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SCIENCE

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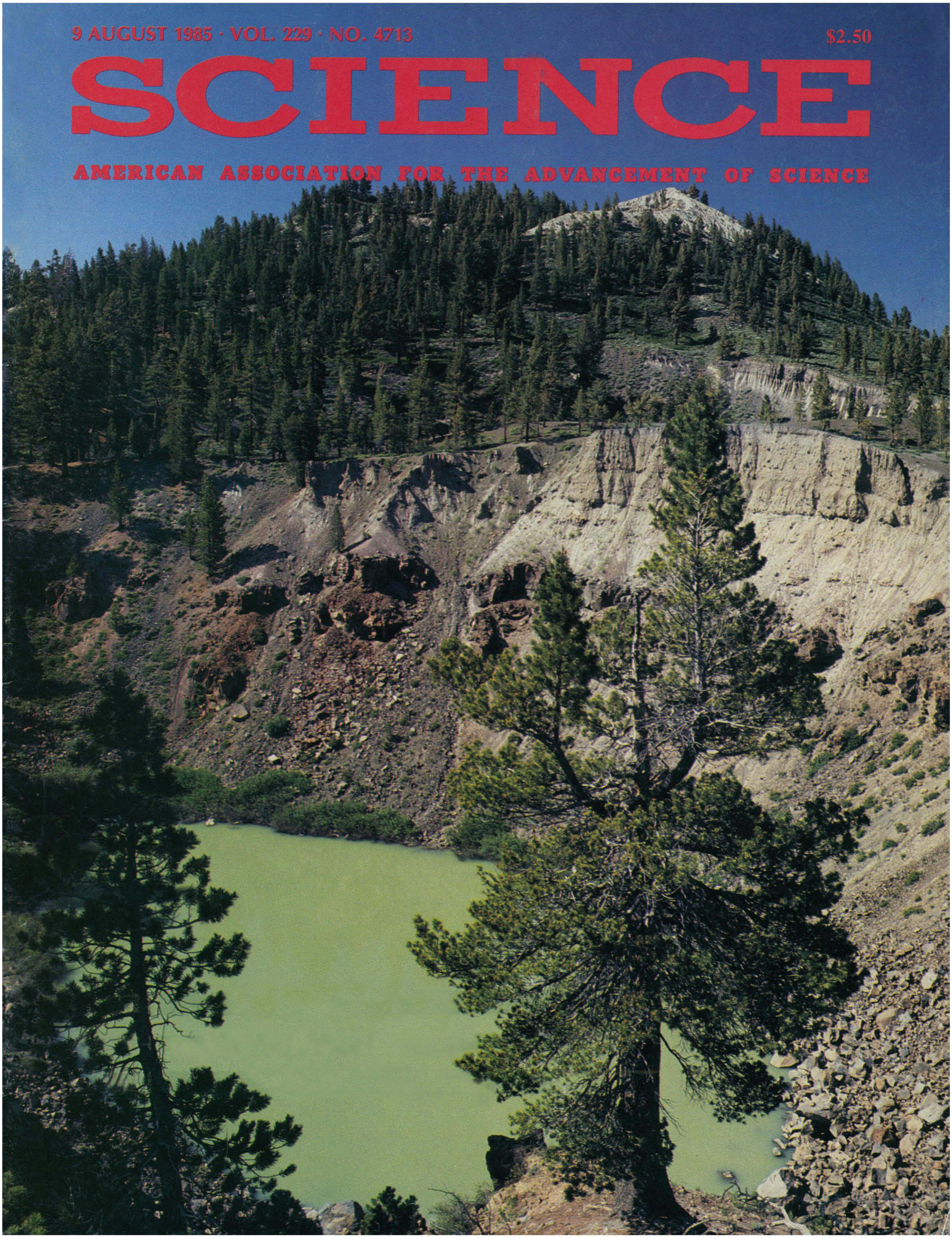

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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

Southern Inyo Crater near Mammoth Lakes in Long Valley Caldera, California. This phreatic explosion crater apparently formed late in a sequence of eruptions which ended 550 years ago. The caldera has, since 1978, been experiencing renewed magmatic resurgence accompanied by uplift and an increase in seismicity and fumarolic activity. See page 551. [Stanley N. Williams, Department of Geology, Louisiana State University, Baton Rouge 70803]

Hemocyanin is an ancient protein

The protein hemocyanin, which transports oxygen throughout the body of an arthropod just as hemoglobin carries oxygen in human blood, existed at least 540 to 600 million years ago (page 519). The history of hemocyanin has been deduced by Linzen *et al.* through comparisons of the structures of hemocyanin molecules from a spiny lobster, a crayfish, two horseshoe crabs, and a tarantula. These arthropods diverged from each other during the early Paleozoic era. Hemocyanin molecules have six or more subunits, each of which has three discrete domains (regions of function). The second domain is identified with the molecule's oxygen-transporting function. Amino acid sequence data indicate that this second domain has been the most highly conserved through time, a finding expected in light of its functional importance. Conserved sequences also were found in the other domains for which functions have not been assigned; such sequences are thought to be responsible for proper folding of this large and complex molecule.

Mammalian extinction and climate change

A number of North American land mammal species became extinct about 32 million years ago, most likely as the result of major changes in global climate and vegetation (page 550). The world was growing cooler during the Oligocene period, an ice cap was forming at the South Pole, and sea level was dropping. Prothero correlated fossil and climate data of this period and found that these events occurred during a 200,000-year interval—a short time in geologic terms. Some mammalian species vanished, others did not change, one became markedly dwarfed, and ancestors of many contemporary mammals continued to evolve. The selective nature of the changes indicates that a major global catastrophe did not take place. In addition, models that predict catastrophic extinctions every 26 to 32 million years cannot account for this extinction event, since it occurred only 5 to 6 million years after the better known Eocene extinctions.

Geochemical clues to volcanic activity

Atypical patterns of two volatile substances in gases emitted by volcanoes may be useful in predicting eruption hazards since their abundances in soil distinguish current from past volcanic activity (page 551). Williams analyzed mercury on soil particles and radon in the gases of soil at California's Long Valley Caldera, the large almost circular depression that formed during a major eruption 700,000 years ago. The caldera has not erupted for more than 500 years. However, in 1978, unusual seismic activity, ground deformation, and uplift were detected there, suggesting that the eruption potential of the caldera was increasing. In several areas with high potential for eruption by traditional measures–seismic and geothermal activity—soil was enriched in radon and depleted in mercury. A reversed profile of radon and mercury characterized soils at sites of ancient volcanic eruptions.

How seals avoid the bends

Weddell seals can dive to depths of 500 meters and at rates of 70 meters per minute without developing the bends (joint and abdominal pain) or nitrogen narcosis (unconsciousness or "the rapture of the deep") (page 556). Other divers as well as aviators face these hazards whenever atmospheric pressure plunges from high to low and nitrogen bubbles form in the blood and body tissues. Falke *et al.* studied the seals' diving mechanism by monitoring blood nitrogen and hemoglobin concentrations of four seals making a series of dives beneath the Antarctic ice. Blood sampling equipment and a microcomputer were glued to the seals' fur for the 3 to 5 days of the experiment. The seals exhaled before diving. Then, at a depth of about 30 meters, the lungs collapsed and nitrogen uptake was limited. Increased hemoglobin in the blood dissolved nitrogen and redistributed it to blubber and other tissues that have a high capacity to absorb inert gases. Nitrogen in the seals' blood did not rise high enough to produce narcosis. Gases remaining in the respiratory tract were compressed; later, during the seals' ascents, these gases expanded to open the collapsed lungs.

Positional effects on gene expression

Eye color in fruit flies is determined by at least three factors—the information carried by the eye-color gene, the gene's position on the chromosome, and the location in the eye of cells carrying the gene (page 558). The standard (wild-type) eye-color gene, when positioned at 20 or more different sites on the chromosome, produces red eye pigmentation. However, at two chromosomal sites, the gene produces abnormal pigmentation patterns in the eye: in one, flecks of red are distributed at random on a lightly colored yellow background while, in the other, nonrandom areas of light and dark pigmentation are found and the pattern is heritable. Levis, Hazelrigg, and Rubin further analyzed eye-color gene expression using P elements—movable pieces of DNA—to shunt the genes from the two positions causing mutant eye coloring to a number of new chromosomal locations. At most locations, wild-type pigmentation developed, showing that the gene itself had not been defective in the mutants but that its proper expression depended on its chromosomal microenvironment. At a few locations, abnormal random pigmentation patterns developed. A single new site was identified at which the gene produced a nonrandom heritable pattern, again demonstrating a role for cellular position in the development of pigmentation patterns.

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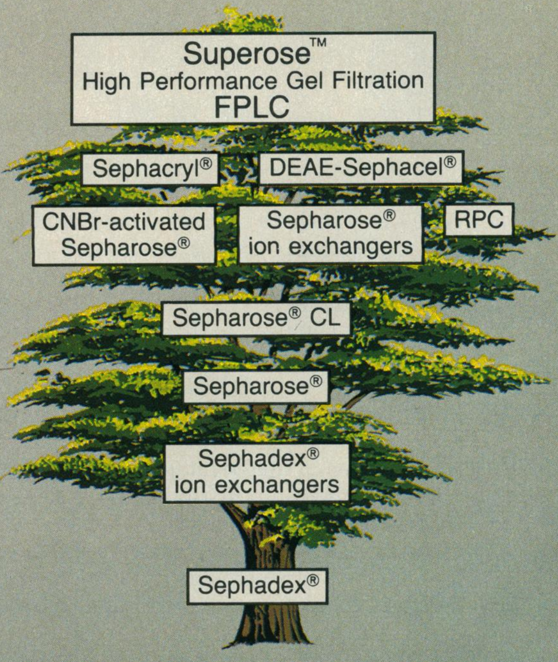

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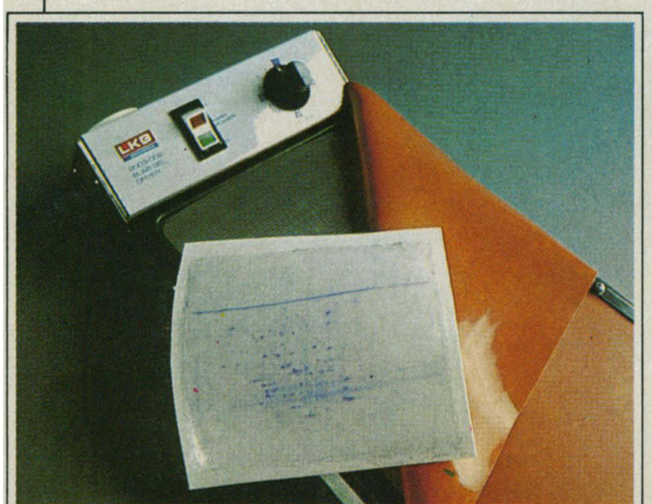
This fine 2-D gel shows the use of the LKB Gel Dryer in preparing gels for storage, scanning or autoradiography ▼



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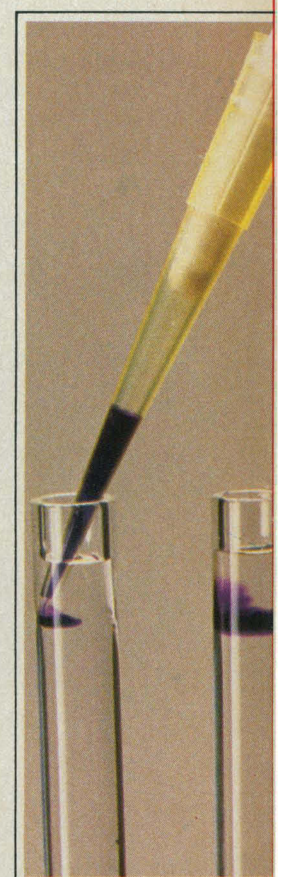
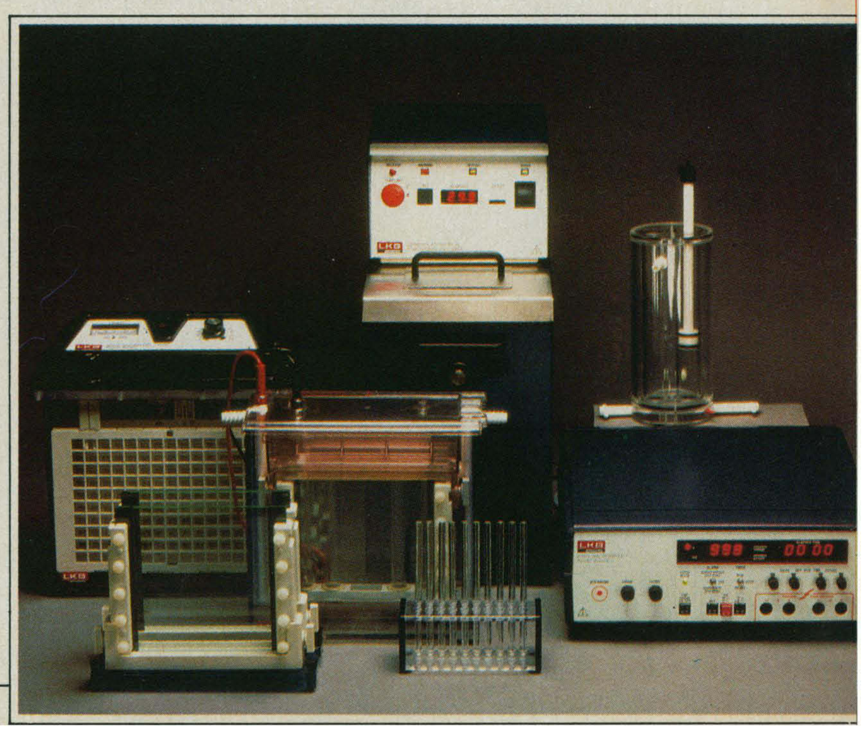
The Tube Gel Kit allows the LKB system to perform both the first and second dimensions in 2-D applications ▶



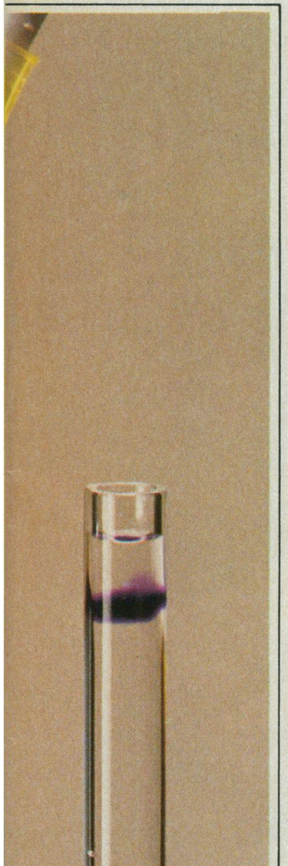
PAGE and gradient PAGE techniques
Conventional PAGE and SDS/PAGE techniques, using either continuous or discontinuous buffers, are fully catered for by the basic LKB system. The addition of our Gradient Gel Kit provides a quick and convenient method of casting both linear and exponential gradient polyacrylamide 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 ▼



Vertical Electrophoresis Systems

ve different techniques



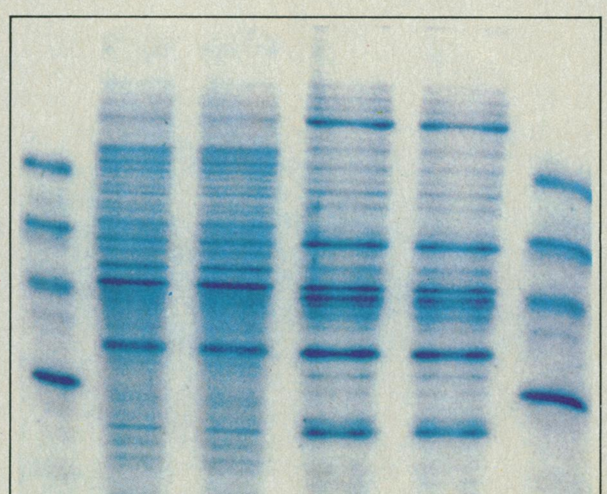
Agarose gel techniques
For researchers who sometimes want to use agarose, there is a special kit to help you cast and run the 3 mm agarose gels on the LKB Vertical Electrophoresis System. The kit includes frosted glass plates to provide essential support for the gel.

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.

Want proof?
These may sound like extravagant claims, but just call us and we'll be happy to come and demonstrate the versatility of the LKB Vertical Electrophoresis System for you and your colleagues. At your convenience.

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SCIENCE

Science and the Philadelphia Story

We are little more than a year and a half away from celebrating the bicentennial of the American Constitution. Are we light-years away from waking up to the impacts of scientific and technological exuberance on the vital propositions of that political statement? Perhaps apocryphal, but nonetheless striking, is the remark ascribed to a scientist and framer of our Constitution, Benjamin Franklin, who emerged from the Philadelphia conclave to tell a curious bystander, "We have given you a republic, sir, if you can keep it."

Apart from providing for patent and copyright protection, the Constitution is quiet on the subject of science in the affairs of the budding nation. This was natural enough two centuries ago, even though, in the debates over the Constitution, proposals for the encouragement of science were considered and finally dropped. It would have been astonishing had the authors guessed the extent to which science and technology would become entangled with government in the second half of the 20th century—at once enriching, extending, and complicating the political process. Now, however, the intricacy of government's involvement with science is such that the constitutional considerations must be taken seriously.

All things considered, there is little doubt that advances in science and technology have served to fortify the constitutional purposes. The reach of the general welfare clause, for example, has been extended through science with immense benefits to the nation's health, economy, productivity, and industrial capacity. Technology, in turn, has done much to multiply choices, opportunities, and both humanistic and material benefits as well as dilemmas.

It would be fine if we could leave it at that. But it is also the fact that the new centrality of science and technology is imposing pressures on the politics that we practice, especially on those fundamental power equations that are built into the Constitution and that made up the main agenda of the Philadelphia conferees. If we mean to keep our republic, that agenda is as much ours as it was theirs.

Some of these power equations bear on the coequal powers of the branches of government, others on the reserved powers of Congress, and still others on the supremacy of civil authority over the military. With scientific and technical complexity suffusing the business of Congress, whose members are overwhelmingly generalists, the task of preserving the coequal status of the Legislative and Executive branches, in fact as well as in the textbooks, is no minor challenge. When the same complexity taxes the abilities of the voters to evaluate technical risk and make informed choices, government by the people is in trouble. When military power is locked into weapons poised for "launch on warning" under delegated authorities, the reservation of the war-making power to Congress is reduced to something akin to fiction, and the supremacy of the civil authority is compromised. All these difficulties require us to think again about our understanding of the equations of power that were so carefully set down by the framers of our Constitution two centuries ago and that we will celebrate in 1987.

The political dialogue of our day is concentrated not on constitutional fundamentals but on issues of immediacy, on taming the budget deficit, on prospective winners and losers under tax reform, on threats of trade wars and anarchy in the Middle East, on insurgency and the enduring enigma of Soviet intentions. What is grist for the media is what focuses our attention and thought. This, too, is a result of scientific and technical inventiveness and is further evidence of altered equations of power.

Science, once the province of philosophers, scholars, and inventors, is now a prime mover of the goals of a nation. So much power must be reconciled with the checks and balances to which we still subscribe. They are at the heart of the Philadelphia story.—WILLIAM D. CAREY