17 August 1979 • Vol. 205 • No. 4407

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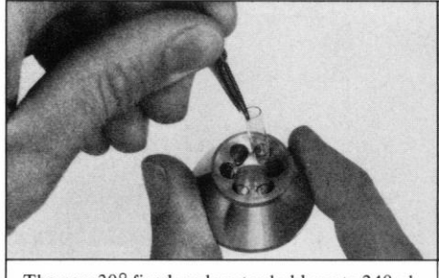
SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

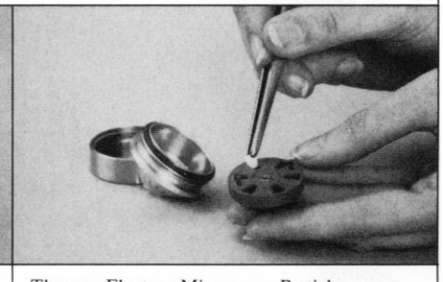
New rotors for the Airfuge®-

the small-sample ultracentrifuge.



The new 30° fixed angle rotor holds up to 240 µl per tube and provides forces up to 178,000 g.

The new Batch Rotor rapidly pellets 2 to 7 ml of material.



The new Electron Microscopy Particle Counting Rotor is useful for virus research.

The Airfuge® air-driven ultracentrifuge, with its high forces and speeds, is unsurpassed for centrifuging small samples rapidly. The Airfuge continues to grow in versatility. Now there are five rotors to choose from for numerous applications.

Two fixed angle rotors, the 18° and the new 30° rotor, can pellet any material that can be sedimented in a full-sized ultracentrifuge, but in a fraction of the time. The rotors accelerate to a maximum speed of 95,000 rpm in just 30 seconds. They can be used for separations ranging from molecular weight determination studies, binding studies, cellular separations, lipoprotein fractionation, to steroid hormone receptor assays.

The Batch Rotor pellets material in a polyethylene liner or in the rotor body itself. The Electron Microscopy Particle Counting Rotor sediments particles uniformly onto the surfaces of specimen grids for rapid, accurate, and reliable detection and counting. The unique Chylomicron Rotor clarifies lipemic sera by flotation of chylomicrons in just ten minutes.

The Airfuge ultracentrifuge uses ordinary laboratory air pressure to spin rotors almost friction-free on a cushion of air. It's efficient, quiet, and simple to operate. Ask about the 30-day free trial offer for the Airfuge. For a description of the Airfuge and its applications, write for the new Airfuge brochure, SB-557, to Beckman Instruments, Inc., 1117 California Ave., Palo Alto, CA 94304.

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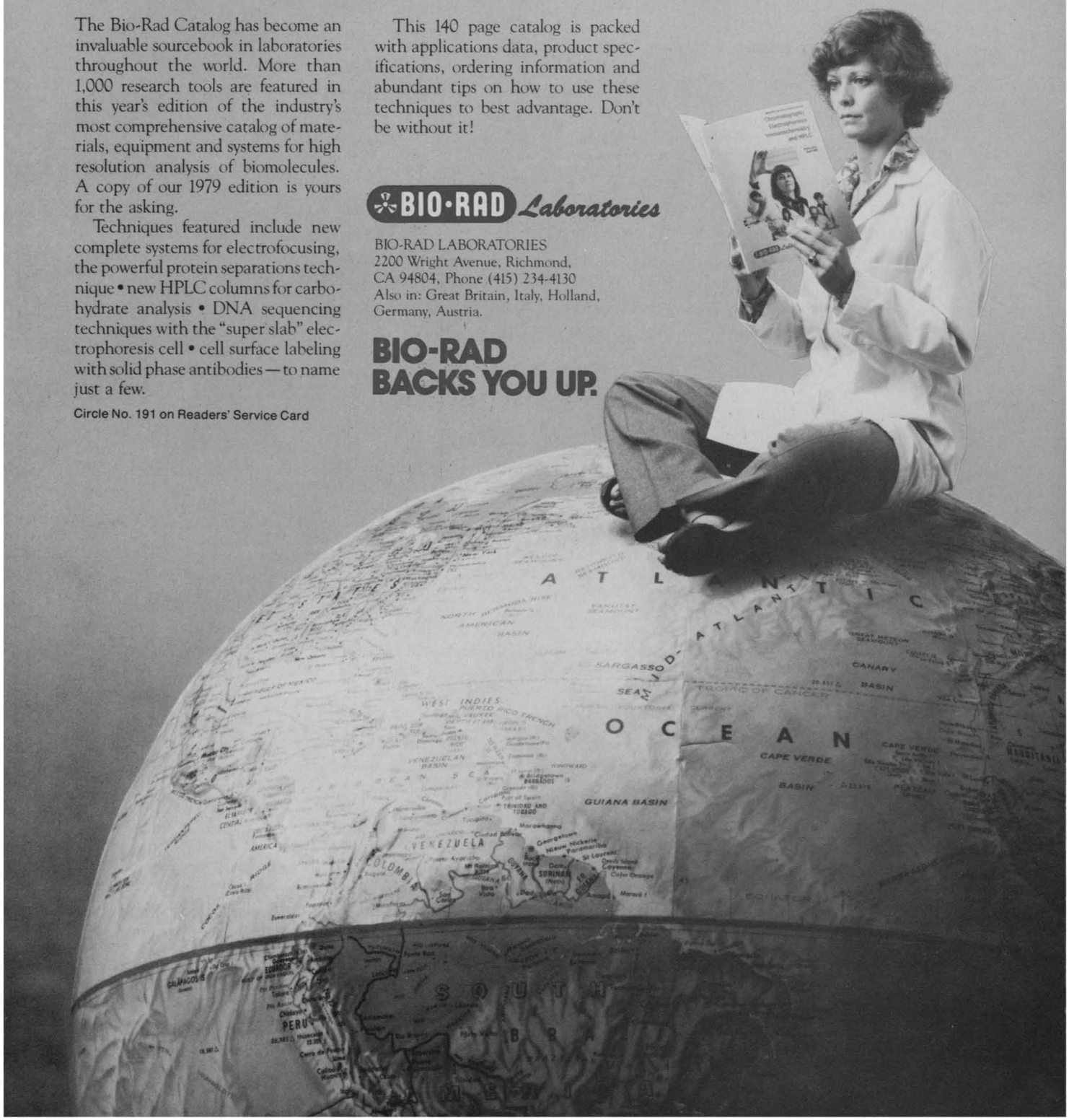

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SCIENCE

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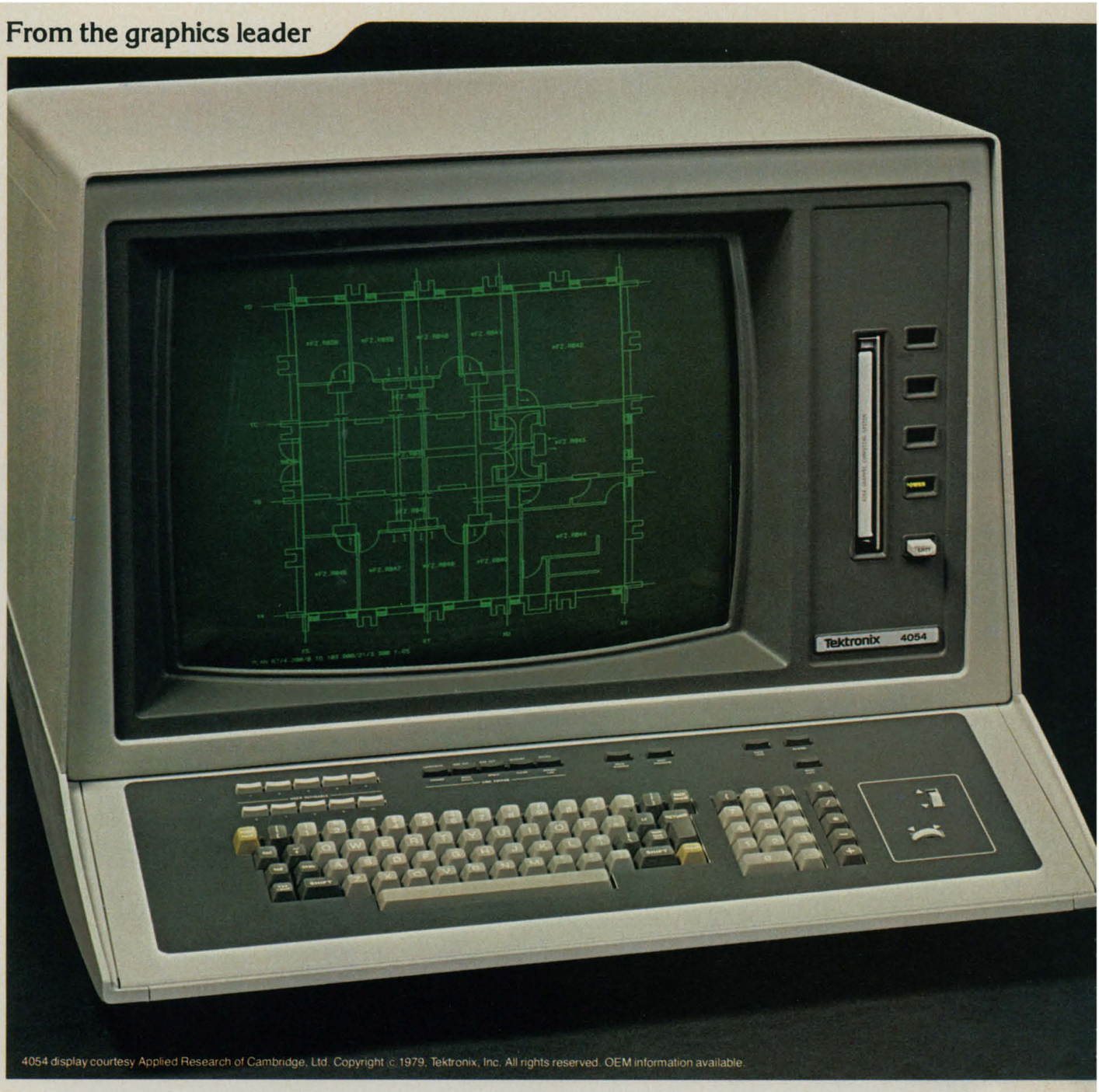
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Sea palm (*Postelsia palmaeformis*) pictured overgrowing both goosenecked and acorn barnacles and mussels. These competitively brown algae, about 25 to 35 centimeters tall, inhabit sites characterized by extreme wave shock (Tatoosh Island, Washington). See page 685. [A. R. Palmer, University of Washington, Seattle]

From the graphics leader



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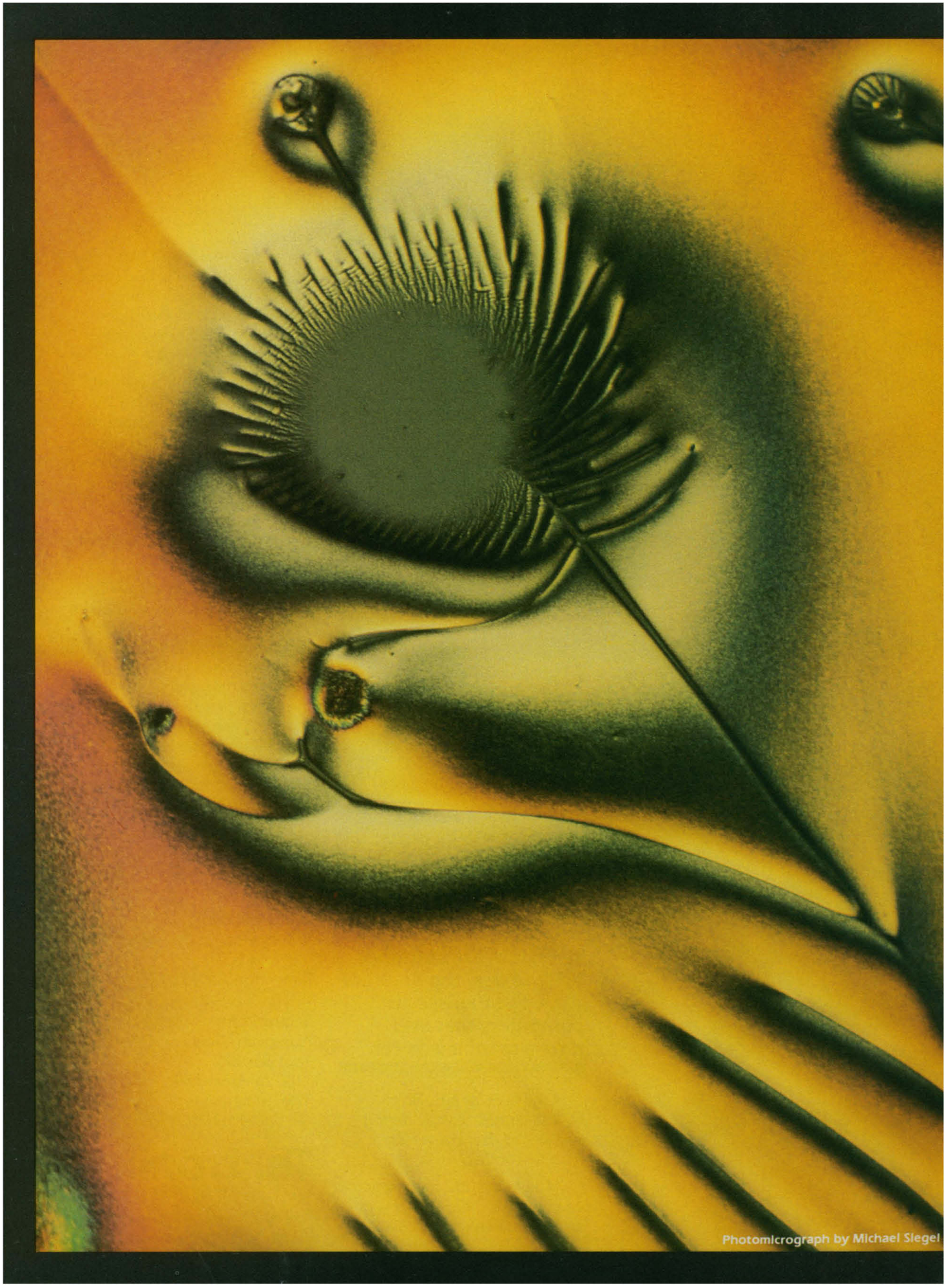
Photomicrograph by Michael Siegel

The ability to precisely and faithfully record specimens on film has always been the ultimate test of microscope optics. Shortcomings that would be insignificant in less exacting tasks are glaring in a photomicrograph.

Now, with a single stunning innovation, Nikon has produced an unprecedented advance in microscope technology. Called CF optics, it's a development so revolutionary that it represents far more than a refinement. It stands as nothing less than an entirely new standard of light microscope performance. A standard against which all others will be measured.

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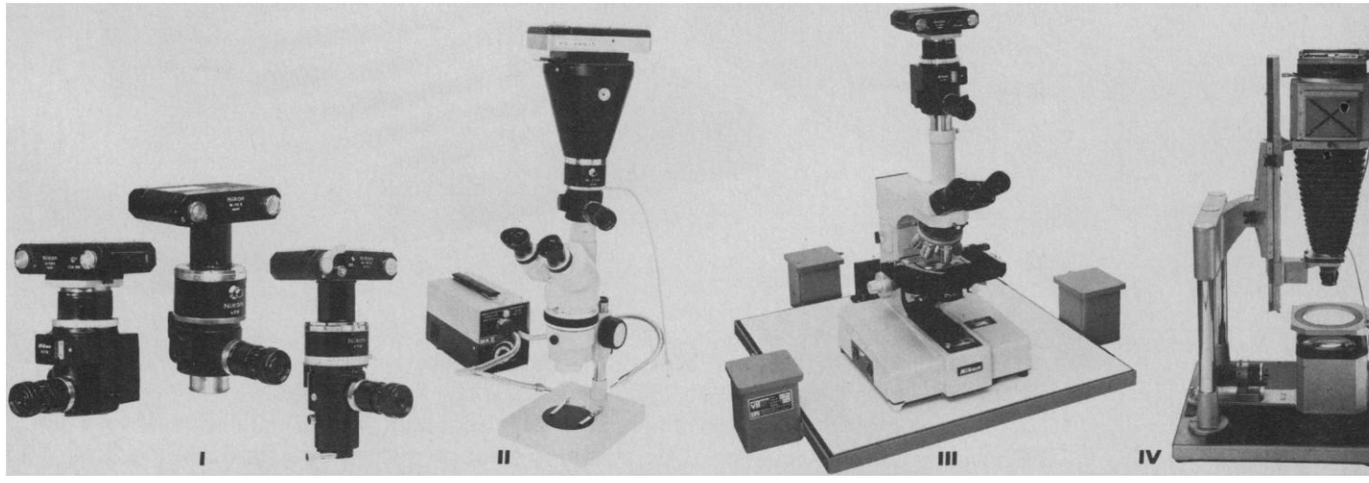
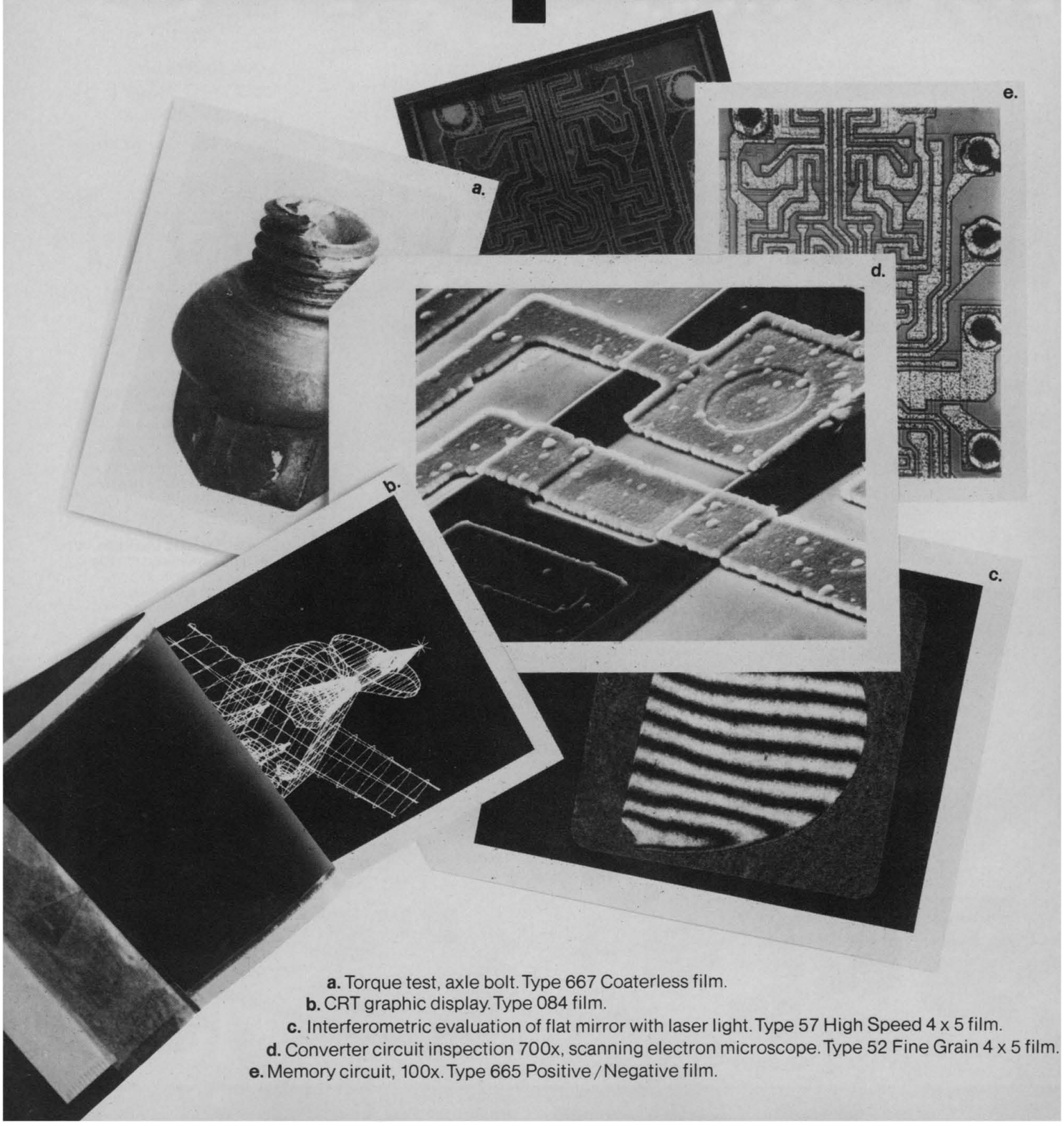


Technical for impatient



a. Torque test, axle bolt. Type 667 Coaterless film.
b. CRT graphic display. Type 084 film.
c. Interferometric evaluation of flat mirror with laser light. Type 57 High Speed 4 x 5 film.
d. Converter circuit inspection 700x, scanning electron microscope. Type 52 Fine Grain 4 x 5 film.
e. Memory circuit, 100x. Type 665 Positive / Negative film.

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Our wide range of equipment lets you record everything from microbes to metal stress tests. With Polaroid self-developing films you can have professional quality results in color in 1 minute, or in black and white (with or without a usable negative) in seconds. And our equipment is simple to use. So you can take the photographs you need without needing to know a lot about photography.

The MP-4 Multipurpose camera (1) is a versatile, self-contained photo studio anyone can operate. It uses 14 different Polaroid instant films to keep you out of the darkroom. And it copies, delivers close-ups, reductions, macrophotographs and photomicrographs, to bring your answers to light.

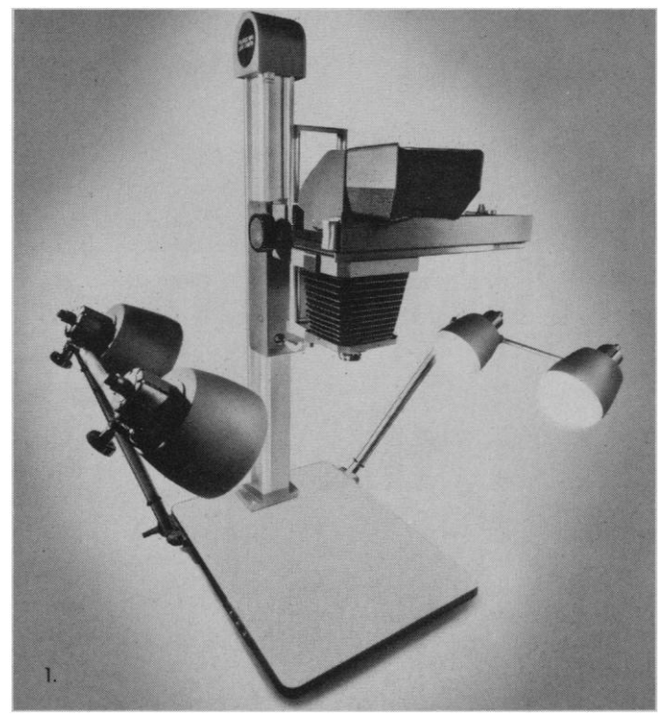
Our CU-5 Close-up camera (2) is a lightweight, hand-held system you can take almost anywhere and get instant photos from ¼ to 3 times life size. Exposure is easy to set, lighting is built in and framing is automatic. So all you have to think about is the picture. You can even use the CU-5 to capture a transient image on a cathode ray tube.

Many cameras and instruments can be adapted quickly and easily for instant photography with Polaroid film holders (3). They come in 3 models to handle 3 different sizes of Polaroid Land film (3¼ x 4¼, 4 x 5, and 8 x 10 in.), so you can get instant results in almost any format.

Many other manufacturers of cameras and instruments also supply Polaroid Land camera backs that adapt their equipment to instant photography. These backs use 9 different convenient Polaroid pack films, so you can see your project in a new light.

To find out how you can get instant results, mail the coupon below. Or if you're a *very* impatient person, call us toll-free from the continental U.S. at 800-225-1618 (from Massachusetts, call collect 617-547-5177).

And stop tapping your foot while you wait for your photos to come back from the lab.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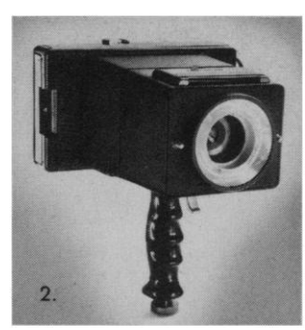
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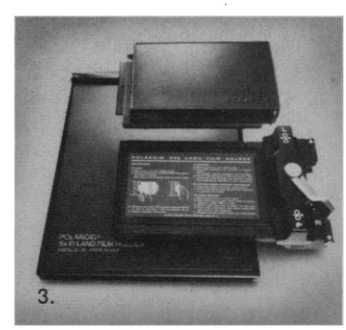
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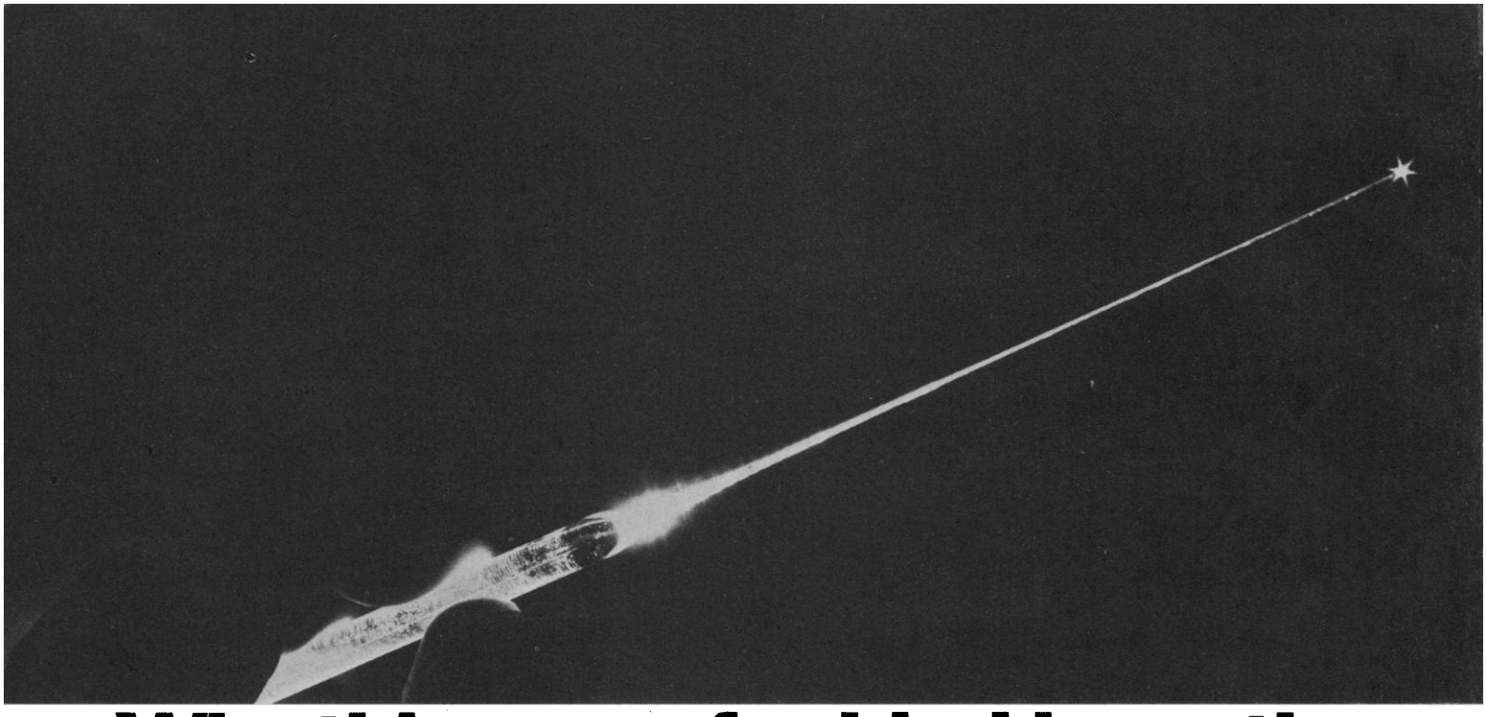

Why this one-of-a-kind invention didn't end up as the only one of its kind.

Every new invention needs another new invention—the one that can mass-produce it at an affordable cost.

For example, Bell Labs invented a process for making the glass rods from which hair-thin fibers used in lightwave communications can be drawn. The fibers have far greater capacity than conventional copper wires, so they'll help keep costs down. In fact, they've been carrying voice, data, and video signals under city streets for about two years in a Bell System demonstration.

But standard lightwave systems will require *miles* of the fiber, produced at low cost and to specifications nothing short of microscopic.

That's where Western Electric's Engineering Research Center comes in.

A Unique Center

The Center is devoted exclusively to manufacturing research.

Here, a highly trained team of scientists and engineers probe fundamental questions about materials and processes. They provide Western Electric factories with pre-tested, proven ways to manufacture products based on the latest technology coming out of the laboratory.

For example, while Bell Labs scientists were inventing new glass fibers, Western Electric engineers and scientists were tackling the manufacturing problems involved.

The fibers had to be drawn from molten glass at high speeds, with less than a 1% deviation in diameter.

But how do you control a "thread" of glass being spun at rates up to 15 feet per second?

Scientists and engineers at the Center discovered that laser light beamed onto the fiber cast a characteristic pattern. By correlating the pattern to the fiber's diameter, they were able to build a monitoring system into the fiber drawing machinery. It measures the fiber 1000 times per second, automatically adjusting production to keep the diameter constant.

The system works so well that in all the miles of fiber produced by Western Electric, the diameter varies by no more than 30-millionths of an inch.

The Key to the Future

In the Bell System, technology is the key to keeping costs down. It is the key to constantly improving your phone service.

And Western Electric's Engineering Research Center is an essential link between the ideas of the laboratory and the realities of the factory.

So your Bell Telephone Company can make the best one-of-a-kind inventions a part of your phone service.

Keeping your communications system the best in the world.

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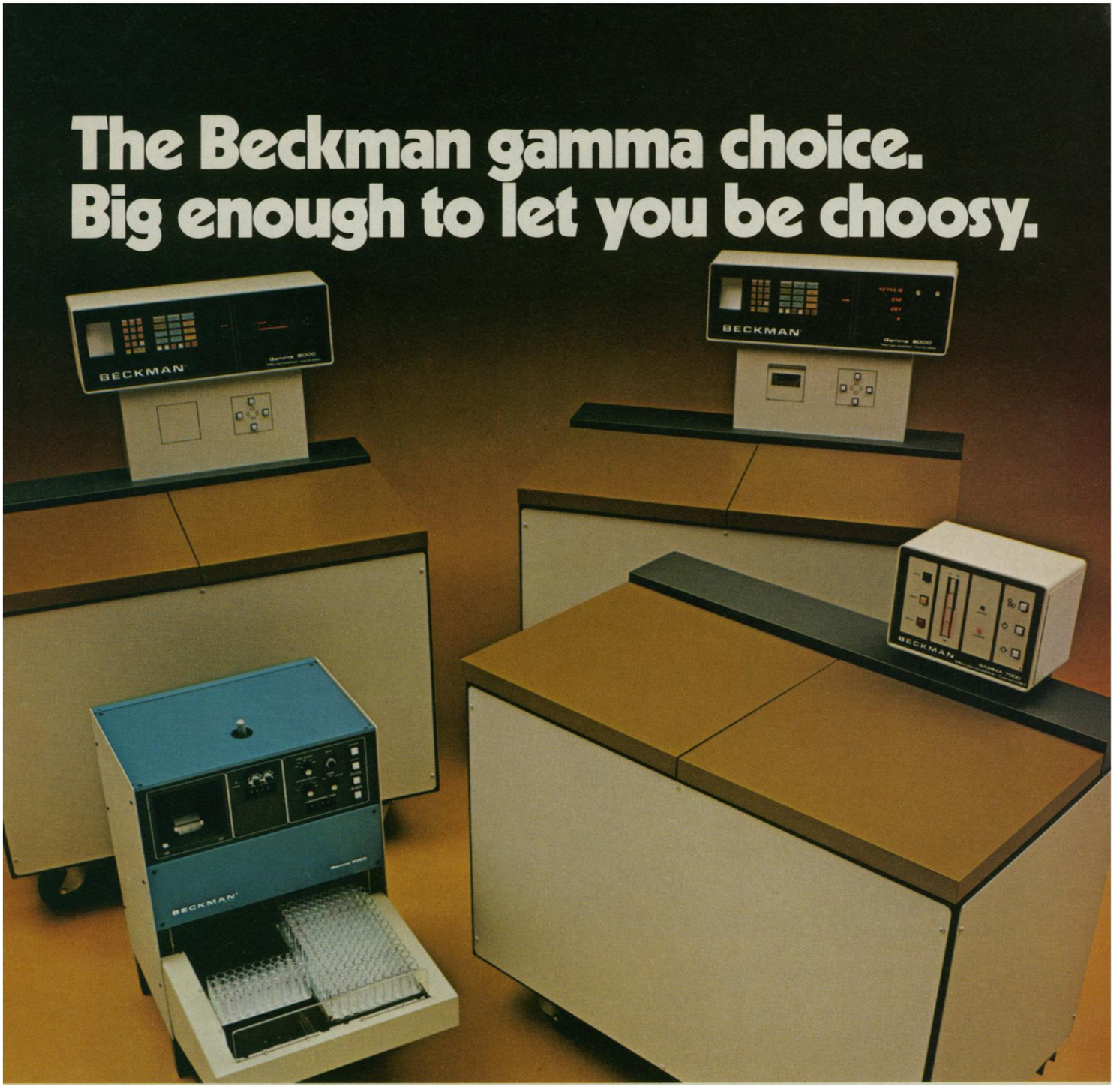

Beckman now offers the research and clinical laboratory a complete choice of gamma-counting instruments. Check the features below to find the one instrument that can most effectively satisfy your needs.

The low cost Gamma 4000 is a high performance, bench-top unit featuring ease of operation, 200 or 400 sample capacity, preset and variable windows, and a choice of print-out devices. The optional DP-5000 computer/printer provides on-line data reduction capability—for Radio-Immunoassay final answer calculations.

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The Gamma 8000 takes micro-processor-control one step further and allows the user to design special counting programs, while maintaining the simplicity of operation unique to Beckman Instruments.

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Of course, if you're really going to be choosy about your next gamma instrument, you'll need complete technical information. Why not get it now?

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"VAX offered us almost three times the address space of our 370/168."

Bill Miller, Senior Systems Analyst
Chevron Geophysical Co., Houston, Texas

Chevron Geophysical is heavily engaged in seismic data processing involving matrix operations on large arrays.

As Senior Analyst Bill Miller states the problem: "Our IBM systems, running on TSS, give 24 bits of true address space—for a maximum program size of 16 megabytes. But only 10 to 12 megabytes of this can be used by the programmer—and our application had grown to the point that TSS was simply cramping us.

"With the VAX-11/780, we know we can have application programs that use a full 32 megabytes as we're configured now—and it could be more if we wanted."

But Chevron didn't buy their VAX without first benchmarking it against the far more expensive 168.

Miller comments: "We developed a number of benchmarks to test specific areas of performance. On the average, the VAX CPU appears to be about a third as fast as the 168, which is really quite impressive. And it's very possible that for certain applications, we may see a negligible loss of throughput over the 168, thanks to VAX's unique page clustering scheme."

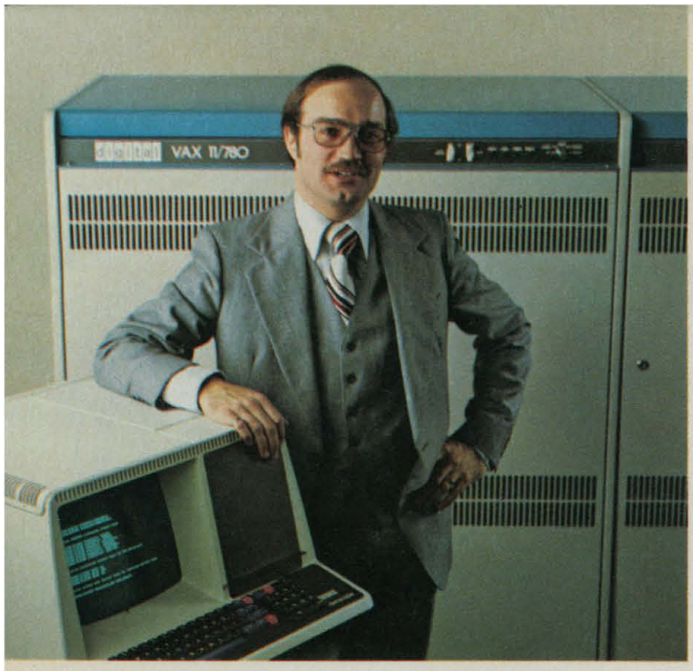
And as far as system performance to date, Miller reports: "The VAX/VMS operating system has been remarkably reliable. The people at Digital have done a phenomenal job."

"VAX's true 32-bit addressing puts its potential capacity so far out, we don't have to worry about it."

Dr. Edwin Catmull, Director,
Computer Graphics Lab
New York Institute of Technology,
Old Westbury, New York

The Computer Graphics Lab at New York Institute of Technology is a leading research and production facility for computer animated commercial and educational films.

In Dr. Catmull's words, here's what brought NYIT to the VAX-11/780: "While spending years developing our capabilities with minicomputers, we



"With a 22,000-point data base, we really needed VAX's huge memory capacity."

Peter Ackermans, Manager of Computer Systems Engineering
CAE, St. Laurent, Quebec, Canada

CAE Electronics Ltd., currently has thirteen VAX-11/780 systems under development for both flight simulation and supervisory power control.

Here again, VAX capacity was key. Systems Manager Peter Ackermans told us: "Our SCADA systems for the power market need to handle a 22,000-point data base. VAX's large memory capacity and the VAX/VMS virtual memory operating system made it a very attractive machine."

But speed was also important. "In flight simulators," Ackermans continues, "top FORTRAN performance is essential, and on that score, VAX measures up well. Our FORTRAN programmers have also been impressed with the machine's debug facility and file handling capabilities."

Digital's VAX-11/780, with its true 32-bit address space, has set a new standard for program capacity. This means that you can run large programs easily on VAX, with a potential for growth that's unmatched in the industry.

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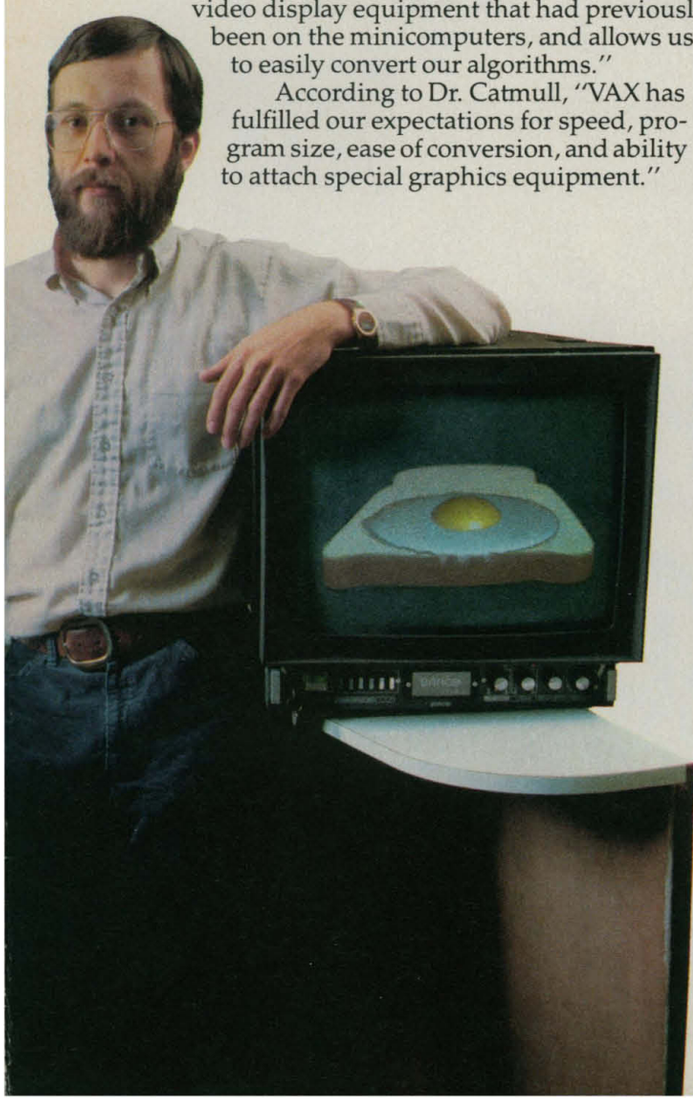
continually ran into the problem of small address space. Our work demands the large address space we can get with a 32-bit machine. We were dealing with extremely large, randomly accessed data bases, and memory mapping is not the answer."

Dr. Catmull continues, "The VAX UNIBUS lets us easily hook up a wide range of special video display equipment that had previously been on the minicomputers, and allows us to easily convert our algorithms."

According to Dr. Catmull, "VAX has fulfilled our expectations for speed, program size, ease of conversion, and ability to attach special graphics equipment."



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Dr. R.L. Phillips
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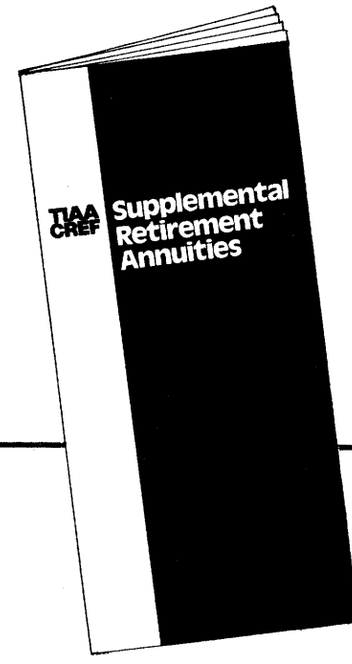

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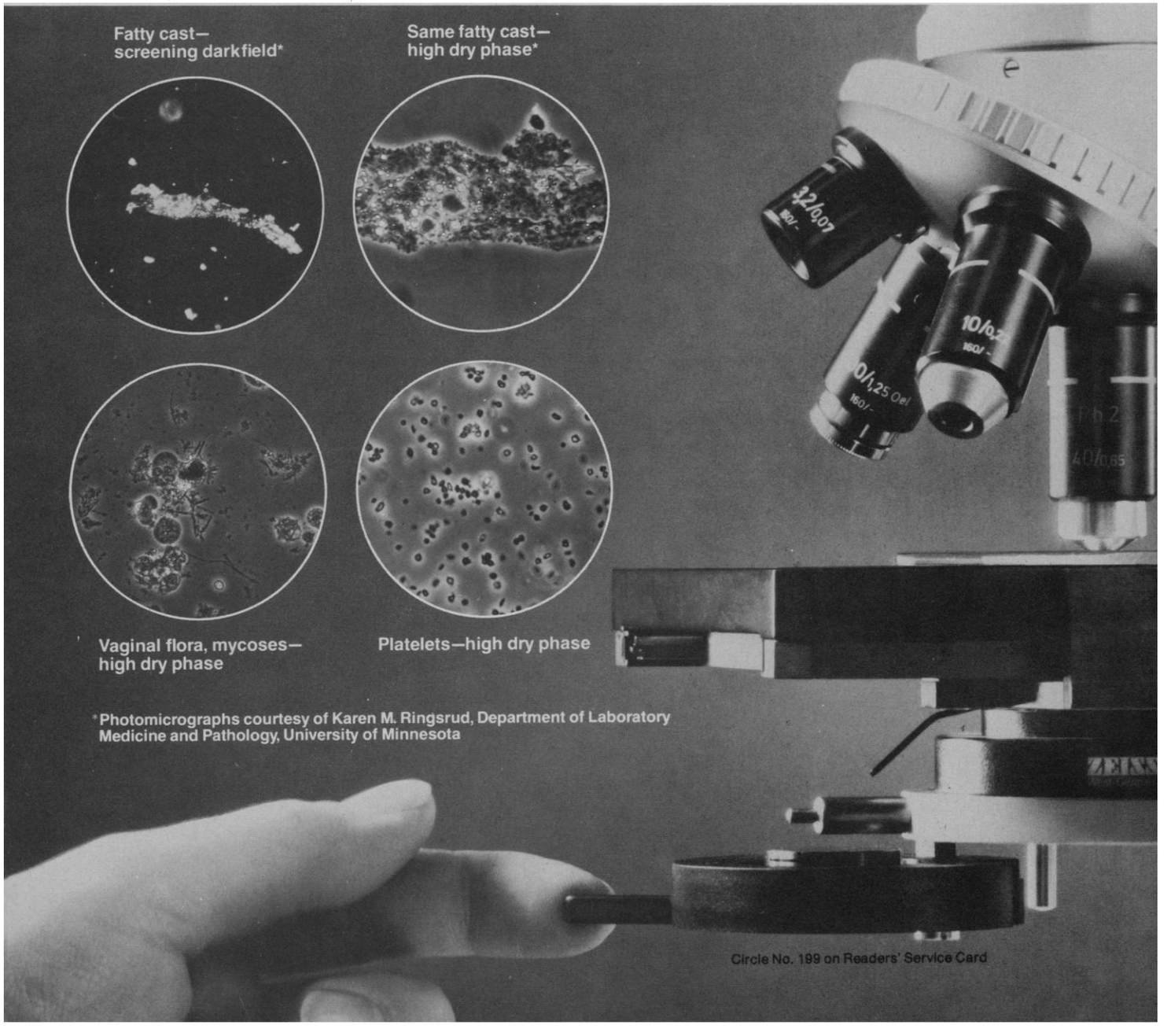

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NICK TRANSLATION SYSTEM

The world's first. Packaged complete.

Naturally it is more convenient than assembling the components yourself. But even more important is its reliability. For example, the *E.coli* DNA Polymerase I is cloned in our laboratories to ensure extremely high reproducibility. The dCTP, [α –^{32}P]- is tested for nick translation by our Biological Testing Laboratory. (Typical incorporation is 40%, and we guarantee 1 x 10^8 dpm/μg DNA.) The supercoil PBR322 Plasmid DNA control we use to test each lot of systems is included so you can check yours. Finally, the DNAse I, dNTP mixture, stop-buffer, and sterile deionized water are optimized for compatibility and stability. Approximately twenty assays can be run. A bulletin describing this exclusive system is yours for the asking.

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Caution: Not for use in humans or clinical diagnosis.

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Ohaus Brainweigh 300

Never before, for so little, could you get so much.

The Ohaus Brainweigh 300 costs only $1,195 and gives you a capacity of 300g with a readability of 0.01g. (If you want to find out how much that price is going to save you, just check what our competitors are charging for balances with similar capabilities.)

And we didn't stop with just economy. We went on to design in features that would be costly "extras" on any other balance on the market—if you could even get them.

Like extended visibility

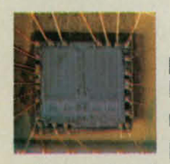
Stand up; sit down; go to the back of the room. The display on the Ohaus 300 is still easy to read. That's because the no-glare window with the big, easy-to-read digits is deliberately angled for maximum visibility wherever you are. And that can save a lot of headaches whether you're in a lab, or on the line or in a classroom.

It tells you when it's ready—and when you've goofed

No more guessing whether the balance has settled down; no more annoying digit flutter. When the "g" appears beside the digits—in 3 seconds or less—it's your guarantee that the reading is stable.

And if the pan is overloaded or dislodged, you'll get an error sign in the window.

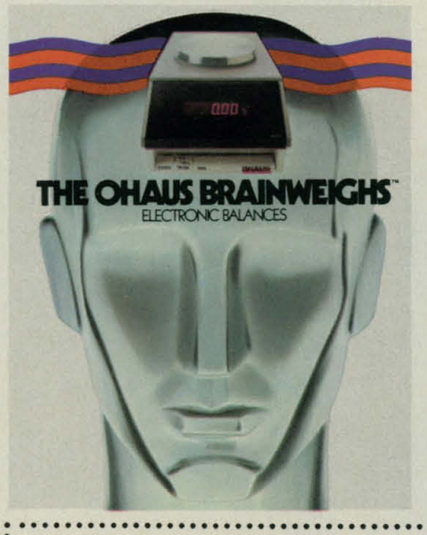
The 300 is a new generation balance



This new, low-profile balance is only a little larger than an ordinary desk phone. But packed inside is enough advanced technology to make the Ohaus 300 a generation ahead of any other balance on the market. Its state-of-the-art electronic components are almost entirely plug-in for easy service. And there are fewer of them—for better reliability and more dependable performance.

Want a BCD interface now—or later?

You don't have to worry about it. Unlike other electronic balances, every Ohaus Brainweigh comes equipped to handle a BCD option. You can add a BCD interface right away—or whenever you come to need it.



Parts and service are as near as your dealer

The Ohaus 300 is made right here in the U.S. And although its built-to-take-it die-cast case and solid state components put maintenance at a minimum, when the balance finally needs a little attention, it's nice to know your local dealer can do the job.

Get all the facts

If you'd like to see the rest of the reasons why the Ohaus Brainweigh 300 outclasses the competition, and the many ways it can make your operation faster, easier and more accurate, just return the coupon.

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☐ Yes, show me the weigh of the future. Send me the full-color catalog on the Ohaus Brainweighs.

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novel theory concerning the predictability of heart attack. We welcome the opportunity to recapitulate our arguments.

We strongly uphold the right of individuals to determine for themselves what will be done to their minds and bodies. The basic right to self-determination, however, is threatened by two forces represented in the current "rituals" offered in the name of "informed consent." An informed consent ritual is an attempt to defend the underlying "right"; it is not in itself, either legally or ethically, a "right." It is justified *only* to the extent that it actually promotes self-determination. We very deliberately chose the term "ritual" to distinguish certain practices from the underlying "right" to self-determination. The ethical question with such "rituals" is whether or not they are the best possible ones to ensure that the "right" is protected.

The threats are these. First, institutional lawyers dictate the form of recommended consent forms, so that the forms become releases designed to protect the institution, not information designed to inform the individual. One has only to read a few such forms to note the legal language, the requirement for witnesses, and the obvious intent. We point out this happening, emphasize that it does not even protect the institution, and urge that the practice stop.

Second, those who have been formulating informed consent rituals have not paid sufficient attention to the injury that may be caused by the ritual itself. We point out, and our respondents agree, that harm may result from ill-considered offerings of "information." The harm may take the form of suggested symptoms, induced anxiety, panic-related accidents, or serious physiological reactions. The respondents would argue that all individuals have a right to this information, and that all must receive it. But does a right to harm people exist? The right of free speech has, in American legal and ethical thinking since Holmes, been specifically held to deny the right to cry "fire" in a crowded theatre. Thus, the action of unnecessarily evoking anxiety reactions which can lead to physical harm cannot be a "right"; it is this property of present informed consent rituals that we criticize.

The consent form is inescapably a part of the experimental procedure. If it has potential for harm, the subject must be warned against this possibility just as surely as against the other hazards of an experiment. Current consent form rituals constitute human experimentation, but

oddly enough they have not been subjected to as rigorous control as other forms of human experimentation. Who is going to watch the watchdog?

What, then, shall we tell our subject? "Full disclosure" is often naïvely equated with "full knowledge." In point of fact, more comprehension is generally achieved by transmission of smaller amounts of clearly stated information than by prodigious quantities of "fine print." "Full access" is a more reasonable approach, and is the one which we urge. For example, a consent form might in two or three sentences outline the experiment and accurately define the expected level of risk in terms of a universally understood referent. (As dangerous as . . . the drawing of blood, a tonsillectomy, an airplane trip.) The reverse of the form, or a separate booklet, a copy of which the subject would retain, could contain all additional information that might be desired.

Nothing should be withheld from those who wish to know it. Similarly, nothing should be forced down the throats of those who do not wish to know. For those individuals who choose to know all, there are numerous ways in which information about potential adverse side effects can be presented to them. Whatever way is chosen, it is wise to include a discussion of the placebo effect and its potential for adverse reactions, since this may mitigate the adverse effects. This recommendation, of course, is one of offering access to *more* information than is currently the custom.

We closed our editorial by noting that in some instances subjects might be at greater risk from their self-appointed guardians than from the experiment; it was precisely individuals such as our respondents that we had in mind. They would not allow the risks of informed consent to be considered; this, they say, is "mischievous." They reflexly defend actions alleged to be in defense of a fundamental right without considering whether such actions actually defend or threaten the right of individuals to determine what will be done to their minds or bodies. These obtuse advocates of full information unfailingly argue that "more is better"; they argue for protection of the subject even as their rituals increase that subject's peril. Human beings have a right to access to information that will affect them, but they simultaneously have the right to choose when they have had enough.

JAMES F. FRIES
ELIZABETH F. LOFTUS
Center for Advanced Study in the Behavioral Sciences

How to figure the cost of living ...a longer life.

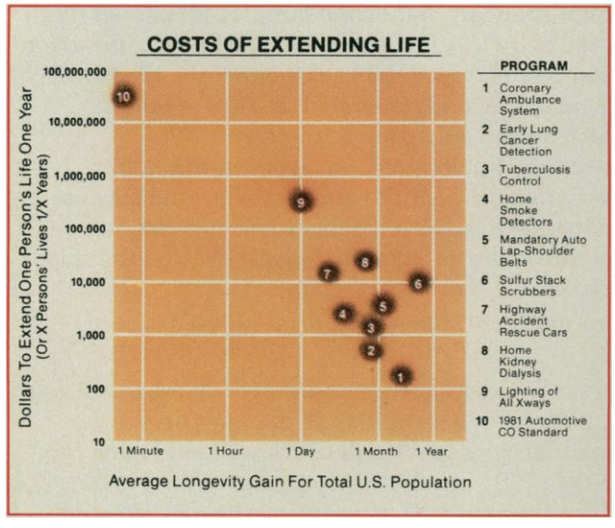
What's the fairest way of allocating the nation's limited funds to reduce various risks to human life and health? A loaded question, to be sure.

One way of evaluating a given risk-reduction program is to compare estimated costs with expected benefits, both measured in dollars. But this kind of analysis is controversial. For one thing, it requires placing a price on life itself.

Here at the General Motors Research Laboratories, societal analysts have developed a method which avoids that problem completely. It focuses on longevity and rests on the simple logic that since all life inevitably ends, no amount of risk reduction can *save* lives . . . only *lengthen* them.

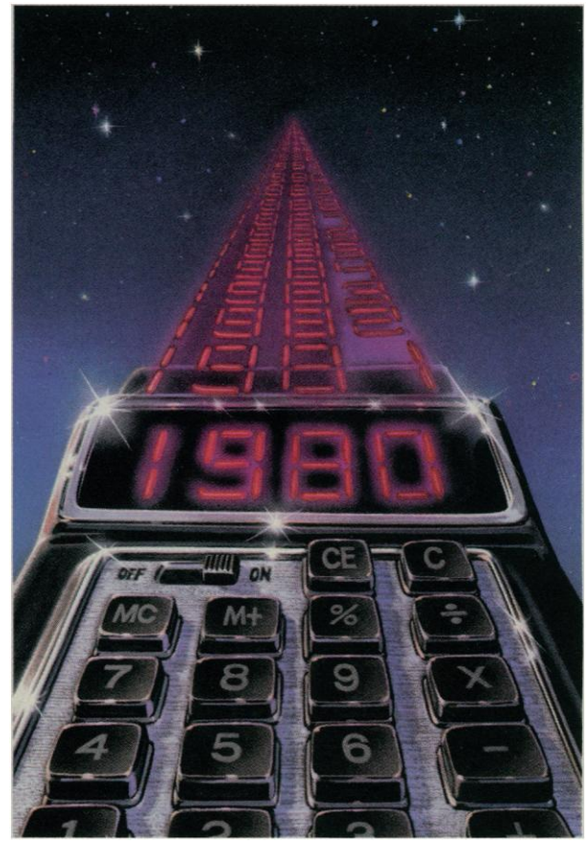
The method involves using the extensive data for all categories of mortality risks and determining the effect on longevity of each category independently. The results can be summarized for each risk by the equation: Average Years Of Longer Life = 0.2 x Annual Deaths Per Million Population.

This equation serves two purposes. First, it provides a perspective of days or years gained from risk-reduction programs. Second, combined with cost estimates, it helps rate the effectiveness of those programs.



To illustrate its utility, we performed a study to compare the cost-effectiveness of several medical, environmental, and safety programs presently under serious consideration. The chart above shows the extreme variation in the costs of extending life by implementing those options.

Through such unbiased comparisons, policymakers can obtain a clearer picture of which programs offer the greatest potential gain for a fixed budget and, thereby, have a better basis for decision.



GM

General Motors Research Laboratories
Warren, Michigan 48090

17 August 1979, Volume 205, Number 4407 SCIENCE

Synthetic Chemicals in South Africa

Much has been written about various methods of obtaining synthetic fuels. But the South African efforts, although mentioned, have not received as much attention as they merit. The Sasol (South African Coal, Oil and Gas Corporation) installation is the largest synfuel plant based on coal operating anywhere. It converts an inferior high-ash (35 percent) coal into a broad spectrum of products. These may include ethylene, propylene, butylene, gasoline, and long straight-chain alcohols and hydrocarbons. The Sasol plant has been operating for about 24 years. During that time efficiency has increased and much has been learned about control of products. Sasol is a profitable operation while selling gasoline at the refinery gate for about 50¢ a gallon (14¢ a liter).

South Africa has substantial deposits of coal but no oil, and it obtains 75 percent of its energy from coal. The plant at Sasolburg is located on a huge coal field. Sasol I, the existing synthetics plant, is part of a versatile chemical complex that supplies much of South Africa's needs for materials such as nitrogen fertilizers, plastics, and pipeline gas. Consumption of coal at Sasol is 5 million tons a year. Coal is gasified in Lurgi reactors with steam and oxygen at total pressures of about 20 atmospheres. Principal products are H_2, CO, CO_2, and CH_4. The key components are H_2 and CO. Their ratio can be adjusted by varying the amounts of H_2O and O_2 used in the gasification. Constituents present in addition to the major gaseous products include NH_3, H_2S, and other sulfur-containing substances. To purify the raw products the gas is cooled, condensing out water and phenolic-type substances, and the remaining gas is passed through three absorption trains employing very cold methanol. This removes essentially everything except H_2, CO, and CH_4. Sulfur abundance in the purified gas is less than 1×10^{-8}. This guarantees relative freedom from sulfide poisoning of catalysts and a low sulfur content in the final products. Reactions between H_2 and CO can give rise to an enormous number of products. The outcome depends on the initial concentration of H_2 and CO, pressure, temperature, and catalysts employed. The South Africans have made substantial discoveries about formulations and performances of catalysts. However, ultimates in specificity have probably not been reached.

When the plant was first operated in 1955, very great problems were encountered. All segments of the plant had been tested successfully on a pilot scale. But the full-scale synthetic part did not function as expected, and 5 years of discouraging struggles followed. Today, the plant performs well above its design capability.

In October 1973, when the international price of oil was raised, South Africa began intensified efforts to cut its dependence on imports. A large-scale synthetics plant, Sasol II, designed principally to produce gasoline, was authorized. This will be coming on-stream in 1980. When the Shah of Iran was deposed, oil from that country was no longer directly available. South Africa was forced to go to the spot market and pay high prices. Very quickly an additional major synthetics plant was authorized. The two installations, which are designed for zero emission of liquid wastes, will produce more than 100,000 barrels of hydrocarbon liquids a day and will supply more than half South Africa's consumption. Both installations will probably be in full production by 1984. Construction costs will total about $7 billion. Considering South Africa's gross national product and energy consumption, its effort is comparable to a $300-billion crash program for the United States.

The South African synthetic fuels program is well designed to fit their particular needs. Our needs and opportunities differ. We have heavy oils, tar sands, and oil shale. A number of schemes for direct hydrogenation of coal are being developed. Efforts to use bioenergy are being expanded. However, if we wish to obtain synthetic liquids quickly, on schedule, and at predictable costs, we might do well to look closely at the extensive South African experience.—PHILIP H. ABELSON

Calculating the mean weight or net weight of 48 weighed samples takes time.

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For literature, just write: Sartorius Balances Division, Brinkmann Instruments, Inc., Cantiague Road, Westbury, N.Y. 11590.

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