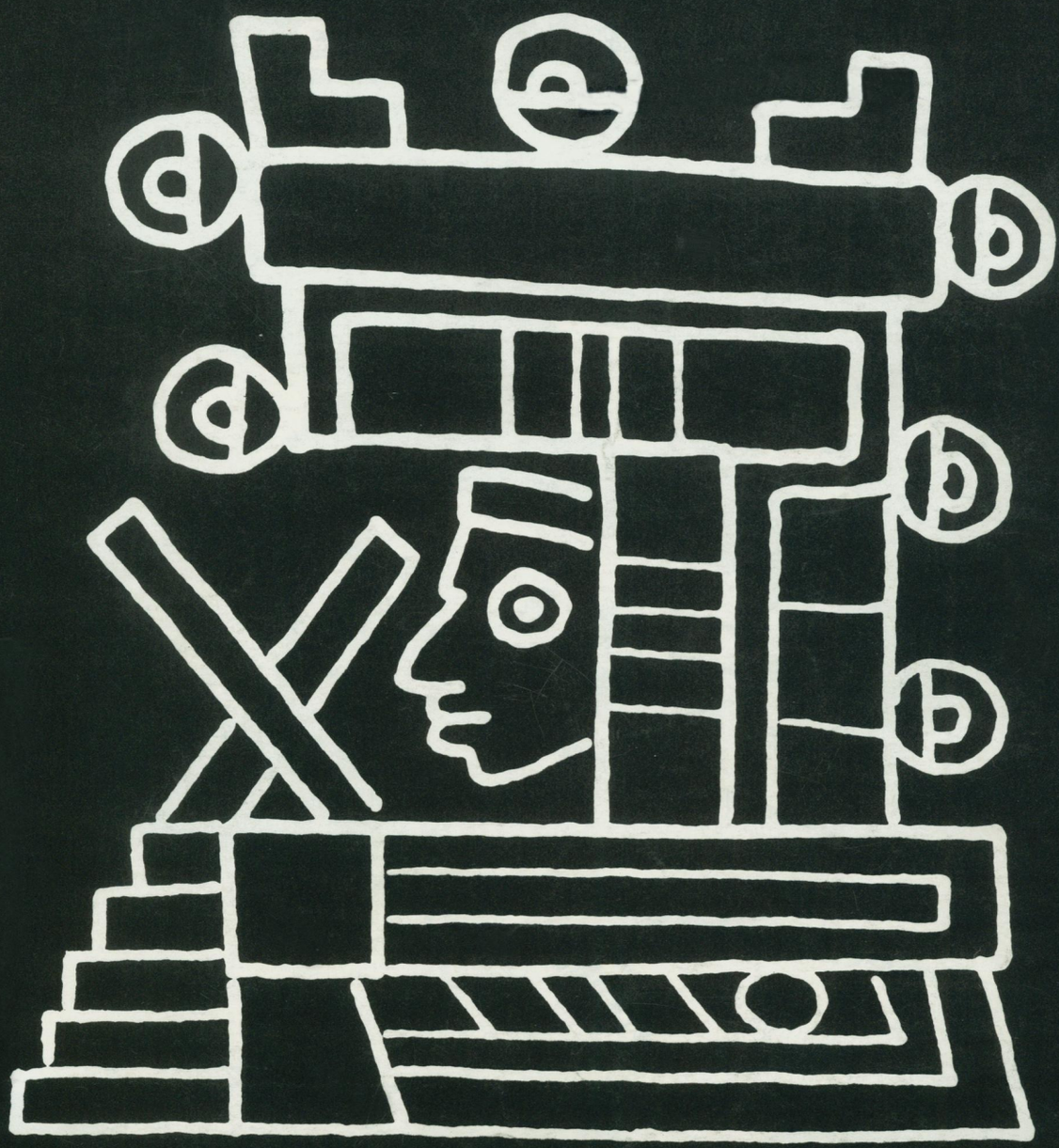
SCIENCE

6 June 1975

Volume 188, No. 4192

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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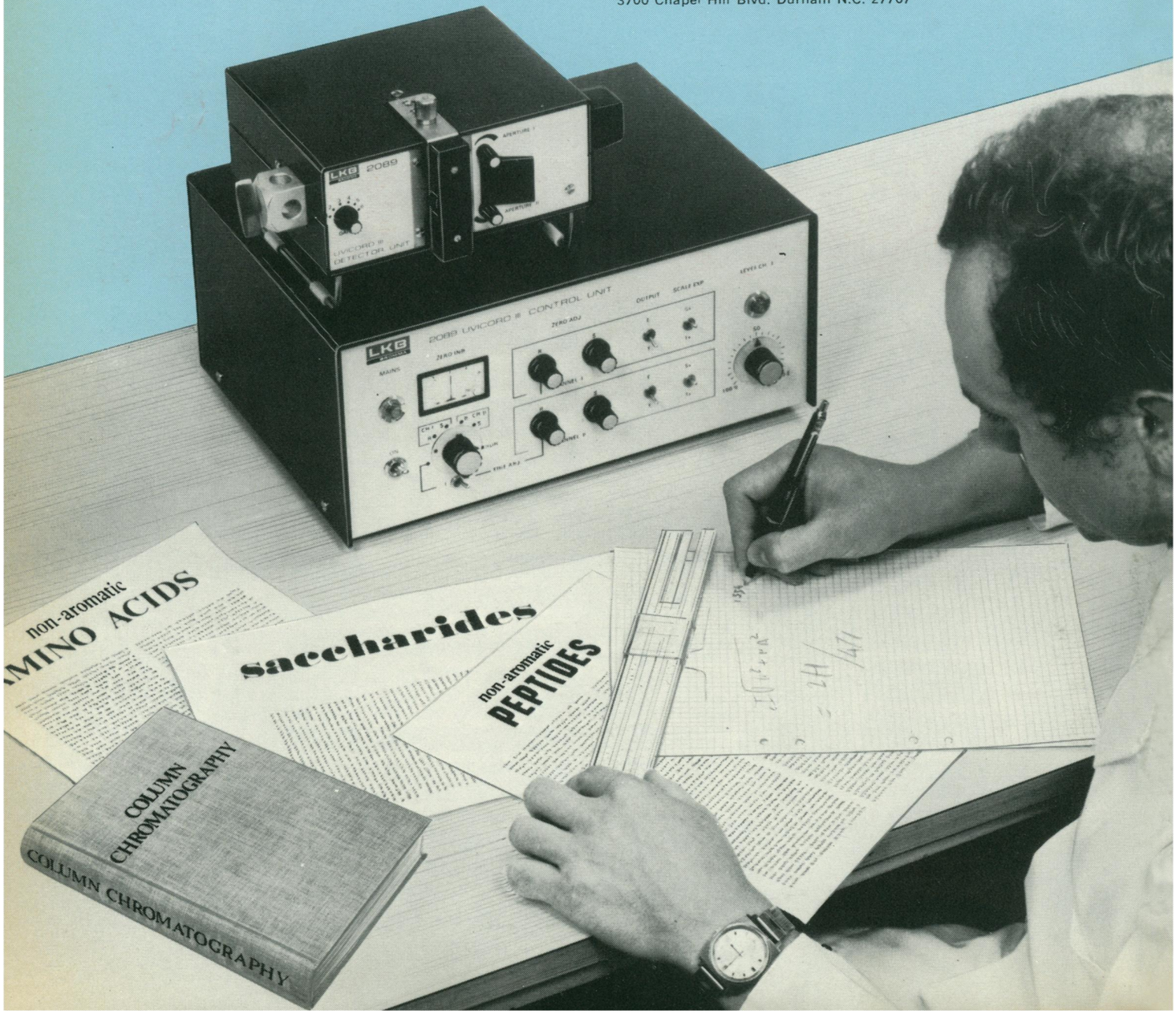

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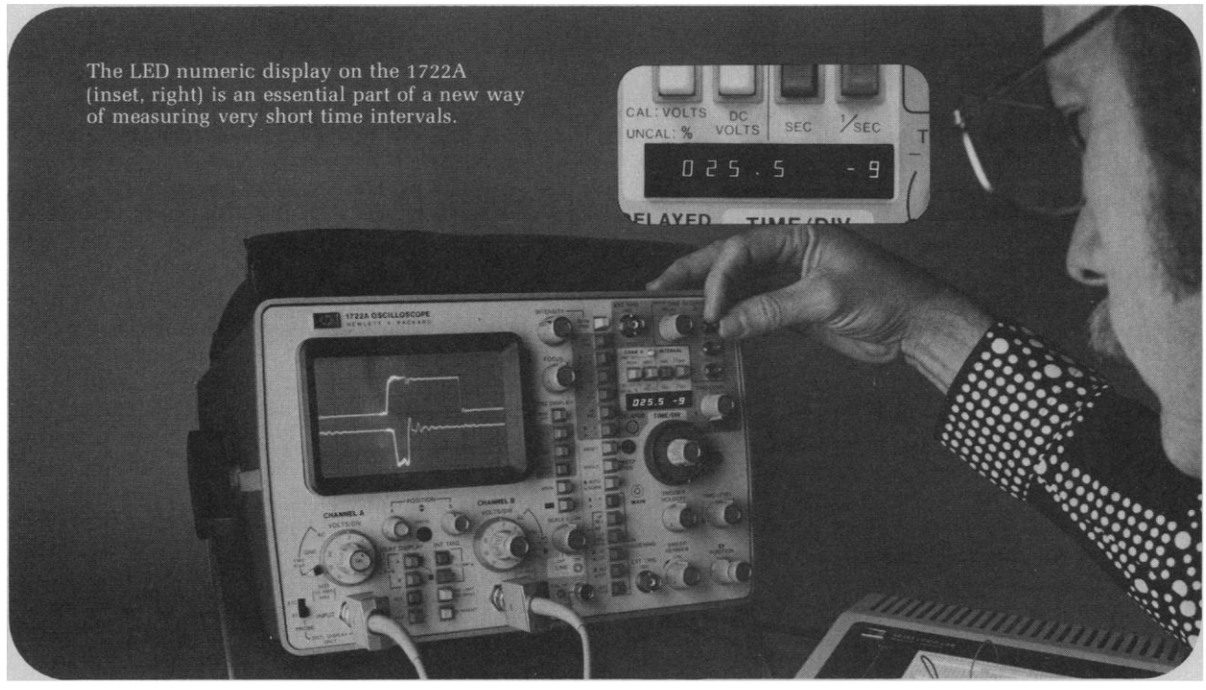
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Astronomer-priest viewing the stars with crossed sticks from the doorway of a temple. See page 977. [Drawing from the Codex Bodley 32-IV by Horst Hartung, Universidad Guadalajara, Guadalajara, Mexico]



The LED numeric display on the 1722A (inset, right) is an essential part of a new way of measuring very short time intervals.

The first smart oscilloscope: an introduction to the "new measurement" technology.

Hewlett-Packard's "new measurement" technology radically changes the traditional relationship between man and machine. It does so by giving the machine some of the intelligence previously supplied by the human operator. It creates "smart" instruments that can monitor their own operations, detect and avoid procedural errors, perform all the necessary computations, and directly produce the desired final answer.

As a leading manufacturer of both measurement and computation instruments, we know that it's possible to make many kinds of "smart" instruments—right now—through a marriage of separate measurement and computation instruments. And we know that such a marriage results in unique advantages that far outweigh its cost.

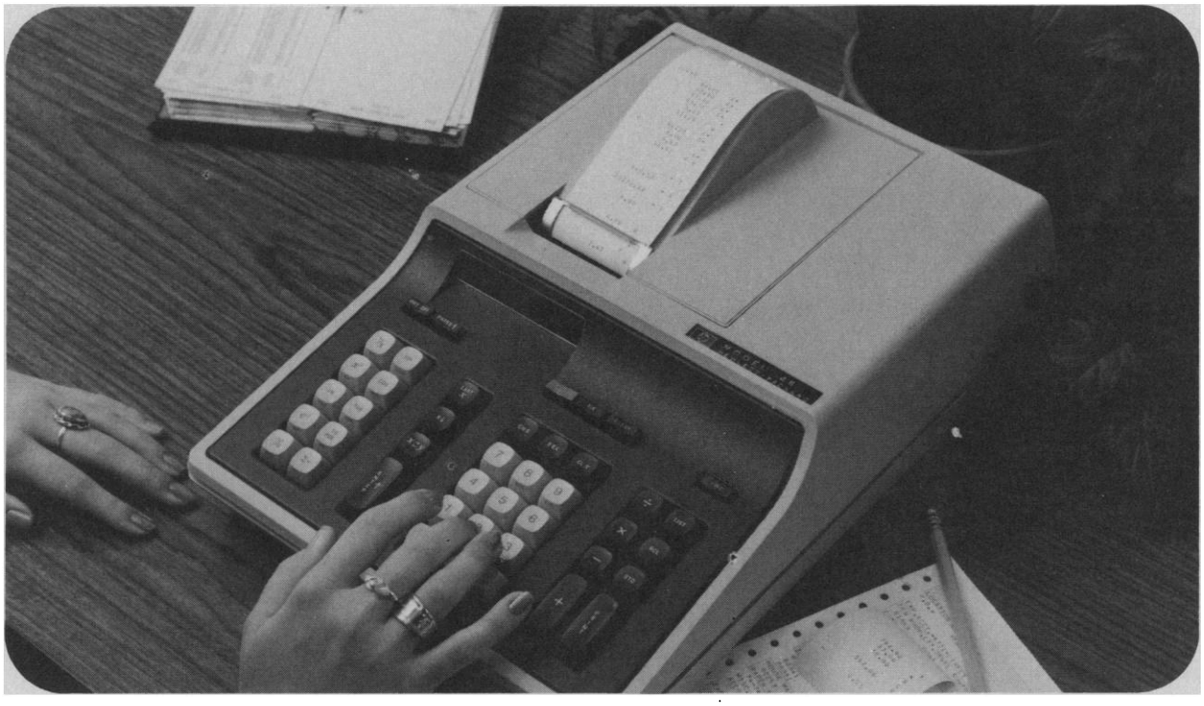
The new HP 1722A oscilloscope is a recent case in point. Its development started, typically, with a choice of candidates for the marriage. For *measurement*, we chose our 1720A scope, a 1.3 nanosecond rise time, 275 MHz bandwidth, dual-channel instrument; and for *computation*, the digital microprocessor originally developed for the HP-35 pocket-sized calculator.

It was clear from the outset that the proposed instrument could not realize the full potential of microprocessor control if the scope were limited to state-of-the-art *single* delayed sweep capability. So the marriage was put off while our designers developed the technology for *dual* delayed sweep. In the 1722, this new two-dot system operates under microprocessor control to keep track of any two events automatically, whether they originate on the same or different channels.

With its combined measurement and computation capabilities, the 1722 is clearly in a class by itself, the first of a new generation of "smart" oscilloscopes. It can make time interval measurements more accurately than has ever before been possible with an oscilloscope. The 1722 also avoids the numerous errors that can creep into conventional scope measurements: it never misreads control settings, never misses events, and its automatic lock-out systems prevent most wrong interpretations.

The 1722's built-in computation provides final answers—directly, digitally, and automatically—for frequency, instantaneous voltage, and relative amplitude measurements as well as for dc voltage and time interval.

Priced at $4750*, the 1722A is ideally suited for clock phasing measurements in large computer systems. It also easily qualifies for less demanding applications where its speed, convenience, and automation more than justify its moderately higher cost.



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The HP-46 performs arithmetic, statistical, transcendental, and trigonometric calculations, the latter in any of three angular modes. It instantly converts angles to degrees, polar coordinates to rectangular, and U.S. units of length, weight, or volume to metric. It also performs two-dimensional accumulations simultaneously for vector calculations, and adds or subtracts vector components.

The HP-46 features characteristics that you have come to expect from HP calculators: 200-decade range, floating decimal, 10 significant digits, and computer-based logic with 4-register operational stack.

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stances and speculative recovery mechanisms being assumed. One can only admire the tremendous courage of investigators who pronounce their conclusions with confidence in spite of these almost frightening handicaps. Yet, before we accept these estimates, it would be well to examine how such exploratory expectations have fared in the past.

The latest evaluation of the overall exploration statistics (*1*) confirms earlier studies showing that in only one out of some 50 new-field wildcat wells is as much as 1 million barrels of oil or its gas equivalent discovered. A specific example of recent drilling failure, despite the best of hopes, is extensively described in an article in the *Oil and Gas Journal* (*2*): "Ten unsuccessful wildcats have badly wounded hopes for finding major reserves of oil and gas under the first crop of leases in the vast northeastern Gulf of Mexico.... the exploratory opportunities remaining could at best yield only a fraction of the reserves industry expected from this Cretaceous-Jurassic province." The hoped-for prize was the huge Destin anticline structure, over which an Exxon-Mobil-Champlin group acquired, in 1973, six tracts at a cost of some $630 million, and on which it has now drilled six noncommercial wells. Surely this group must have applied the most sophisticated analytical and operational exploration techniques known to the industry. A major discovery may yet result from further testing, but as of now, the gap between optimistic expectations and reality is wide indeed—both psychologically and financially.

There is widespread feeling that if we only apply conservation measures and begin extensive exploratory drilling on the continental shelves, we shall certainly find the billions of barrels of oil needed to make us independent of foreign supplies by 1985. Very little has been done to set up emergency oil stockpiles or to get started on the development of both the technology and financial structures required for alternative energy sources, such as coal conversion, shale oil extraction, and environmentally acceptable increased nuclear energy production. But what if the shelf drilling should turn up many more unproductive "Destins" than expected? As it is, the only certain new net domestic supplies we can count on by 1985 are the 1 to 2 billion barrels per day in 1977 or 1978, when the Alaskan pipeline is operating, and perhaps 500,000 more barrels per day from expanded secondary and tertiary recovery operations. It would be prudent to consider new oil discoveries resulting from the proposed federal offshore leasing program as unscheduled blessings. Policies to safeguard the national security and economic stability of this country should be based on conservative judgments about the results of exploring unknowns rather than on anticipated materializations of plausible possibilities.

MORRIS MUSKAT
2414 South Voss Road, Houston, Texas 77027

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1. *Oil Gas J.* **73**, 45 (19 May 1975).
2. D. McNabb, *ibid.* **73**, 21 (10 March 1975).

Alexandering

After reading Tinbergen's reply to the critics (Letters, 2 May, p. 401) of his views on autism, it came as something of a relief to discover that my own researches on Alexander are likely to be spared the further benefits of his ethological approach. Still, at the risk of encouraging any dormant spirit of collaboration which may remain, I must point out that, through a typographical error, an important line (indicated below in italics) was dropped from my communication to *Science*. "Now Tinbergen," I wrote, "devotes half *of his Nobel Prize speech to the promotion* of a curative system which he identifies with the Alexander technique." It may be that the complete sentence would have cleared up (as my entire letter apparently did not) Tinbergen's Alice-in-Wonderland puzzlement about my views: (i) in his Nobel speech Tinbergen appears to be talking not about the Alexander technique—a form of kinesthetic reeducation which I do indeed recommend in my book (*1*, pp. xlv - xlvi) as effective for many people, although not suitable (*1*, p. xxxi) for others—but instead about some form of osteopathic treatment or Esalen massage; (ii) he makes a number of specific *curative* claims for the technique and these are claims which thus far have no scientific support. The final passage of his reply to me does, however, indicate a welcome shift of position. Whereas Bernadette reporting the good news from Lourdes seems comparatively restrained next to Tinbergen in the Alexander half of his Nobel address, he now confines himself to the quite simple and jovial recommendation: "Alexandering may be good for you—why not give it a try?" Tinbergen, it seems, is repeating the wisdom of the onetime label on the Lydia E. Pinkham bottle: "Recommended in conditions for which this preparation is adapted."

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1. E. Maisel, Ed., *The Resurrection of the Body: The Essential Writings of F. Matthias Alexander* (Delta, New York, 1974).

6 June 1975, Volume 188, Number 4192

SCIENCE

Changing Climate for Medicine

A generation ago, the practice of medicine was very often ineffective. Today, because of medical research, diagnosis and treatment are greatly improved. However, the government is now deeply involved in the financial and educational sides of medicine, and a deeper involvement, including detailed management of treatment, is likely. We will probably witness episodes in which well-intentioned but shortsighted governmental action leads to long-term destruction. The academic community, which lives with wreckage resulting from the exercise of federal power, should monitor developments in medicine closely. Intervention may become necessary.

The essence of the practice of medicine is in the interaction between patient and physician. In spite of the tools that have been invented or will be devised, medicine will remain an inexact science. The best physicians are highly motivated, highly intuitive. There is no substitute for the conscience of the physician. If conscience and motivation are lost, little will be left. Current developments are placing at hazard these key factors.

Intervention by the Congress and by the Administration has come because of demands of the public that are based at least in part on unrealistic expectations of what can be delivered in the way of patient care. The average person's concept of what is possible medically is conditioned by a memory of miracle drugs and polio vaccine and by accounts of organ transplants and great new medical discoveries. The public expects the best possible medical care but wants it delivered in the style of a generation ago—the doctor appearing at the home with black bag and stethoscope. Some medical problems can still be handled in the home, but to do justice to serious illness, the doctor must be able to employ a full set of modern diagnostic aids and therapeutic equipment. The public also has come to demand that physicians never make mistakes in technique or judgment, as indicated by the current rash of malpractice suits.

Some of the complaints of the public are legitimate. One is the comparative scarcity of general practitioners or primary care physicians. The proliferation of knowledge arising from research has made specialization in medicine seem necessary. Specialization has had the further effect of encouraging concentration of doctors in big medical centers. The result is geographical maldistribution, with rural areas and the ghettos suffering shortages of physicians.

Without adequate analysis, someone dreamed up the theory that the cure for such shortages was to increase the output of the medical schools. It was reasoned that some of the excess doctors would spill over into the shortage areas. The medical schools were treated to the carrot and stick approach. They were put under pressure to increase enrollments and given the inducement of capitation grants, that is, subsidies based on enrollment. To a degree, the treatment has worked. Enrollment today is about 60 percent above that of 7 years ago. However, the graduates have settled in the areas that already enjoyed ample numbers of physicians. Instead of getting at root causes of the problem and offering substantial incentives to practice medicine in less desirable environments, Congress is now considering legislation that would force young doctors to spend 2 years in what amounts to indentured servitude. Moreover, the medical schools now rightly fear that capitation will either be eliminated, causing severe financial distress, or be used as a weapon against the students. One form this action may take is government-imposed quotas on the number of specialists that may be trained. Is the government so wise and foresighted that it can mandate intelligently how many scientific specialists of any kind there should be?

Medicare and Medicaid have also given the government financial power which seems destined to be used to regulate all phases of medical practice. Such details as the length of stay in hospitals are to be prescribed. There is danger that procedures will be standardized and routinized to such an extent that the quality of the practice of medicine will decline.

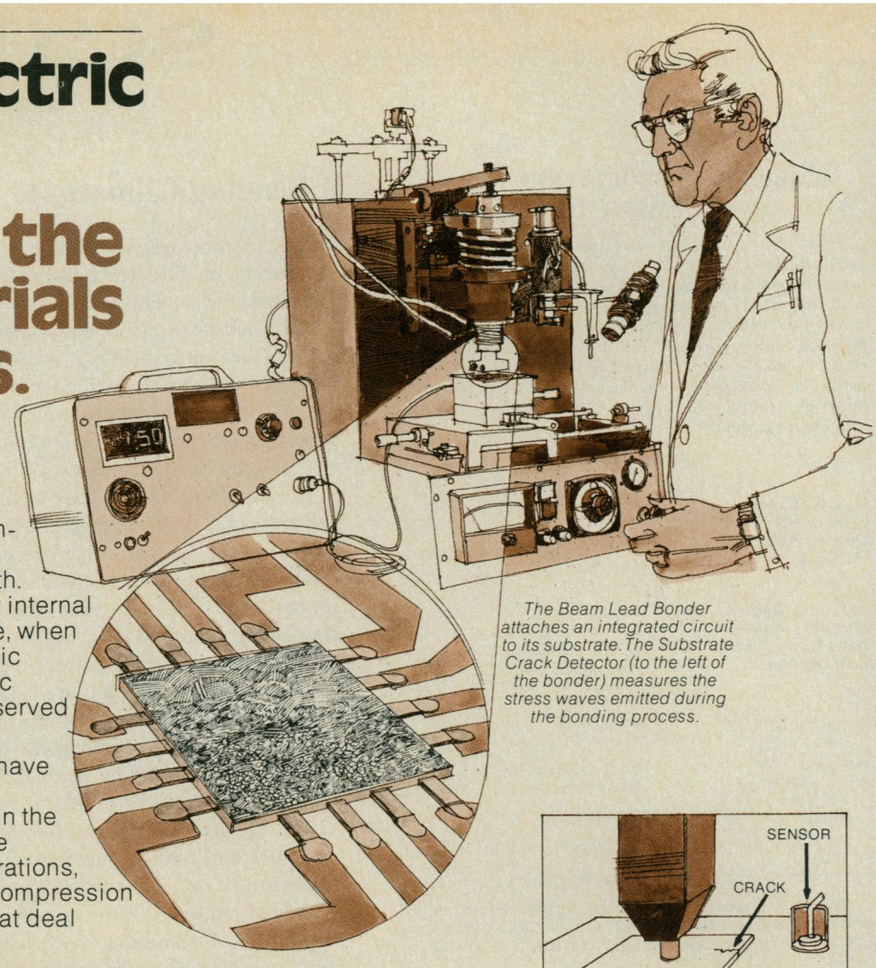
In these momentous developments, the most important factor of all is being overlooked. How will they affect the motivation and conscience of the physician?

—PHILIP H. ABELSON

Adapted from a commencement address, Medical College of Wisconsin, 25 May 1975.

Western Electric Reports:

Listening to the cry of materials under stress.



The Beam Lead Bonder attaches an integrated circuit to its substrate. The Substrate Crack Detector (to the left of the bonder) measures the stress waves emitted during the bonding process.

Opera stars have shattered a glass by singing at its resonant frequency. The phenomenon: Acoustic standing waves in the glass can exceed its breaking strength. Acoustic waves can also be set up by internal metallurgical processes. For example, when a material is strained beyond its elastic limit, it emits a "cry." This characteristic signal, called a "stress wave," was observed by Bell Labs' scientists in 1948.

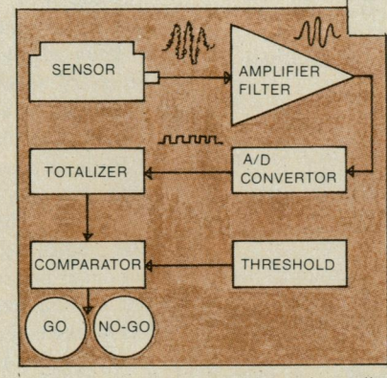
Now Western Electric engineers have applied acoustic techniques to non-destructive testing of materials used in the manufacture of Bell System telephone equipment. Many manufacturing operations, such as drilling, welding and thermocompression bonding, place materials under a great deal of stress, which may lead to cracking.

For example, when silicon integrated circuits are bonded to their ceramic mounts, the ceramic may sustain very small "microcracks." While that may be of no immediate consequence, it can lead to failure years later, when moisture accumulated in the microcracks may disrupt circuitry. Detecting microcracks with a microscope or by destructive sampling is both costly and tedious.

Western Electric's Engineering Research Center has developed the bold idea of detecting microcracks by *listening to the sound of the bonding process.* The "cry" of the unit being bonded is compared to sounds normally emitted during a satisfactory bond. Anything outside the normal range indicates microcracking. The process can detect microcracks smaller than a thousandth of an inch.

Benefit: Monitoring stress wave sounds has made possible real-time, non-destructive testing of ceramic substrates on the production line, to help ensure that each circuit will give years of uninterrupted service to Bell System users.

An acoustic sensor, attached to the base of the bonder, detects the sound of a microcrack.



Thresholds were determined experimentally at the Engineering Research Center. A go/no-go signal tells the operator whether to accept or reject the unit.

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. . . and human health

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204-75 **Perceptual Systems: Images, Hallucinations, and Dreams** (I). Discussions among psychoanalysts and psychologists working with perceptual and fantasy-image formation.

. . . and the metropolis

193-75 **Urban Medical Problems** (I). Reports on major medical problems of urban communities, including alcoholism and drug abuse; also discusses the availability of care for acute health problems and the cost of hospital care.

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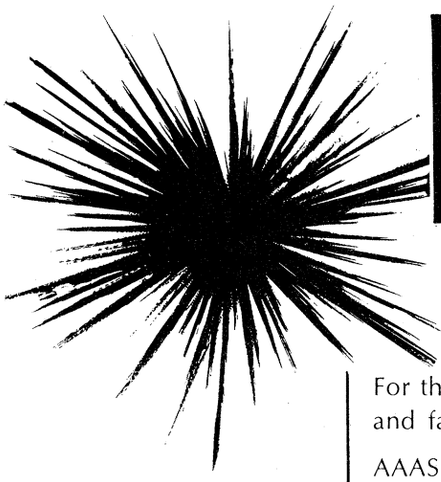

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