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Science

19 December 1997 $7.00
Vol. 278 • Pages 2021–2192

Breakthrough of the Year

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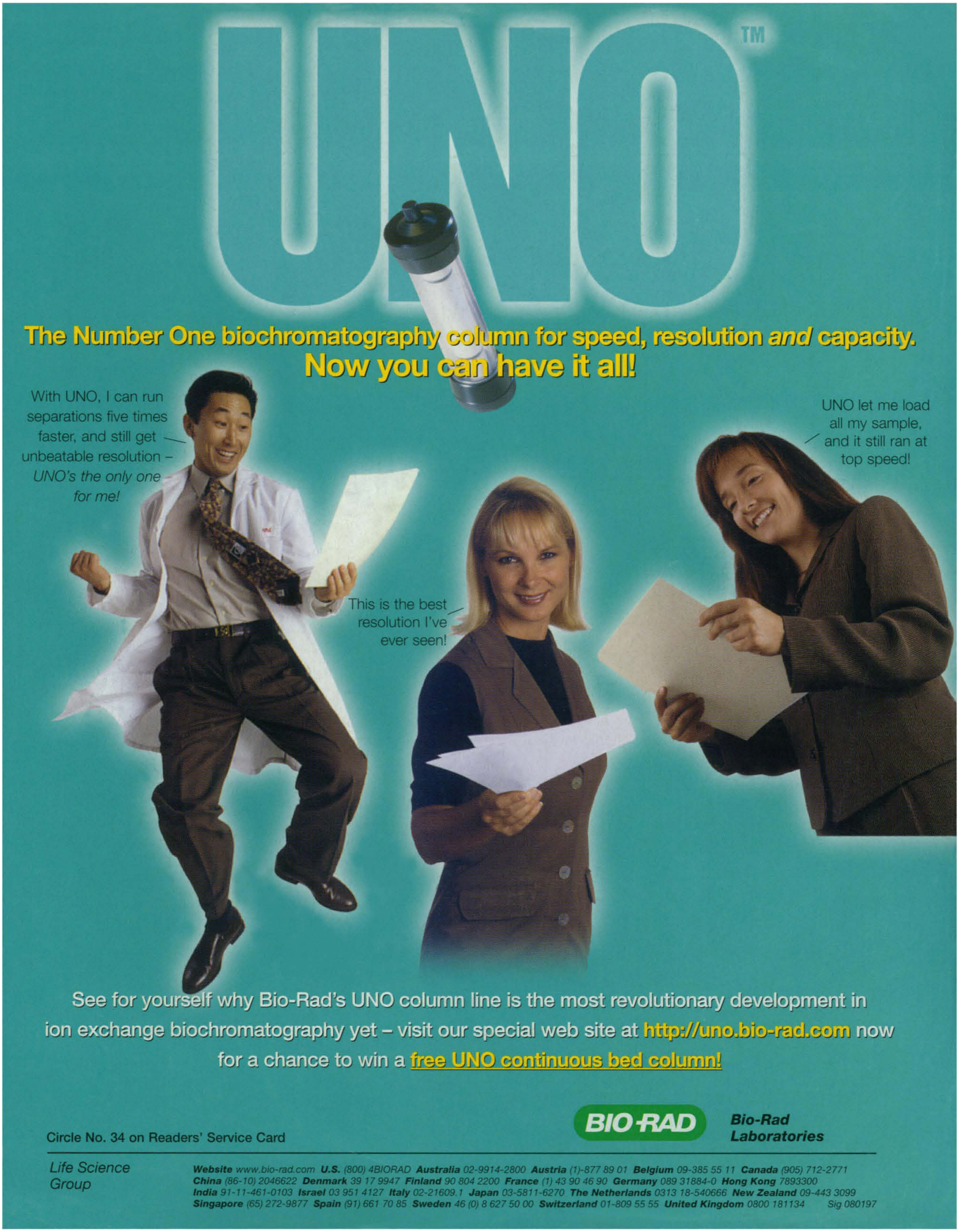
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ISSN 0036-8075
19 DECEMBER 1997
VOLUME 278
NUMBER 5346

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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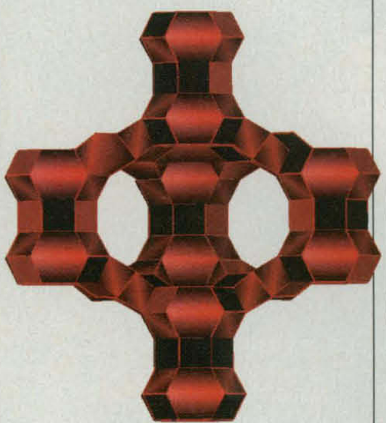

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COVER

Identical sheep face the future. Photographically reproduced Finn-Dorset sheep illustrate the power of cloning, which is the Breakthrough of the Year for 1997. See the Breakthrough of the Year special section beginning on page 2038 and the Editorial on page 2029. Also, six new transgenic sheep clones, two carrying the gene for the human factor IX protein, are described in a Report on page 2130. [Photographic illustration: Ann Elliott Cutting]

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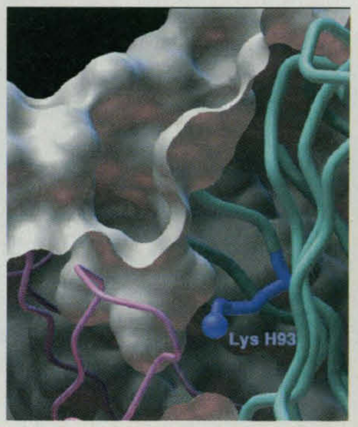
Broadening the scope of antibody catalysis



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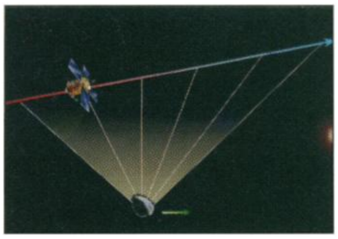
edited by PHIL SZUROMI

Regulating the ribosomal economy

Protein synthesis in bacteria is tightly regulated; the number of ribosomes, which translate messenger RNA into proteins, is limited by ribosomal (rRNA) transcription. Gaal *et al.* (p. 2092; see the Perspective by Roberts, p. 2073) show how rRNA transcription is regulated by the availability of adenosine and guanosine triphosphate (ATP and GTP). In *Escherichia coli*, rRNA promoters require high concentrations of ATP or GTP because they form very short-lived complexes with RNA polymerase. Because ATP and GTP concentrations increase with growth rate, so will rRNA transcription and ribosomal activity, until protein synthesis depletes cellular ATP.

Rubble in space

The Near Earth Asteroid Rendezvous (NEAR) spacecraft launched in 1996 was looping through its first orbit on its way to asteroid 433 Eros when scientists realized they could perform some observations of asteroid 253 Mathilde (see the Perspective by Asphaug, p. 2070). Yeomans *et al.* (p. 2106) report how the NEAR navigational team, using ground-based observational data of Mathilde's orbit and reference star data from the Hipparcos and Tycho catalogs, accurately predicted the orbit of Mathilde to position NEAR for a close flyby (as close as 1225 kilometers). A mass of about 1×10^{14} metric



tons was estimated for Mathilde from its gravitational pull on NEAR. Veverka *et al.* (p. 2109) report the NEAR imaging results, which estimate this irregular asteroid dimensions as 66 kilometers by 48 kilometers by 46 kilometers. Mathilde's estimated bulk density is only 1.3 times that of water, suggesting that it is very porous, very hydrated, heavily fractured, or some combination of all three. The presence of at least five large impact craters leaves scientists wondering how this low-density "pile of rubble" remains intact.

Field day for dots

Excited state energies in quantum-confined structures such as quantum dots can be shifted with an electric field through the Stark effect; this effect can be used to modulate an optical signal electrically. Empedocles and Bawendi (p. 2114) used fluorescence microscopy to measure the Stark effect in single cadmium selenide quantum dots. Shifts in the lowest excited state energy could be induced that were much larger than the apparent linewidths, and the excited states are highly polarizable—excited-state dipoles as large as ~90 Debye could be induced by local electrical fields.

Cobalt route to cages

Although numerous new types of molecular sieves (zeolites) have been synthesized, it has been difficult to create zeolites that contain the faujasite structure with a three-dimensional network of 12-ring channels. Bu *et al.* (p. 2080) show how, by incorporating a large fraction of cobalt into aluminum phosphate molecular sieves, several new structures, some with unusually large cages, can be made.

Tunable semiconductor diode

Schottky diodes consist of a metal and a semiconductor and pass current in only a certain voltage range. In principle, the turn-on voltage should vary with the work function of the metal, but in practice the voltage is almost the same for different metals because of "pinning" to surface states. Lonergan (p. 2103; see the Perspective by Scott, p. 2071) shows that by using a conducting polymer as the metal, a tunable diode can be formed. Embedded in the polymer is a gold grid that can be used to dope the polymer electrochemically and change its work function.

Order! Order!

When metal complexes are used to catalyze reactions in solution, they are usually thought to function independently of each other. Töllner *et al.* (p. 2100) now show that, for a rhodium complex that has very low reactivity in the homogeneous system, the order imposed by a Langmuir-Blodgett film of the complexes led to significant increases in catalytic activity. High substrate selectivity is also observed.

Greater control in cloning

An important application of cloning technology in large animals will be the ability to produce large amounts of medically relevant products. As a step toward this goal, Schnieke *et al.* (p. 2130) have inserted the gene for factor IX into ovine fetal fibroblasts and then inserted the transgenic nuclei into enucleated oocytes and produced transgenic sheep. Although there was a higher incidence of premature births and deaths, the technique has several advantages over earlier technologies, including the ability to start with a characterized cell population, to predetermine the sex of the offspring, and to avoid mosaic founders who will not transmit the transgene.

Genetic clocks and climate

The gene *period* is part of a clock that keeps the body's rhythms cycling at about 24 hours no matter what the temperature. Natural populations of fruit flies show one of several variants of this gene, with differing lengths of a threonine-glycine–encoding repeat in the *period* gene. Now Sawyer *et al.* (p. 2117) relate this variation to the ability of the flies to keep their rhythms constant under different temperature conditions—those with a greater ability to temperature-compensate are found in northern latitudes of Europe, whereas those with less ability are found in a more southerly distribution.

Protein conduits

Proteins destined for secretion are cotranslationally translocated across the endoplasmic reticulum (ER). Beckmann *et al.* (p. 2123; see the Perspective by Powers and Walter, p. 2072) present a three-dimensional reconstruction of key components of the translation-translocation machinery—the ribosome in a complex with Sec61, a protein thought to act as the protein-conducting channel in the ER. Channels in the ribosome and the Sec61 complex are aligned, which would allow direct transfer of the nascent chain between the two complexes.

Regulating abscisic acid

Cyclic ADP–ribose (cADPR) is one of many possible components that could be used in cellular signal transduction mechanisms. Wu *et al.* (p. 2126; see the news story by Pennisi, p. 2054) provide evidence that the physiological response of plants to the hormone abscisic acid is mediated through cADPR and calcium. Abscisic acid regulates higher plant responses to a great variety of stresses, including drought and cold.

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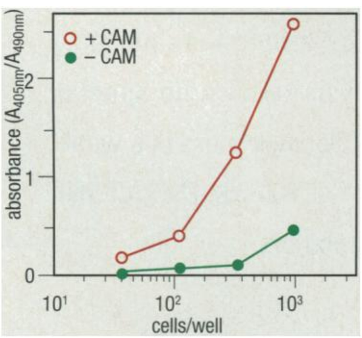

Figure 1. Sensitive detection of nucleosomes in cytoplasmic fractions at different cell concentrations using the Cell Death Detection ELISA. HL-60 cells were cultured at different cell concentrations with or without CAM (camptothecin) at 2 µg/ml for 4 hr at 37°C. Cell lysates were prediluted 1:10 and tested in the immunoassay with a 10 minute substrate reaction.

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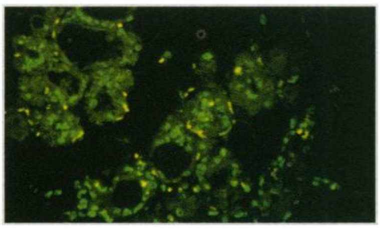

Figure 2. Detection of apoptotic cells (green) in involuting mouse mammary glands by fluorescence microscopy. Formalin-fixed, paraffin-embedded tissue sections were dewaxed and stained using the *In Situ* Cell Death Detection Kit, Fluorescein, to show apoptosis occurring in involuting mouse mammary glands after 3 days. Erythrocytes appear yellow due to autofluorescence (data kindly provided by R. Friis, University of Bern, Switzerland).

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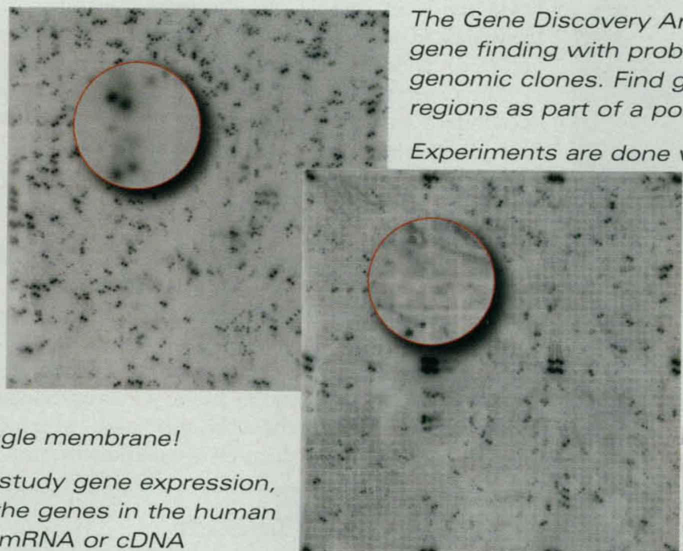

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Fellowships start:	October 1998

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