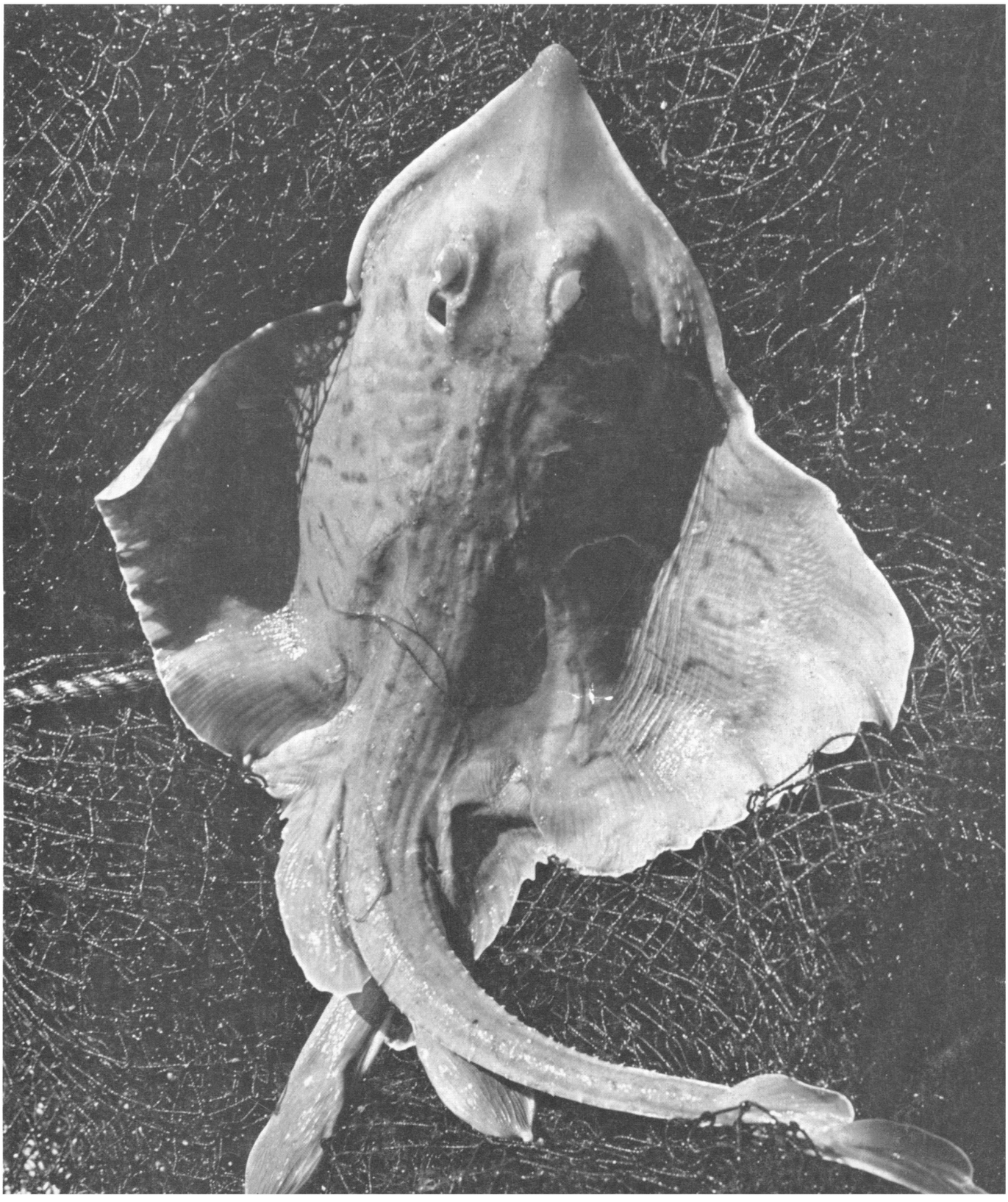
SCIENCE

4 October 1974

Vol. 186, No. 4158

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



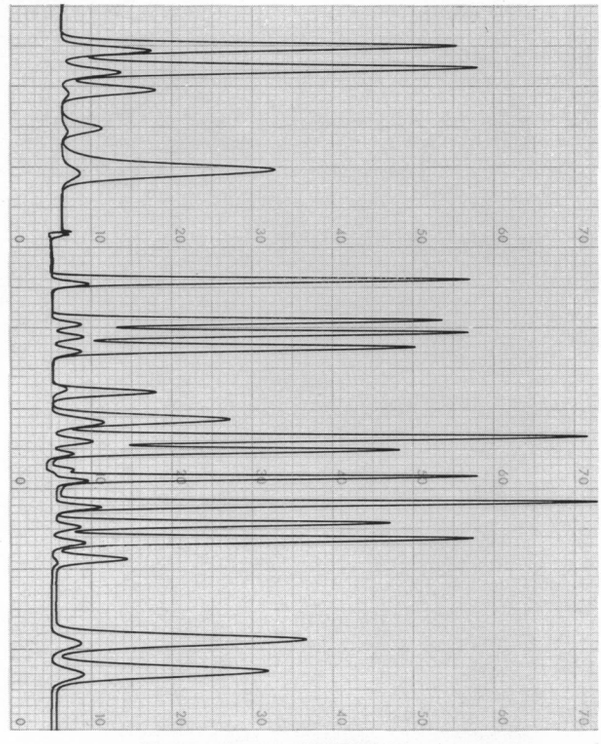
The 121M Amino Acid Analyzer runs samples as small as 0.1 nmole

This new Beckman Amino Acid Analyzer offers the important advantages of microcolumn operation—rapid, high sensitivity analyses, less sample volume, and 1/10 the reagent consumption of conventional systems.

With its microbore (2.8 mm) columns, the Model 121M can analyze samples as small as 0.1 nanomole per component. That's 20 times the sensitivity of our Model 121 Analyzer which uses conventional bore (9.0 mm) columns. Model 121M sample volume can be as little as 20 μl, an important plus when only a limited amount of sample is available. And, a typical hydrolyzate run takes only 90 minutes at conventional column pressures.

The fully automatic Model 121M will analyze up to 72 samples without operator attention. You can get computed results, too—in concentration, percent concentration, molar ratio, and 440/570 nm ratio—by adding the new Beckman System AA Computing Integrator.

Let us send you full information on the 121M. Write Spinco Division, Beckman Instruments, Inc., 1117 California Avenue, Palo Alto, Calif. 94304.



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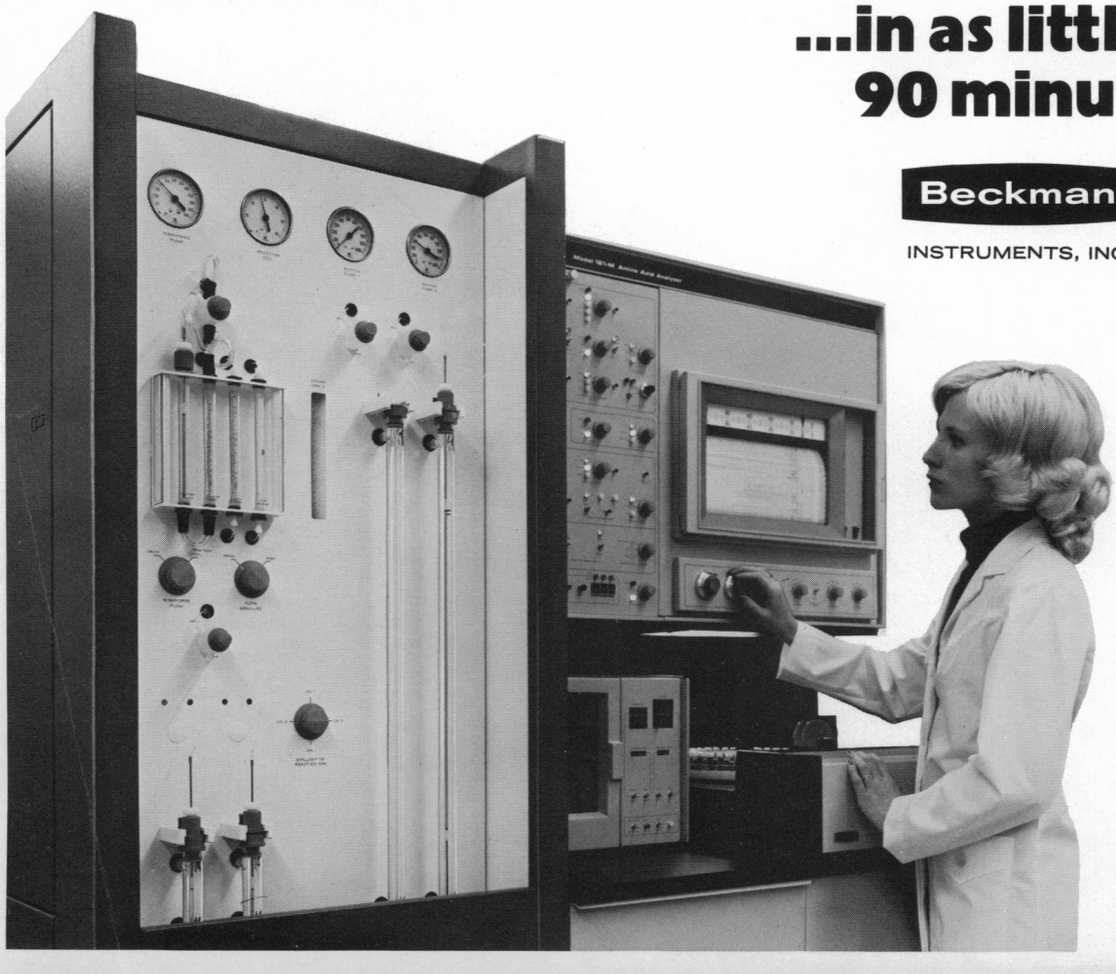

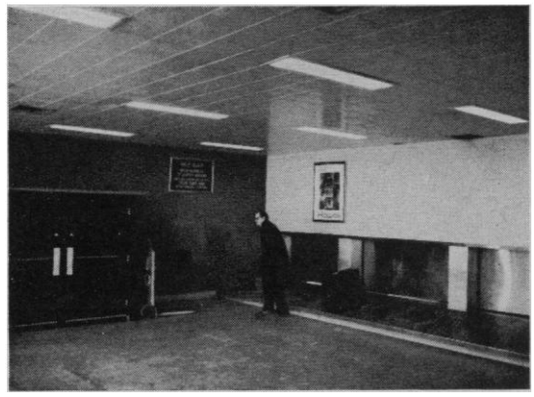

Fear of crime can help see growth of
tissue
tides
traffic jams
corrosion
construction projects
storms
birds' nests

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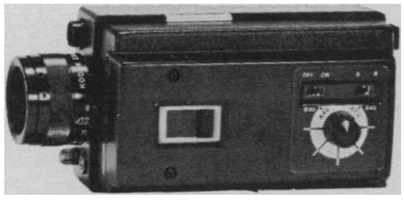


Widespread worry over suspicious activities brought forth the KODAK ANALYST Super 8 Camera. The quantity produced has been sufficient to keep the price less than $245, complete with mounting bracket, sound-absorbent box, sighting mirror.

If interested in acquiring one or more, write Kodak, Graphic Data, Department 661B, Rochester, N.Y. 14650. (Hold your payment. Just write.)

The camera takes 3600 pictures at a loading, 7200 if you can forego showing them on a movie screen. Choose your interval anywhere from 1¼ seconds to 90 seconds. For longer intervals a suitable timing device can be plugged in. Shutter speed is 1/100 sec. Operates as cold as −18 C. Powered by 4 AA-size 1.5 V alkaline batteries or by converter from 117 V, 60 Hz outlet. Aperture adjusts itself to the light conditions up to *f*/1.9. Lens has focusing scale and zooms to permit choice of field coverage from 10 inches x 14 inches at 6 feet to 45 feet x 61 feet at 150 feet.

Takes a variety of films that come in 50-ft super 8 cartridges, including KODAK 4-X Reversal Film 7277 at 400 daylight speed, color films at 160 tungsten speed, black-and-white films that can be processed to a negative or reversal image either commercially or with your own simple equipment. Also takes 100-ft cartridges of KODAK MFX Film that can be processed to a negative or positive for study on a film editor or viewer. Interesting frames can be blown up to paper prints.

Kodak

Price subject to change without notice.

4 October 1974

Volume 186, No. 4158

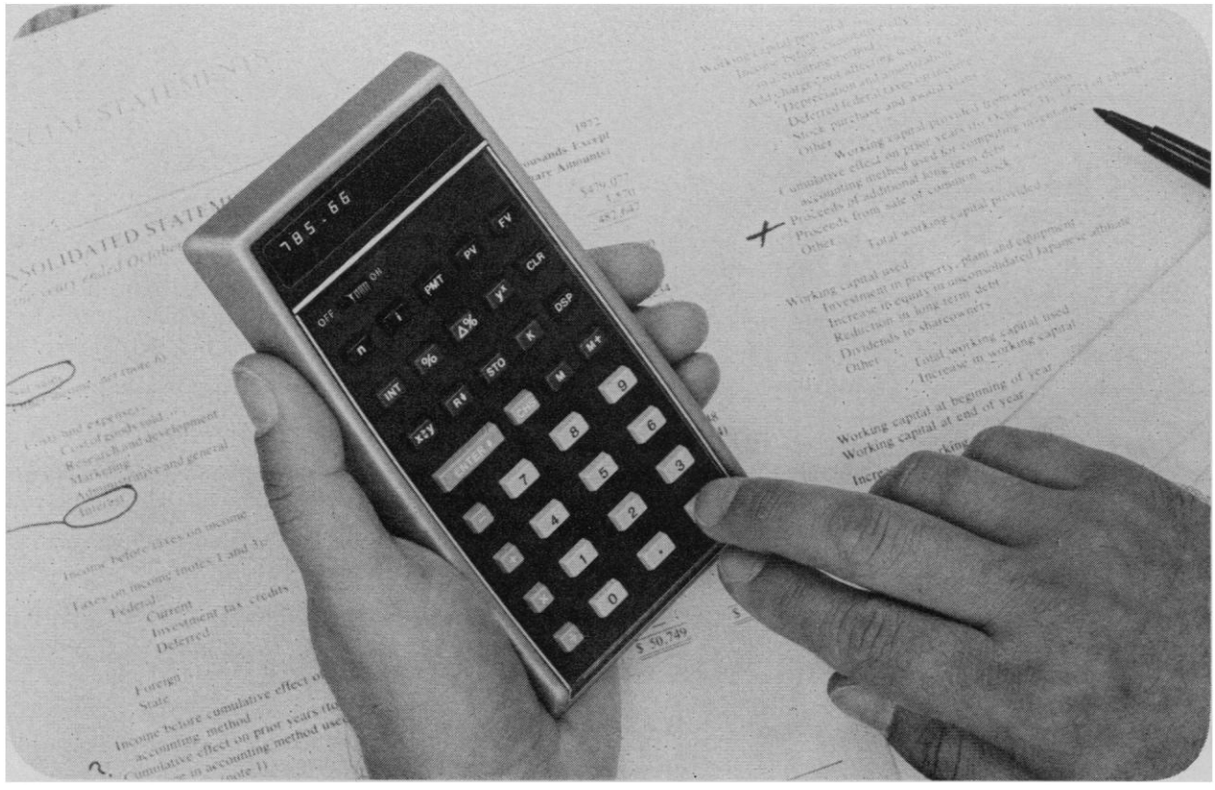
SCIENCE

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

COVER

Freshly captured clearnose skate (*Raja eglanteria*). Hemoglobins from this and other elasmobranch species show molecular adaptations to the high concentrations of urea normally found in their blood. See page 57. [Ken Susman and Tom Fisher, Duke University Marine Laboratory, Beaufort, North Carolina]



The HP 70: a new business calculator you won't outgrow.

A little over a year ago, we introduced the HP-80, the first pocket-sized calculator for time-and-money management. Although we designed it expressly for the financial specialist, it wasn't long before non-specialists were buying it by the thousands, simply because the HP-80 served the needs of business far better than any existing pocket-sized calculator. Out of this realization came the new HP-70.

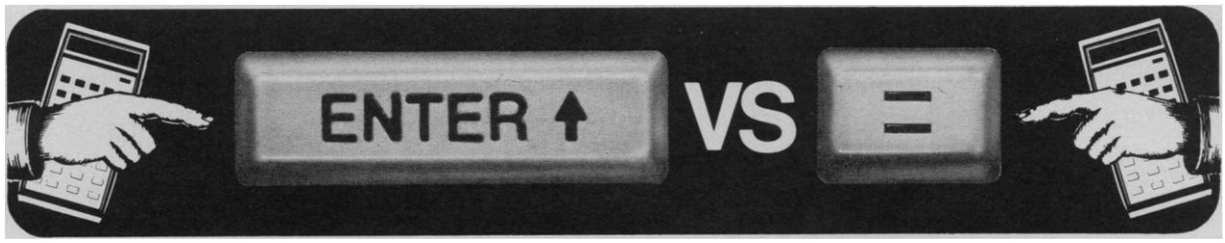
Designed to solve the *general* time-and-money problems of the businessman rather than the *special* calculations of the financial professional, the HP-70 is easier to use than its financial counterpart. Its keyboard is simpler. Yet the HP-70 retains the row of five financial keys found on the HP-80, pre-programmed to solve more than 100 time-and-money problems. Problems such as compound interest, effective return on investment, declining balance depreciation, mortgage payments, finance charges, future value of an annuity, etc. All you do is press the keys. The ponderous equations and cumbersome tables are stored electronically in the HP-70.

To make these powerful financial keys really easy to use, we gave each its own memory bank. Now you can enter the numbers of a financial problem in any order and change any number in the problem without having to re-enter the other numbers—a nice convenience.

The HP-70 also has two addressable memories and a four-memory operational stack. This stack, plus the non-algebraic computer logic we use in all our pocket calculators, lets you solve all problems in the same consistent way, even when they include serial, chain, or mixed calculations. (You'll find more information on our non-algebraic approach across the page.) You never have to jot down and re-enter intermediate results obtained during chain calculations because the operational stack stores them for you and brings them back to the working register—automatically.

Each of the HP-70's two addressable memories (the K and M keys) lets you store any number that you might want to use later in a lengthy calculation or repeatedly in a series of calculations. Since you can use one of these registers (M) as an accumulator, you can keep two running totals at the same time—one in the stack and one with M+.

As you discover more and more ways to put your HP-70 to work, its exceptional calculating power will give you capability you won't outgrow. And the quality and care of its manufacture mean that it will be fully operational when you need it. The $275* price includes rechargeable batteries, AC adapter and battery charger, soft case, owner's handbook, and reference guide.



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. 00434

Mail to: Hewlett-Packard, 1507 Page Mill Road, Palo Alto, CA 94304

Please send me the *ENTER VS =* booklet, together with information on HP pocket-sized calculators.

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Western Electric Reports:

An inside look at crystal growth.

Engineers at Western Electric's Engineering Research Center have developed an improved method for controlling the growth of the crystals used in light emitting diodes (LED's). The new technique represents one more step toward low-cost, mass produced LED's.

LED's have found many uses in telecommunications equipment as illuminators, indicator lamps and numeric displays. They consume very little power and last from 10 to 100 times longer than the devices they replace.

LED's used in the Bell System are made from gallium phosphide (GaP) single crystals. Economical processing using standard-sized fixtures requires crystals of uniform diameter. But because GaP single crystals must be grown inside a high pressure vessel, monitoring and controlling crystal growth has been a problem.

Previously, crystal growth could only be monitored visually. The halo surrounding the growing crystal was observed through closed circuit television. Since the halo would expand and contract with the diameter of the growing crystal, it provided some measure of control. But phosphorous vapors condensing on the viewing window partly obscured the halo, making precise control difficult.

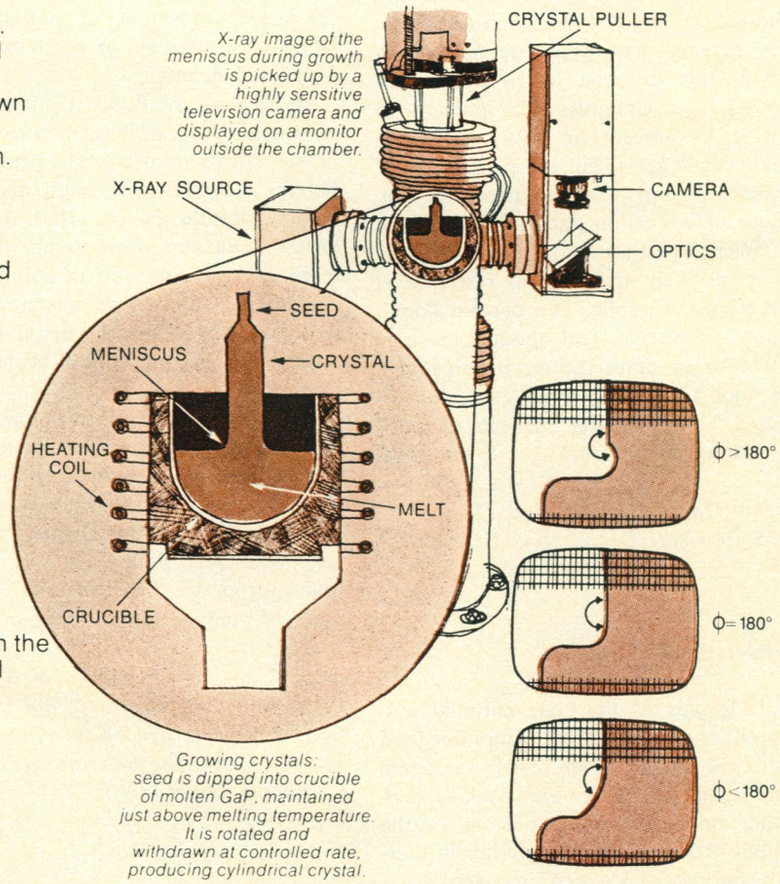
The new monitoring technique is similar to the use of a fluoroscope in medicine. X-ray imaging provides an unobstructed view of the meniscus formed where the solid crystal meets the liquid melt. Western Electric engineers have correlated the height and angle of this meniscus to the crystal's growth condition. This is useful because a change in the shape of the meniscus signals a change in the temperature of the melt *before* it is manifested as a change in the crystal's diameter.

A change of just 4° in the liquid-solid contact angle can be observed, allowing adjustments to be made in either temperature or pulling rate to maintain uniform growth.

X-ray imaging is in production use at Western Electric's plant in Reading, Penn.

Benefit: X-ray imaging of the meniscus of a growing crystal has permitted a marked improvement in the monitoring and control of crystal growth. It helps insure high yields of uniform diameter crystal wafers for processing into LED's.

Crystals of uneven diameter are difficult to process economically and efficiently. X-ray imaging now yields crystals of a diameter within a tolerance of ± 1/16 inch.



X-ray image of the meniscus during growth is picked up by a highly sensitive television camera and displayed on a monitor outside the chamber.

Growing crystals: seed is dipped into crucible of molten GaP, maintained just above melting temperature. It is rotated and withdrawn at controlled rate, producing cylindrical crystal.

THE LIQUID-SOLID CONTACT ANGLES

X-ray image of the meniscus at various temperatures. The smaller the angle, the lower the temperature. The larger the angle, the higher the temperature. An angle of 180° indicates the desired "steady state" growth condition.

Western Electric

We make things that bring people closer.

4 October 1974, Volume 186, Number 4158

SCIENCE

Circum-Pacific Energy and Mineral Resources

Before raw materials can be utilized, they must be found and the magnitude of the resources evaluated. These tasks are the function of economic geologists. When this particular clan gathers, formal speeches are not fully revealing. However, much additional information can be gleaned from private conversations. The recent Circum-Pacific Conference on Energy and Mineral Resources* in Honolulu provided an unusually good window on prospects for future supplies. Registrants included geologists from more than 50 countries.

On the agenda for the conference were many excellent papers. A significant phenomenon was the ubiquity of competent native geologists in countries throughout the Pacific rim. In an earlier period such competence was confined to the advanced countries, which were able to drive hard bargains in the exploitation of the world's resources.

The papers devoted to mineral resources indicated a vista of abundance. Both formally and informally, there were many reports of new discoveries and extensions of existing deposits. Optimism was partly based on the effectiveness of geochemical and geophysical tools. The concept of plate tectonics and the images obtained from the Earth Resources Technology Satellite have helped order and stimulate the thinking of economic geologists. They now know better where and how to look for minerals.

The picture with respect to energy was neither so clear nor so cheery. Some oil is being found off the coast of East Asia and in the vicinity of Indonesia. In the headwaters of the Amazon in eastern Peru there are substantial reserves of oil. The total quantities reported, while significant to the nations involved, are not great in comparison with current world consumption.

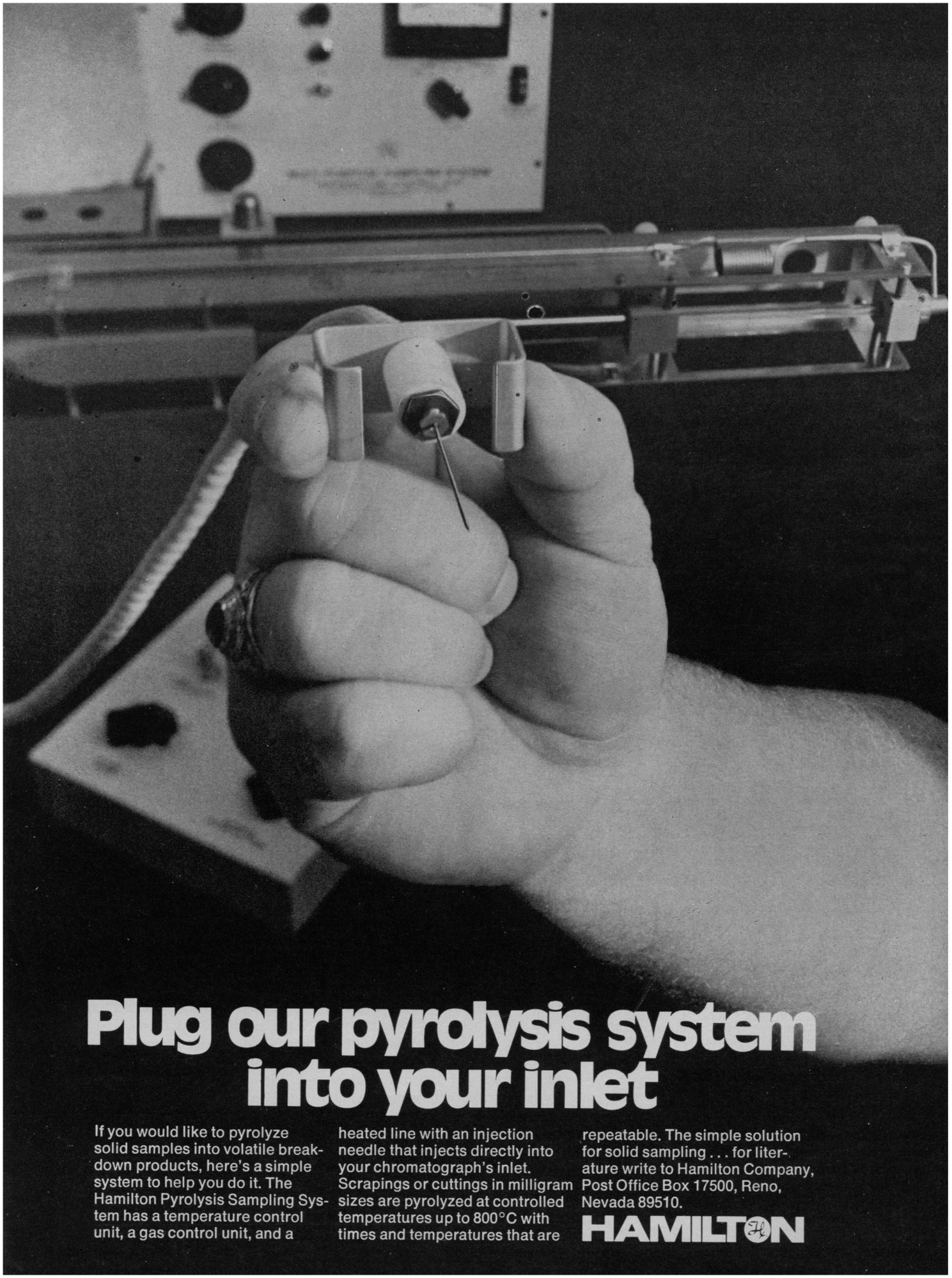
Many papers were devoted to geothermal energy. This was to be expected, for the circum-Pacific region has been picturesquely termed the Rim of Fire. Some indication of the possible magnitude of potentials was provided by D. Hadikusumo and L. Pardyanto of Indonesia. They pointed out that, in their country, there are many hundreds of volcanoes and hot springs. They estimated that, by the year 2000, Indonesia might be enjoying an installed capacity of 60,000 megawatts of electricity based on its geothermal resources.

Thus one had the impression of substantial energy potential. However, other papers indicated that there may be a long road between potential and fulfillment. Much or even most geothermal energy is associated with hot water heavily loaded with salts of various kinds. Some are corrosive; others clog pipes when the water is cooled.

A small sample of the problems to be encountered was provided by a description of results of drilling near the Hawaiian crater Kilauea, from which frequently emerges lava at a temperature of about 1200°C. The drill hole was pointed toward the predicted location of a hot pool of lava. In the first 490 meters, some of the temperatures encountered were lower than those at the surface. About 500 meters below the surface and 500 meters above sea level, the drill encountered rocks fully saturated with water having a salinity greater than that of seawater. The hole bottomed at 160 meters below sea level, and the maximum temperature noted was 137°C.

The world does not now face acute shortages of mineral resources. They are abundant, and techniques for exploitation are well developed. In contrast, energy resources are either limited or the techniques for using them are not established.—PHILIP H. ABELSON

* General chairman of the conference was Michel T. Halbouty of Houston, Texas. Selected papers from the conference are to be published in a memoir.



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