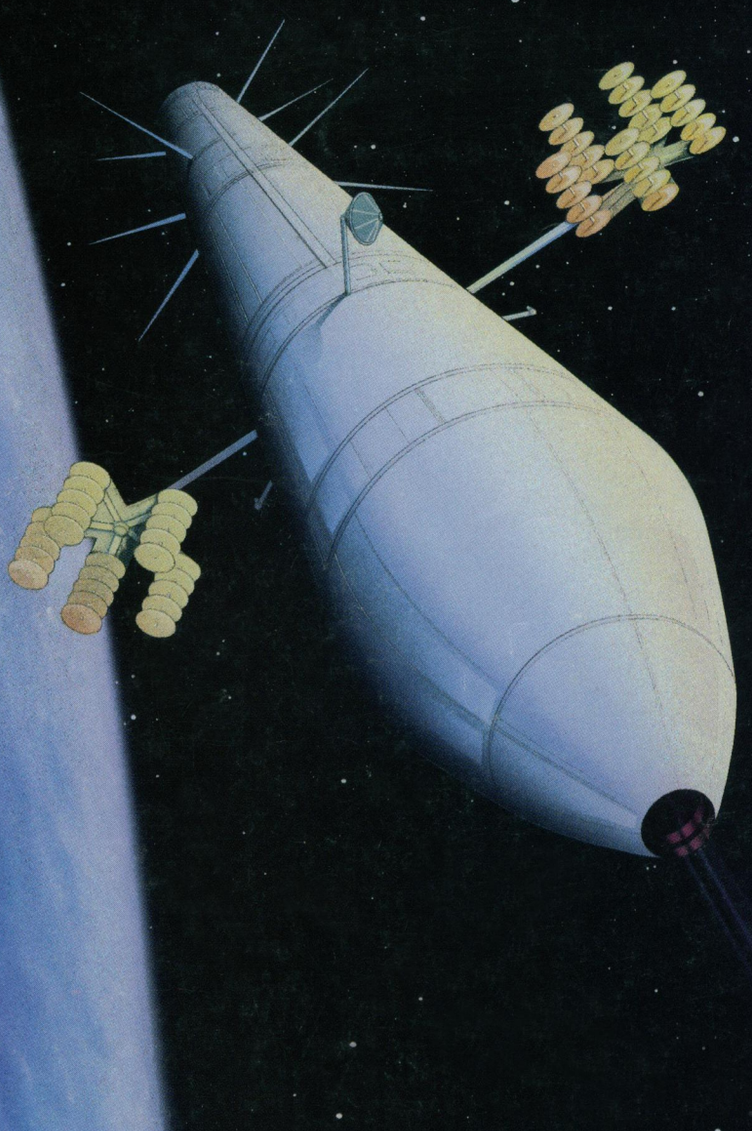
American Association for the Advancement of Science

SCIENCE

28 April 1989 $3.50
Vol. 244 ■ Pages 397–504



NUCLEAR NOISE:

UNSHIELDED REACTORS BLIND GAMMA RAY ASTRONOMERS

Separations Cells Can Live With.

Thanks to the new JE-5.0 Elutriator Rotor from Beckman. Now you can obtain large numbers of living cells and expect complete viability in one rapid run.

There are other ways to separate cells, of course. But none offers all the advantages of counterflow centrifugal elutriation. It is the ideal way to separate cells before culturing them, to establish primary cell cultures, and to obtain a specific subpopulation of cells.

And the new JE-5.0 makes elutriation better than ever. All working parts of the rotor are in a single, quick-release assembly. The entire "cartridge" withstands autoclaving for sterilization. Interchangeable chambers adapt the rotor for both small and large volume applications.

Find out more with our elutriation primer and annotated applications bibliography with more than 900 literature references.

Contact Beckman Instruments, Inc., Spinco Division, 1050 Page Mill Road, Palo Alto, CA 94304. (800) 742-2345. Offices worldwide.

BECKMAN

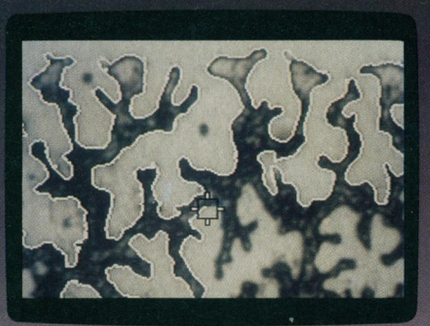
A SMITHKLINE BECKMAN COMPANY

Circle No. 222 on Readers' Service Card

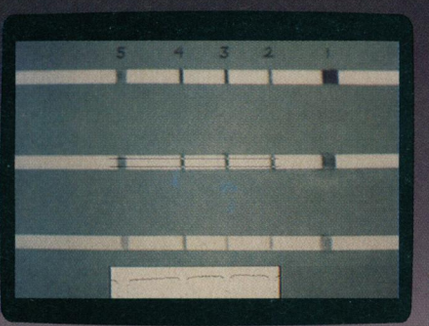
INTRODUCING

Java™

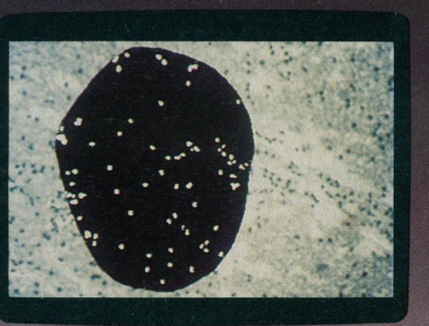
JANDEL VIDEO ANALYSIS SYSTEM



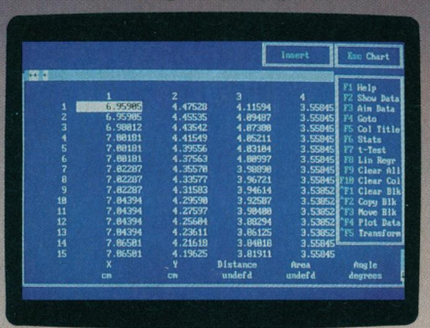
Automatic edge tracking (2x zoom)



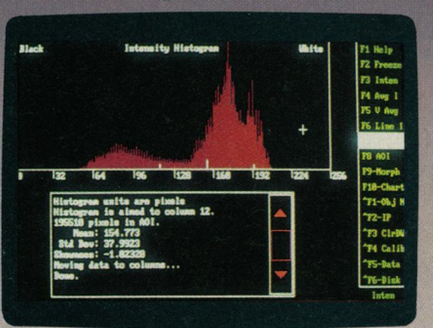
Density along a strip



Automatic object counting



16k x 64k data worksheet



Intensity histogram

User defined transformations

Analyze and make measurements From nearly any video image—with JAVA™— Jandel's new Video Analysis Software.

JAVA™ features a powerful assortment of image processing and measurement functions at a surprisingly reasonable cost. Prepare an image for study with contrast enhancement, histogram equalization, and user-defined convolutions. Determine densities at points, along lines, or from vertically averaged strips in seconds. JAVA's automatic line and edge tracking allows strip-charts and perimeters of complex objects to be digitized without hand tracing. Automatic object or grain counting is standard.

Direct measurements to JAVA's 64,000 row by 16,000 column worksheet. From there, use JAVA's descriptive statistics, t-tests, screen plots, and powerful transforms. Standard ASCII data are easily transferred to LOTUS or other programs, including Jandel's Sigma-Plot™.

JAVA™ accepts standard output from video cameras and VCRs (RS-170/NTSC composite video), and many pre-digitized images (e.g. CAT, MRI, ultrasound).

An IBM XT, AT or compatible, mouse and video digitizing board (frame grabber) will put JAVA to work for you. As with all Jandel products, it comes with a money-back guarantee.

For a FREE brochure, complete features and price list, call us today—800-874-1888. In CA or Canada call 415-924-8640.

Circle No. 243 on Readers' Service Card

Jandel
SCIENTIFIC
"Microcomputer Tools for the Scientist"

65 Koch Road ▪ Corte Madera, California 94925
Toll Free 800-874-1888 ▪ Inside CA 415-924-8640
▪ FAX: 415-924-2850 ▪ Telex: 4931977

In Europe: R.J.A. Handels GmbH
Grosser Mühlenweg 14A, 4044 Kaarst 2, FRG
Phone: 2101/666268 FAX: 2101/64321

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE

ISSN 0036-8075
28 APRIL 1989
VOLUME 244
NUMBER 4903

■ **SCIENCE is published weekly on Friday, except the last week in December, and with an extra issue in February by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, DC 20005.** Second-class postage (publication No. 484460) paid at Washington, DC, and at an additional entry. Now combined with **The Scientific Monthly**® Domestic individual membership and subscription (51 issues): $75. Domestic institutional subscription (51 issues): $120. Foreign postage extra: Canada $46, other (surface mail) $46, air mail via Amsterdam $85. First class, airmail, school-year, and student rates on request. **Single copy sales:** Current issue, $3.50; back issues, $5.00; Biotechnology issue, $6.00 (for postage and handling, add per copy $0.50 U.S., $1.00 all foreign); Guide to Biotechnology Products and Instruments, $18 (for postage and handling add per copy $1.00 U.S., $1.50 Canada, $2.00 other foreign). Bulk rates on request. **Change of address:** allow 6 weeks, giving old and new addresses and 11-digit account number. **Postmaster:** Send Form 3579 to *Science*, P.O. Box 1722, Riverton, NJ 08077. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

■ The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

COVER Artist's rendering of a Soviet Radar Ocean Reconnaissance Satellite, or RORSAT, which is used by the Soviet military to follow U.S. naval fleet movements. The electrons, positrons, and gamma rays produced by the RORSAT's nuclear power reactor have interfered with the efforts of astronomers to measure gamma-ray sources such as the sun and supernovae. The reactor core, shown being ejected, is designed to be boosted into a storage orbit at the end of the RORSAT's useful life. See Perspective, page 407, and Reports, pages 441 to 451. [Artwork by Paul Roberts/Bill Burrows and Associates, based on information provided by Charles P. Vick]

QIAGEN
the fastest way to pure plasmids

12 high purity plasmid preps in less than an hour ?

Yes, with one of the new QIAGEN >plasmid< kits

- **matching CsCl purity**
- **with new, short & simple protocols**
- **mini, midi or maxi scale.**

QIAGEN Hi purity >plasmid< kits contain our proprietary anion exchange resin QIAGEN in disposable plastic tips, together with all the buffers and solutions required to go from overnight cultures to pure plasmids in 50 minutes (for minipreps, 90 min for maxi preps).

Hi purity kits are available for either 25 Mini- or, 25 Midi or, 10 Maxi preps of DNA of a purity equivalent to CsCl gradients. A fourth kit, QIAscreen, for 300 Mini preps of "screening" quality produces plasmid DNA ideal as a substrate for restriction analysis.

High recoveries
Excellent reproducibility
Non-toxic reagents

All you need to get started is a

QIAGEN >plasmid< kit

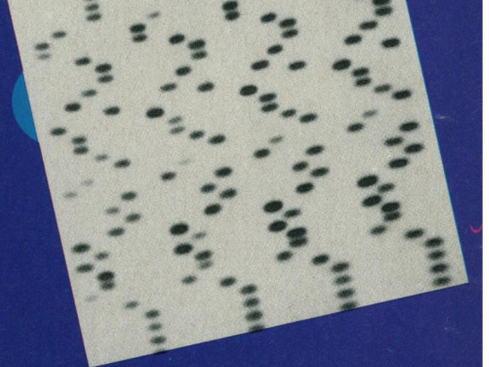
Circle No. 47 on Readers' Service Card

Mini preparation (plasmid DNA)
Hi purity ("for sequencing")

This protocol is designed for 1–3 ml cultures of E.coli.

Procedure

1. *Resuspend the bacterial pellet in 0.3 ml of buffer P1.*
2. *Add 0.3 ml. of buffer P2, incubate at room temp. for 5 min.*
3. *Add 0.3 ml of buffer P3, centrifuge at 4°C for 15 min.*
4. *Apply the supernatant to a QIAGEN-tip 20, pre-equilibrated with 1.0 ml of buffer QB.*
5. *Wash the QIAGEN-tip 20 with 2 x 1.0 ml of buffer QC, and elute the DNA with 0.8 ml of buffer QF.*
6. *Precipitate the DNA with 0.8 volumes of isopropanol.*



For orders and further information contact

GERMANY / AUSTRIA: DIAGEN GmbH, Niederheiderstraße 3, D-4000 Düsseldorf 13, Phone (211) 79 30 37, Fax (211) 79 04 44
USA/CANADA: QIAGEN Inc., POB 7401737 Studio City CA 91604, Phone 800-426-8157, in CA 818-508-5258, Fax 818-508-5536
Distributors:
SCANDINAVIA: Kebo Lab AB Sweden/Finland: +46 (8) 621 34 00, Denmark: (2) 68 18 00, Norway: (6)-84 54 10
BENELUX: Westburg B.V.(33)95 00 94
UK: Hybaid Ltd. (1)-977 3266
ITALY: Genenco (M-Medical) (55) 24 78 25 4
JAPAN: Funakoshi Pharmaceutical Co., Ltd. (3) 295-5548
FRANCE: Mallet SA (1) 48 62 43 55
SWITZERLAND: Kontron Instruments AG (1)-435 4111
ISRAEL: Bio-Lab Laboratories Ltd. (2) 52 44 47
AUSTRALIA: Phoenix Stansens Scient.Div. (3) 544 8022

QIAGEN

Cold fusion

THE hottest topic in physics today is cold fusion. If recent claims are true, a limitless, cheap, and easily generated source of power would become available. It was on 23 March at a press conference that the announcement was made of the possibility that cold nuclear fusion had been achieved in a beaker of heavy water; this is not the standard method by which new scientific findings are generally reported. Why was this done? Pool assesses the story behind the story, the politics of this unconventional approach to reporting scientific findings, and the roles played by commercial and patent considerations and the "old-boy's network" in fast-tracking an incomplete, unexplained, but potentially dynamite experimental observation (page 420).

Hydrogen sulfide on Jupiter's moon

HYDROGEN sulfide (H_2S) has been found outside the earth for the first time. It appears to be present on the surface and in the atmosphere of Io, one of Jupiter's moons (page 454). Ground-based infrared spectra of Io show a band at 3.915 micrometers. The band's intensity is variable in different spectra; this suggests that it might represent a volatile substance. Nash and Howell carried out laboratory experiments in which the infrared reflectance properties of different mixtures of H_2S frost and SO_2 frost (a known constituent of the surface) were recorded. A thin layer of H_2S frost evaporating off a thick layer of SO_2 frost provided the best band match to the telescopic band at 3.915 micrometers; the concurrence of telescopic and laboratory spectral bands is taken as diagnostic of H_2S deposited on or cocondensed with SO_2 on Io. A survey of Io spectra shows that H_2S frost is widespread. Where this frost emanates from—internally from the volcanoes on Io or externally from the magnetosphere of Jupiter—is unclear. The ephemeral nature of the H_2S frost probably reflects the ever-changing thermal conditions that pertain at the surface of Io.

Malignant hibernomas and metastatic tumors

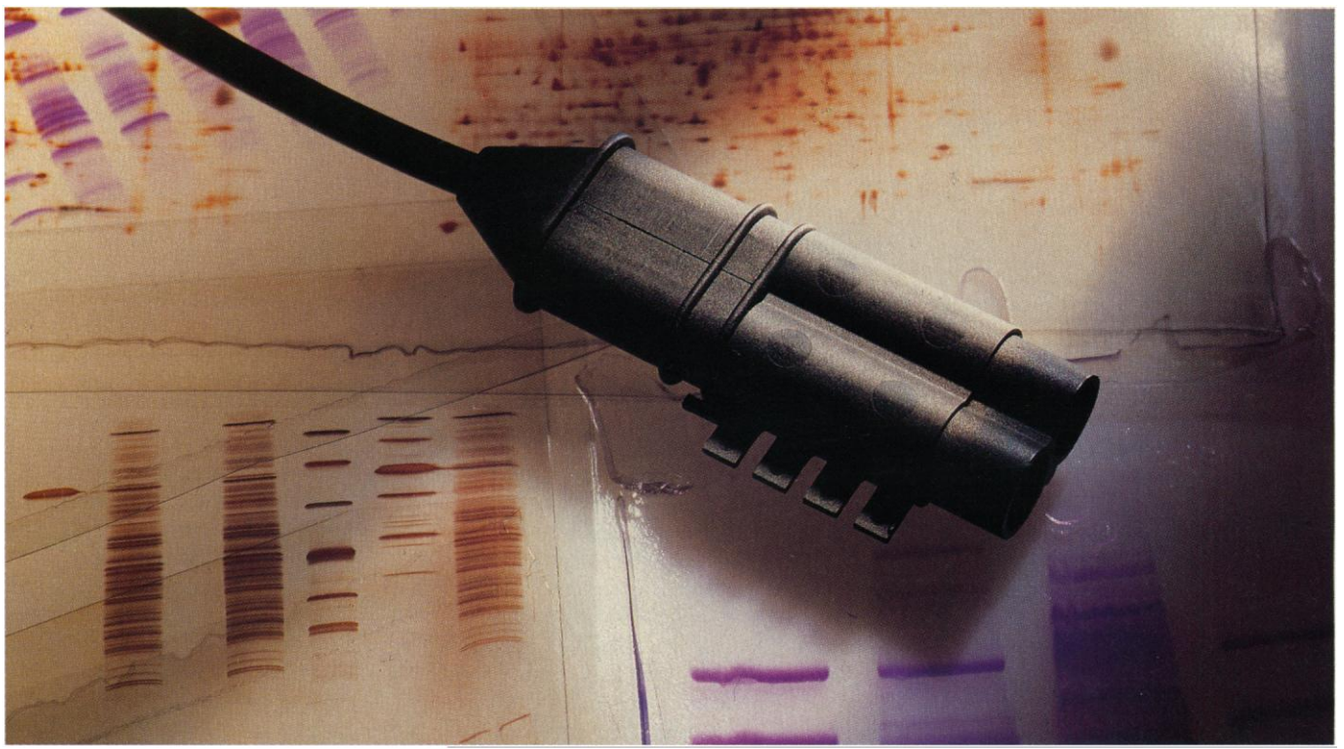
AN animal model for studying primary tumors of brown fat tissue and for studying metastatic tumors that arise in the liver, lungs, spleen, heart, and adrenals has been discovered somewhat serendipitously. Mice that had received a hybrid gene (a promoter of α-amylase fused with the SV40 tumor antigen gene) developed malignant tumors—hibernomas—in brown adipose tissue (page 460). Depots for fat storage were unexpected sites for tumor development; it had been anticipated that tumors would develop in the liver, parotid, and pancreas, because the promoter normally regulates gene expression in these tissues. (Two liver tumors but no parotid or pancreatic tumors developed.) Fox *et al.* then found, however, that the α-amylase gene is, in fact, expressed in normal fat tissue, and thus the expression of the transgene in such tissue was appropriate. Thus, it should be possible to target other genes to the fat tissue by fusing them to the α-amylase promoter and to study how they affect various aspects of fat metabolism and tumor development in fat tissues.

Developmental genes

WHAT genes are turned on during embryonic development and where in the embryo are they activated? An experimental approach to answering these questions is described by Gossler *et al.* who developed two types of vectors for introducing "reporter genes" into embryonic stem cells (page 463). Clones of cells in which the reporter genes were active could be detected by a staining procedure. Clones were injected into mouse blastocysts; as embryos developed and genes that were near the reporter were activated, the reporter gene was also expressed, because it was under the control of the host regulatory elements. Temporal and spatial patterns of reporter gene expression could be followed by staining. One reporter gene construct has been passed through the germ line to progeny embryos; staining patterns in the embryos were the same as those of the chimeric parent. These vector constructs should simplify the process of cloning developmental genes that are contiguous with the reporter genes. Comparisons can be made of normal and mutant genes, their expression and regulation, and their protein products.

HTLV-II in drug abusers

ONE-FIFTH of the intravenous drug abusers surveyed in New Orleans are infected with a virus of the human T cell leukemia family, HTLV-II (page 471). This virus has, in the past, only rarely been linked to disease: two of the four associations were with unusual T cell malignancies. HTLV-II is related to the more frequently seen virus HTLV-I that is associated with adult T cell leukemia, tropical spastic paraparesis, and other malignancies and that is endemic in certain parts of Japan, Africa, and the Caribbean. The two viruses are difficult to distinguish serologically. Lee *et al.* screened blood samples for antibodies to "generic HTLV" and then used a molecular method—a modification of the polymerase chain reaction that amplifies DNA—to assess whether cells in the antibody-positive individuals had genetic material characteristic of HTLV-I or HTLV-II. The DNA evaluations were performed on blood mononuclear cells. Most of the infected individuals—23 out of 25—were infected with HTLV-II and not HTLV-I. It is likely that cells carrying the virus are passed from person to person through needle-sharing. The infected individuals are asymptomatic; follow-up studies may, however, show that HTLV-II, like HTLV-I, has a long latency period and that its presence is associated with diseases that affect the immune, circulatory, or nervous systems.



The unique Safety Key for MultiDrive™ XL prevents overloading instrument systems and ensures your personal safety.

Power alone isn't the key

It's how power is channeled and controlled that makes the difference.

With 30 years' experience in electrophoresis we've learned what a difference it can make when power settings are optimized and accurately controlled. With you in mind, we incorporated all this experience into one power supply: MultiDrive XL.

Versatile and easy to program.

MultiDrive XL can power most electrophoretic techniques including isoelectric focusing, SDS-PAGE, DNA sequencing and blotting. You can choose either the MANUAL or PROGRAM mode to run your experiments.

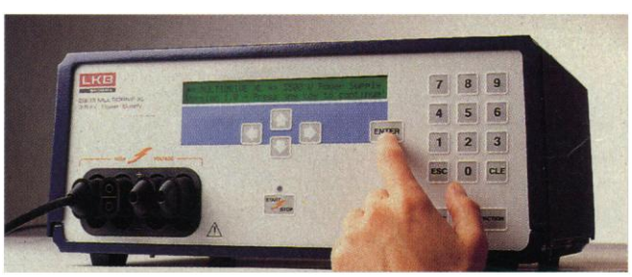
Accurate and reproducible.

With its perfect memory, MultiDrive XL will accurately control even your most sophisticated methods. And you can use volthour or milliampere-hour integration to compensate automatically for differences in gel thickness and ionic strength or temperature.

Safe.

The most important key to a successful electrophoresis experiment is still your personal safety. You can always expect to find the best safety features in all our power supplies.

For more information consult your Pharmacia LKB representative or ask for our new power supply guide.



The new MultiDrive XL (3500 V, 400 mA) improves accuracy and reproducibility with automated control.

P.S. The real power is in your results.

Pharmacia

Pharmacia LKB Biotechnology

2105

Head office Sweden Tel 46 (018) 16 30 00. **Australia** Tel (02) 888 36 22. **Austria** Tel (0222) 68 66 25 0. **Belgium** Tel (02) 242 4660. **Brazil** Tel 55-11 284 5815/289 8967. **Canada** Tel (514) 457 6661. **Denmark** Tel (02) 26 52 00. **East Europe** Tel 43 (0222) 92 16 07. **Federal Republic of Germany** Tel (0761) 490 30. **Finland** Tel (90) 502 1077. **France** Tel (01) 64 46 36 36. **Great Britain** Tel (0908) 66 11 01. **Holland** Tel (031) 348 07 7911. **India** Tel (0812) 29 634. **Italy** Tel (02) 25 32 844/26 700 475. **Japan** Tel (03) 444 4811. **Norway** Tel (02) 54 90 95. **Soviet Union** Tel 46 (08) 799 80 00. **Spain** Tel (34)-3 675 44 11. **Sweden** Tel (08) 799 80 00. **Switzerland** Tel (01) 821 18 16. **United States** Tel (201) 457 8000. **Far East** Tel 852 (5) 814 8421. **Middle East** Tel 30 (1) 894 73 96. **Other countries** Tel 46 (08) 799 80 00. *(8901)*

SCIENCE

28 APRIL 1989
VOLUME 244
NUMBER 4903

Low Probability–High Consequence Accidents

The Valdez oil disaster fits into a class of low probability–high consequence dangers that are among the most difficult to predict and handle. As in the case of earthquakes, dam collapses, or nuclear accidents, disaster plans and appropriate machinery must be kept in readiness as part of the response to the unlikely but potentially catastrophic event. To say that an event is complex is not sufficient to absolve those who fail in meeting their responsibility. In fact, assigning responsibility and authority in advance may be one of the major ways in which future disasters can be averted.

Although the entire story is not yet known, it seems apparent that the oil company in this case was cavalier in regard to its responsibility. Failure of other agencies—the Coast Guard, Alyeska, and local authorities—does not obscure the primary role of the provider of service in the Valdez case. This accident suggests that a complacency can be generated by allowing a multiplicity of agencies to be involved, inviting a multiplicity of accusations in the wake of a disaster. The oil company should have the responsibility not only to develop a coherent emergency plan, to direct practice drills, and to have adequate clean-up equipment available, but also to provide continuous monitoring of operations to avert a disaster in the first place. Although detailed plans cannot be devised for all situations, certainly they can be developed for a busy port like Valdez, and more general plans for any area through which oil tankers travel. The plan, developed in consultation with environmental, legal, and various government authorities, would then be subject to evaluation and approval by the appropriate legal agencies. The line of authority in case of an accident must be spelled out and the individuals delegated sufficient power to be able to act rapidly to implement the plan.

In addition to assigning responsibility, much can be done to improve procedures. Some experts in this type of risk management suggest that too much attention has been placed on mechanics and too little on human factors. Research and procedures directed at counteracting the inevitable lapses of attention that occur in jobs with long periods of high boredom are indicated. Automated tracking of ships may be unnecessary on the high seas, but in coastal waters the expense may be justified. Because too much reliance on automation can be harmful, more extensive studies are required on the adverse consequences of automatic pilots as well as the management of employee frailties such as drinking and drug abuse. A financial structure should be developed that puts heavy premiums on prevention. Punitive damages for delinquent plans, coupled with actuarially devised rates of assessment that reward companies with superior prevention procedures, would help. One device to accomplish this would be an international consortium that maintained bases for emergency action at strategic locations around the world and provided advice on detailed plans. Oil companies would pay dues based on the volume of their tanker business, the quality of their plans, and their "good driver" record. Ports could then demand membership in this organization as a condition for entry.

The advance approval of contingency plans seems to be essential to ensure swift action. For example, the use of dispersants, although controversial, may be indicated when factors such as weather, local terrain, local fauna and flora, and size of spill are considered. A well-developed plan would eliminate the delays caused by ill-informed or obstructive officials and the temptation to blame them when the true problem was the lack of available equipment. By having everyone on record ahead of time, one can improve the quality of first guesses and undermine the authority of the second guessers.

The management of low probability–high consequence calamities is a new area which needs extensive research and new ideas. However, the immediate hazards we face today do not allow delay until ideal plans are realized. Existing knowledge is sufficient to implement plans that provide powerful incentives for prevention and better operational direction after an accident. Those plans and incentives can then be upgraded as new research and new experience become available.—DANIEL E. KOSHLAND, JR.

Zeta Potential Distributions

JUST A MINUTE!

And you're in control of colloid particle behavior.

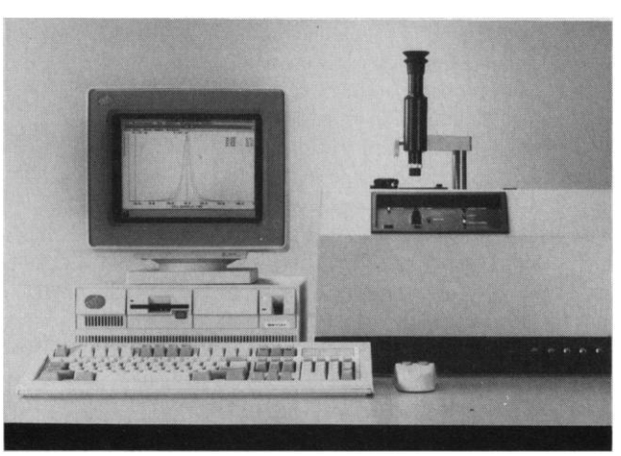
COULTER® DELSA 440

Sixty-second analysis provides the key to control

Zeta potential is the key to understanding and controlling colloid particle behavior, a critical factor in quality and process control. Simply inject 0.8 ml sample into sample cell, insert cell into optical bench, set run parameters, and request 'Run.' Clear, concise results are ready in just 60 seconds. Only the laser-based DELSA 440 does electrophoretic light scattering analysis using simultaneous multi-angle detection to measure Doppler shifts. It confirms true mobility spectra and plots high resolution zeta potential distributions for:

- Accurate determination of isoelectric points;
- Reliable prediction of aggregation phenomena;
- Easy monitoring of surface binding reactions of particles or biological cells.

The DELSA 440 also reports mean particle size of colloidal suspensions to facilitate flocculation studies.



With sensitivity to your applications

The DELSA 440 measures electrophoretic mobility distributions of particles ranging in size from 10nm to 30µm, and determines zeta potential, critical in many industrial applications such as:

- Predicting colloidal suspension stability in the manufacture of pharmaceuticals and pulp or paper.
- Changing the properties of clay or other suspensions used in the manufacture of ceramics and superconductors.
- Achieving pigment dispersion and controlling shelf life in the manufacture of paints and other surface coating systems.

With service and support for your peace of mind

When it comes to service and support, like all Coulter instruments, the DELSA 440 is backed by the world's most recognized service and support team. No matter what your service need or application question – you can depend on Coulter. For complete information about the DELSA 440, and how it can help you control colloid particle behavior, call our toll-free number today and request extension 2818.

In the U.S., call

(800) 526-6932

Outside the U.S., contact your Coulter representative, or call 1-305-885-0131.

COULTER CORPORATION
Scientific Instruments
P.O. Box 2145 Hialeah, Florida 33012-0145 USA

Circle No. 257 on Readers' Service Card

RECOGNIZING YOUR NEEDS ARE MORE THAN INSTRUMENTAL