
Science
17 September 1999
Vol. 285 No. 5435
Pages 1809–2020 $8
BIOLOGICAL INVADERS
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

VOLUME 285 17 SEPTEMBER 1999 NUMBER 5435

Science

www.sciencemag.org

COVER Invading species such as the rosy wolf snail (*Euglandina rosea*) (shell length, ~5 cm), a Florida import that now preys on native Hawaiian snails, are devastating ecosystems worldwide. Although ecologists still cannot predict invasions with certainty, researchers and policy-makers are finding new ways to battle these organisms. See the special News Focus beginning on page 1834. [Photo: Jack Jeffrey]

1826
A safer way to grow vaccines?

NEWS

NEWS OF THE WEEK

NEWS FOCUS
BIOLOGICAL INVADERS

RESEARCH

REPORTS

1883
Modeling the rise and fall of Montserrat

DEPARTMENTS

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005. Periodicals Mail postage (publication No. 484460) paid at Washington, DC, and additional mailing offices. Domestic individual membership and subscription (51 issues): $110 ($62 allocated to subscription). Domestic institutional subscription (51 issues): $325; Foreign postage extra: Mexico, Caribbean (surface mail) $55; other countries (air assist delivery) $90. First class, airmail, student, and emeritus rates on request. Canadian rates with GST available upon request, GST #1254 88122. Publications Mail Agreement Number 1069624. **Printed in the U.S.A.**

1864
Toward imaging distant planets

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Salamander love

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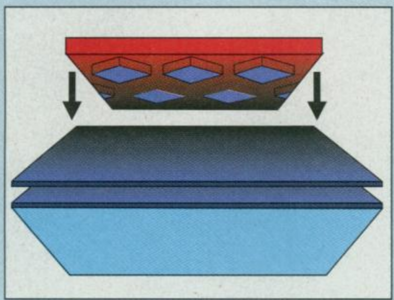
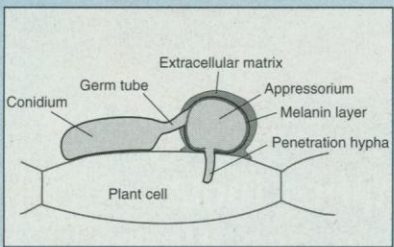
MONITORING PLANT BREAK-INS

Fungal pathogens are capable of directly breaking through the tough exterior layer of a plant, the cuticle. Previous studies have suggested that high internal pressures within the appresoria push a structure called the pene-





tration peg into the cuticle. Bechinger *et al.* (p. 1896; see the Perspective by Talbot) have used optical imaging techniques to quantify this pressure. The deformation of a plant cell surface layer was measured with waveguide optics, and pressures were calibrated with a glass capillary similar in diameter to the penetration plug. Pressures with the appresoria of about 5 megapascals generated forces of 17 micronewtons at the plant cell surface.

THE RISE AND FALL OF MAGMA

Observations of surface deformation and seismicity during the recent eruptions at Soufriere Hills volcano, Montserrat, showed oscillations of summit inflation and deflation as well as earthquake swarms that punctuated seismic quiescence on time scales of 3 hours to 3 days. Wylie *et al.* (p. 1883) modeled the change in pressure, volatile dissolution rate, and magma flow rate in a simplified volcanic conduit, where the lower part of the conduit has elastic walls that can flex with the addition of magma. With this model, they were able to produce oscillatory flow in their simplified conduit that fits with the observations at Montserrat. Their model, which depends on a known or estimated rate of volatile dissolution from the magma in the conduit, can be generalized to describe the instability of any siliceous magmatic eruption and thus provides the potential to assess volcanic hazards in the future.

CURVED CRACKS ON EUROPA

Images of the icy surface of Jupiter's moon, Europa, taken by the Voyager and Galileo spacecrafts have shown a widely distributed series of connected bowlike (cycloidal) features whose formation remains a puzzle. Hoppa *et al.* (p. 1899) developed a model in which the cycloidal features are formed by the propagation of a crack caused by tidal stresses. Because the tidal stresses on Europa vary in orientation and time, the crack is curved and during short periods (about 3 hours) the crack may stop propagating when the stresses are too low to fracture the ice. When high stresses return, a new curved crack begins to form. Repetition of this cycle eventually creates a series of connected bowlike features. This model also places some limits on the thickness of the Europan ice layer (less than 1 kilometer) and requires a global fluid layer (the inferred Europan ocean) beneath the ice to generate enough tidal stress to fracture the icy surface.

WRITING BACTERIAL HISTORIES IN IRON

The processes through which bacteria mineralize iron can lead to characteristic isotopic fractionation in the iron species formed. Two reports discuss how such fractionation could be used to construct records of the distribution of iron-reducing microorganisms or of the temperature of the bacteria's paleoenvironment. Sedimentary rocks, such as banded iron formations, show a small variation in the iron isotopic composition of their iron-bearing minerals that is not seen in igneous rocks. Beard *et al.* (p. 1889) performed controlled laboratory experiments in which they grew iron-reducing bacterium (*Shewanella algae*) on ferrihydrite. They found a small change toward lighter iron isotopes in the solution formed on the ferrihydrite that was not observed in their control experiment without the bacterium. They suggest that the iron isotopic variation in some sedimentary rocks is related to microorganisms and can be used to trace the occurrence of these organisms through the entire rock record. The intracellular formation of magnetite (Fe_3O_4) by magnetotactic bacteria results in a characteristic morphology of long chains of small single domains. Mandernack *et al.* (p. 1892) studied the fractionation patterns of oxygen and iron in magnetite produced by two different bacterial strains in laboratory-controlled experiments kept in the temperature range from 4° to 35° Celsius. They found no fractionation of the iron isotopes, but the oxygen isotopes showed a temperature-dependent fractionation between the magnetite and water. The correlation between oxygen isotopes and temperature should be useful for determining the temperature of environments from which the bacteria have long since disappeared.

BLUE LASERS WARMING UP

The development of semiconductor lasers emitting in the blue is crucial as the demand for reading and writing higher density optical disks grows. The vertical cavity surface-emitting lasers (or VCSELs) have the additional benefit of being readily patterned into an array containing many devices, thus allowing parallel processing. However, if they are to find mass application, the operation temperature must be increased above the cryogenic temperatures currently required. By careful design of the laser cavity, with particular attention being paid to growth of the mirrors, Someya *et al.* (p. 1905) show lasing operation in VCSELs at room temperature.

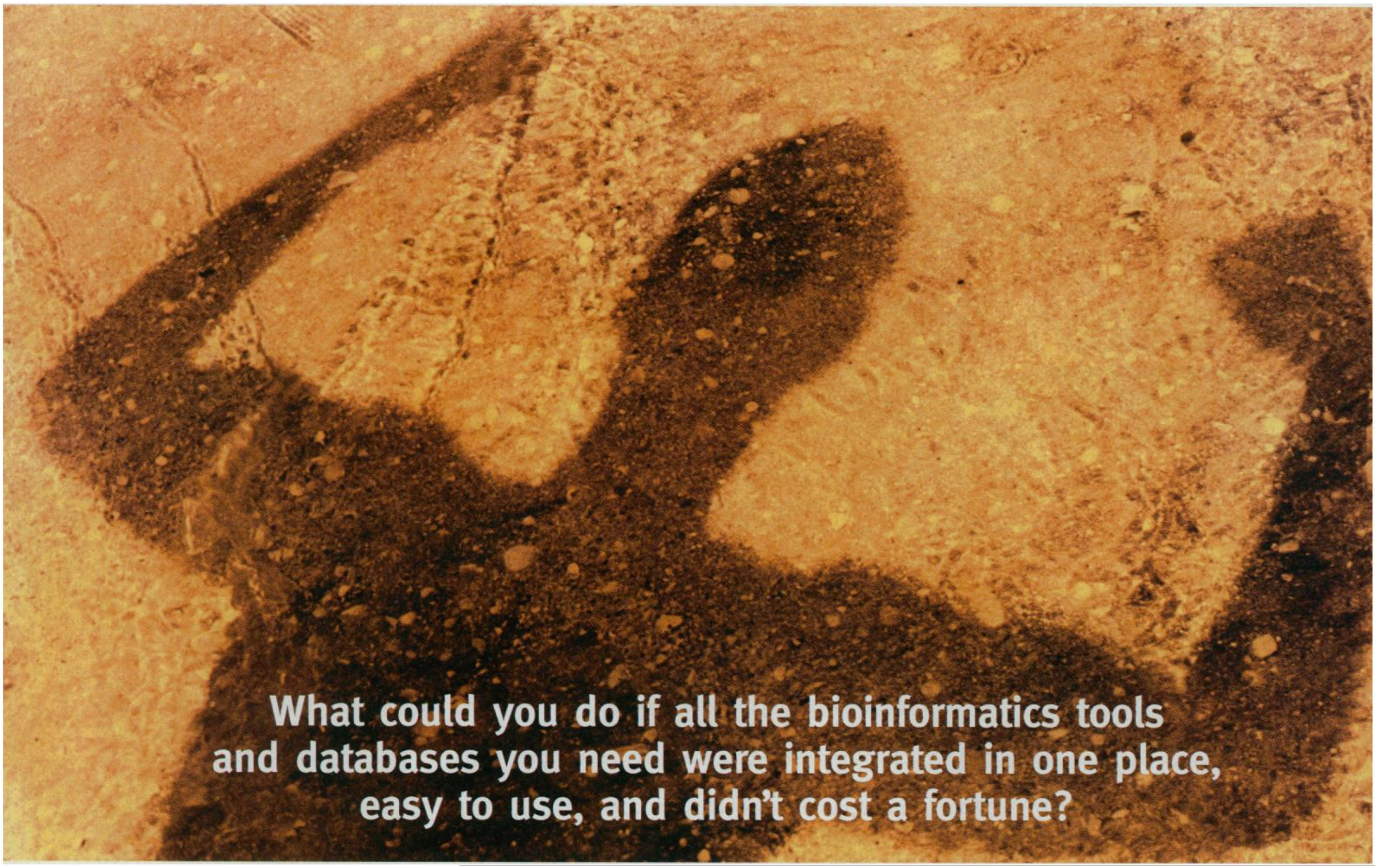
CARBON MEMBRANES

Small molecules such as nitrogen and oxygen can be separated with nanoporous inorganic membranes, but even the smallest cracks can render such materials useless. Shiflett and Foley (p. 1902) show that by carefully controlling the thickness of the deposited precursor films, nanoporous carbon molecular sieves could be made that were thick enough to have high selectivities yet thin enough to remain plastic and thus avoid stress-induced catastrophic cracking. Such membranes could produce a 100% enrichment of oxygen in air in a single pass.

SENDING THE RIGHT SIGNALS

Animals often use chemical signals (pheromones) to attract receptive mates, but some species use them to induce receptive responses such as ovulation in a partner they are courting. The male

CONTINUED ON PAGE 1819



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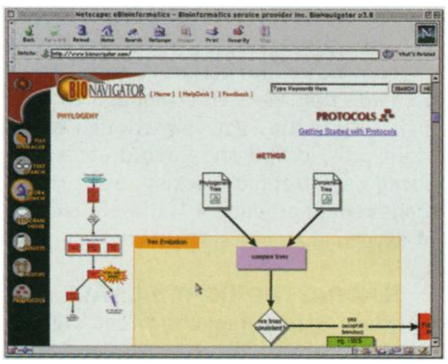

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CONTINUED FROM PAGE 1817

Plethodon jordani salamander produces a pheromone in a specialized gland under his chin. Rollmann *et al.* (p. 1907) purified and cloned the plethodontid pheromone and showed that when the pheromone is applied to the nares of the female salamander during courtship, female receptivity is affected. This plethodontid receptivity factor is homologous to interleukin-6, which suggests that this increased receptivity may be a specific neurological response induced in the female.

STAYING MOIST

Soil arthropods—collectively one of the most abundant terrestrial life forms—are usually considered transitional between aquatic and terrestrial with respect to their water balance. In particular, they have been thought to have no physiological adaptation to water stress because of the high permeability of their skin; during drought, they have been assumed simply to migrate to deeper soil layers. Bayley and Holmstrup (p. 1909) show that, on the contrary, a common soil arthropod increases the osmolarity of its body fluids in response to low humidity and thus increases its ability to absorb water from the surrounding air. This finding requires a re-evaluation of the physiological adaptations of terrestrial arthropods to drought and desiccation.

WANDERING ATTENTION

When looking around, we constantly make saccades with our eyes, jumping from one point of attention in the visual world to the next. How does the central nervous system incorporate information about the visual scene into the neuronal commands that generate saccades? Moore (p. 1914) presents recordings from neurons in area V4 of the visual cortex of monkeys. These cells not only respond to a stimulus of appropriate orientation but also show bursts of activity after a delay just prior to a saccade toward the stimulus. In addition, there is more presaccadic activity in trials when the saccades are effectively guided by orientation information, that is, when the monkey's gaze lands along the axis of an object that is the target for a saccade.

ALL IN THE FAMILY

Mutations in the tumor suppressor protein APC inappropriately activate the transcription factor Tcf4, which in turn activates genes that cause intestinal epithelial cells to become transformed into cancer cells. Roose *et al.* (p. 1923) show that the gene encoding another member of this transcription factor family, *Tcf1*, is a direct target of Tcf4. Tcf1 acts as a feedback repressor of Tcf4 by antagonizing its effects on cell transformation. Thus, Tcf1 cooperates with APC in suppressing tumorigenesis.

MULTIPLE THREAT

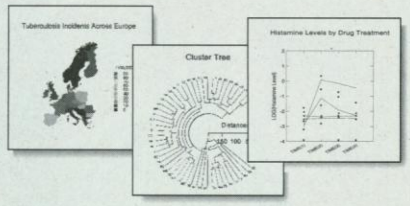
Bacterial pathogens can inject target cells with virulence factors. Orth *et al.* (p. 1920) have determined that a virulence factor of *Yersinia pseudotuberculosis*, the YopJ protein, can bind to several members of the mitogen-activated protein kinase (MAPK) superfamily and prevent their phosphorylation and activation. This binding resulted in a specific block in signaling pathways that would otherwise have led to cytokine synthesis and apoptosis, both of which are involved in host defenses against bacterial infection. Proteins related to YopJ are found in many bacteria that are plant and animal pathogens.

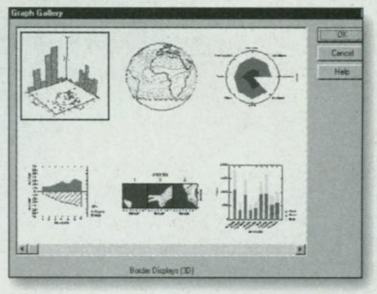
CONFORMATION MATTERS

Antithrombin belongs to the serpin family of serine protease inhibitors and functions in the blood clotting cascade. Carboxyl-terminal cleavage induces a conformational change in antithrombin, and O'Reilly *et al.* (p. 1926; see the Perspective by Carrell) show that this change confers a new biological activity on the protein. Cleaved antithrombin exhibits potent antiangiogenesis and antitumor activity in mouse models. This discovery suggests that clot formation and angiogenesis may be regulated in tandem and raises the possibility that antithrombin, already in clinical use, may find new applications in the treatment of angiogenesis-dependent diseases such as cancer.

HORMONES AND BLOOD PRESSURE

Women are less susceptible than men to cardiovascular disease and atherosclerosis as long as their blood estrogen levels are elevated. Valverde *et al.* (p. 1929; see the Perspective by Silberberg and Magleby) show that estrogens can directly bind to a subunit of the maxi-K channel. These calcium-regulated potassium channels are key regulators of vascular smooth muscle cells, which constrict arteries and raise blood pressure. This acute estrogen effect does not require genome activation or generation of other intracellular signals.





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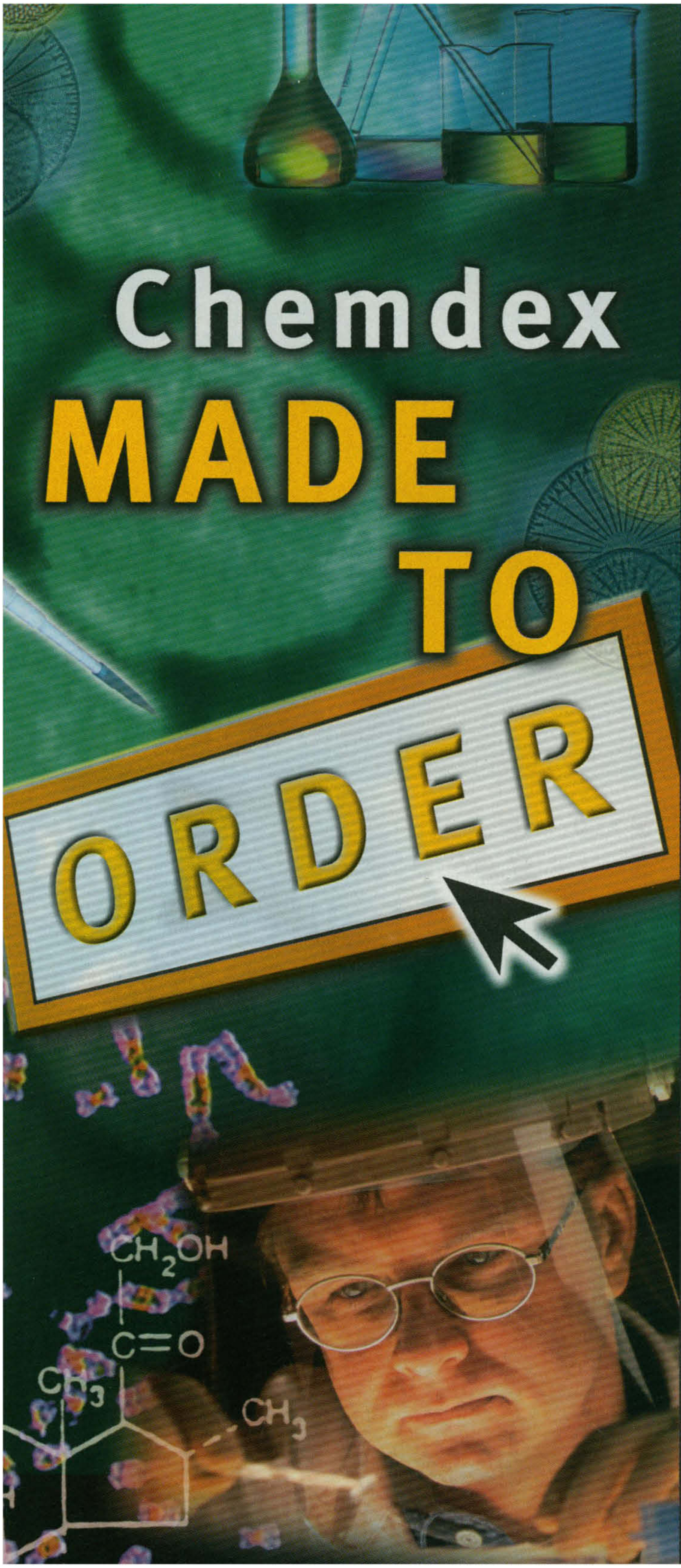

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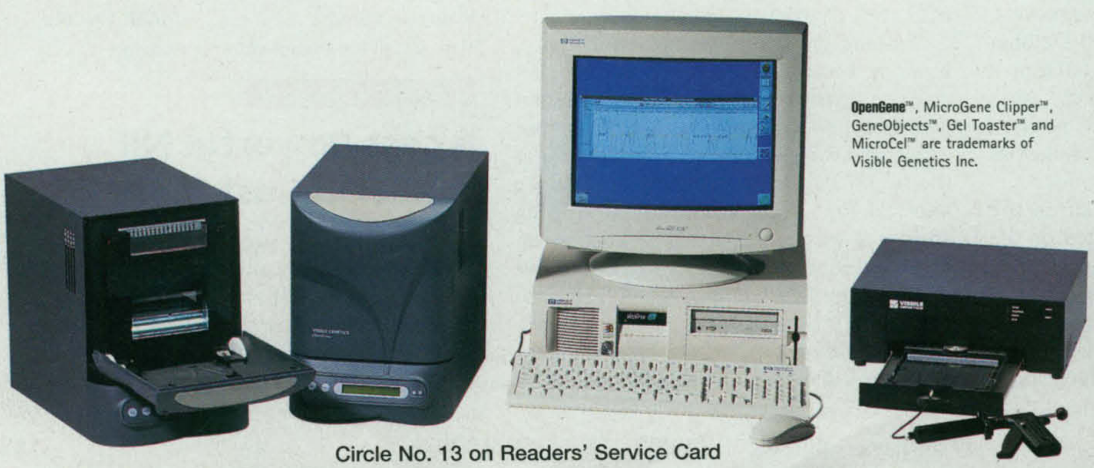

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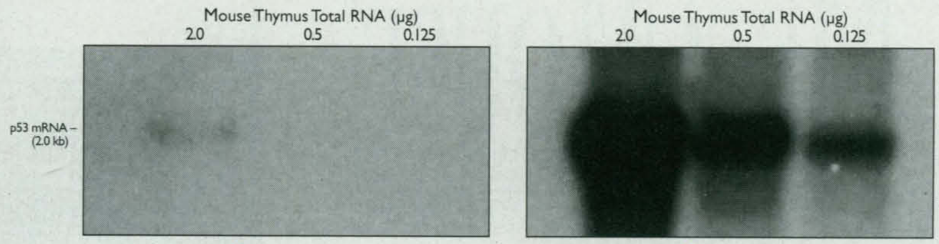

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1. *Molecular Cloning: A Laboratory Manual*, 1989. Sambrook, J. Fritsch, E.F., Maniatis, T. Cold Spring Harbor Laboratory Press.

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