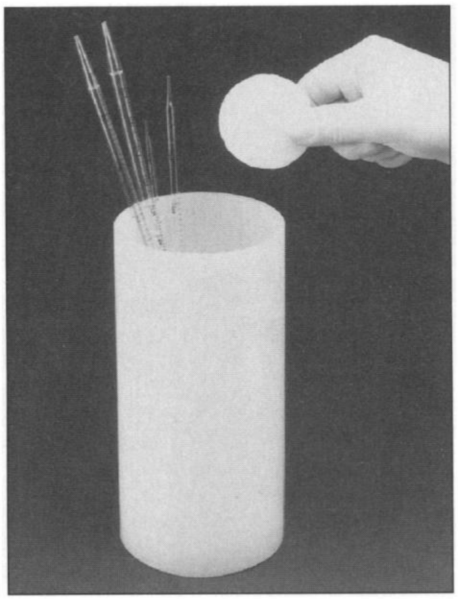

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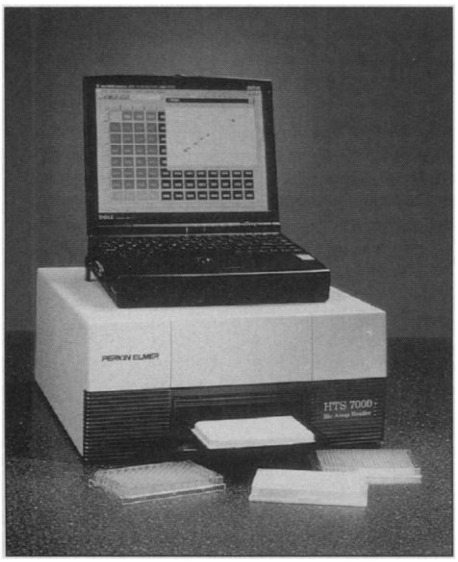

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