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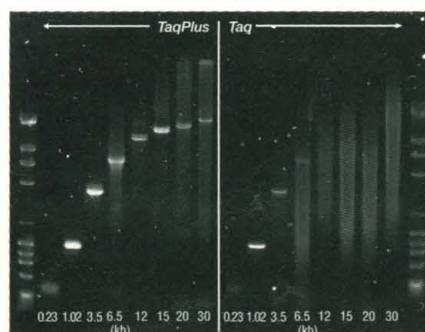


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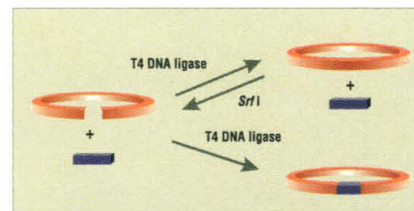


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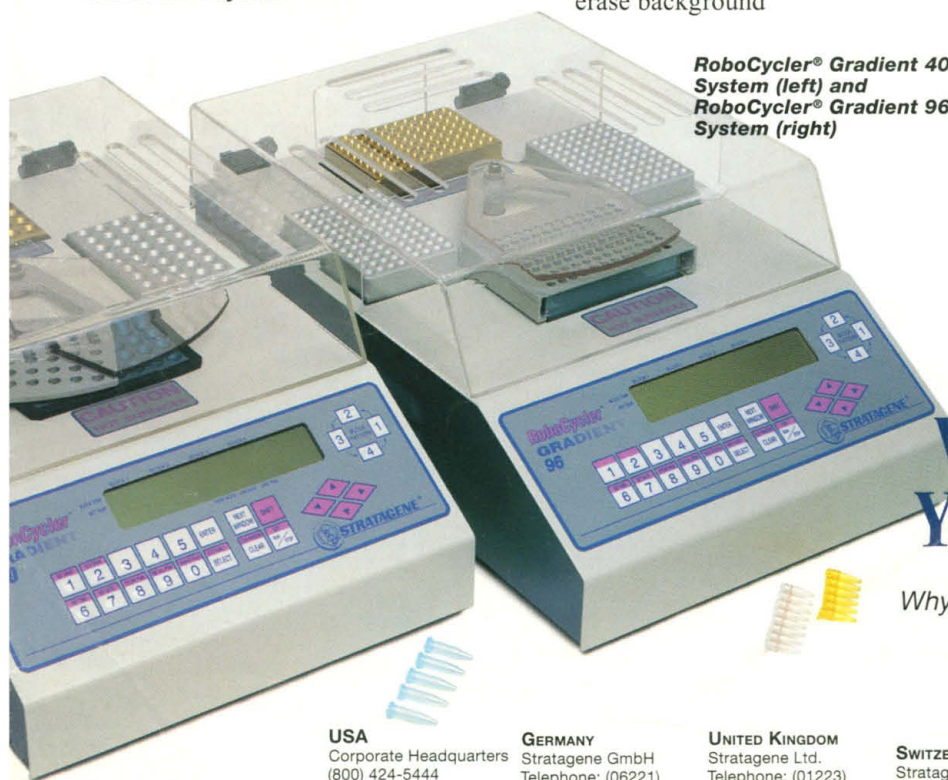
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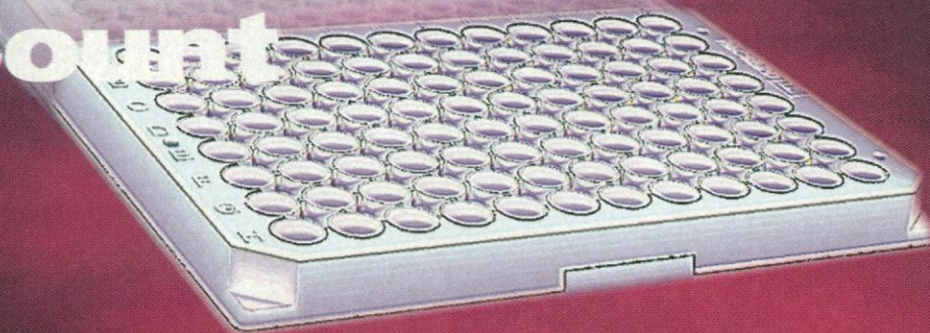
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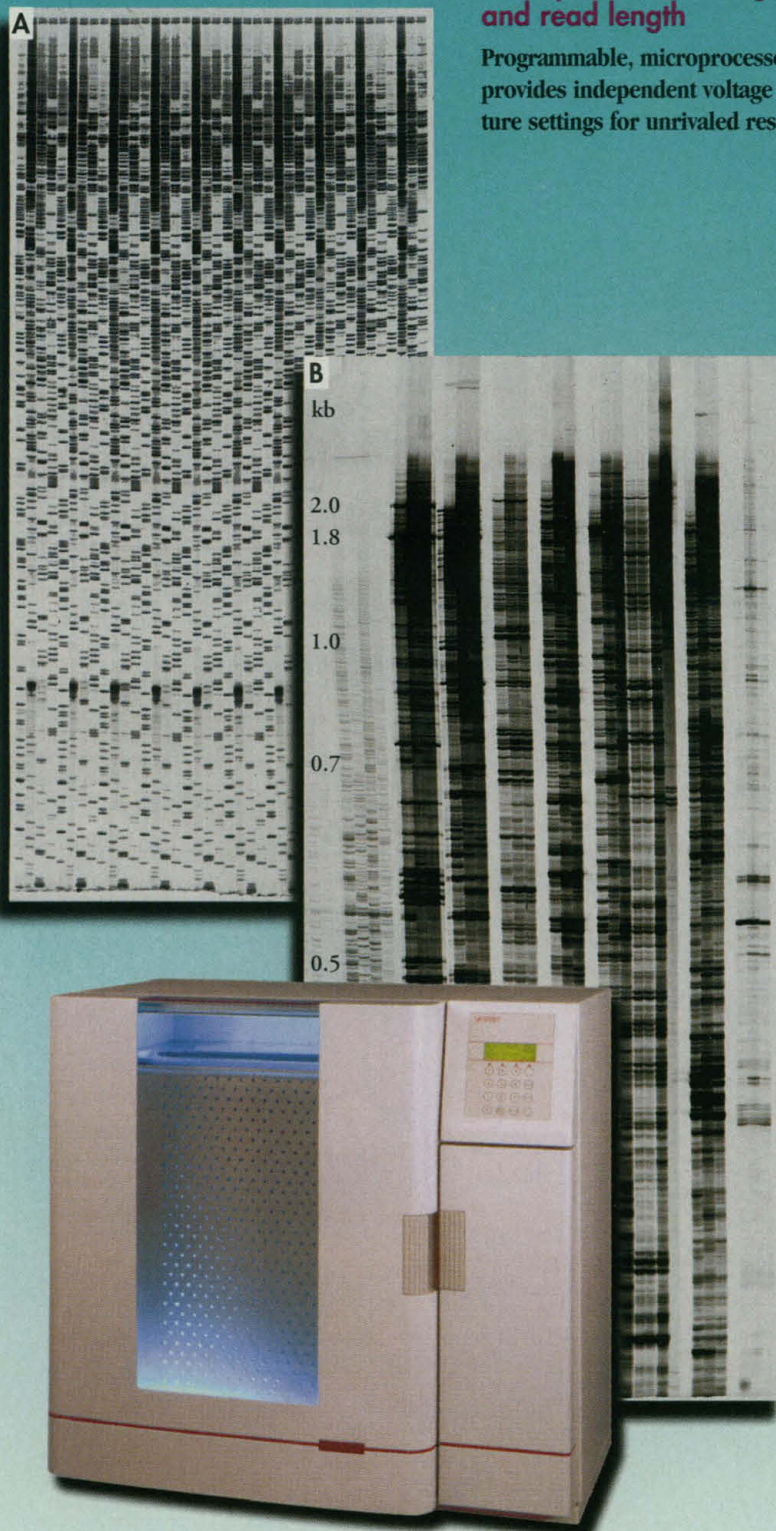
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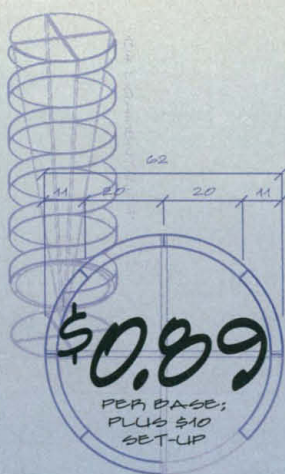


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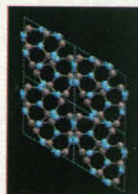
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COVER

Epitracheal gland (EG) of a *Manduca sexta* (tobacco hornworm) pharate pupa. The gland is composed of a large Inka cell (left, ~140 micrometers in diameter), which produces the ecdysis-triggering hormone, and two smaller glandular cells (right). Individual EGs are

attached to the ventral side of the tracheal tube adjacent to each spiracle, comprising a peripheral, segmentally distributed endocrine system of 18 glands per animal. See page 88 and the Perspective on page 40. [Image: Dusan Zitnan]



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Helping language-impaired children



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THIS WEEK IN SCIENCE

edited by PHIL SZUROMI

Tunable magnets

The ability to control magnetic phase transitions in molecular compounds would be useful in data recording and device applications. Sato *et al.* (p. 49) synthesized a class of mixed valence chromium cyanides whose magnetic transitions could be electrochemically tuned. Initially ferrimagnetic, the compounds can be switched reversibly between ferrimagnetic and paramagnetic states through reversible redox reactions.

Hard calculations

Carbon nitrides are being scrutinized as a class of materials with extreme properties, including hardness comparable to or greater than that of diamond. Teter and Hemley (p. 53) investigated the structure and stability of several C-N compounds using theoretical calculations. A cubic form of C₃N₄ that is stable at high pressures may have a bulk modulus greater than that of diamond. Their analysis also suggests that previously predicted β -C₃N₄ compounds may not actually be stable.

Critical parallelism

Combinatorial optimization tasks, such as the traveling salesman problem, are usually solved by using computationally demanding local search techniques that find a minimum or maximum of some mathematical function. Macready *et al.* (p. 56) discuss the implications of performing such searches in parallel in order to find better solutions faster. As the degree of parallelism increases, the performance in finding solutions increases but then reaches a critical point where they become no better than a random search.

Overcoming impairments in language learning

Functional plasticity of the brain as a result of experience—that is, changes in processing of sensory inputs—has been demonstrated in experiments on humans as well as non-human primates. Merzenich *et al.* (p. 77) and Tallal *et al.* (p. 81) present an example of this effect on comprehension of modified, language-based phonemes by language-learning impaired (LLI) children and how this training can result in improvements in the comprehension of unmodified language (see the news story by Barinaga, p. 27). After training with computer games designed to hone their temporal processing skills for acoustic stimuli, LLI children improved their game scores and also improved in their performance on standardized tests using normal, unmodified speech.

This behavior is seen in both spin-glass models and the traveling salesman problem.

Water clusters

One way to gain insight into the structure of liquid water is to examine the structure and dynamics of small water clusters. Cruzan *et al.* (p. 59) and Liu *et al.* (p. 62) present analyses of vibration-rotation-tunneling spectra for the water tetramer and pentamer, respectively. The data for tetramer, which forms a quasi-planar ring, may help constrain the interaction potential for bulk water. The pentamer, which may be one of the predominant arrangements in liquid water, forms a slightly puckered ring.

Denied clearance?

Patients with cystic fibrosis (CF) are prone to respiratory infections caused by the bacterium *Pseudomonas aeruginosa*. Pier *et al.* (p. 64) provide evidence that mutations in the cystic fibrosis transmembrane regulator (CFTR) may disrupt a host-defense mechanism that is important for clearance of this bacterium from the respiratory tract. Cultured airway epithelial cells

expressing the most common mutant form of CFTR were defective in internalizing *P. aeruginosa*, but not other bacterial pathogens. In a mouse model, inhibition of *P. aeruginosa* internalization produced a build-up of bacteria in the lungs.

Of sex and silk

Spiders are the focus of two reports this week. The female red-back spider consumes the diminutive male during sperm transfer in 65% of natural matings. Why do males apparently facilitate their own consumption? Andrade (p. 70) reports that male complicity is adaptive because cannibalized males gain two paternity advantages over



those that survive copulation: longer periods of copulation and rejection of subsequent suitors by the female. The superior mechanical properties of spider silk have been difficult to unravel. Simmons *et al.* (p. 84; see the Perspective by Tirrell, p. 39) obtained deuterium nuclear magnetic resonance spectra

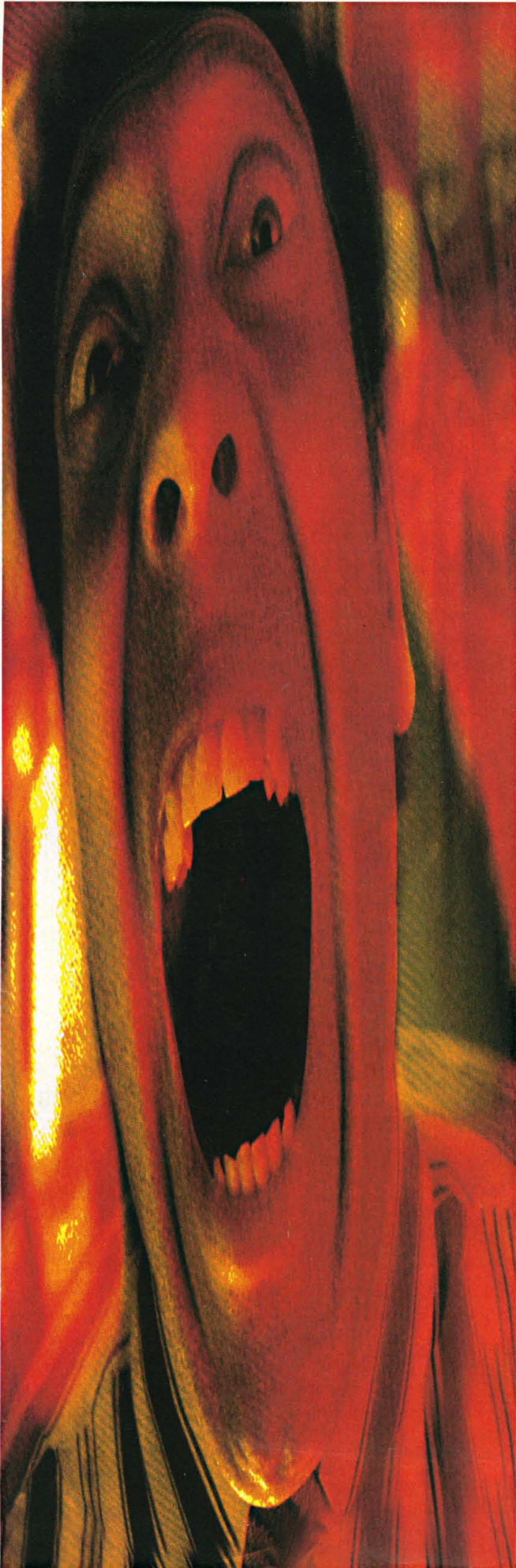
which show that dragline spider silk contains two types of alanine-rich regions, one highly oriented and one loosely packed. They propose a structural model that is consistent with previous models that can account for the stress-strain behavior of spider silk.

Shell games

Many organisms can form biominerals from calcium carbonate as they grow. Moreover, such organisms often exert control over which polymorph is formed, calcite or aragonite. Falini *et al.* (p. 67) report experiments showing that macromolecules in contact with the mineral components of mollusk shells have a primary role in determining which polymorph forms. Macromolecules extracted from aragonite sections induced aragonite growth *in vivo*, and those extracted from calcite portions induced calcite growth. These macromolecules actively nucleate their respective calcite polymorph rather than inhibiting the competing form.

Behind the shedding

In insects, the brain peptide eclosion hormone has been thought to be the trigger for ecdysis, the shedding of cuticle during development. Žitňan *et al.* (p. 88; see the cover and the Perspective by Truman, p. 40) describe the discovery of a previously uncharacterized insect endocrine system. A series of segmentally repeated glands, the epitracheal glands, produce a hormone, Mas-ETH. When injected into larvae, pupae, or adults, Mas-ETH rapidly causes preecdysis and subsequently ecdysis.



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1. Bernard, P. *et al.* (1993) *J. Mol. Bio.* 234: 534-541

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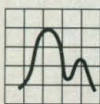
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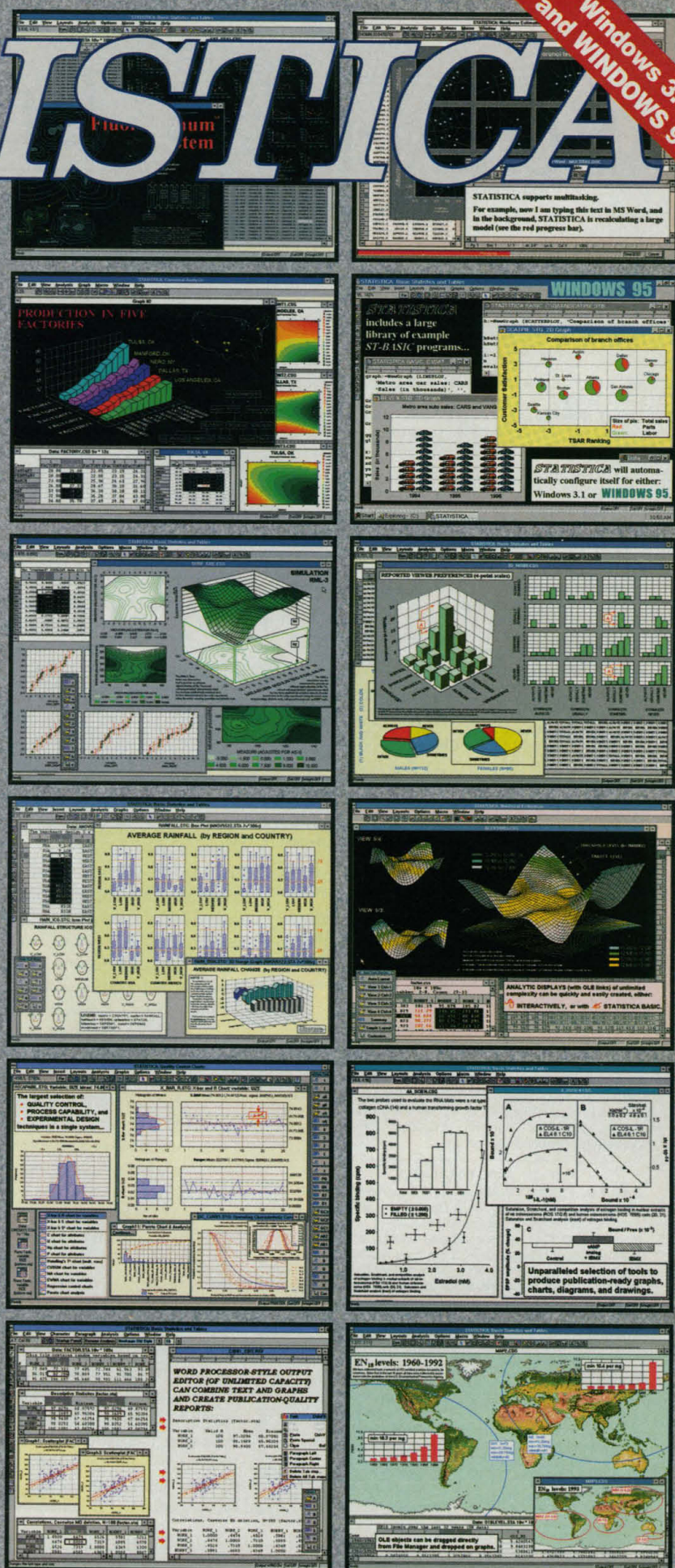
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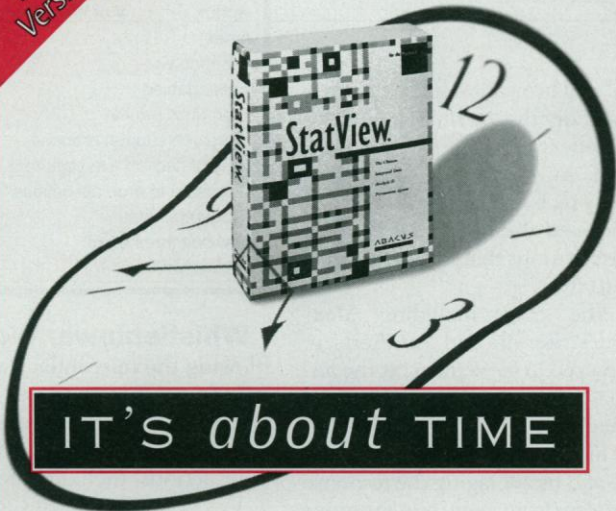


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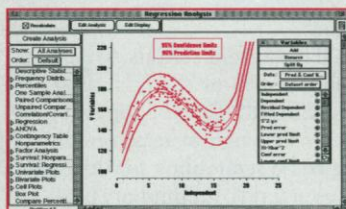
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