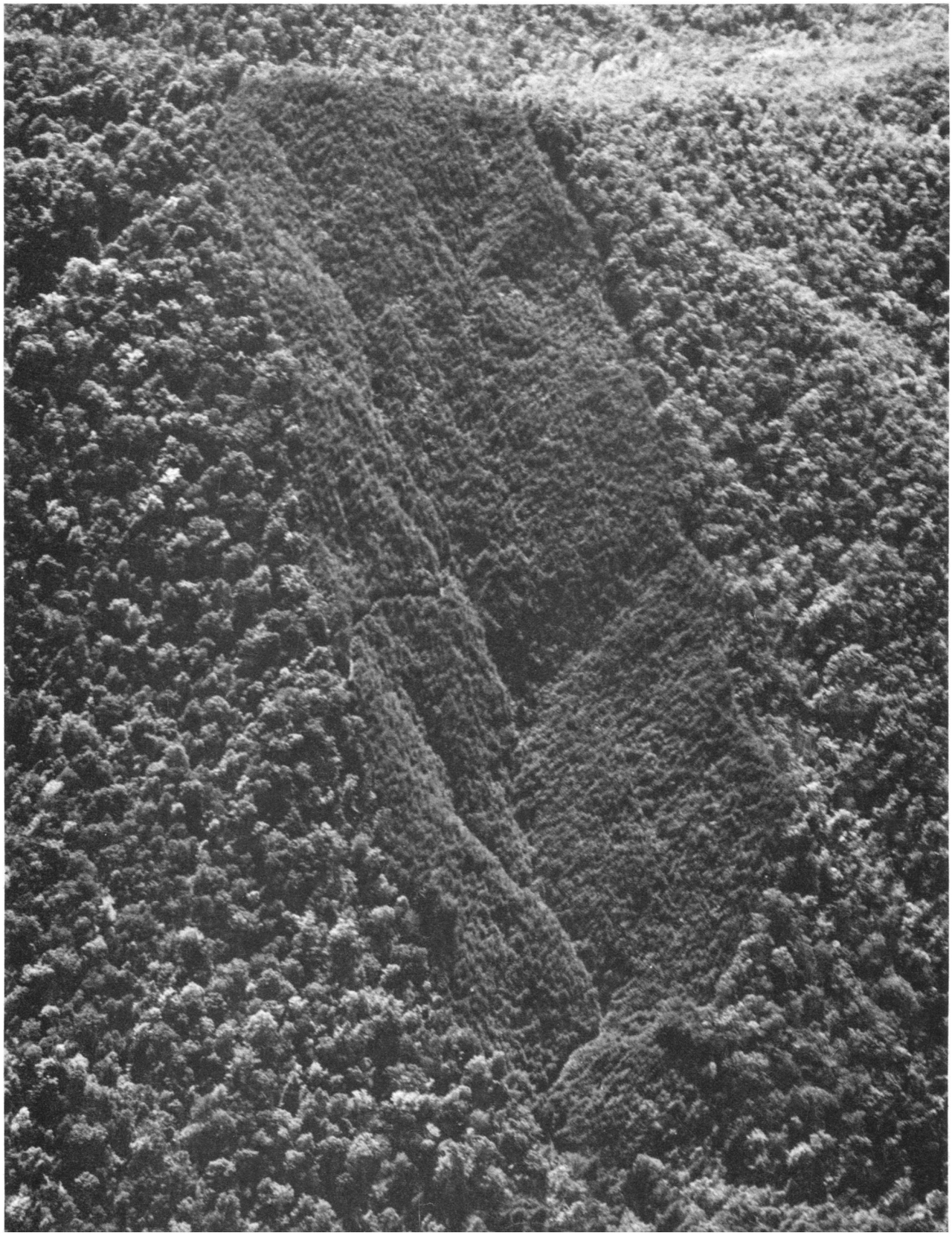
SCIENCE

6 September 1974

Vol. 185, No. 4154

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Start a quiet revolution

Turn on a Beckman J-21B Centrifuge

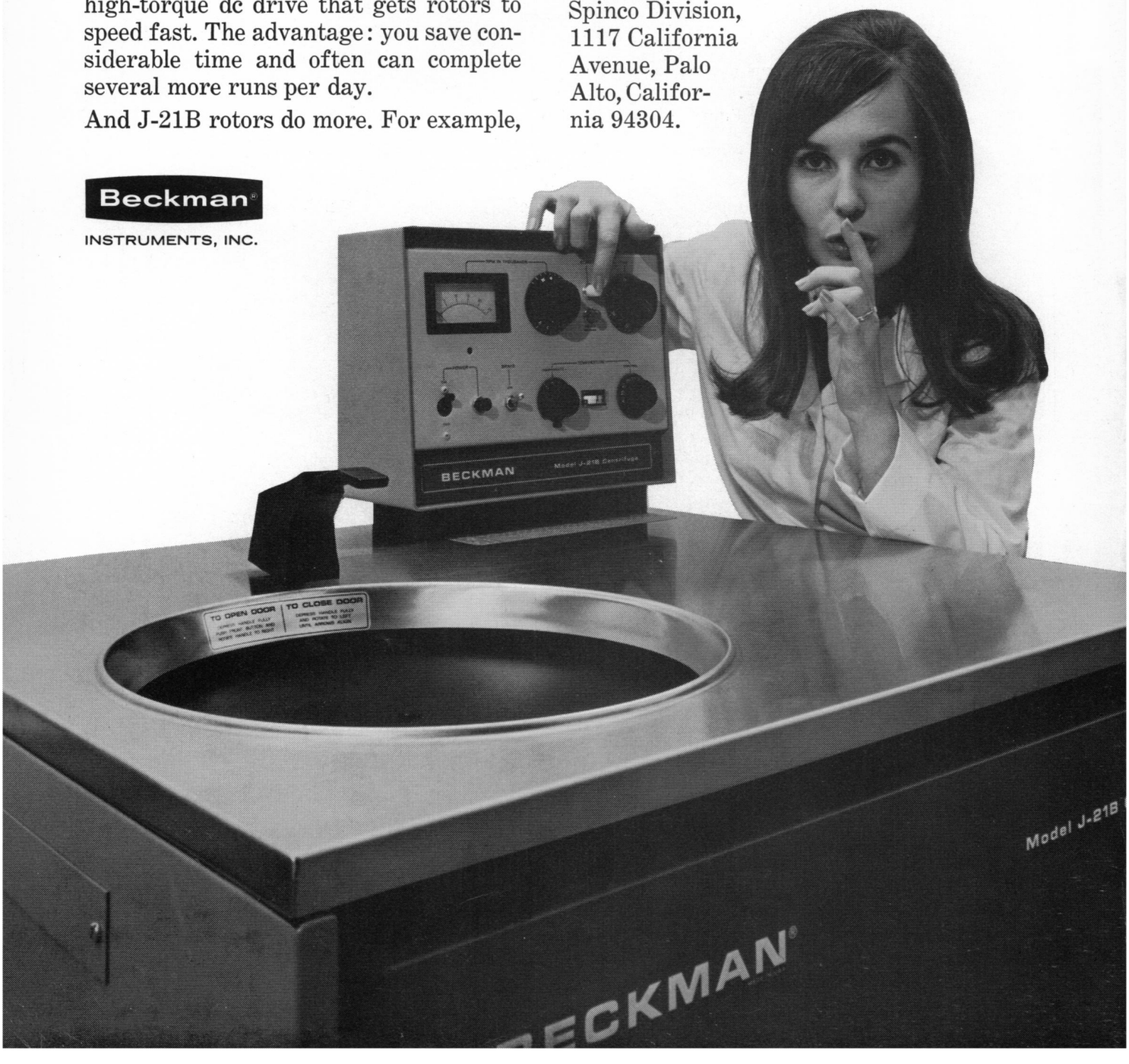
The new Beckman J-21B refrigerated centrifuge is quieting down a lot of labs. We've thoroughly sound-dampened it and vibration-isolated the drive so there's no whine and very little noise.

But quiet is only one advantage of the J-21B. It has an automatic vacuum system that reduces wind friction and a high-torque dc drive that gets rotors to speed fast. The advantage: you save considerable time and often can complete several more runs per day.

And J-21B rotors do more. For example, the JCF-Z rotor permits separations by continuous flow, zonal and reorienting gradient techniques—all in one rotor body with interchangeable cores.

You can start a quiet (and more efficient) revolution in your lab by buying a J-21B. Send for Brochure SB-366 to Beckman Instruments, Inc., Spinco Division, 1117 California Avenue, Palo Alto, California 94304.

Beckman®
INSTRUMENTS, INC.



dull dull dull dull dull dull dull dull dull dull

Dullness is in the eye of the beholder. Soon he is sound asleep. Too bad, because it was an interesting subject. Unfortunate. Unfair.

To get even, you do it to others. Mumbling becomes a way of life. Mumble or be deemed flamboyant.

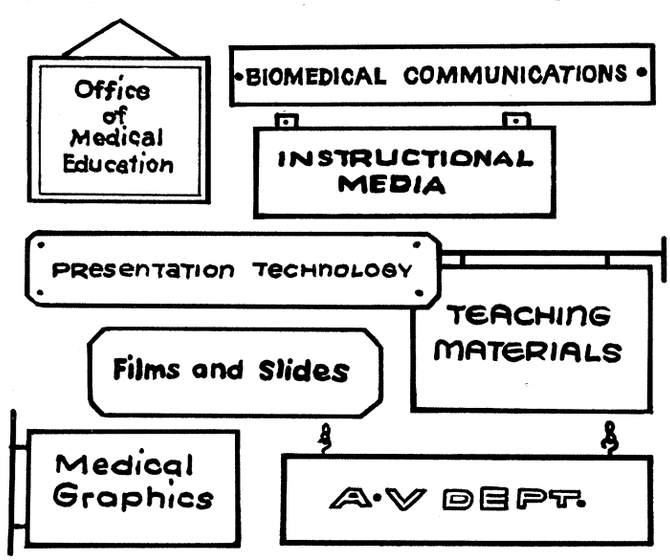
Flamboyance is to be shunned. Only content matters.

Most institutional environments now shelter departments that are in the business of packaging information for effective transmission across the mind/mind barrier. They know what will or won't work as a slide.

Fie upon them. Just indicate what pages from what notebooks, charts, and miscellaneous scraps of old graph paper you want photographed as slides and tell them to be quick about it. Tomorrow morning at the latest. Nothing fancy. Only content matters.

And so a merciful stupor engulfs all but the one person in the audience who doesn't face the impossible task of making anything out of the slides. Having discussed the data thoroughly with the speaker months ago, that person can hardly wait to wake them up by questioning the validity of the whole approach.

Perhaps higher education and intellectual enterprise in general might be better served if savants would more often go looking down strange corridors for some such sign as:



Such signs often lead to people who take as much pride in their competence as you do in yours.

Kodak

6 September 1974

Volume 185, No. 4154

SCIENCE

LETTERS

Behavior Modification: *B. F. Skinner*; The Tragedy of the Sahel Commons: *V. R. Potter*; Watergate Tape Erasure: *C. C. Counselman III* and *I. I. Shapiro*; Shadow of the Sun: *A. L. Jones*; Teratogens and the Delaney Clause: *R. E. Staples*; Confidentiality: *J. J. Casserly*; Scientific Methods in Ethology: *G. Ankerl* and *D. Pereboom; D. R. Griffin* and *P. Marler* . . 813

EDITORIAL

The Humility Factor: *A. Etzioni* 817

ARTICLES

University Isotope Separator at Oak Ridge: The UNISOR Consortium: *J. H. Hamilton* 819

Behavioral Regulation of the Milieu Interne in Man and Rat: *J. Garcia, W. G. Hankins, K. W. Rusiniak* 824

Effects of the Scopes Trial: *J. V. Grabiner* and *P. D. Miller* 832

NEWS AND COMMENT

Nuclear Safety: Calculating the Odds of Disaster 838

Dalkon Shield Affair: A Bad Lesson in Science and Decision-Making 839

Fermi National Accelerator Lab: Making the Users More at Home 841

Green Revolution: Creators Still Quite Hopeful on World Food 844

RESEARCH NEWS

Niobium-Germanium: Becoming a Practical Superconductor 846

Chemistry and Science: The Next Hundred Years 847

SCIENCE is published weekly, except the last week in December, but with an extra issue on the fourth Tuesday in November, by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Now combined with The Scientific Monthly®. Second-class postage paid at Washington, D.C. Member rates on request. Annual subscription $40; foreign postage: Americas $6, overseas: $8, air lift to Europe $20. Single copies $1 (back issues, $2) except Guide to Scientific Instruments which is $4. School year subscription: 9 months $30; 10 months $33.50 Provide 6 weeks notice for change of address, giving new and old address and zip codes. Send a recent address label. Science is indexed in the Reader's Guide to Periodical Literature.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

BOOK REVIEWS

Archaeological Researches in Retrospect, *reviewed by R. M. Adams*; The People of America *and* The Pacific Islanders, *W. M. Bass*; Biopolymers, *G. D. Fasman*; Books Received 849

REPORTS

Asbestiform Amphibole Minerals: Detection and Measurement of High Concentrations in Municipal Water Supplies: *P. M. Cook, G. E. Glass, J. H. Tucker* 853

Electrical Resistivity Variations Associated with Earthquakes on the San Andreas Fault: *A. Mazzella* and *H. F. Morrison* 855

Streamflow Greatly Reduced by Converting Deciduous Hardwood Stands to Pine: *W. T. Swank* and *J. E. Douglass* 857

Human Serum Albumin Phenotype Activation in Mouse Hepatoma–Human Leukocyte Cell Hybrids: *G. J. Darlington, H. P. Bernhard, F. H. Ruddle* 859

Amino Acid Difference Formula to Help Explain Protein Evolution: *R. Grantham* .. 862

Reverse Transcriptase in Normal Rhesus Monkey Placenta: *R. J. Mayer, R. G. Smith, R. C. Gallo* 864

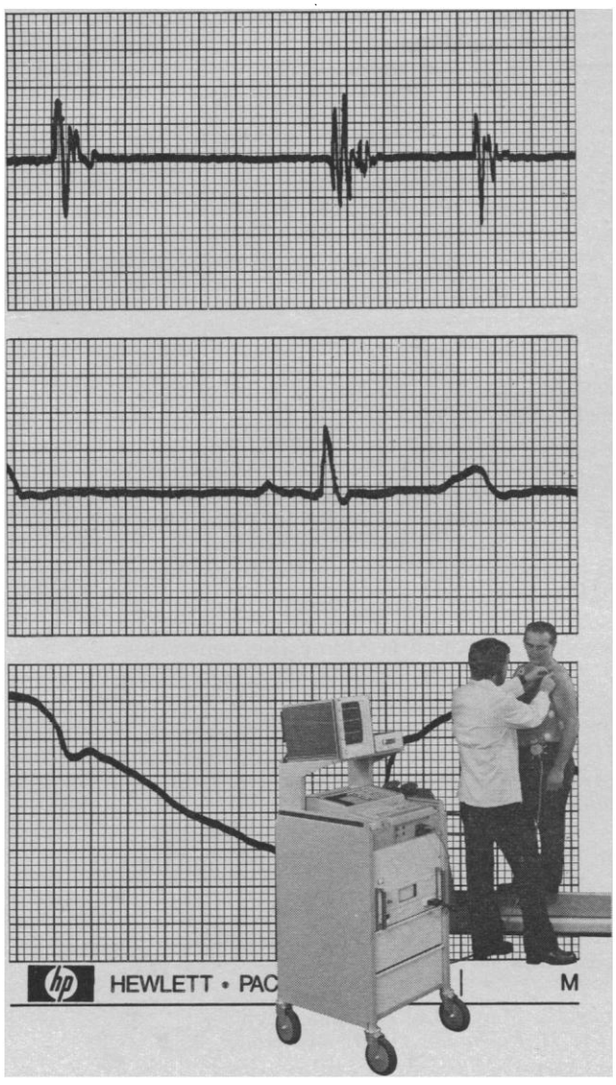
Inert Gas Narcosis, the High Pressure Neurological Syndrome, and the Critical Volume Hypothesis: *K. W. Miller* 867

Antibody to Leukemia Virus: Widespread Occurrence in Inbred Mice: *R. C. Nowinski* and *S. L. Kaehler* 869

Technical Comments: Language in Man, Monkeys, and Machines: *J. L. Mistler-Lachman* and *R. Lachman; D. M. Rumbaugh, T. V. Gill, E. C. von Glasersfeld* 871

COVER

Watershed (area of 13.4 hectares), one of two in the southern Appalachian Mountains that were experimentally converted from indigenous hardwoods to white pine. After only 15 years, streamflow from both pine-covered watersheds was substantially less than flow from watersheds covered with mature deciduous hardwoods similar to those shown adjacent to the pine. See page 857. [Forest Service, U.S. Department of Agriculture]



Heart Attack: a new test may help prevent it.

In June 1972, a jet aircraft crashed during takeoff for no apparent reason. An autopsy of the 51-year-old pilot revealed the cause: he had suffered a heart attack due to atherosclerosis "so severe that it must have been developing for 30 years or more," according to the examining pathologist. Yet the pilot's annual cardiograms showed no evidence of cardiovascular disease.

This dramatic case is not exceptional: according to the American Heart Association, about 60 percent of adults with severe cardiovascular disease have normal "at rest" cardiograms.

The problem is not that the conventional electrocardiogram is wrong: the ECG is and has been for years an important test of the heart's condition *in a resting state*. The problem is that the conventional ECG cannot show early signs of coronary heart disease—constriction of the coronary arteries—that can become a serious hazard when heart and blood vessels are stressed and demands for oxygen-laden blood rise sharply.

What is needed, the majority of cardiologists now agree, is an accurate measure of cardiac performance and circulatory response both at rest and during exercise. There is also a growing consensus that the ECG is most informative when taken during an exercise routine that calls for maximal effort by the patient.

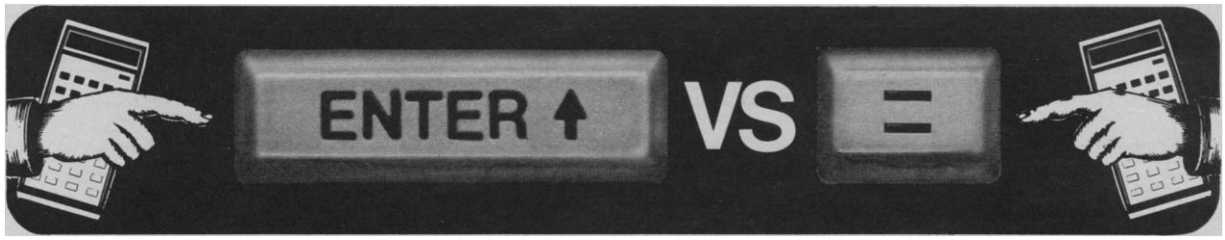
During a typical stress ECG, the physician continuously monitors heart action while you work out on a treadmill. He gradually increases your workload on a schedule that is precisely tailored to your age and condition.

By examining your stress ECG, the cardiologist can determine the condition of your coronary arteries. If he detects a depression in a critical segment of the cardiogram, he knows your coronary arteries are not supplying enough oxygen to support your heart muscle during stress; the amount of the depression gives him a sensitive measure of the degree of impairment in the arteries.

Many cardiologists agree that, properly administered, the stress ECG can detect early coronary disease and even latent stroke dangers. And stress testing is being used by an increasing number of cardiologists to prescribe specific exercise therapy for cardiac patients.

Aware of the increasing documentation of the diagnostic and prognostic value of ECG stress testing, our medical instrumentation specialists have designed a complete, mobile Exercise ECG System to facilitate and optimize the procedure in offices and hospital exercise laboratories. The new HP 1525A system includes an automatic 3-channel cardiograph that can record a complete 12-lead ECG in 10 seconds while the patient is exercising on a treadmill.

This system also incorporates a large, nonfading scope for continuous monitoring. Its flexible controls allow the cardiologist to keep a waveform on the scope for as long as 40 seconds; to observe PVC and other transient changes and permanently record them, just by flipping a switch; and to display a prestress ECG trace while continuously comparing it with a current stress ECG. The system also includes a heart rate meter and a number of valuable optional features: defibrillator, heart sound/pulse wave amplifier for noninvasive systolic time interval studies, and pushbutton selection of Frank leads or any three of the 12 classical leads for simultaneous display and recording.



HP pocket-sized calculators give you answers you can trust. (Why we chose to be different.)

Most pocket-sized calculators have an = key, and you can pick up one you've never seen before and solve a simple equation by entering values the way they're written and pressing = to see your answer.

Pick up one of our pocket-sized machines and you'll hunt in vain for the = key. Instead you'll see one that says ENTER and you'll wonder what to do with it.

To find out, you'll have to look in the Operating Manual. When you do, you may think, "Why did they go this route when they could have kept it simple?"

But as you work the examples in the manual and practice with your own problems, you'll find yourself thinking, "This is very easy, and I'm getting answers I can really trust."

Easy because you always enter your data the same way—from left to right, the way you read an equation, but without having to keep track of parentheses and brackets.

Trust because you see the result of each intermediate calculation displayed as you perform it, and you can check your progress and correct errors as you go. You can also go back and review stored numbers at any time.

When we started out to design a small, powerful scientific calculator several years ago, we assumed it would have an = key. It did, in the breadboard stage.

But along the way from breadboard to prototype, our designers realized that there was a better method which got around some of the severe limitations inherent in the "algebraic" approach.

These limitations start showing up as problems get more complicated and you have to spend a lot of time figuring out how to put them into an algebraic calculator. "A plus B times C minus D divided by E equals" won't do it.

You find you must write down intermediate answers to re-enter later. You may work your way through a long equation and see an answer you know is wrong. Where did you goof?

Or you may get a wrong answer and think it's right. Disaster.

Our non-algebraic approach not only makes it unnecessary for you to write and re-enter intermediate results, but gives you the continuous feedback you need to avoid ending up with a wrong answer.

It's an approach we first adapted and applied some years ago, using an unambiguous, parentheses-free language developed by the Polish mathematician Jan Lukasiewicz.

Before you invest in a pocket-sized calculator, you should look beyond its ability to solve simple problems in the most obvious way. To understand more fully the difference between our approach and the algebraic one, return the coupon for a copy of the booklet ENTER VS. =. You owe it to yourself to read it. We will also send you information on our pocket-sized calculators: the HP-35 electronic slide rule ($225*), the HP-45 advanced scientific calculator ($325*), the HP-65 programmable computer calculator ($795*), the HP-70 business calculator ($275*), and the HP-80 financial calculator ($395*).

For more information on these products write to us. Hewlett-Packard, 1507 Page Mill Road, Palo Alto, California 94304.

*Domestic USA prices only. 00433

Mail to: Hewlett-Packard, 1507 Page Mill Road, Palo Alto, CA 94304
Please send me information on:

( ) HP 1525A Exercise ECG System
( ) Please send me *ENTER VS. =* booklet.

Name_____ Title_____
Company_____
Address_____
City_____ State_____ Zip_____

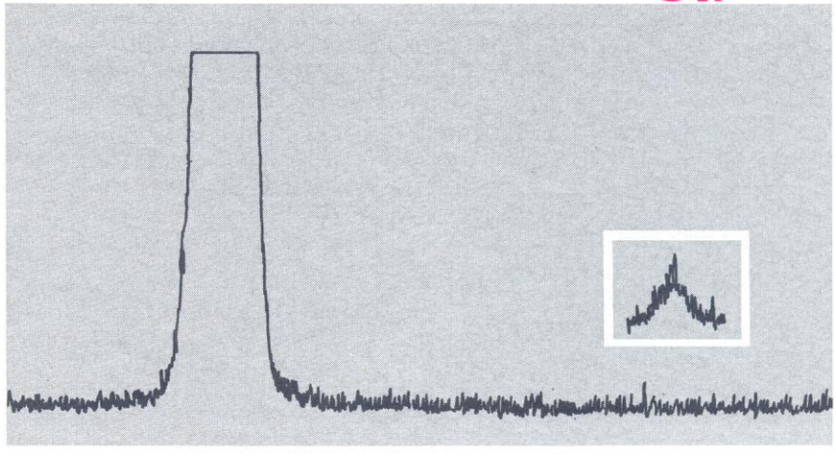
HEWLETT hp PACKARD

Sales and service from 172 offices in 65 countries.
Palo Alto, California 94304

Unless you scrutinized our catalog pretty carefully, you'd never know that when we're analyzing our labeled compounds for impurities we run two radio-chromatograms, not just one. For the second scan we dilute the compound 1:100, then compare this to the elevated areas of the base line. By this method we can determine with greater accuracy the percentage of impurities — typically to within 0.5%.

The small extra step in our quality control system increases your assurance of a better product, and it's one of the many reasons why people choose New England Nuclear.

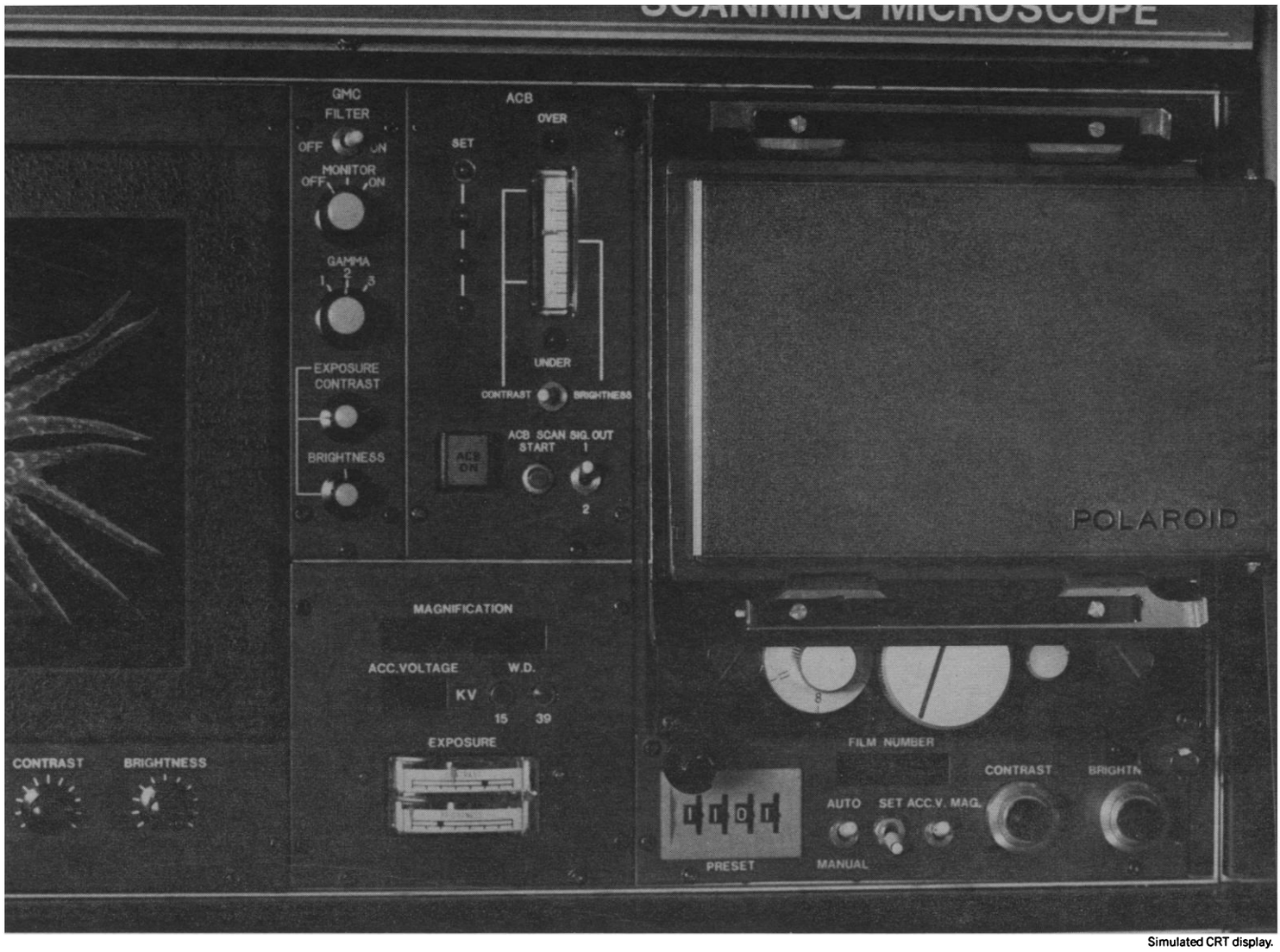
In tracer methodology,



it's the little things that count.

NEN New England Nuclear
575 Albany Street, Boston, Massachusetts 02118
Customer Service 617-482-9595

Canada: NEN Canada Ltd., Dorval, Quebec, H9P-1B3, Tel: (514) 636-4971, Telex: 05-821808
Europe: NEN Chemicals GmbH, D6072 Dreieichenhain, Siemensstrasse 1, W. Germany. Tel: Langen (06103) 85035



Simulated CRT display.

Polaroid's instant negative pack film can back up almost any professional photographic instrument you now use.

Whether you make photomicrographs, CRT recordings or just quick photos for record purposes, Polaroid's Type 105 Land film will back up your equipment with a kind of flexibility you've never had before.

With Type 105 you get an instant photograph with superb tonal gradation and sharp detail, ready for immediate use. And you also get an instant professional-quality negative.

Without a trip to the darkroom.

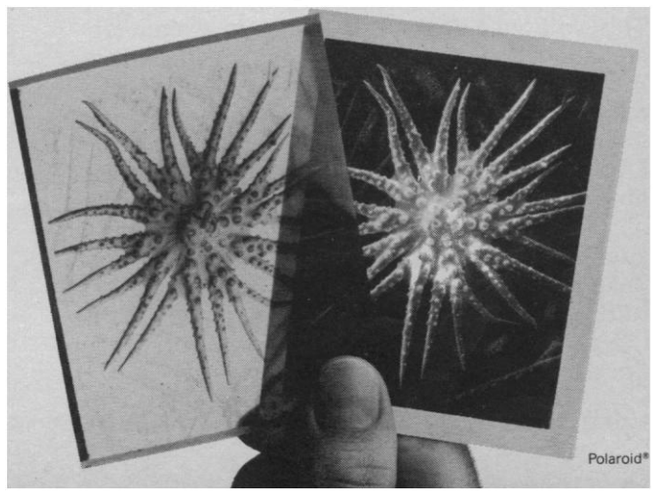
After a simple clearing and washing of the negative, you can make as many copies and enlargements as you need.

Type 105 comes in a 3¼ x 4¼ inch film pack that fits any instrument or camera that accepts a Polaroid pack film back. And with our Model 405 pack film holder our film can be used with most 4 x 5 inch cameras and instruments. In addition, pack film is economical and easy to use. And since it develops outside the camera, you don't have to waste time between shots. Speed is a convenient 75 ASA.

With our 105 you know what you've got when you've got it. And thanks to the instant negative, you can get as many copies and enlargements as you want when you want them.

See your photo dealer for more details.

Polaroid Type 105 positive/negative film.



Here are a few problems Olivetti is ready to solve for you on its newest, fastest, most powerful P-652 microcomputer.

How many are on your list? Check them off and send to us.

STATISTICAL SIGNIFICANCE AND REGRESSION ANALYSIS:

- ☐ Regression coefficients with standard errors
- ☐ Paired data analysis with transformations and confidence limits
- ☐ Multiple linear regression
- ☐ Polynomial regression
- ☐ Stepwise linear regression
- ☐ Multiple correlation coefficients
- ☐ Partial correlation coefficients
- ☐ F-statistic with significance levels
- ☐ t-statistic with significance levels
- ☐ Confidence limits on statistics
- ☐ Curve fitting (we have a wide range of models)
- ☐ Test for linearity
- ☐ Test for outliers
- ☐ Test for normality
- ☐ Distribution studies (Poisson, Beta, Binomial, Erlang, Weibull, etc.)
- ☐ Biserial and point biserial correlation coefficients
- ☐ Contingency tables
- ☐ Non-parametric statistics
- ☐ Moments and statistics of frequency distributions
- ☐ Moving averages
- ☐ Smoothing
- ☐ Trend analysis (Quadratic, Exponential, Logistic, Gompertz, etc.)

ANALYSIS OF VARIANCE:

- ☐ One-way ANOVA
- ☐ Two-way ANOVA
- ☐ Three-way ANOVA
- ☐ Analysis of Covariance

(We have a wide range of models.)

- ☐ Latin Square
- ☐ Factorial design
- ☐ Nested (hierarchical) design
- ☐ Randomized Block design
- ☐ Bartlett's Test
- ☐ Scheffe's Test
- ☐ Newman-Keuls Test
- ☐ Tukey's Test
- ☐ Least significance difference
- ☐ Comparisons among class means

BIOSTATISTICS:

- ☐ Quantitative log-dose response
- ☐ Quantal log-dose response

(We have both single and parallel line assays.)

- ☐ Slope-ratio assays
- ☐ Logit, NED, or Probit transformations
- ☐ Variance-weighted Radioimmunoassay data reduction
- ☐ RIA kit data reduction

(We have systems for most major protocols.)

OTHER _____

_____

_____

_____

_____

ARE YOU MAINLY INTERESTED IN:

- ☐ Hypothesis testing?
- ☐ Parameter estimating?
- ☐ Forecasting?
- ☐ Quality control?
- ☐ Determining significant variables?

WOULD OFF-LINE PROCESSING OF DATA FROM ANALYTIC INSTRUMENTS BE IMPORTANT?

☐ Yes ☐ No

Olivetti Corporation of America, 500 Park Avenue, New York City 10022
Attn: Microcomputer Systems

I've checked what I need. Please send me the specifics.

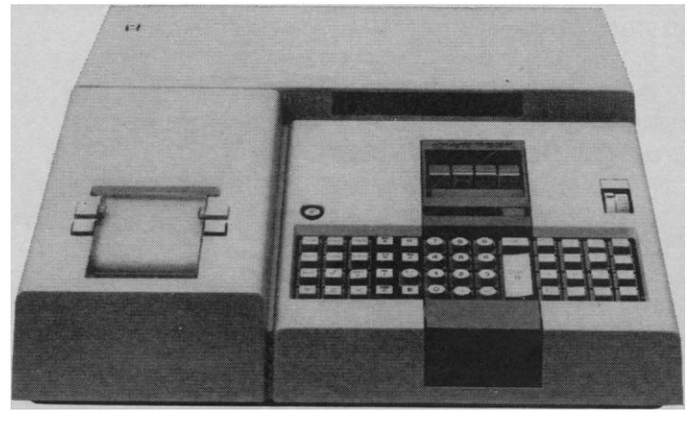
☐ I'm already using an Olivetti P-101 or P-602

NAME _____ TITLE _____

COMPANY _____ ADDRESS _____

CITY _____ STATE _____ ZIP _____ PHONE _____ S-9

This, without a doubt, is the ultimate system for statistical analysis on a small data base. It utilizes the newest, most advanced hardware—Olivetti's P-652 microcomputer (fifty times faster than our P-101, the famous statistical desk top computer used in labs and schools all over the world). And a comprehensive library of detailed, documented software offering all sorts of options for different running modes with special emphasis on error correction procedures. Take a look, there's nothing like it on the market. And, of course, it's backed by that famed reliable Olivetti service. Want to know more? Send the coupon.



OLIVETTI CORPORATION OF AMERICA, 500 PARK AVE., NEW YORK CITY 10022

6 September 1974, Volume 185, Number 4154 **SCIENCE**

The Humility Factor

There is a humbling lesson in the recent sharp decline in highway fatalities. Traffic accidents are a major social problem by any standard, and until recently more Americans died each year on the roads than in all the years of war in Southeast Asia, roughly 55,000 in 1970. The number of persons injured that same year ran to 5,100,000. The annual economic loss per seriously injured person in medical expenses, property damage, and lost earnings runs into the billions.

Over the years the problem was studied and a variety of efforts were launched to correct it. Some favored the educational approach, especially driver education classes and public persuasion campaigns ("the life you save may be your own"). Others subscribed to technological cures: redesign of the automobile (Ralph Nader argued that the cars were "unsafe at any speed," not the drivers) and redesign of the roads (railings, flexible signposts, and so on). Still others appealed to the long arm of the law, asking for stiffer penalties for traffic violators and mandatory use of seat belts. And yet another set of people pointed to alcohol as the major cause of fatal accidents and called for greater use of breath analyzers to get those driving while under the influence of liquor off the road. Each approach had its proponents, detractors, supportive data, and counterclaims. The number of traffic deaths continued to rise from 38,000 in 1960 to 49,000 in 1965 to 55,000 in 1970, while injuries went from 3,078,000 to 4,100,000 to 5,100,000 in the same years.

Then came the energy crisis, hardly designed by any traffic safety council, and the 55 mile an hour speed limit, introduced, oddly enough, not to save lives but to conserve energy. Since then the slaughter on the highways has been curtailed by more than 23 percent.

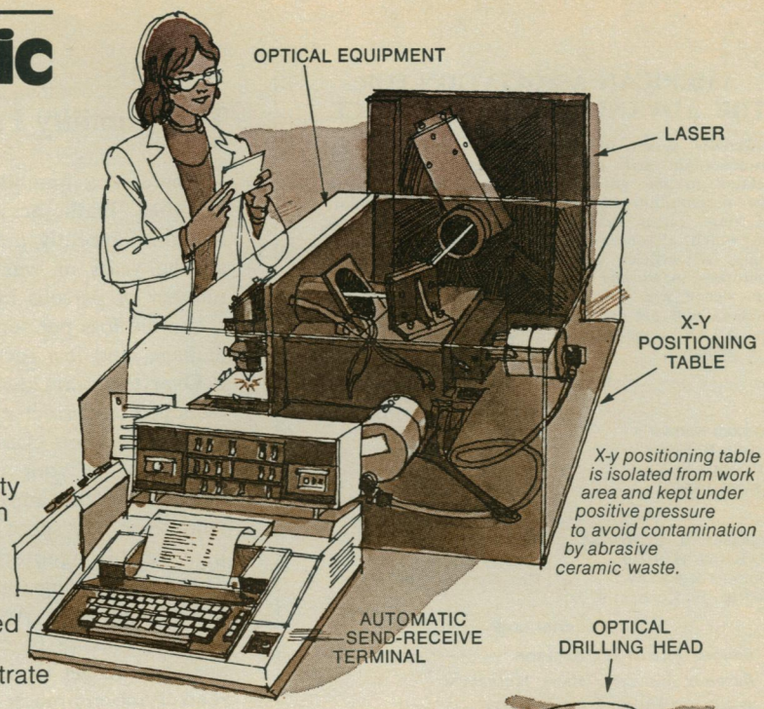
This is not the only social problem to be drastically affected by factors neither foreseen nor deliberately introduced for the purpose. The sharpest drop in the number of mental patients in state mental hospitals was caused not by any root change in the psychiatric treatment administered, but chiefly by the discovery of tranquilizers, which allow many patients to remain at home with little cost to the state. Thanks to tranquilizers, the number of people kept incarcerated in state mental hospitals fell from 535,540 in 1960 to 373,984 in 1969.

Finally, the problems of the major urban centers, such as housing, welfare, and busing, were to a very large degree created by an influx of millions of poor Americans from the countryside, especially the South. More than any program created by any major city council or state or federal agency, the recent cessation and partial reversal of this movement, including remigration to the South, may ameliorate conditions in the cities. (Between 1940 and 1970, 4.4 million blacks alone left the South. A recent study suggests that between 1970 and 1973 more blacks migrated to the South than from the South.)

The moral? Our capacity to engineer society is at a relatively early and primitive stage. The cliché "If we can put a man on the moon, we should be able to . . ." holds only as an aspiration for the farther future. For the near one, humility is of the essence. A scientific orientation to our societal problems is essential, but first of all in the sense of a rational, open-minded, empirical orientation, rather than one which relies on a priori beliefs and assumptions. The easy optimism that goes with the assumption that we can design a quick cure for most things that ail us is not called for. It results in an oversell of what science and technology can do for the highly intricate, societal world, whose dynamics we are only slowly learning to understand.—AMITAI ETZIONI, *Professor of Sociology, Columbia University, and Director, Center for Policy Research, Inc., 475 Riverside Drive, New York 10027*

Western Electric Reports:

Laser drilling. We do it with mirrors.



X-y positioning table is isolated from work area and kept under positive pressure to avoid contamination by abrasive ceramic waste.

Thin-film circuit boards in high capacity telephone transmission systems often require hundreds of connections to power and ground sources.

Plated through-holes have proven an efficient way to make these connections. Coated with conducting material, they connect the circuitry carried on one side of a ceramic substrate with power and ground on the other side.

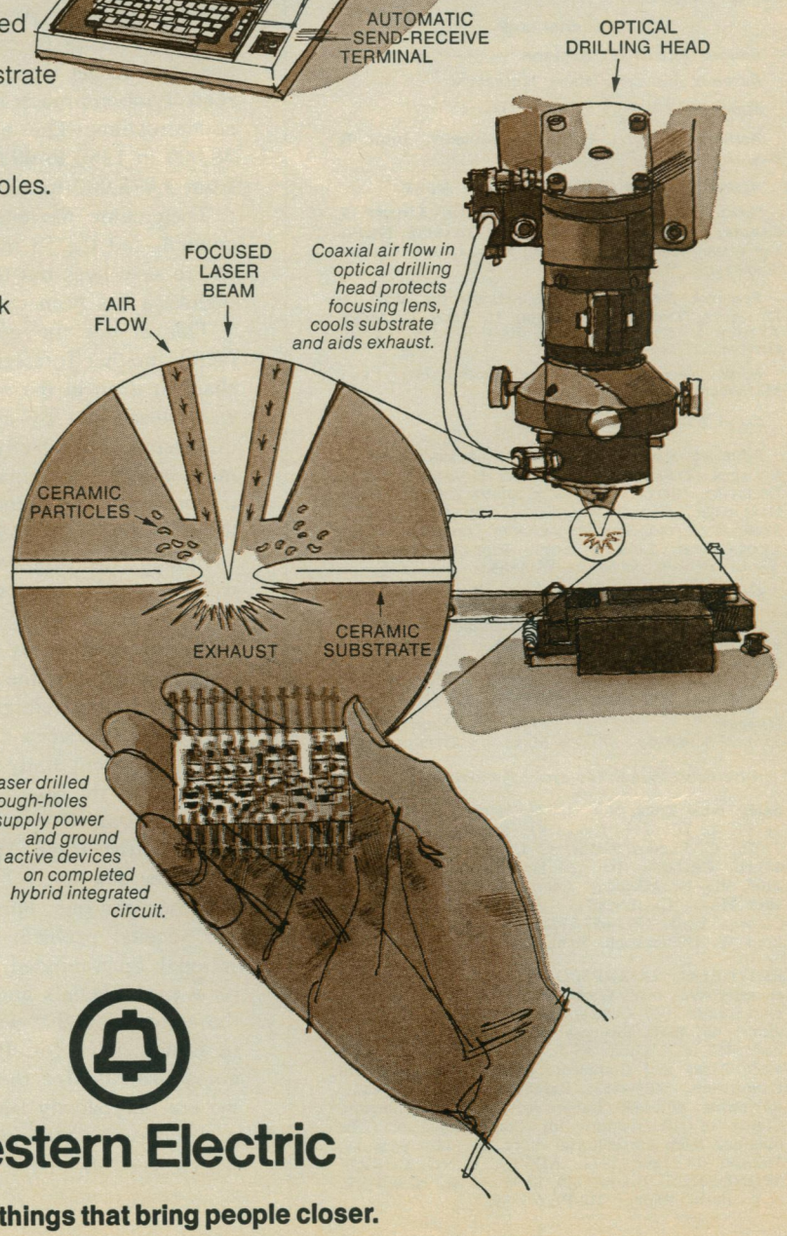
These holes could be punched in the ceramic before it is fired. But shrinkage during firing can move the positions of the holes.

And because of component density, the precise placement of each hole is critical. It can't be more than two mils off.

Engineers at Western Electric's Merrimack Valley Works in Massachusetts recently developed a high-speed method of drilling these holes *after firing* by using a conventional CO_2 laser.

A complex of mirrors on an x-y positioning table is shifted to play the laser beam across a stationary ceramic substrate in a predetermined pattern. The mirrors direct the beam from the laser head enclosure to the positioning table and manipulate it in the x-y axes. An optical drilling head coupled to the table focuses the beam onto the ceramic. The system is controlled by a mini computer coupled with an automatic send-receive terminal. Pattern storage on a cassette tape allows easy changeover and storage.

Benefit: Laser drilling of ceramic substrates after firing has greatly improved positioning accuracy of plated through-holes. And computer controlled laser drilling has doubled the production rate over conventional laser systems—up to five holes a second in closely spaced patterns.



Coaxial air flow in optical drilling head protects focusing lens, cools substrate and aids exhaust.

Laser drilled through-holes supply power and ground to active devices on completed hybrid integrated circuit.

Western Electric

We make things that bring people closer.