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Book Issue

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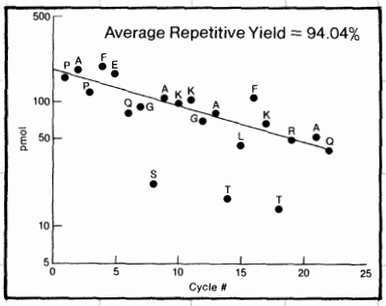
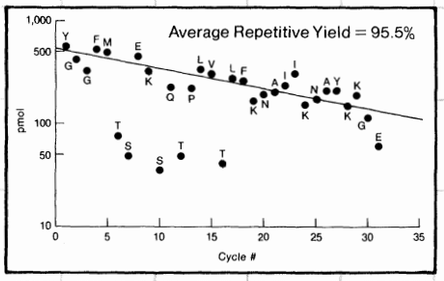


ß-Endorphin — The Complete Sequence

Sequencing a peptide is a good measure of performance. Using ß-endorphin, an average repetitive yield of 95% was attained. All 31 residues were clearly identified.



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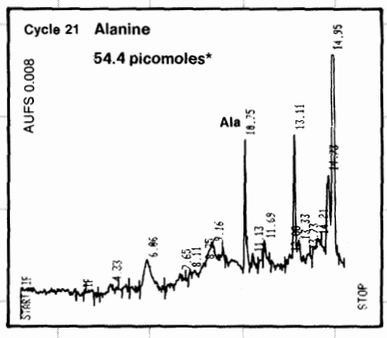

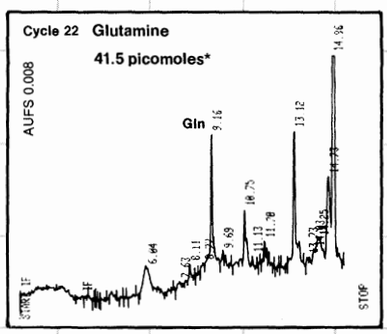

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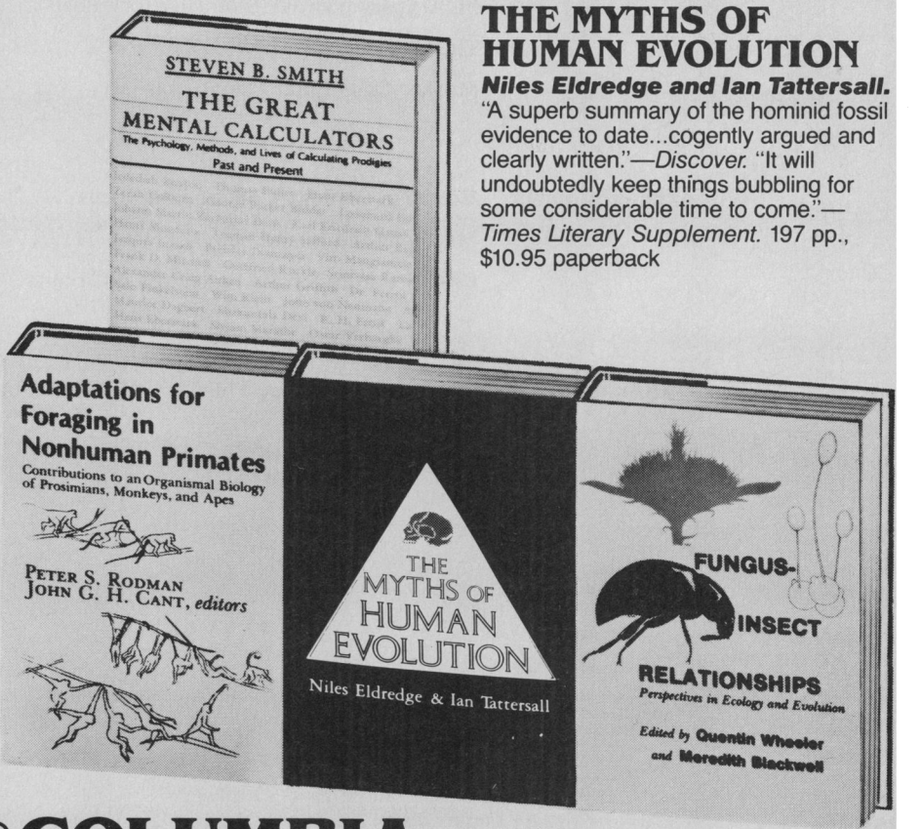

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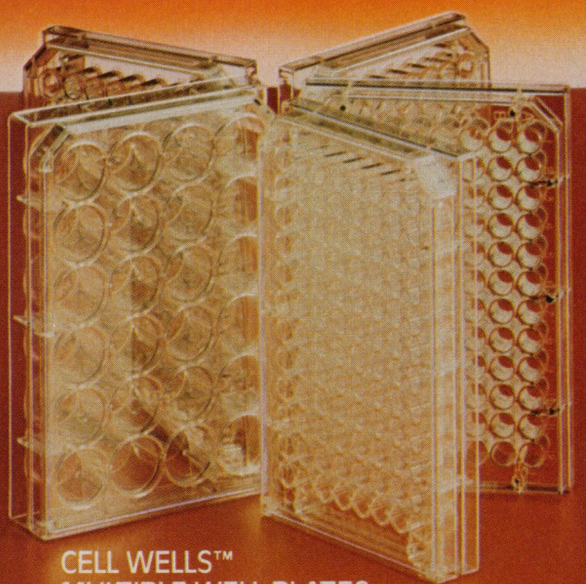
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Color disks and machine to rotate them. James Clerk Maxwell's 1849 theory of color was studied with the use of such disks. Appropriate combinations of red, blue, and green gave the various colors as the wheels were spun. The apparatus shown here, from the University of Pavia, was made around 1865, probably in Italy. [From G. L'E. Turner, *Nineteenth-Century Scientific Instruments*, reviewed on page 731]

BIG PICKIN'S FROM THE ORANGE GROVE



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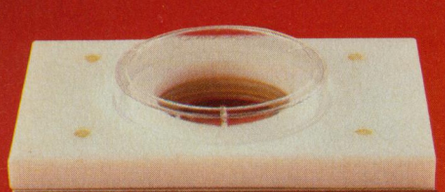

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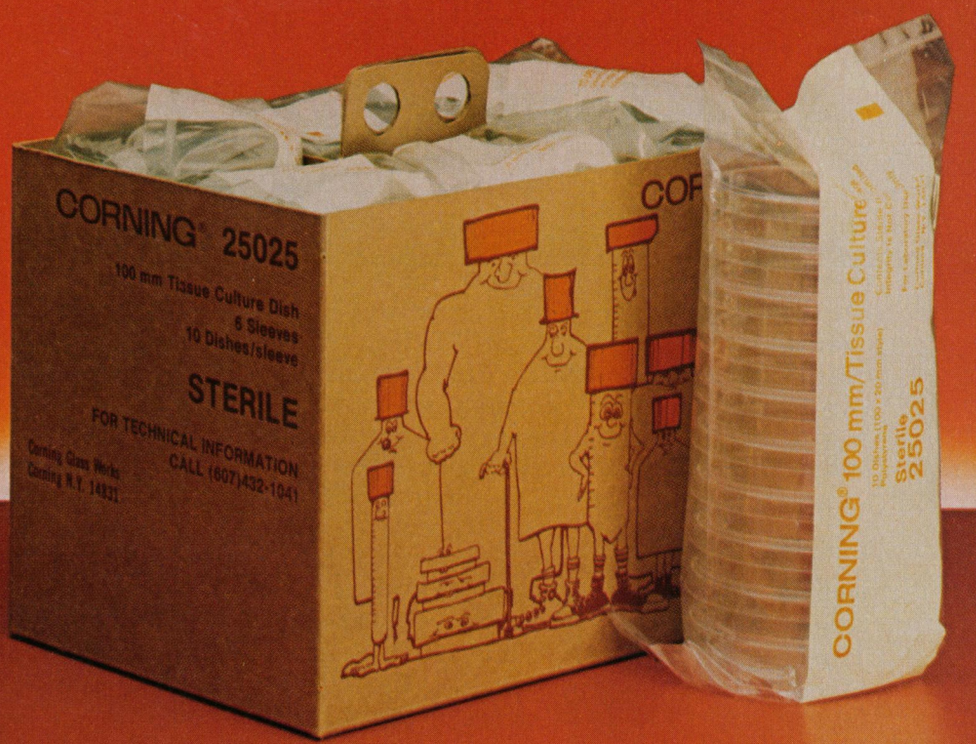

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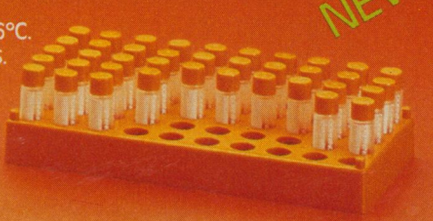


See all the members of the Corning Orange Line. 490 cm^2 and 850 cm^2 roller bottles, and these cell cultures support items: 16 x 125 mm culture tubes, 100 mL graduated cylinder, 250 mL container, and 250 mL Erlenmeyer flask.

SCIENCE/SCOPE

A prototype electronic map developed for the U.S. Air Force makes map reading as simple as pushing a button. The Airborne Electronic Terrain Map System stores digitized terrain data to provide a moving, color-coded computer map of the area over which an aircraft is flying. The map can be projected on standard color or black-and-white cockpit displays or on the head-up display. Like paper charts, the Hughes Aircraft Company map can show the aircraft's actual postion or be "unfolded" electronically to let the pilot look ahead. It can be presented in a shaded relief plan view, much like a standard paper chart, or in a perspective view as though the pilot were looking at terrain ahead of the aircraft.

In a step toward large flat-panel television screens, research scientists at Hughes have developed new mixtures of liquid crystals. A test panel made with the new liquid crystals proved far superior to the kind of displays used in digital watches and calculators. It could be seen clearly at extreme angles without loss of gray scale. The test panel used a mixture of black dye and liquid crystals in a twisted nematic configuration. The transmission-type cells were used with just one polarizer and with diffuse backlighting. The study is part of a program to develop high-performance, flat-panel military displays.

Geologists teamed with the U.S. Navy over Mt. St. Helens in 1980 to use the latest defense technology for a unique view of the simmering volcano. Their eye was the nation's first fully integrated night attack system, built by Hughes for the A-6E Intruder aircraft. The system, called the Detecting and Ranging Set (DRS), includes a thermal imaging sensor that sees through darkness, smoke, or haze. Infrared images recently released by the Navy showed significant hot spots two weeks before the May 18 eruption. The imagery prompted civil authorities to step up their warnings and evacuation efforts. Videotapes were made on flights for later evaluation. Geologists said the DRS gave them a broader, more precise thermal picture of the volcano than was otherwise possible.

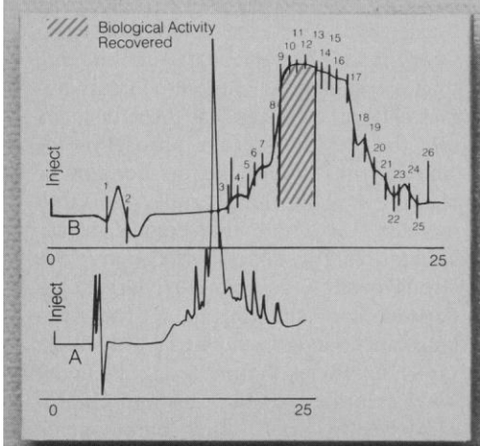
Two broadband gallium arsenide field-effect transistors, operating in the 13- to 15-GHz frequency range, have been introduced by Hughes for use in satellite communications. The new single-cell and dual-cell power transistor chips are mounted on internally matched chip carriers and are guaranteed to operate in a 50-ohm system over a full 2-GHz bandwidth with no additional matching. The chip carriers are compatible with 25-mil alumina microstrip circuits and have 25x1-mil gold ribbon leads. The single-cell device is rated at 0.5 watt minimum output; the dual-cell at 1.25 watt minimum. Highest output is from 14.0 to 14.5 GHz.

Hughes is seeking engineers to develop advanced systems and components for weather and communications satellites, plus the Galileo Jupiter Probe. Openings are in applications software development, data processing, digital subsystems test, microwave/RF circuit design, power supply circuit design, component engineering, GaAs design, digital communications, signal processing, spacecraft antenna design, system integration test and evaluation, and TELCO interconnection. Send resume to Ray Bevacqua, Hughes Space & Communications, Dept. S2, Bldg. S/41, M.S. A300, P.O. Box 92919, Los Angeles, CA 90009. Equal opportunity employer.

Isolate biologically active peptides with higher purity and yield.

Waters preparative chromatographs simplify scaleup for multigram isolations.

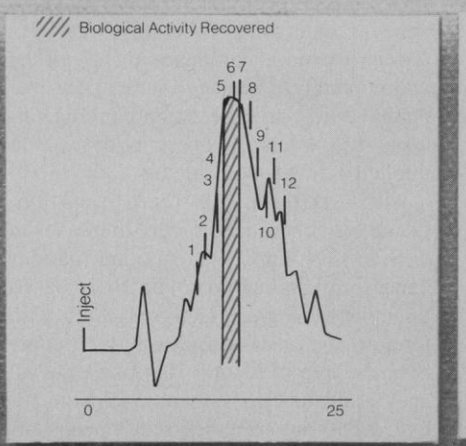
Fast determination of scaleup parameters



Scaleup parameters for multigram isolation on Waters preparative chromatographs are determined via an easy, step-by-step procedure using only microgram quantities of critical sample.

Sample: A) 25 µl of 10 mg/ml Polymyxin Peptides
B) 0.5 ml of 10 mg/ml Polymyxin Peptides
Cartridge: A) Radial-PAK™ analytical C_{18}, 8mm x 10 cm
B) Radial-PAK™ preparative C_{18}, 8 mm x 10 cm
Gradient Conditions:
Solvent: A) 0.1% TFA in H_2O
Solvent: B) 0.1% TFA in CH_3CN
0-100% B, linear, 25 min
Flow Rate: 1.0 ml/min
Detector: A) Model 441 Absorbance Detector, 214 nm, 1.0 AUFS
B) Model 441 Absorbance Detector, 214 nm, 2.0 AUFS

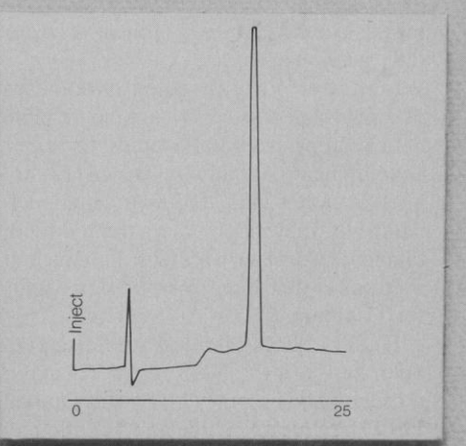
High resolution, gram-scale gradient separation



Using equivalent column chemistries and the gradient solvent system determined using an analytical HPLC system, Waters PrepLC™ 500A System purifies 1.0 g of crude synthetic polymyxin with high resolution in just twenty-five minutes.

Sample: 100 ml of 10 mg/ml Polymyxin Peptides
Cartridge: PrepPAK® preparative C_{18}, 57 mm x 30 cm
Gradient Conditions:
Solvent: A) 0.1% TFA in H_2O
Solvent: B) 0.1% TFA in CH_3CN
0-100% B, linear, 25 min
Flow Rate: 150 ml/min
Detector: Model 481 Absorbance Detector, 214 nm, 2.0 AUFS

98+% purity with 90% isolation yield



HPLC analysis of the polymyxin isolated by Waters PrepLC 500A System confirms biological activity and 98+% purity. From 6.0 g of crude material containing 1.3 g of product, 1.2 g of peptide were recovered.

Sample: 150 µl of Purified Polymyxin Peptides
Cartridge: Radial-PAK™ analytical C_{18}, 8 mm x 10 cm
Gradient Conditions:
Solvent: A) 0.1% TFA in H_2O
Solvent: B) 0.1% TFA in CH_3CN
0-100% B, linear, 25 min
Flow Rate: 1.0 ml/min
Detector: Model 441 Absorbance Detector, 214 nm, 1.0 AUFS

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detract from the critical importance of tobacco as a major cause of preventable disease and death.

In his statement that high-dose exposure to occupational carcinogens "*might* also turn out to be important for particular groups of people" [emphasis added], Ames does not acknowledge the substantial literature on occupational cancer. According to a 1978 federal estimate, occupational exposure just to asbestos and five other carcinogens could, on a worst case basis, account for 18 to 38 percent of all male cancers in coming decades (*11*). Even outspoken critics of these estimates, whose analyses Ames cites, concede that "the minimum proportion of all current cancer deaths attributable to occupation can hardly be less than 2% or 3%" (*1*), 4000 to 6000 male deaths per annum. Asbestos and coke plant workers both have lung cancer rates five to ten times those of appropriate controls (*11*). Some 10 million workers are now potentially exposed to 11 "high volume human carcinogens," and there are major excesses of cancers throughout a wide range of occupational groups, including oil refinery and petrochemical workers, rubber and tire workers, welders and metal-trades workers (*4*), and atomic plant workers (*12*). These studies are all the more important as two- to fivefold excesses in cancer rates have generally been necessary before they could be detected by standard epidemiological techniques (*13*).

Contrary to Ames, substantive studies have documented the carcinogenic effects of urban air pollution or some related urban factor. Accordingly, the World Health Organization concluded that "it is probable that some urban atmospheric factor is involved [in the etiology of lung cancer], resulting from the air pollution from car exhausts, fumes from heating systems and industrial fumes" (*14*); automobile exhaust contains a wide range of carcinogens, many common to tobacco smoke. In addition, many epidemiological studies have documented large geographical variations in standardized cancer mortality rates, on an overall and organ-specific basis, with higher rates in communities located near smelters, petrochemical plants and facilities producing nuclear weapons, and in communities with high levels of atmospheric pollution (*10, 15*); definitive epidemiological evidence of carcinogenic and reproductive hazards from proximity of residence to hazardous waste landfills or industrial impoundments is not yet available, although preliminary data from sites such as Woburn, Massachusetts, are highly suggestive (*16*).

Ames dismisses the possibility that carcinogenic synthetic pesticides, marketed since the 1940's, may contribute substantially to cancer rates, as their dietary intake is claimed to be 10,000 times lower than that of age-old "nature's pesticides." There is, however, much evidence to the contrary. For example, a number of widely used chlorinated hydrocarbon pesticides have accumulated by many orders of magnitude in certain foods to levels comparable to those inducing cancer in small groups of experimental animals (*17*). Chub and trout in Lake Michigan have been found with aldrin and dieldrin residues above 0.3 part per million, and similar residues of chlordane and heptachlor have been found in the Great Lakes and in Long Island and New York City lakes; in 1983 Montana health officials warned against eating game contaminated with concentrations of heptachlor epoxide more than 100 times the Environmental Protection Agency's (EPA's) "acceptable intake level." Aldrin and dieldrin were found to be carcinogenic at dietary concentra-

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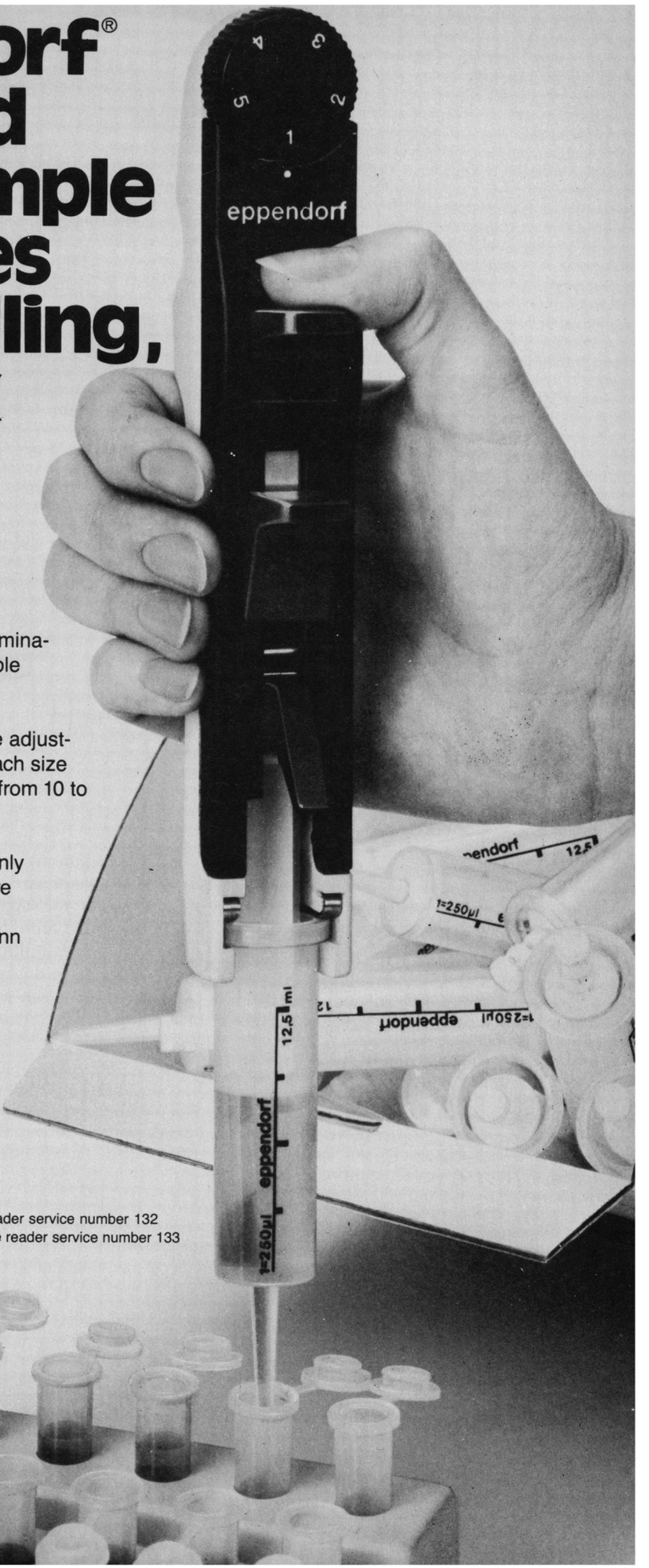

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tions of between 0.1 and 20 parts per million in five separate rodent bioassays, and residues of chlordane and heptachlor have been found in concentrations in human fat similar to those found in rats in whom carcinogenic effects had been induced by these pesticides (*18*). By all principles of extrapolation, such exposures would be expected to result in a significant excess of human cancers. The widespread use of chlordane and heptachlor for termite treatment represents additional major carcinogenic exposures. Indoor chlordane concentrations greater than an arbitrary interim guideline of 5 micrograms per cubic meter have led to the evacuation of more than 1500 contaminated homes at Air Force bases across the country (*19*) and to the petition by a New York State citizens' group, after the finding in April 1983 that 63 percent of 443 treated homes were contaminated, to ban the use of chlordane for termite treatment. Exposure to 5 micrograms per cubic meter of chlordane, approximately 50 micrograms per day for an average adult, according to EPA extrapolations that considerably underestimate risk for several reasons, including neglect of high-dose flattening, would be expected to increase lifetime cancer risks by as much as 0.1 to 0.5 percent (*20*).

Ames' position on the significance of dietary burdens of carcinogenic synthetic pesticides is not supported by recent data on ethylene dibromide (EDB) residues, with concentrations up to 5000 parts per billion in flour and citrus pulp. EPA estimated, again using procedures that minimize risk, that lifetime exposures to "realistic worst case" dietary concentrations of 31 parts per billion of EDB would result in cancer risks of from 10^{-4} to 10^{-3} (*21*), about 300 to 3000 deaths per year; occupational risks were estimated to be as high as 40 percent. Ames has also objected to the regulation of EDB, saying that the "trace of the carcinogen EDB now allowed in food is insignificant" (*22*); this in spite of the fact that available noncarcinogenic alternatives include aluminum phosphide for grains and cold storage for fruits and vegetables.

The minimal references by Ames to problems of poorly regulated exposures to a wide range of environmental and occupational carcinogens are in contrast to his exaggerated emphasis of the roles of high-fat and low-fiber diets and of charred foods as "major risk factors," although evidence for such risks, where not negative, is generally inconclusive. A recent report concludes that "in the only human studies in which the total fiber consumption was quantified, no association was found between total fiber consumption and colon cancer" (*23*). The position that high fat consumption is a major cause of breast and colon cancer is based on experimental and epidemiological studies (*1, 24*). However, this evidence is weak and inconsistent (*3, 25*). There appear to be no data on the correlation between the proportion of fat in the diet, the critical variable examined in the animal experiments, and rates of colon and breast cancers on a nation-by-nation basis; while those rates are strongly correlated with absolute fat consumption, this correlation is equally good with other measures of industrialization, such as per capita energy production (*3*). Moreover, up to 20-fold increases in dietary fat were generally necessary to increase tumor yields in rodents after the administration of carcinogens, whereas between-country differences in total fat consumption are generally less than a factor of 2 (*3*). Finally, no evidence was found in two major case control studies of an associa-

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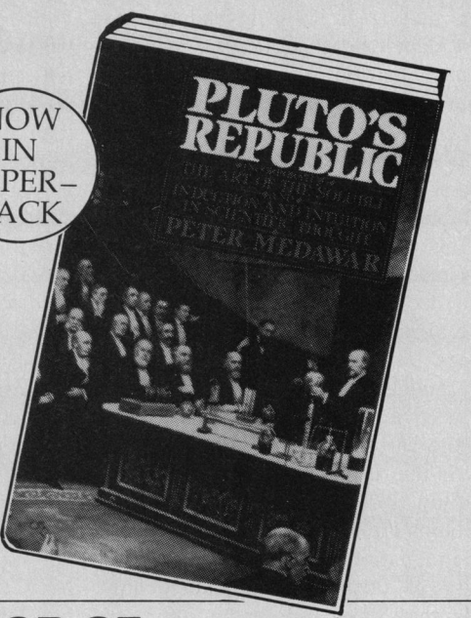

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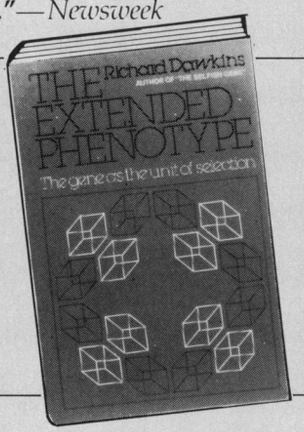

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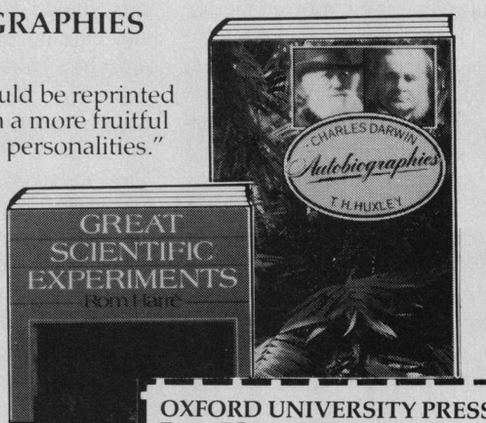

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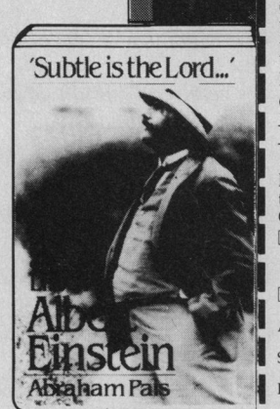

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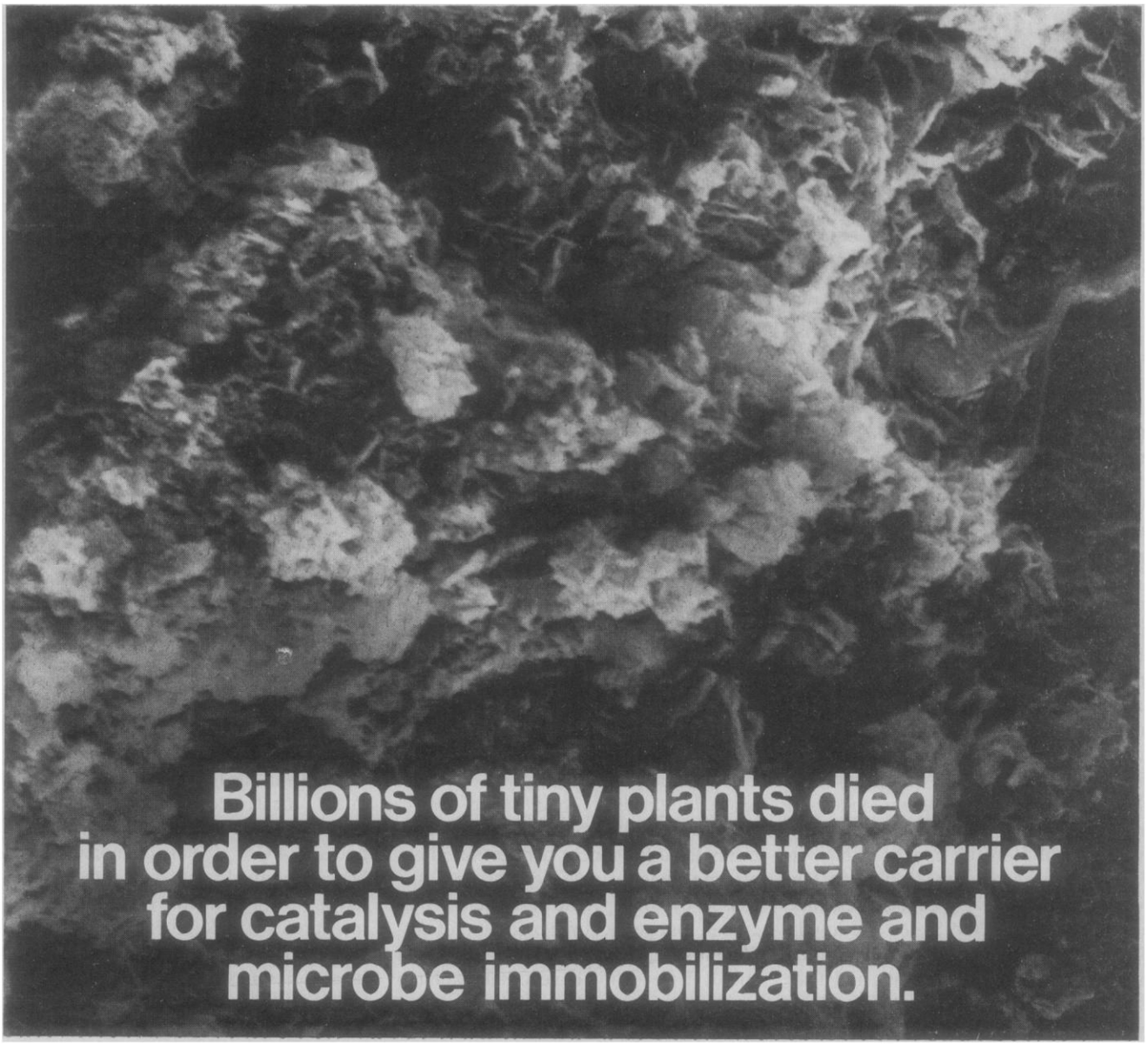

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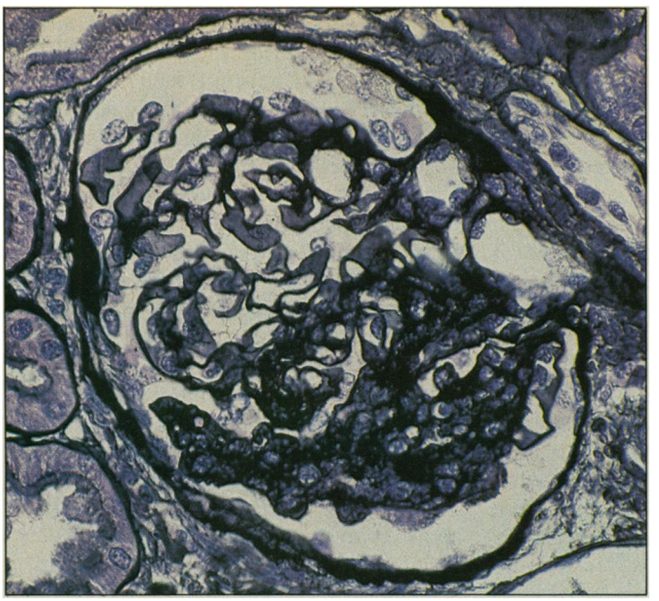

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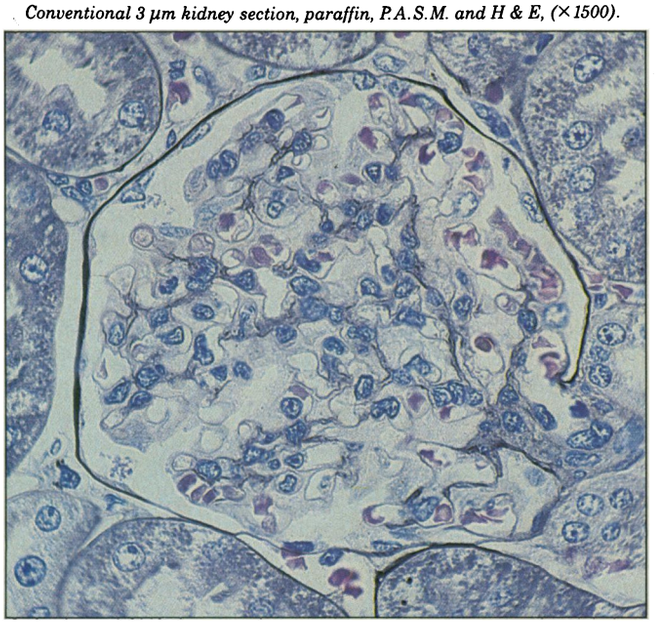

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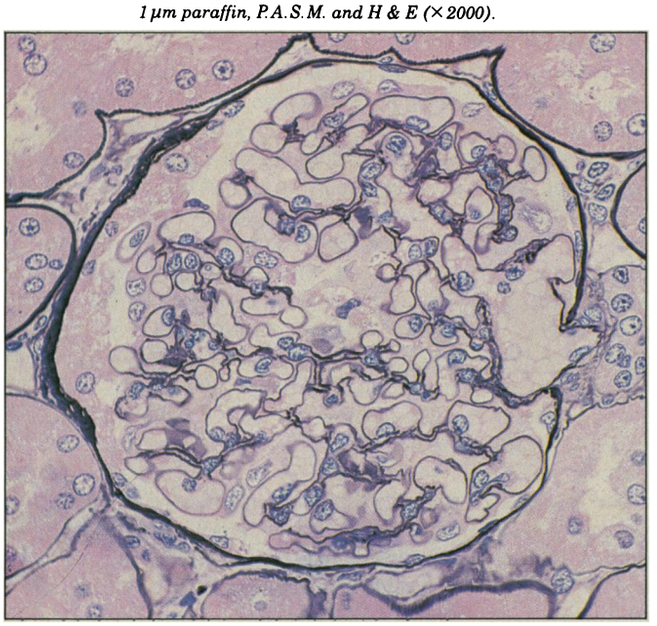

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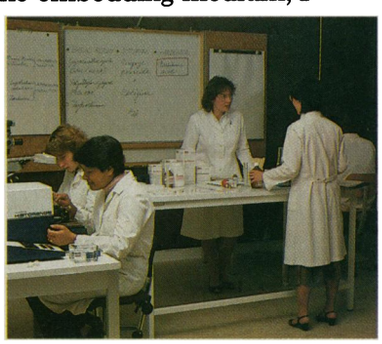

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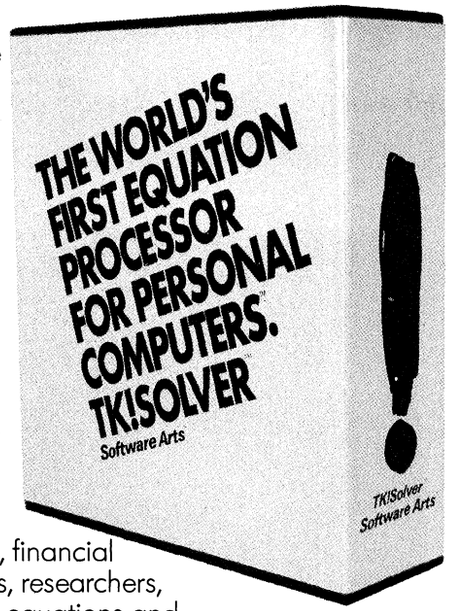

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18 May 1984, Volume 224, Number 4650 **SCIENCE**

Groundwater Contamination

Nearly 50 percent of the people of the United States are dependent on groundwater for their supplies of drinking water. Both nature and humans act to contaminate this essential resource, and public concern about its quality has been building. Recently, two publications* have appeared that describe the extent of such pollution, indicate scientific considerations, outline steps to be taken, and note laws bearing on the matter.

The sources of pollution are many, and they differ from place to place. Industrial wastes have received most of the publicity, but other sources are of comparable importance. Agriculturally related contamination in the western United States is extensive and is likely to become increasingly serious. Municipal landfills let loose a complex collection of pollutants. Effluents from septic tanks on Long Island contaminate the drinking water of some of the 3 million people living there.

The total effect from all sources is to pollute badly about 1 percent of the aquifers. Because many of these aquifers are close to large population centers, the impact is disproportionately large.

The various contaminants interact with the background environment in different ways. In the aerobic zone, bacteria oxidize many of the organic constituents. But, in general, hydrocarbons are not metabolized under anaerobic conditions. In contrast, chlorinated organic compounds seem to be more likely to be attacked in anaerobic environments than under aerobic ones; chlorine atoms are removed.

The underground environment has considerable binding tendencies. For example, where present, zeolite compounds have an ion exchange binding capacity that is effective in holding cationic forms of toxic heavy elements. Most sedimentary horizons contain some organic matter to which hydrophobic organic molecules tend to be adsorbed. Thus, depending on the path that groundwater traverses, some of its contaminants may be removed.

The rate of motion of the fluid is related to the permeability of the material through which it flows. A typical rate is about a foot per day. However, differences in permeability of 15 orders of magnitude have been noted. In general, the deeper the horizon, the less the permeability. Motion in a fine-grained material like clay is much slower than in a coarse-grained sand.

Most drinking water comes from wells that are less than 100 meters deep. Thus in some areas, waste fluids with a density greater than 1.0 could be safely injected if emplaced below 100 meters. An even more secure disposal area is in the arid Basin and Range country of the West. In that region there are basins that have no outflow.

One of the lessons of the past is that careless disposal of wastes can lead to problems that cost billions of dollars to correct. An obvious method of avoiding future additional groundwater problems would be to stop pouring wastes into the ground. For example, combustion of organic wastes would change them to simple products. Proper design of waste lagoons can guarantee that little of toxic substances escape to the environment.

The two publications make it clear that we are only at the beginning of gaining knowledge about underground transformations of substances and about the motions of their carrying fluids. New, sensitive analytical instrumentation will be crucial in identification and quantification of migrating species. Laboratory development of bacteria with metabolic capabilities for wastes may prove helpful. Mapping of the underground aquifers should make it possible to protect our sources of potable water.

The rate of contamination of groundwater appears to have slowed but residuals from earlier carelessness remain. Ultimately we must move toward improved methods of dealing with waste problems. Better knowledge of the underground environment will be an essential element in that progress.—PHILIP H. ABELSON.

*V. I. Pye, R. Patrick, J. Quarles, *Groundwater Contamination in the United States* (University of Pennsylvania Press, Philadelphia, 1983); Geophysics Research Forum, *Studies in Geophysics: Groundwater Contamination* (National Academy Press, Washington, D.C., 1984).

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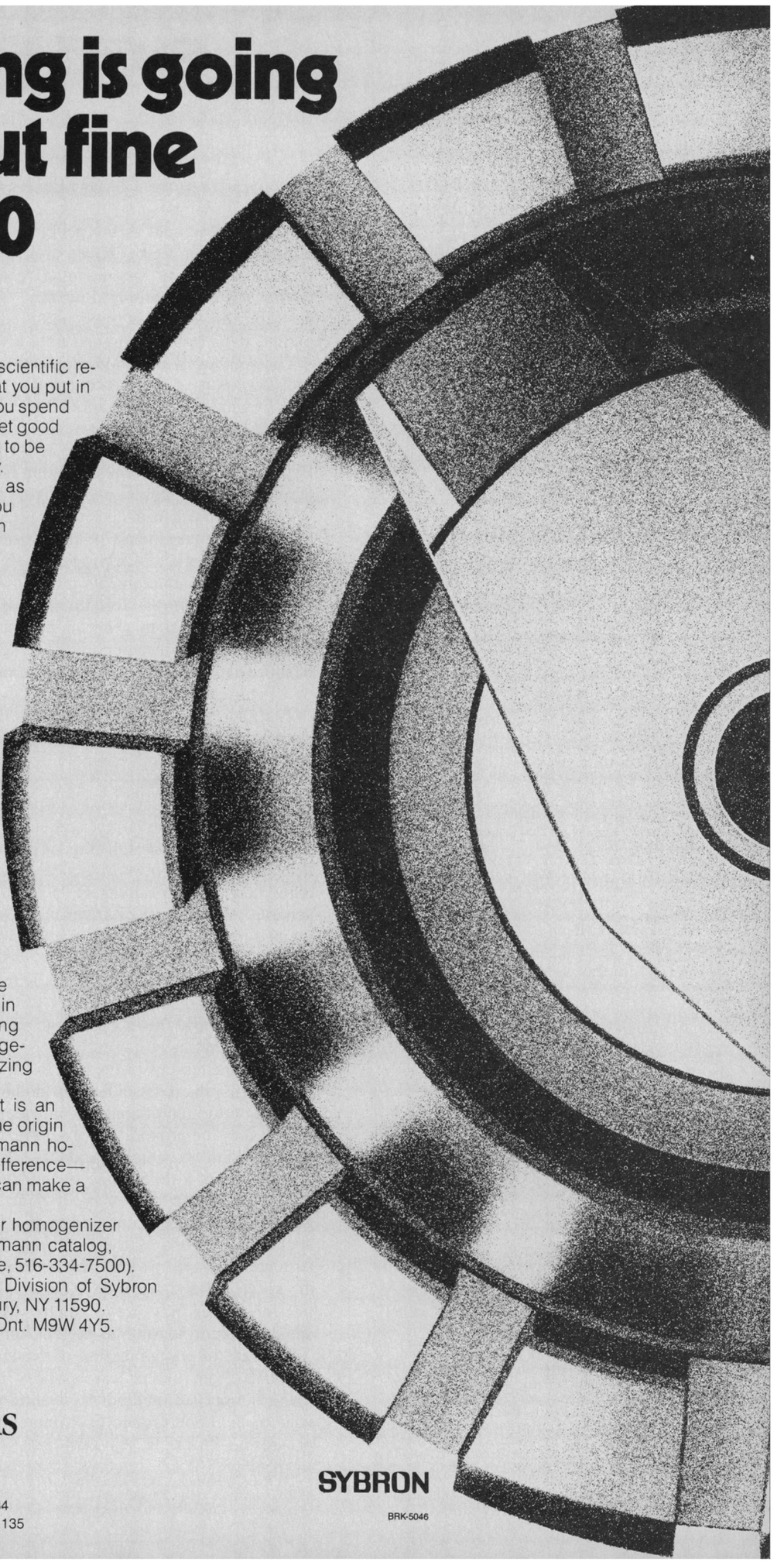

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