8 NOVEMBER 1985 · VOL. 230 · NO. 4726 $2.50

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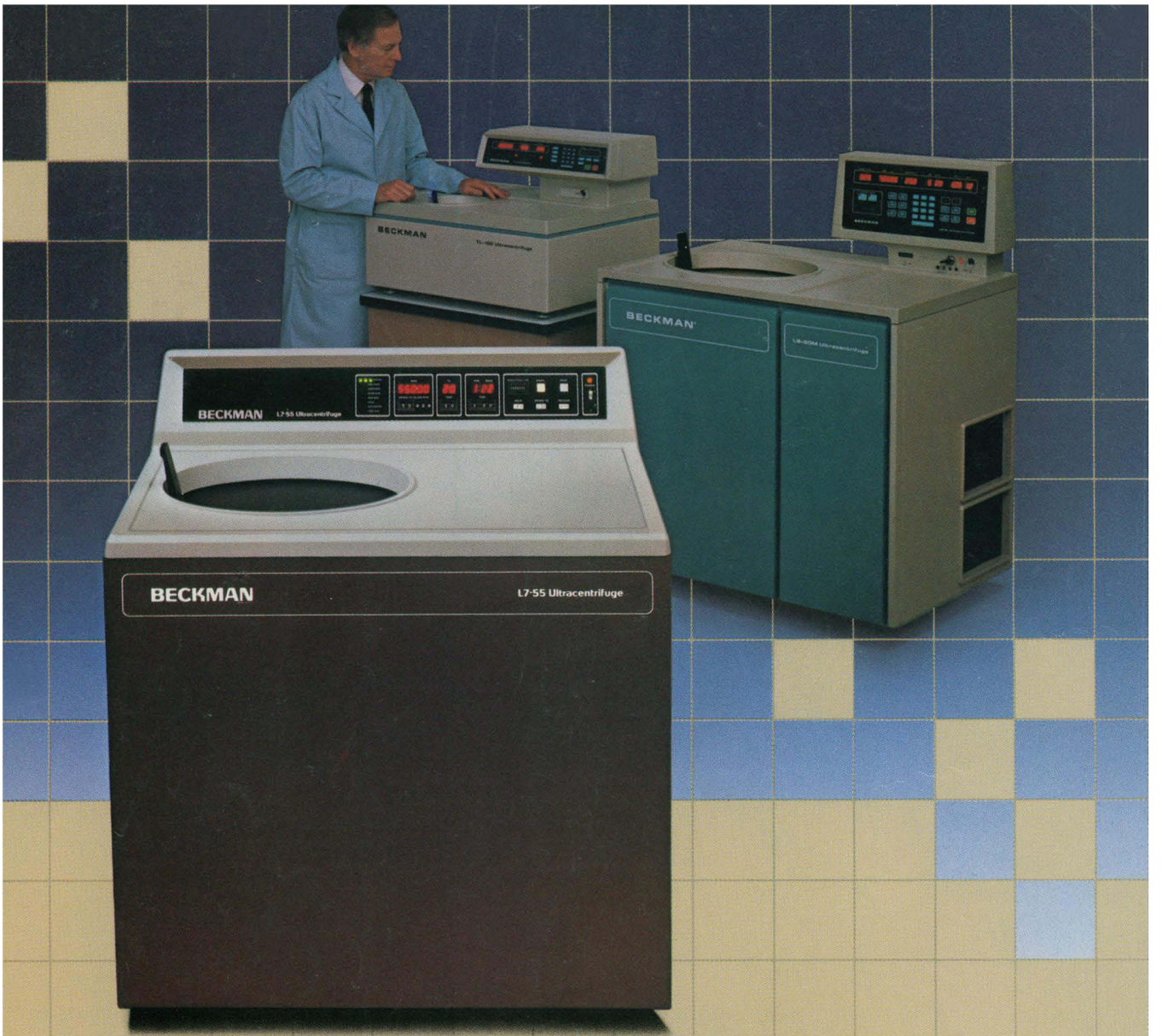

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8 November 1985
Volume 230, No. 4726

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COVER

Section (4.5 by 4.5 millimeters) of a spiral wave of chemical activity traveling through a 1-millimeter layer of a quiescent, excitable Belousov-Zhabotinskii reagent catalyzed by ferroin. The concentration distribution of ferroin was measured by means of a two-dimensional spectrophotometer based on a video camera, a video frame buffer, and a computer. The core of the spiral—a singular site at which the ferroin concentration remains almost constant—is contained within the green circle. The colored curves are Archimedian spirals fitted to isointensity levels that correspond to the lowest (blue) and the highest (red) measured intensities and to the intensity at the core (yellow). See page 661. [S. C. Müller, Max-Planck-Institut für Ernährungsphysiologie, D-4600 Dortmund, Federal Republic of Germany]

THE FIFTH ANNUAL CONGRESS FOR
HYBRIDOMA RESEARCH
JANUARY 26 - 29, 1986
BALTIMORE CONVENTION CENTER, BALTIMORE, MARYLAND

Co-Chairmen:

Zenon Steplewski, The Wistar Institute, Philadelphia, PA • Hilary Koprowski, The Wistar Institute, Philadelphia, PA • Joseph Davie, Washington University, St. Louis, MO

Keynote Speaker: Mark Davis, Stanford University, Stanford, CA **Title:** T-cell Receptor Gene Structure and Function.

We are planning six Working Group Meetings on "Murine Monoclonal Antibodies Available for Clinical Application". These Group Meetings will be restricted to 20 participants each in the following fields:

Group A: Immunohistological Diagnosis
Leader: J. Schlom, NCI, Bethesda, MD
Repporteur: M. Nuti, Laboratorio Di Immunologia, Rome, Italy

Group B: Radioimmunoscintigraphy
Leader: J.-F. Chatal, Center Rene Gauducheau, Nantes, France
Repporteur: J. Powe, Victoria Hospital, Ontario, Canada

Group C: Antigens Shed by Tumor Cells
Leader: R. Bast, Duke University, Durham, NC
Repporteur: J.-Y. Douillard, Center Rene Gauducheau, Nantes, France

Group D: Immunotherapy of Solid Tumors
Leader: A. Houghton, Sloan Kettering Cancer Center, New York, NY
Repporteur: S. Ferrone, New York Medical College, Valhalla, NY

Group E: Immunotherapy of Leukemia and Lymphoma
Leader: J. Ritz, Dana Farber Cancer Institute, Boston, MA
Repporteur: K. Foon, University of Michigan, Ann Arbor, MI

Group F: Immunoconjugates
Leader: K. Krolick, University of Texas, San Antonio, TX
Repporteur: J. Fulton, Southwestern Medical School, Dallas, TX

It is our intent to select participants *actively* involved in the above listed research for in-depth discussion of progress made recently.
The entire day of Monday, January 27, 1986 will be available for these group discussions. The consensus reached by the groups will be presented by the Repporteurs to the whole Congress and results of these discussions will be published in Hybridoma.
Investigators interested in participating in Group Meetings should send a short summary to Dr. Ralph Reisfeld, Scripps Clinic and Research Foundation, 10666 North Torrey Pines Road, La Jolla, California 92037 by November 30, 1985.

Workshop Topics & Chairmen:

HUMAN REPERTOIRE and AUTOIMMUNE DISEASE
A. Notkins, NIH, Bethesda, MD.

GENETIC PROBES IN IMMUNOLOGY
J.D. Capra, University of Texas, Dallas, TX.

MONOCLONAL ANTIBODIES in DISSECTING NORMAL and MALIGNANT STEM CELLS
I. Bernstein, Fred Hutchinson Cancer Center, Seattle, WA.

ISOTYPE SWITCH VARIANTS IN ANALYSIS of ANTIBODY FUNCTION
M. Scharff, Albert Einstein College of Medicine, New York, NY.

Poster Sessions: TECHNOLOGICAL ADVANCES IN HYBRIDOMA RESEARCH

Participants are invited to submit abstracts for the poster sessions. These abstracts will be reviewed up until the time of the meeting; however, only those accepted by Nov. 15 will be published in the journal, Hybridoma. Contact Dr. Zenon Steplewski (215) 898-3924.

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Subsistence survival

A nomadic tribe of 10,000 people in Kenya has survived for generations despite recurring droughts by making ecologically appropriate use of its 85,000 sheep and goats, 10,000 camels, 10,000 cows, and 5,000 donkeys (page 619). Coughenour *et al.* describe the food web through which solar energy flows from plants to livestock and then to the people. Energy utilization emphasizes survival, not productivity (a Western value), and the web's structure presumably accounts for the system's stability. Camel milk is the most reliable food since camels feed on woody plants that do not require continuing rainfall. Opportunistic use is made in wet seasons of cattle (which feed on more water-dependent plants), and contingency use is made of animal meat and blood when milk is in short supply. The needs of the people are met, their life-style remains in balance with the low-productivity environment, and there is little evidence that this pastoral system degrades the environment.

Gene for the IL-2 receptor

Molecular characteristics of genes that code for human interleukin-2 (IL-2) receptors are similar in normal T lymphocytes and in leukemic T cells infected by HTLV-I virus (page 633). Leonard *et al.* found that, in normal cells, eight gene regions are spliced together; messenger molecules made from this genetic template then direct synthesis of receptor proteins. Reading of the messenger can begin at two sites in normal cells; a third site was found in leukemic genes. Normal and leukemic genes had the same base sequence, and, from each, multiple messenger molecules were assembled. IL-2 receptors are critical to maturation of normal T lymphocytes; since they are present in greater than normal numbers on leukemic cells, they may also play a crucial role in the development of these cells.

Chemical reaction makes TV debut

A "video" has been made showing details of a chemical reaction (page 661). Müller *et al.* recorded and analyzed the traveling wave (cover) generated in the Belousov-Zhabotinskii reaction (metal-catalyzed oxidation and decarboxylation of an organic acid). In the reaction, a circular wave propagates outward; rhythmic color variations are visible as a catalyst indicator shifts between two states of excitation. The traveling circular wave, if disrupted by a gentle air blast, becomes a spiral wave that can be described mathematically. The center of the pattern is of particular interest: a slight variation in reactants was sufficient to initiate the system's reactivity. Data describing the core, shape, and propagation of the wave will be applicable to pattern formation in embryonic development and in mathematical equations and to rhythmic phenomena in nature such as impulse transmissions along nerve and muscle fibers.

Possible cause of psoriasis

Psoriasis, a common skin disease, may be caused by a factor secreted by skin fibroblasts (page 669). Red lesions with scaly, silvery surfaces contain dividing keratinocytes, the cells that synthesize proteins essential for skin, hair, and nails. Beneath the lesions, edema, capillary dilatation, and inflammation occur. Saiag *et al.* inserted a plug of psoriatic or normal human skin into a "skin equivalent" made of matrix materials and cells of the outer (epidermal) and deeper (dermal) layers of skin. In all cases, a multilayered epidermis developed. Keratinocytes from normal and psoriatic sources hyperproliferated when dermal fibroblasts in the skin equivalent were from a psoriatic donor. Fibroblasts from a normal donor did not cause hyperproliferation of normal keratinocytes or keratinocytes from asymptomatic areas of psoriatic skin. Keratinocytes from lesions proliferated faster than did normal ones or those from uninvolved areas of psoriatic skin; their hyperproliferation could not be suppressed by normal fibroblasts. Thus, psoriatic pathology involves a fibroblast factor that is capable of disrupting proper functioning of keratin-producing cells.

Metal binder in plants

Plants contain simple peptides, named phytochelatins, that bind heavy metals and thus participate in metal detoxification (page 674). In cultures of cells from several plant species, phytochelatins were inducible by cadmium, copper, mercury, lead, and zinc. More than 90 percent of the cadmium put into cultures became complexed with phytochelatins. Grill *et al.* established that the phytochelatins are small linear polymers of glutamic acid, cysteine, and glycine; the exact sequence of amino acids was determined and confirmed by chemical synthesis. Although metal chelators in vertebrates and fungi are much larger and different in structure, a similar mechanism—metal complexed with organic sulfur—seems to be used for detoxification purposes.

Periodicity of the DNA helix

The shape of a DNA molecule can be related to how the molecule works by a new fragmentation technique (page 679). When DNA is attached to an inorganic precipitate, a simple chemical "knife"—iron(II) EDTA—will cut the DNA backbone in a way that reflects base composition and helical periodicity. In a prototype experiment, Tullius and Dombroski studied the fragmentation of the promoter region of the thymidine kinase gene of herpes virus DNA. The structure of the DNA molecule was elaborated through analysis of the digest. Shapes taken by base sequences in their natural contexts in genes can now be compared with those of simple base sequences previously determined through high-resolution studies.

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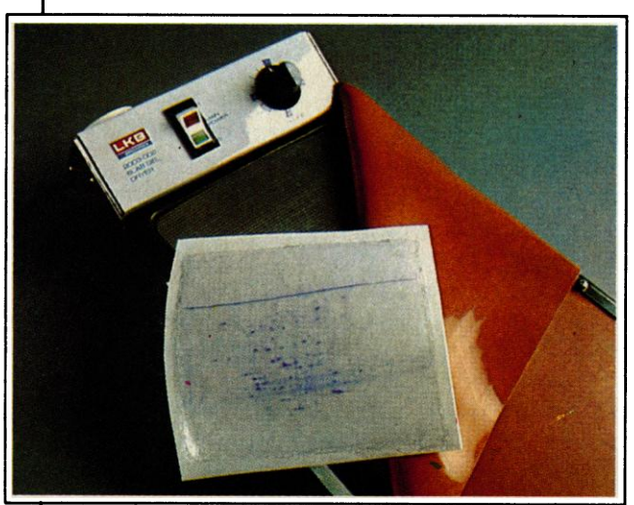
This fine 2-D gel shows the use of the LKB Gel Dryer in preparing gels for storage, scanning or autoradiography ▼



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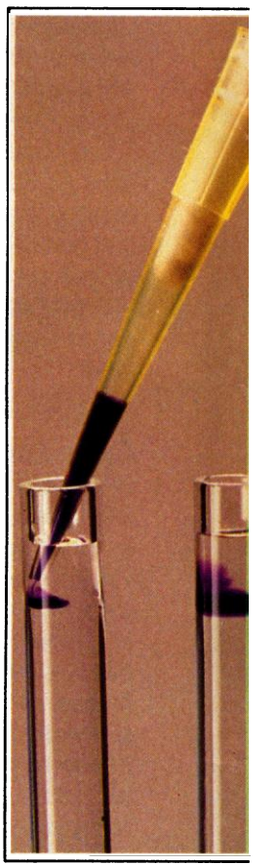
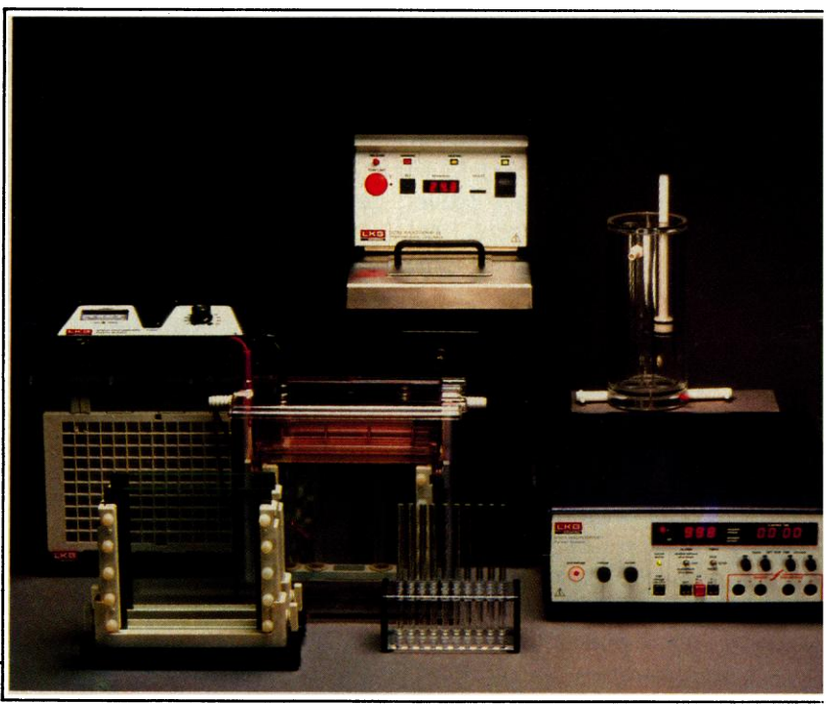
The Tube Gel Kit allows the LKB system to perform both the first and second dimensions in 2-D applications ▶



PAGE and gradient PAGE techniques
Conventional PAGE and SDS/PAGE techniques, using either continuous or discontinuous buffers, are fully catered for by the basic LKB system. The addition of our Gradient Gel Kit provides a quick and convenient method of casting both linear and exponential gradient polyacrylamide gels. Due to their relatively small pore size, these gels effectively limit diffusion. Linear gradients counteract band broadening effects, while exponential gradients are useful for resolving components with widely differing molecular weights.

The Vertical Electrophoresis System, based on the LKB 2001 Electrophoresis Unit, also includes a power supply, thermostatic circulator and all the necessary accessories, kits and quality chemicals ▼



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Vertical Electrophoresis Systems

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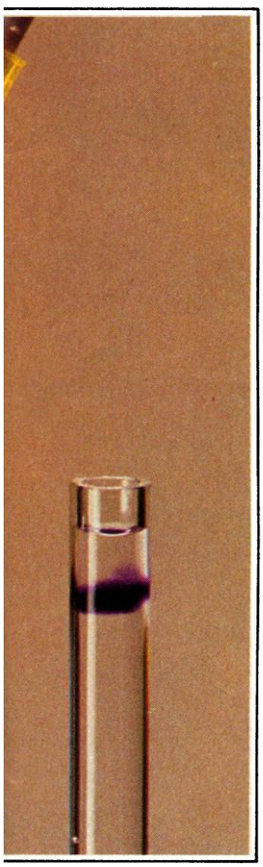


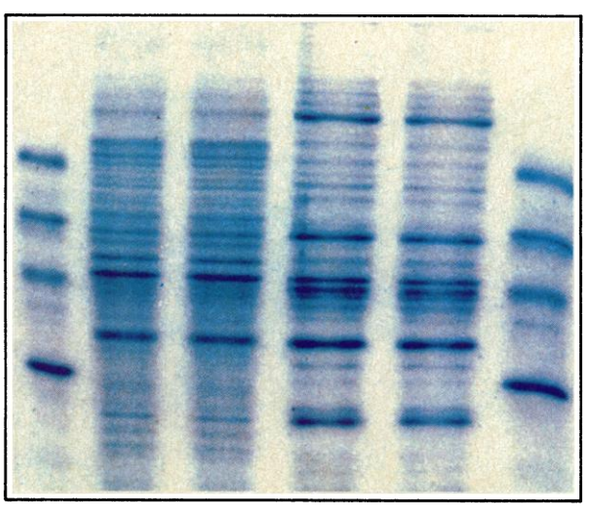
Agarose gel techniques
For researchers who sometimes want to use agarose, there is a special kit to help you cast and run the 3 mm agarose gels on the LKB Vertical Electrophoresis System. The kit includes frosted glass plates to provide essential support for the gel.

Two-dimensional techniques
This is the only complete vertical electrophoresis system that can carry out both the first and second phases of 2-D electrophoresis in a single unit, and can offer the user a choice of either tube or slab gels for the first dimension. Our 2-D Kit includes a special cleaver for preparing slab gels, while tube gels are easily applied to the top of a standard slab gel by means of the trough built into the upper buffer chamber.

LKB's new Transphor Electroblotting Unit improves the sensitivity and resolution of detection procedures ▶

Autoradiography techniques
Another kit, containing all the accessories you need to cast accurate gels only 0.75 mm thick, makes it easy for you to use the LKB Vertical Electrophoresis System for high resolution autoradiography using thin gels. The LKB Slab Gel Dryer, which combines dry heat and reduced pressure to rapidly dry and affix the gel onto paper or film for later analysis and storage, is ideal for drying down thin gels onto disposable plastic sheets prior to detection.

The result of gradient gel electrophoresis of two crude extracts from Beneckea harveyi on the LKB system ▼



Electroblotting techniques
The new LKB Transphor uses the principles of electrophoresis to transfer proteins or nucleic acids from polyacrylamide or agarose gels onto nitrocellulose or other immobilizing matrices. In this way the electrophoresis bands are made easily accessible for faster and more sensitive visualization than on the original gel. The resulting patterns can be stored for months without deteriorating and multiple analyses can be performed using just the one pattern.

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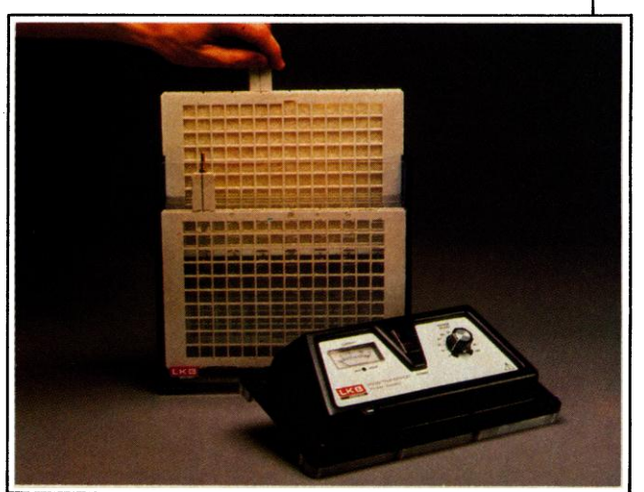

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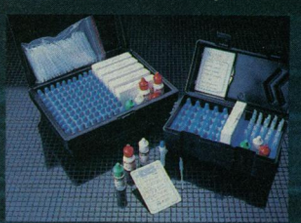

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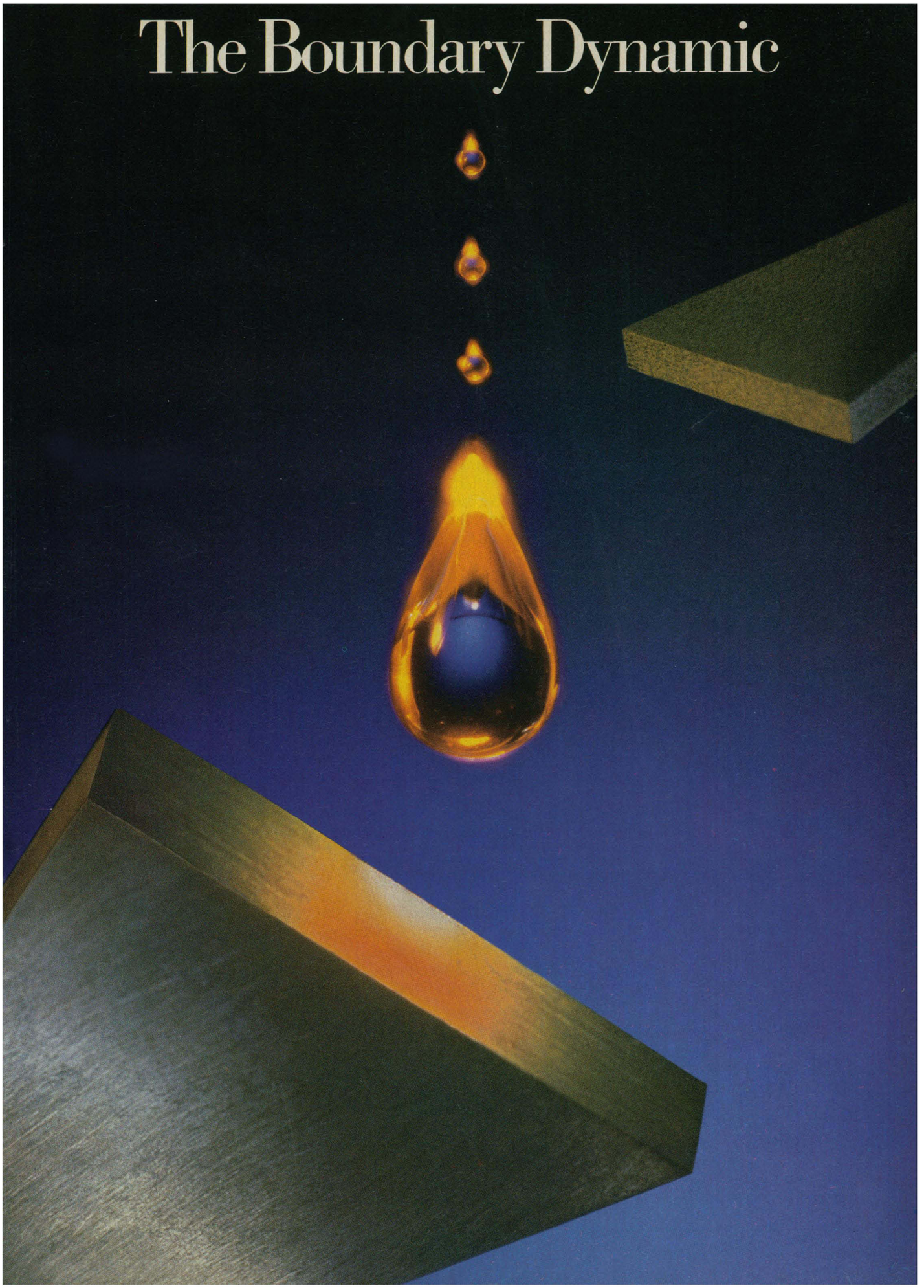
The Boundary Dynamic



The Boundary Dynamic

The performance of a polymeric adhesive depends on the properties and composition of its surface. Now a scientist at the General Motors Research Laboratories has developed and validated a theory that describes the coupled effects of diffusion and chemical reaction on the changing surfaces not only of adhesives, but of chemically reacting surfactant systems in general.

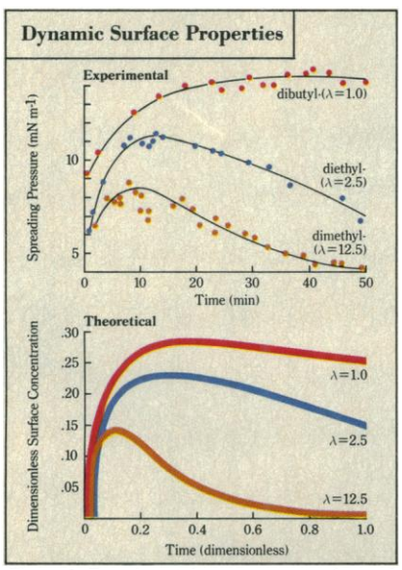


Figure 1: Experimental measurements of spreading pressure v. time for dialkylaminopropylamines with various Damköhler numbers (λ), and corresponding theoretical calculations of surface concentrations.

Figure 2: Evolution of an adhesive surface: Surface-active Solute 1 (red) reacts with host resin (pink tone) to form surface active Solute 2 (brown).

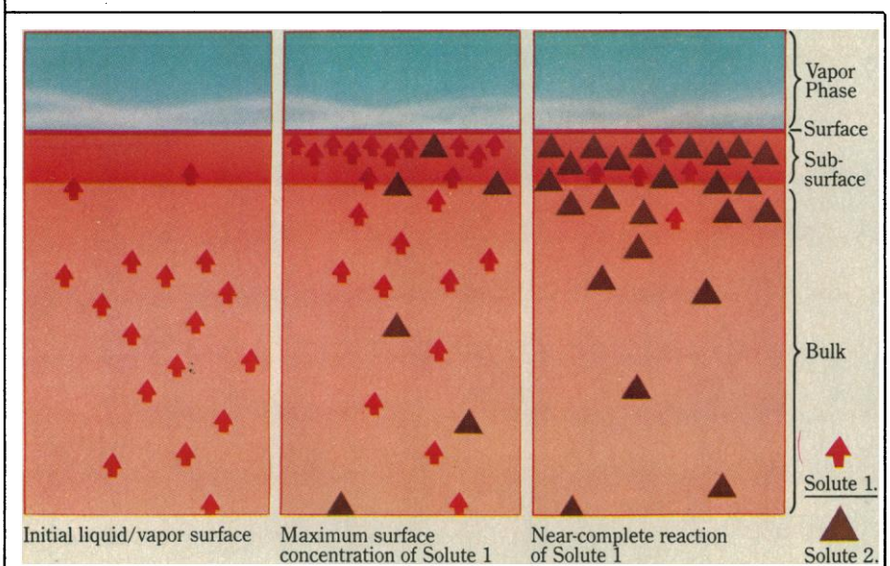
THE USE OF adhesives in the production of an automobile promises to make both the product and the process more efficient. Both weight and operations can be reduced. In practice, however, steel and other metallic surfaces are often contaminated by process lubricants. A durable bond depends on the ability of an adhesive to displace contaminants and to wet the substrate.

Assuring intimate contact between adhesive and substrate requires detailed knowledge of adhesive surface tension, since it is this property that controls displacement of contaminants and wetting. Up to now the surface tension of an adhesive has typically been assumed constant. In reality, though, surface-active components in the adhesive collect preferentially at the interface and also react, so that the surface composition varies with time, giving rise to dynamic surface tension. Variations can be large enough to significantly affect adhesive performance.

The understanding of time-dependent surface tension has been advanced by the work of Dr. Robert Foister, a scientist at the General Motors Research Laboratories. Investigation of dynamic surface properties of thermosetting adhesives led him to develop a general theory of adsorption kinetics in binary, chemically reacting surfactant systems. The significance of this theory is that it includes the coupled effects of surfactant diffusion and chemical reaction, making it possible for the first time to describe quantitatively the changing surfaces of such systems.

In a typical adhesive that polymerizes, or "cures," by chemical reaction (Figure 2), a surface-active curing agent (Solute 1) reacts with the host resin to form a second surface-active species (Solute 2) that is also reactive. Both solutes migrate to the surface, lowering the surface tension. Diffusion to the surface is driven by a potential energy gradient between the surface and the bulk, with the solute molecules experiencing a lower energy at the surface.

Dr. Foister derived appropriate transport equations to describe diffusion and chemical reaction in the bulk, in a subsurface region, and at the surface itself. The transport equations can be solved analytically if the chemical rate equations are assumed to be first order in the concentrations of reacting species, and if the subsurface and surface concentrations can be related to one another by a linear adsorption isotherm. For more complicated isotherms, a set of coupled, non-linear integral equations is generated.



These must be solved numerically.

Analytical solution for the special case of the linear isotherm indicated that the change with time in surface concentration (and consequently in surface tension) is composed of two terms: first the diffusive flux of Solute 1 into the subsurface from the bulk, and second the depletion of this solute due to chemical reaction. Hence, the surface concentration of Solute 1 exhibits a maximum with time (Figure 2). This maximum in surface concentration corresponds to a minimum in surface tension.

MODIFYING the transport equations to include binary adsorption isotherms allowed for consideration of competitive adsorption of the two reacting and diffusing solutes. By solving these equations numerically and conducting dimensional analysis, Dr. Foister identified various dimensionless parameters as predictors of system behavior. The most important of these parameters was a dimensionless number (λ), of the Damköhler type, involving terms representative of reaction, diffusion, and adsorption.

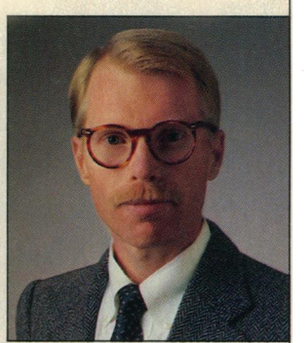
$$\lambda = \frac{k\,(\Gamma_m\, a)^2}{4D}$$

Here k is the reaction rate constant of Solute 1, D its diffusivity, Γ_m its "surface capacity" (the maximum number of molecules absorbed per unit surface area), and a its "surface affinity" (a measure of its energy of adsorption). For an adhesive, lowering λ by reducing k (the reactivity of the curing agent), for example, would prolong the time to maximum, and would increase the value of the surface concentration at the maximum (see Figure 1, Theoretical). As a practical consequence, this would improve wetting by minimizing the surface tension.

In experiments using a series of dialkylaminopropylamine curing agents (dimethyl-, diethyl-, and dibutyl-) in a host epoxy resin matrix, good agreement has been demonstrated between theoretical predictions for surface concentration and the measured dynamic spreading pressure, which is the change in adhesive system surface tension due to the curing agent (Figure 1, Experimental).

"I expect," says Dr. Foister, "that the physical insights gained from this analysis can be applied to other reactive surfactant systems by using specifically tailored isotherms and chemical reaction schemes. Predicting surface behavior can certainly help us design better adhesives for specific applications, but it is also pertinent to the performance of anti-oxidants and anti-ozonants in synthetic rubber, for example. And applied to interfaces in biological systems, a suitably modified theory may prove valuable in understanding the phenomenon of enzyme activity."

THE MAN BEHIND THE WORK



Dr. Foister is a Staff Research Scientist in the Polymers Department at the General Motors Research Laboratories.

Dr. Foister received his undergraduate degree from Guilford College, and holds a Ph.D. in Physical Chemistry from the University of North Carolina at Chapel Hill. His thesis dealt with the role of liquid inertia in the intrinsic viscosities of rod-like polymers.

He did post-doctoral work in Canada as a Fellow at McGill University in Montreal, and in the Applied Chemistry Division of the Pulp and Paper Research Institute of Canada, working on the microrheology of colloidal dispersions.

Dr. Foister joined General Motors in 1980. He is the leader of the Structural Adhesives Group in the GMR Polymers Department. His current research interests center on surface chemistry and adhesion.

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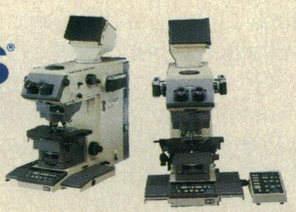

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8 November 1985, Volume 230, Number 4726 **SCIENCE**

Air Pollution and Acid Rain

Research being conducted on air pollution and acid rain is leading to a changing picture of the relative importance of SO_2 and NO_x. Political and regulatory efforts have been focused on sulfur oxides because they produced about twice as much acid as NO_x. However, that emphasis disregards the role of NO_x in the formation of toxic photochemical oxidants. Controlled studies at experimental facilities and observations in the field have identified effects of ozone and NO_x as more damaging to vegetation than SO_2 alone.

In sunlight a complex series of reactions occurs in the troposphere, including photolysis of NO_2 to produce excited atomic oxygen and thence ozone. Additional reactive species formed include hydrogen peroxide, methyl hydroperoxide, peroxyacetic acid, and reactive free radicals, including OH, NO_3, and HO_2. Maxima in the amounts of these species usually occur between 9:00 a.m. and 4:00 p.m. in midsummer. Monitoring has revealed considerable variability in concentrations of the oxidizing pollutants related to abundance of the input substances. Some ozone may be present that originates in the stratosphere.

It has been known that SO_2, NO_x, and O_3 can have toxic effects on plants. In the early days, experiments tended to be performed "scientifically"; that is, plants were exposed in chambers in which the chemicals were tested one at a time. Under those circumstances, it was noted that concentrations of SO_2 and NO_2 greater than ambient were required to produce notable pathology. Indeed, low concentrations of NO_2 were sometimes beneficial (perhaps a fertilizer effect). However, in the real world, pollutants are present together. When experiments were conducted with ambient midday levels of ozone present (for example, 50 to 100 parts per billion), toxicity was noted. When the ozone was supplemented with NO_2, there was usually a substantial additional toxicity attributable to NO_2. Similar results were noted when ozone was supplemented with SO_2.

The deleterious effects of ozone on agricultural crops have been documented and analyzed in a report* issued by the Environmental Protection Agency. It is estimated that a reduction in ambient ozone levels of 25 percent would produce nearly $2 billion in benefits, while a 25 percent increase in ozone would lead to an additional $2.3 billion in crop losses.

The photochemical oxidants, particularly OH, have an important role in the oxidation of SO_2 leading to H_2SO_4. In the summer, with abundant OH present, the oxidation proceeds much more rapidly than in winter. Sulfur dioxide emissions in winter and summer are about the same, but the total deposition of sulfate in January and February at stations in northeastern states was found to be a third or less than what it was in midsummer. Deposition of nitrate showed little seasonal effect. Thus, at the crucial time of the spring runoff, the contribution of nitric acid was about equivalent to that of sulfuric acid.

Initiatives to reduce acid rain tend to be centered on the electrical utilities and on their emissions of SO_2. When new coal-fired plants are built, they are required to include facilities for flue gas desulfurization. This adds substantially to the cost of the plant, decreases the efficiency of energy conversion to electricity, and diminishes overall reliability. While the process is effective in capturing SO_2, it is ineffective in removing NO. Any program aimed at reducing acid rain should take into consideration the total air pollution problem, including NO_x. Efforts to reduce SO_2 emissions should be accompanied by a corresponding emphasis on reducing NO_x, whatever the source. For the electrical utilities, this would mean providing more flexibility to use technologies that reduce both SO_2 and NO_x. But in addition, the other large contributors to NO_x, such as motor vehicles, should come under scrutiny.—PHILIP H. ABELSON

*R. M. Adams, S. A. Hamilton, B. A. McCarl, *The Economic Effects of Ozone on Agriculture* (Environmental Research Laboratory, Environmental Protection Agency, Corvallis, Ore. 1984).

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