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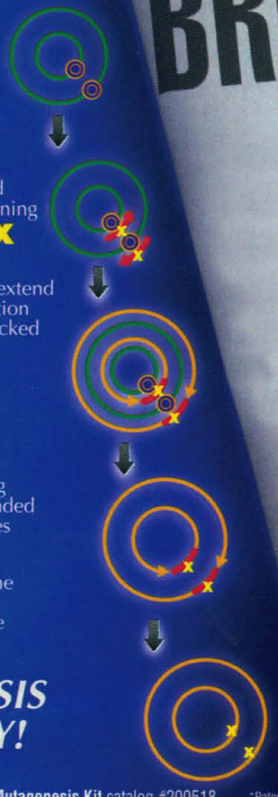

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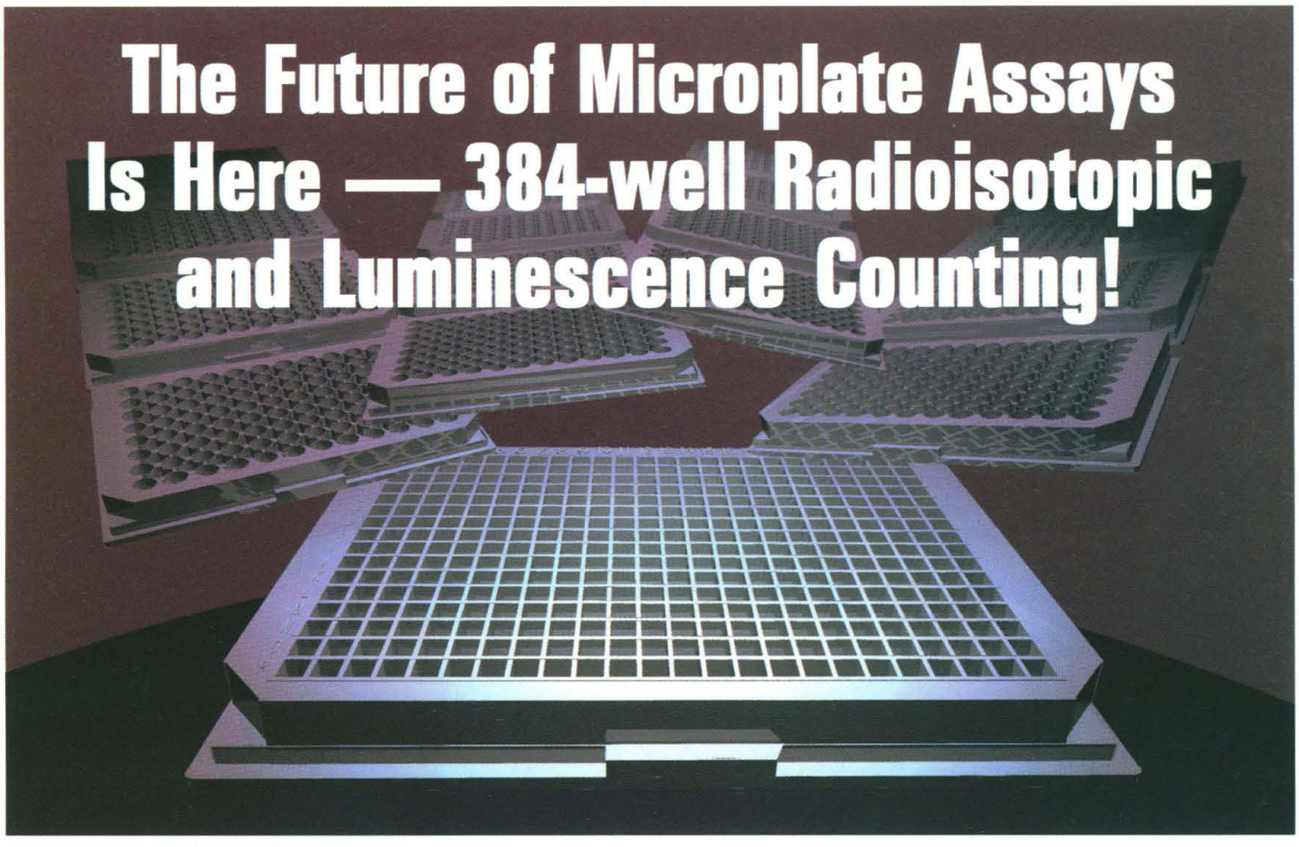

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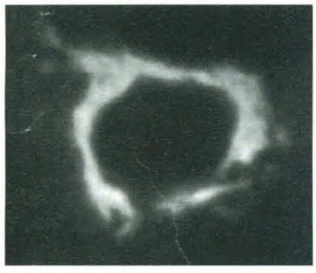

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COVER

Many plants do not produce flowers at the tips of their shoots but continue to grow indefinitely. In the *terminal flower 1* (*tfl1*) mutant of *Arabidopsis*, the tip is transformed into a cluster of flowers, as shown in this top view scanning electron micrograph (the cluster is ~500 micrometers across). The wild-type *TFL1* gene is expressed just below the plant apex, where it normally promotes continued growth of the plant tip. See page 80. [Image: D. Bradley, O. Ratcliffe, C. Vincent, R. Carpenter, and E. Coen]

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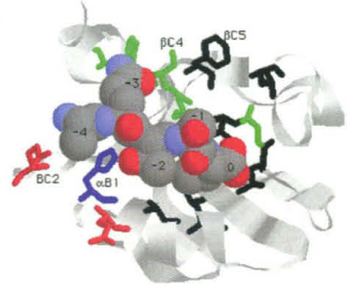

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A Sense of Discovery

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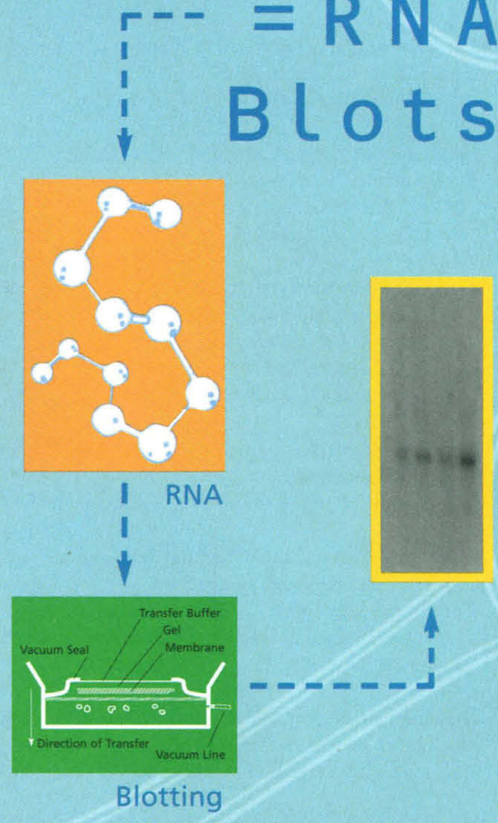

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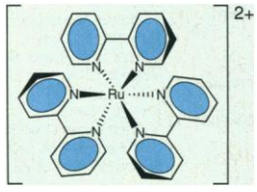
edited by PHIL SZUROMI

Risk management in computing

Many hard computation problems (such as the shortest path visiting a given set of cities) cannot be solved exactly in any reasonable amount of time but must be attacked by heuristic algorithms, which often use trial and error methods. Certainty of an answer usually comes at the risk of very long run times. Huberman *et al.* (p. 51; see the news story by Seife, p. 33) show that this risk can be managed by constructing a "portfolio" of different programs running in parallel that have a range of performance characteristics. In an example problem (graph-coloring), they show that performance can be greatly increased (by a factor of 30) with a reduced risk of not finding a solution.

Overly excited

Many key events in photoexcitation of molecules, such as the *cis-trans* isomerization of rhodopsin, can occur on the time scale of hundreds of femtoseconds (1 fs = 10^{-15} second). The traditional view of photoexcitation has assumed that if higher lying excited



states are formed, then they would decay to the lowest excited state, which then controls the photochemistry. Damrauer *et al.* (p. 54) show that in a molecule that has been often used in photochemical studies, $[Ru(bpy)_3]^{2+}$, a complex spectral evolution occurs in the first 300 femtoseconds after photoexcitation before a long-lived excited state forms. The presence of such complex dynamics can be important for understanding and designing molecules for artificial photosynthesis and for photovoltaic applications.

Enigmatic emissions in space

Satellite-based instruments have extended the range and sensitivity of astronomical observations in the ultraviolet (UV) and x-ray wavelengths, and some of the observations have been puzzling, such as the excess soft x-ray emission from the Virgo and Coma clusters, and some have been unexpected, such as the generation of x-rays by comet Hyakutake. Two reports offer some theoretical explanations. X-ray studies have shown that the intracluster medium of galaxies can contain very hot gas (at 20 million kelvin), and recently, extreme UV studies have revealed the presence of a cooler component (at 0.5 to 1 million kelvin) that seems to require a very rapid cooling rate. Fabian (p. 48) presents a model which suggests that gas mixing can resolve this problem—smaller quantities of very hot gas (at 10^8 kelvin) undergoing turbulent mixing with cooler gases (at 10^4 kelvin) could produce gas at 10^6 kelvin that would account for the excess emission. Bingham *et al.* (p. 49) present a model which shows how the interaction of the solar wind and the cometary plasma can produce electrons with energies up to several kiloelectron volts that can initiate x-ray production from atoms. Conversely, such x-ray production could be used to obtain composition data and infer the condition of the solar wind.

Measles epidemic model

The incidence of measles in 60 towns in England and Wales in the prevaccination era provides one of the most complete data sets in population ecology. Keeling and Grenfell (p. 65) have used these data to address a central question of many epidemiological problems: What determines the critical size at which a disease dies out in a community? Previous models have overestimated the critical size by one or two orders of magnitude, whereas the authors' model accurately predicts stochastic fadeout by including biologically realistic assumptions about incubation and infectious periods of the virus.

Floral rearrangements

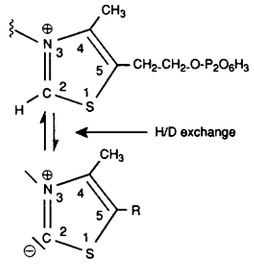
The arrangement of flowers on a stem, and the timing with which they appear, is controlled by genetic and environmental influences. Bradley *et al.* (p. 80; see cover) have compared genes from *Arabidopsis* (a member of the mustard family) and *Antirrhinum* (snapdragon) that determine whether a meristem spins off flowers indeterminately (as in lily of the valley) or terminates in a final flower (as in the buttercup). The similarities in the gene suggest conservation of flower determination mechanisms over a great evolutionary distance. The gene from *Arabidopsis* also affects the time at which the plant meristem switches from vegetative to flowering phase.

ASK1 first

MAP (mitogen-activated protein) kinase signaling pathways regulate many biological processes. These pathways include a series of three sequentially activated protein kinases that ultimately activate one of the MAP kinase family members [MAP kinase, stress-activated protein kinase (SAPK), or p38]. Ichijo *et al.* (p. 90) describe and characterize a protein kinase called ASK1 that functions as a MAP kinase kinase kinase (the first in the series of three kinases) and leads to activation of both SAPK and p38. Activation of ASK1 causes apoptosis (cell death) in mink lung epithelial cells and ASK1 appears to be required for induction of apoptosis by tumor necrosis factor–α.

Vitamin activation

Vitamins are versatile molecules in that they can assist several enzymes perform a variety of difficult reactions. Thiamin diphosphate, obtained as vitamin B1, is utilized as a carbanion source for attack at substrate carbonyl carbons. Several proposals for how a thiamin-



containing enzyme forms a deprotonated thiazolium C2 carbon have been put forth. Kern *et al.* (p. 67) provide nuclear magnetic resonance evidence that the crucial step is an enzyme-induced acceleration of proton abstraction.

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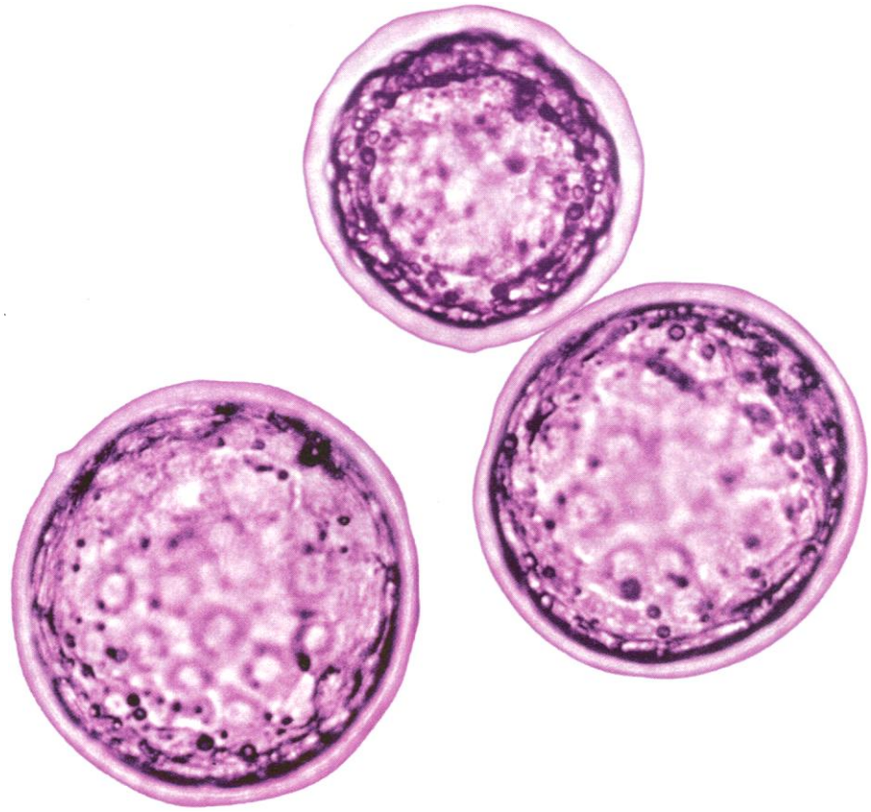

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