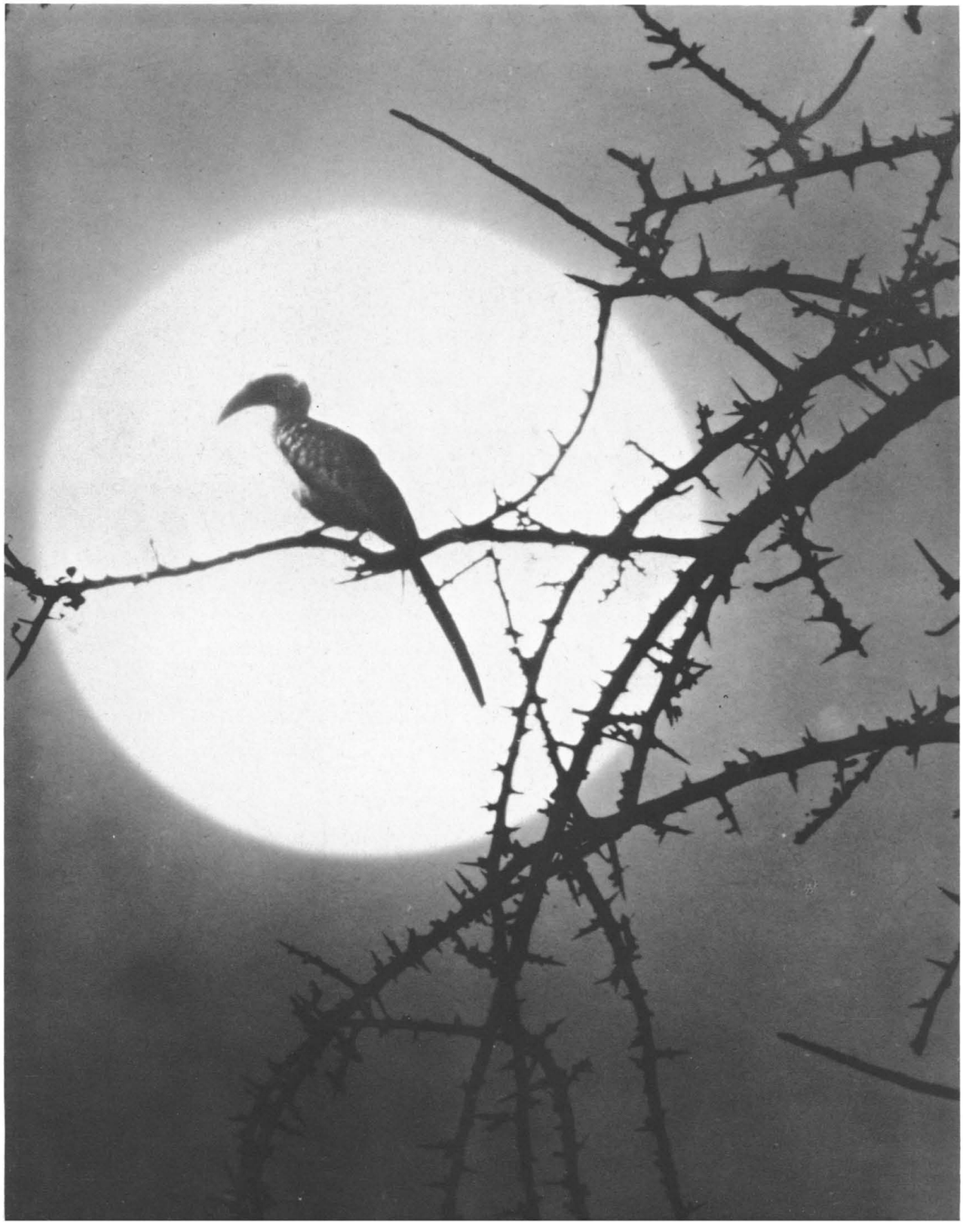
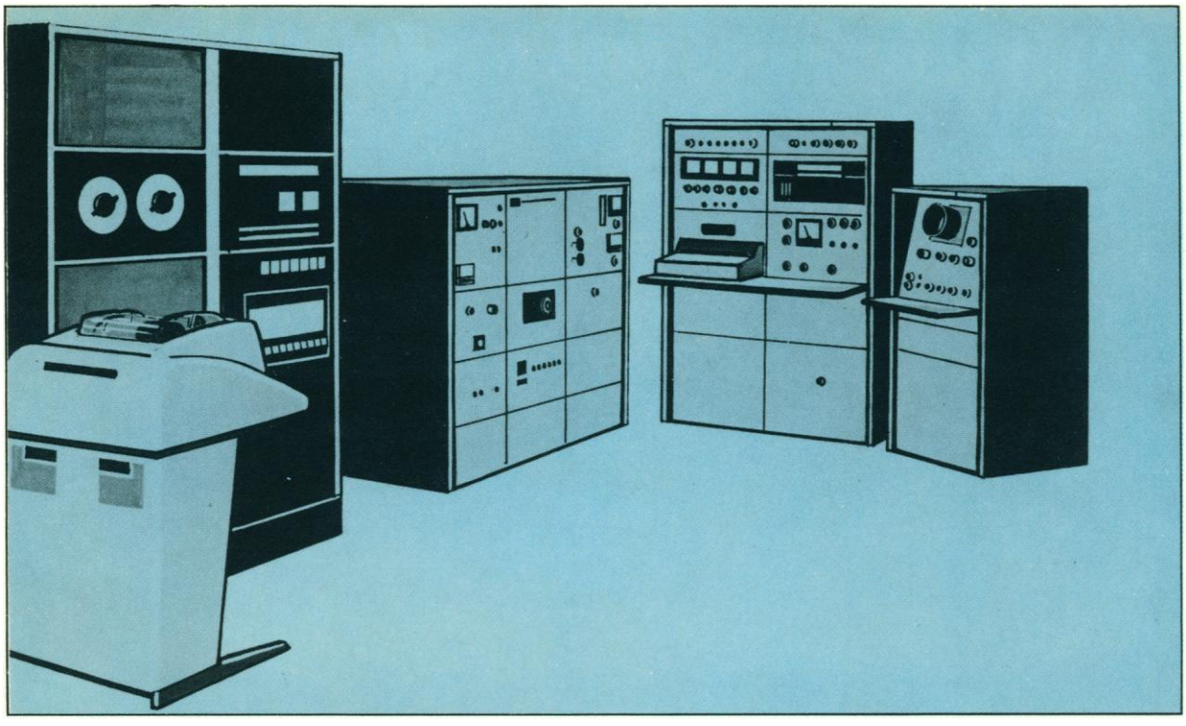
SCIENCE

30 October 1970

Vol. 170, No. 3957

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE





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Available in three different capacity/accuracy ratios—1000g/0.1g, 200g/0.015g and 100g/0.01g—these new, reasonably priced balances are ideal for a variety of applications, from student use and research to quality control weighings.

If you're in the market for a new balance for weighing in the range from less than 100 grams up to 1500 grams, you really ought to find out more about the new Series 1100. We'll be happy to send you complete literature and our free 52-page catalog. Just write: Sartorius Division, Brinkmann Instruments, Cantiague Rd., Westbury, N.Y. 11590.

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SCIENCE

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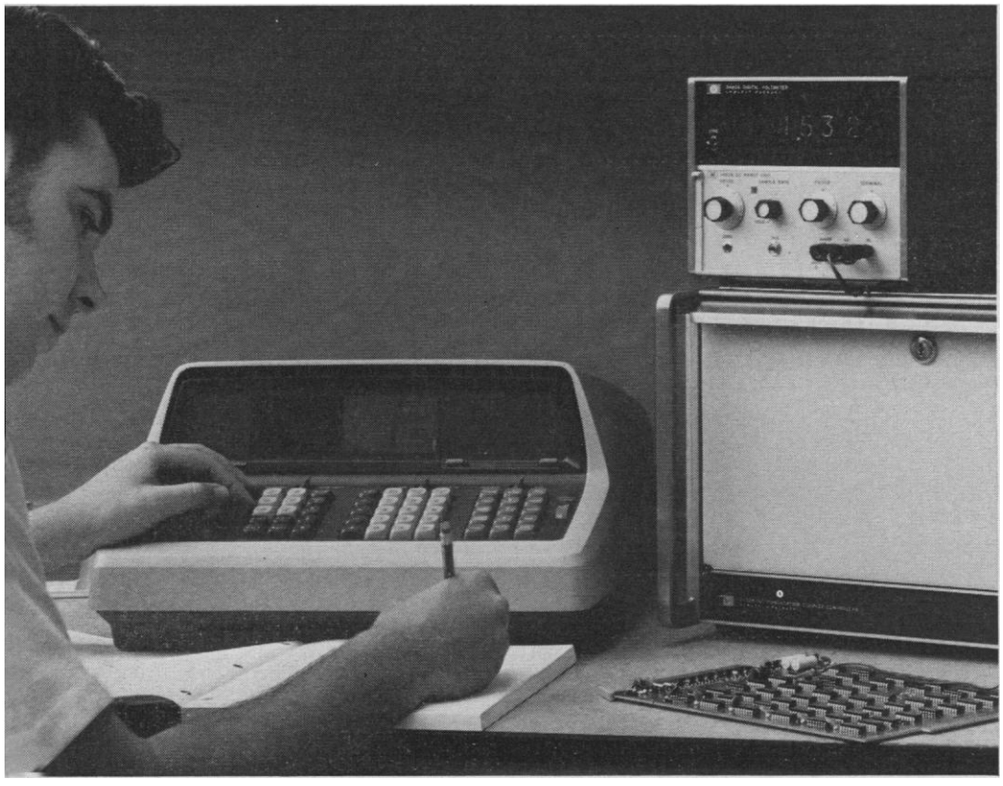
The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

COVER

African hornbill. [Toni Angermayer, Munich, Germany]

Some things are changing for the better.



Turn your desk calculator into an on-line data handling system

Let's assume that you now perform scientific and engineering computations on the HP 9100 Calculator, entering data off-line on its keyboard.

But now you'd like to get the answers automatically, on-line, by letting your data-gathering instruments communicate directly with your data processing system. You might think the time has come for a large investment in a computer.

Not so. With the new HP 2570 Coupler/Controller, you can now tie many of your HP measuring instruments (more than 40 models including voltmeters, counters, GC integrators, quartz thermometers) to the 9100 and get reduced data directly. By simple cable connections.

You can even tie a teletype to the 2570 and get complete reports of your experiment, formatted as you like them and prepared automatically during the experiment, on a typewritten sheet or punched paper tape. Or on the calculator X-Y Plotter.

We'd be happy to send you a 24-page Bulletin that explains how the 2570 can expand the capabilities of your 9100 for on-line data handling and even for automatic test systems. Write for "Calculator-Based Instrumentation Systems." Price of the Coupler is only $1625. Interfaces cost $450—$1500 per device.

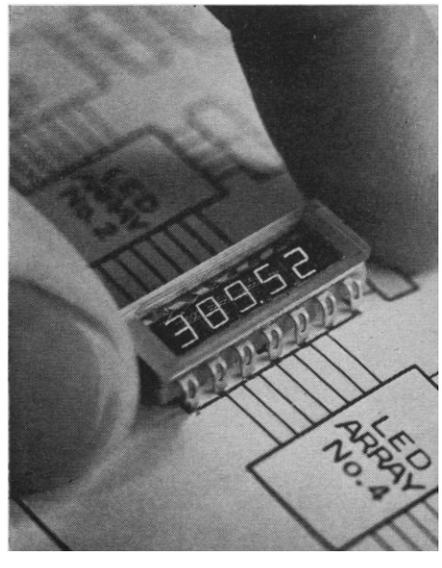
Keep an eye on solid-state displays: they're moving fast

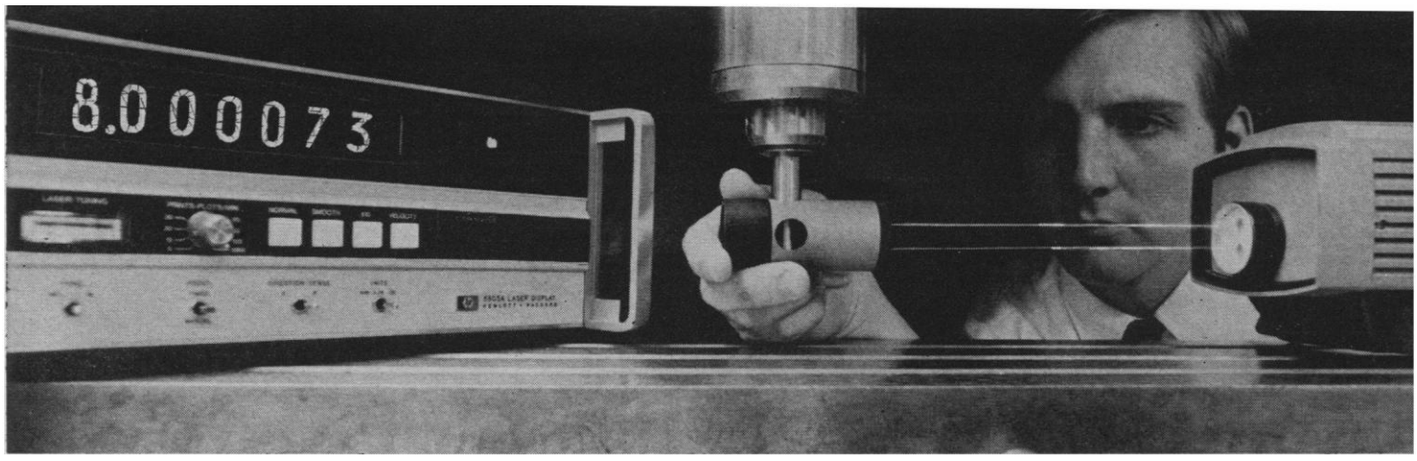
If you haven't been paying very close attention in the last several months, some fast-moving developments in solid-state displays based on GaAsP light-emitting diodes (LED's) have undoubtedly escaped your attention.

Earlier this year, HP introduced an alphanumeric display that incorporates 35 LED's per character, arranged in a 5 x 7 dot pattern. There are two outstanding advantages to this design: it can display highly readable letters and symbols as well as numbers, and it is suitable for dynamic as well as static operation. In static operation, all of the diodes that are needed to form a character are *on* continuously; in a dynamic display, the LED's are scanned one row or column at a time, at high speed. If the scanning rate approaches 100 times per second, the eye sees only the complete character and there is no flicker. The scanning technique not only permits sharing the same character generator and scanning circuits by several displays but also greatly reduces the number of interconnections.

HP scientists have just announced the development of a monolithic display which is fabricated from a single GaAsP chip into which seven LED's are diffused. Its seven-segment character (contrasted to the previous 35 dot matrix) is suitable only for number generation. Counter-balancing this, its fabrication from a single chip is fully automated, a fact that has already reduced its price to $7 per character (compared to $30 for the alphanumeric) and promises a further reduction to $2 in large quantities.

All HP solid-state displays are hermetically sealed, IC-compatible and have a life expectancy of at least 100,000 hours. We'll be glad to send you technical data on any of them.



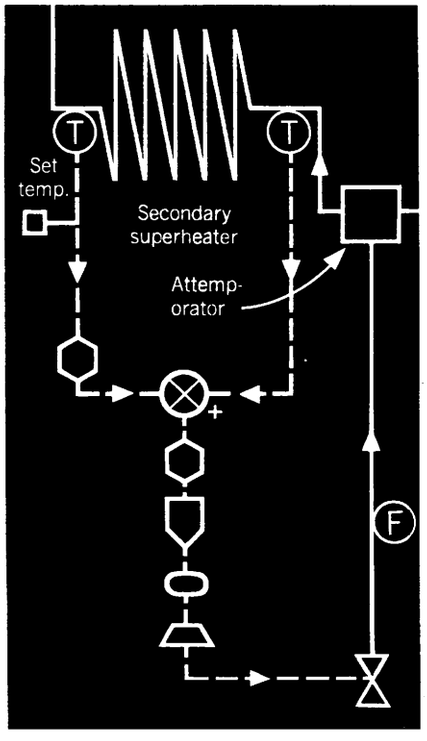


For interferometers, two frequencies are better than one

All interferometers built since Michelson's original experiments in the 1890's use two light beams of the same frequency. They measure distance by counting the cycles of beam intensity in the reflected light caused by alternate constructive and destructive interference of the two beams, as the reflector is moved. Direction is measured by detecting the phase difference between two portions of the measuring beam. These two signals are used to drive a counter one way or the other, after dc amplification.

And there's the rub. Any variation in the intensity of the light source due to atmospheric disturbances or normal dc amplifier drift, can cause erroneous readings or put the system out of commission.

A new interferometer completely avoids this problem by the simple expedient of operating entirely on ac. This was made possible by the development, in the HP Laboratories, of an entirely new laser which oscillates *on two frequencies simultaneously.* An axial magnetic field Zeeman splits its main spectral line into two frequencies, 1.8 MHz apart and of opposite circular polarization (thus easily distinguishable).



One of these frequencies (f_1) is isolated in a reference path. The other (f_2), isolated in a measuring path, is bounced off an external reflector and recombined with f_2 at the interferometer. If the external reflector remains stationary, the difference between the two is exactly 1.8 MHz. But when the reflector is moved, the measuring beam's frequency is Doppler-shifted at a rate of about 1 MHz for a 1 foot-per-second reflector velocity, and the difference between these two frequencies becomes $(f_1 \pm \Delta f - f_2)$.

Movement is determined by sensing differences between the Doppler signal and the constant reference signal $(f_1 - f_2)$ and counting the cycles on separate registers. A subtractor keeps a running count of the differences in quarter-wavelengths of light, while a built-in IC calculator converts wavelengths to units of length.

Besides a radical decrease in susceptibility to air turbulence, the HP Model 5525A Interferometer ($11,500) measures distance to 1 microinch resolution, requires no warmup and tunes itself automatically. These characteristics suggest great utility in metrology laboratories, for measurements from microinches to 200 feet, as well as machine tool use. The August 1970 issue of the HP Journal tells the whole story: write for your copy.

New tool for on-line system analysis

Very recently at a large power station in England, a system analysis of an attemperator or temperature control loop was completed on-line, without disturbing plant output in any way. As the control characteristic of the loop was displayed on a screen during the experiment, adjustments were made to optimize the control system and the results were displayed immediately.

The job of the control system engineer —to predict how the system will react to a given input pulse — has not always been so easy. If he tests the system with an impulse that is large enough to produce a measurable response, plant output is changed in a way that cannot be tolerated.

Some progress was made when control system analysts discovered the power of cross-correlation. With this mathematical technique, a test noise signal is applied to system input at such low levels that system output is not changed beyond normal background disturbances. Yet by cross-correlating the test noise with the system output over a relatively short period, the engineer is able to extract the impulse response of the system; background disturbances do not interfere because they are uncorrelated with the test noise.

At first, cross-correlation did not help because it could only be accomplished after the fact, through off-line digital computation. What made the difference in the English experiment was the availability of two new HP instruments: a Model 3721A on-line correlator that's about as easy to use as an oscilloscope, and a Model 3722A precision noise generator that synthesizes repeatable pseudo-random noise, ideally suited to system analysis. The correlator costs $8325 and the noise generator $2650. On request, we'll be glad to send you a packet of information on these two instruments, correlation and the on-line experiment.

If you're involved in the techniques of digital analysis or correlation, we can offer a new product-oriented handbook, "Discrete Signal Analysis," which will help. For this 96-page booklet or any of the other material mentioned, write to: Hewlett-Packard, 1507 Page Mill Road, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.

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AUDIO
TAPES

A Message to Students (of all ages)

At the Annual Meetings of the American Association for the Advancement of Science, many of the most thoughtful and concerned scientists and their counterparts in other areas of creative endeavor come together to explore, in public, advances in sciences and their consequences. With the permission of the speakers a wide selection of their discussions are recorded. It represents an extraordinarily rich collection of views, commentaries, analyses, and critiques.

Listed below are 11 diverse topics, typical of several score of others that are available for sale. Persons interested in the issues of the day and of the future, often exhilarating or profoundly troubling, will profit from their study.

THE IDENTITY AND DIGNITY OF MAN: A SCIENTIFIC AND THEOLOGICAL DIALOGUE ON ISSUES EMERGING FROM BEHAVIORAL, SURGICAL, AND GENETIC INTERVENTION (in 8 parts) 11/69 I,II,III,IV,V,VI,VII,VIII

Leading life scientists, theologians, and social ethicists are engaged in a dialogue on issues related to the ethical problems emerging from the biotechnical revolution and the heightened concern for the preservation and enhancement of human identity and dignity.

Hudson Hoagland (Worcester Foundation for Experimental Biology), Roger L. Shinn (Union Theological Seminary), Francis D. Moore (Harvard Medical School), L. Harold DeWolf (Wesley Theological Seminary), Bernard D. Davis (Harvard Medical School), James M. Gustafson (Yale University Divinity School), Ernst Mayr (Harvard), G. Evelyn Hutchinson (Yale), Helen B. Taussig (Johns Hopkins Medical School), Alan F. Guttmacher (New York), Kenneth E. Moyer (Carnegie-Mellon University), Hans Jonas (New School of Social Research), Isaac Asimov (Boston University), John R. Platt (University of Michigan), Paul M. Doty (Harvard), Philip Morrison (M.I.T.), and others.

SCIENCE AND THE FUTURE OF MAN (in 3 parts) 35/69 I,II,III

How can the scientist as an individual and as a member of a scientific community become a more effective and constructive force in society? How can society be made aware of scientific developments directly affecting its future?

J. Tuzo Wilson (University of Toronto), Franklin A. Long (Cornell), Lewis Mumford, John Platt (University of Michigan), George Wald (Harvard), Victor F. Weisskopf (M.I.T.), Senator Edmund S. Muskie, Philip H. Abelson (Carnegie Institution), and others.

IS THERE AN OPTIMUM LEVEL OF POPULATION? (in 4 parts) 10/69 I,II,III,IV

Is there an optimum level of population for the United States? What do we mean by "optimum" and how does it depend not only on the level but also on the concentration and rate of growth?

Preston E. Cloud (University of California at Santa Barbara), Harrison Brown (Foreign Secretary, National Academy of Sciences), Alvin M. Weinberg (Oak Ridge National Laboratory), John H. Knowles (Massachusetts General Hospital), Bernard Berelson (Population Council), Garrett Hardin (University of California at Santa Barbara), Margaret Mead, and others.

PHYSICS AND THE EXPLANATION OF LIFE 40/69

Is it possible and sufficient to seek explanations of life by calling on the insights of the physical sciences alone?

George Wald (Harvard), Eugene P. Wigner (Princeton), J. Bronowski (Salk Institute), Isaac Asimov (Boston University).

CURRENT PROBLEMS IN COSMOLOGY 16/69

New insights in astronomy make it possible to reopen cosmological questions and seek a deeper understanding of the past and future of the universe.

John Stachel (Boston University), Peter Bergmann (Syracuse University), E. R. Harrison (University of Massachusetts), Philip Morrison (M.I.T.), John Wheeler (Princeton), David Layzer (Harvard).

INNOVATION 45/69

Our understanding of the innovation process is, at best, imperfect. Can engineers be taught to utilize existing scientific knowledge more imaginatively? What are the special characteristics of the technological entrepreneur? How does one redirect groups of people toward new goals?

Myron Tribus (Assistant Secretary of Commerce), Edward B. Roberts (M.I.T.), Alvin M. Weinberg (Oak Ridge National Laboratory), Donald A. Schon (Organization for Social and Technical Innovation).

EDUCATION OF THE INFANT AND YOUNG CHILD (in 2 parts) 51/69 I,II

Experiences in very early life have long-lasting powerful impacts upon developing organisms, including the human.

Jerome Kagan (Harvard), Jerome S. Bruner (Harvard), William A. Mason (Delta Regional Primate Research Center), and others.

EFFECTS OF NUTRITION ON BEHAVIOR—STUDIES IN ANIMALS AND MAN (in 2 parts) 3/69 I,II

The discussion centers on the different kinds of malnutrition, the effects on different species, and the effect on human children in different countries.

Joseph J. Vitale (Boston City Hospital), Harry F. and Margaret K. Harlow (University of Wisconsin), Herbert G. Birch (Albert Einstein College of Medicine), and others.

BRAIN AND LANGUAGE 44/69

The acquisition (and loss) of language skills, the common threads of grammar, and design of word sequences are analyzed.

Jerome Y. Lettvin (M.I.T.), Noam Chomsky (M.I.T.), Norman Geschwind (Harvard Medical School), Eric Lenneberg (Cornell), and Stephen Toulmin (Michigan State).

BIOLOGY AND SOCIOLOGY OF VIOLENCE (in 2 parts) 24/69 I,II

Aspects of violence are reviewed from the vantage points of the life and social sciences.

Frank Ervin (Harvard Medical School), Lawrence Rasavi (Stanford), John Spiegel (Brandeis University), and others.

SCIENCE AND MUSIC (A CONCERT/SYMPOSIUM) 55/69

The musical sources and motivations for sound synthesis and the use of electronic media are clarified by discussion and examples.

Concert Selections: Ussachevsky "Of Wood and Brass"
Davidovsky "Synchronism #2 for Four Instruments and Tape"
Babbitt "Ensembles for Synthesizer"

David Epstein (M.I.T.), Vladimir Ussachevsky (Columbia), John Heiss.

Please refer to SCIENCE, **31 July 1970 (pages 422–424) for a complete listing of all available tapes.**

The cost of the tapes may be calculated as follows: single-session symposium, $11 per session; multi-session, $11 for the first session ordered of each symposium; $9 for each additional session ordered of the same symposium. There is a handling and postage charge of 75¢ per session for foreign orders. AAAS members enclosing payment with their orders will receive a discount of 10 percent of their total order. Use form below to order reels, cassettes, or a free catalog. Please print. If payment enclosed, use check or money order.
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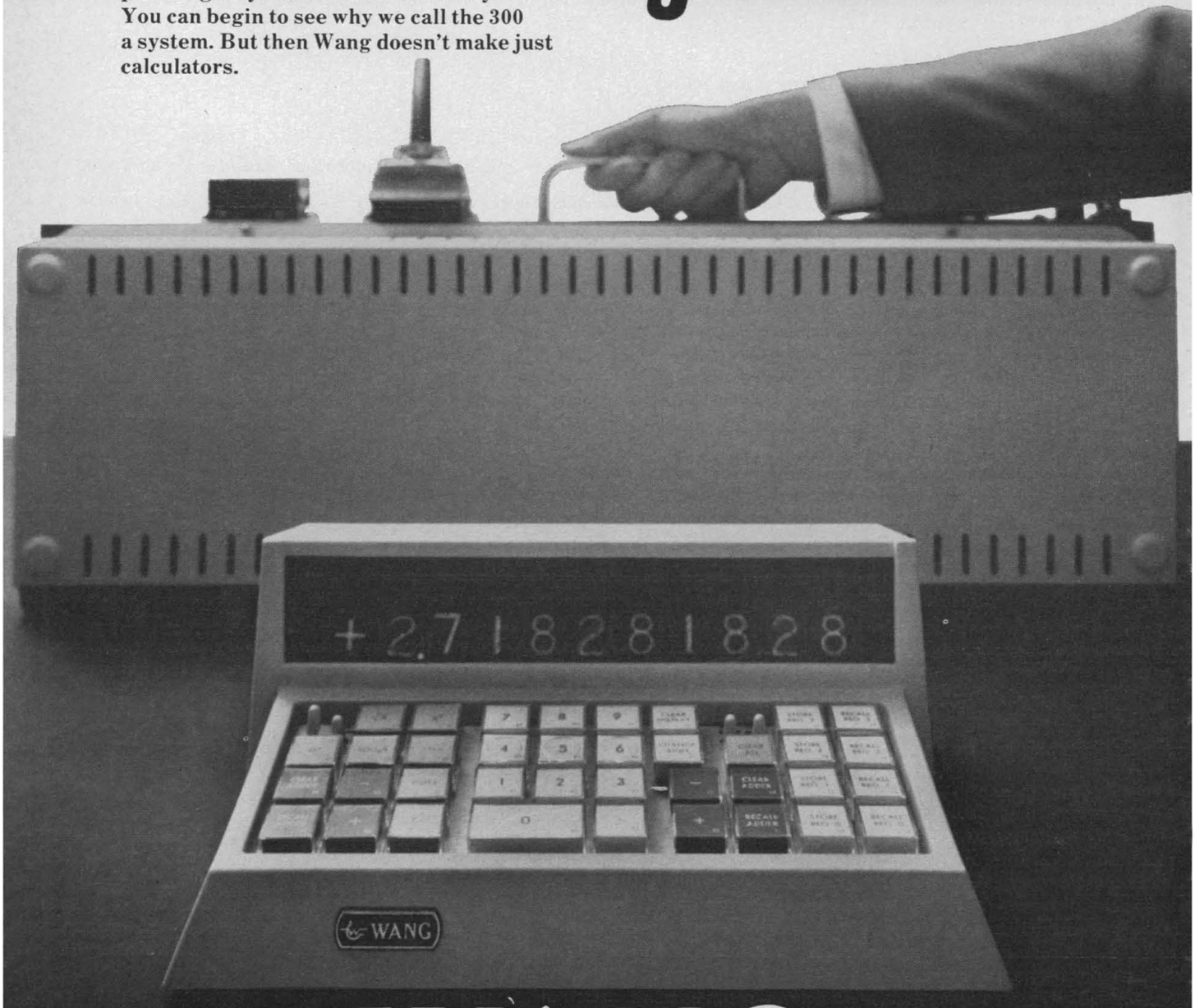
The idea behind the Wang 300 series calculating system is a central brain that can be shared by more than one user. This unique Wang concept gives you the most performance and flexibility for the least money. It also gives you a compact keyboard unit that gives you a lot of space on your desk to do your other work.

As many as four individuals can share the brain of the 300 at the same time. A brain so sophisticated it even does logarithms. But even though they are sharing, they don't have to share alike. They can all do different things at the same time. And their keyboards can be for different functions.

The optional card programmer and column printer give you additional flexibility. You can begin to see why we call the 300 a system. But then Wang doesn't make just calculators.

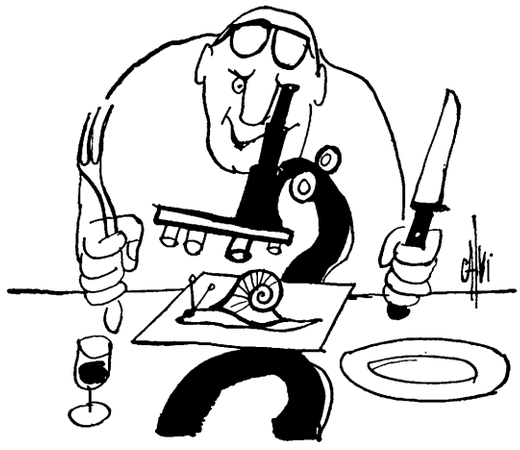
For a demonstration of the Wang calculating system at your own desk, call one of our factory sales/service offices from coast to coast. Wang Laboratories, Inc., Dept. S-10B, 836 North Street, Tewksbury, Mass. 01876. Tel. (617) 851-7311.

Backed by a brain.



WANG

Tiens, une revue scientifique française.



En 6 mois, "La Recherche" est devenue la première revue scientifique de langue française en Europe.

Et nous avons tout fait pour cela.

Nous nous sommes délibérément orientés vers l'innovation scientifique et technologique.

Nous avons diversifié nos sommaires pour aborder tous les aspects de la recherche fondamentale ou appliquée.

Et nous avons choisi, pour chaque discipline, de dégager l'essentiel d'une actualité souvent surabondante : vous ne pouvez pas lire les deux millions d'articles originaux qui paraissent chaque année dans le monde.

Aujourd'hui, "La Recherche" a pris place parmi les grands de l'information scientifique internationale.

Maintenant, nous pouvons venir chez vous.

Après tout, nous parlons le même langage.

Même si nous écrivons en français.

Au sommaire du n° 5 :

Les frontières de la biologie par Jacques Monod

Les constantes physiques fondamentales par B.M. Taylor, D.N. Langenberg et W.H. Parker

Les membranes par B.A. Pethica et M. Cambrai

La guerre chimique par N.D. Tam

– Informatique : une passe difficile.

– Des matériaux nouveaux pour la navette spatiale.

– Les choix nucléaires et la restructuration industrielle.

– Comment miniaturiser les lasers de grande puissance, etc.

Je désire profiter d'un abonnement d'un an (11 numéros) à "La Recherche", au prix spécial de lancement de $ 16.00.

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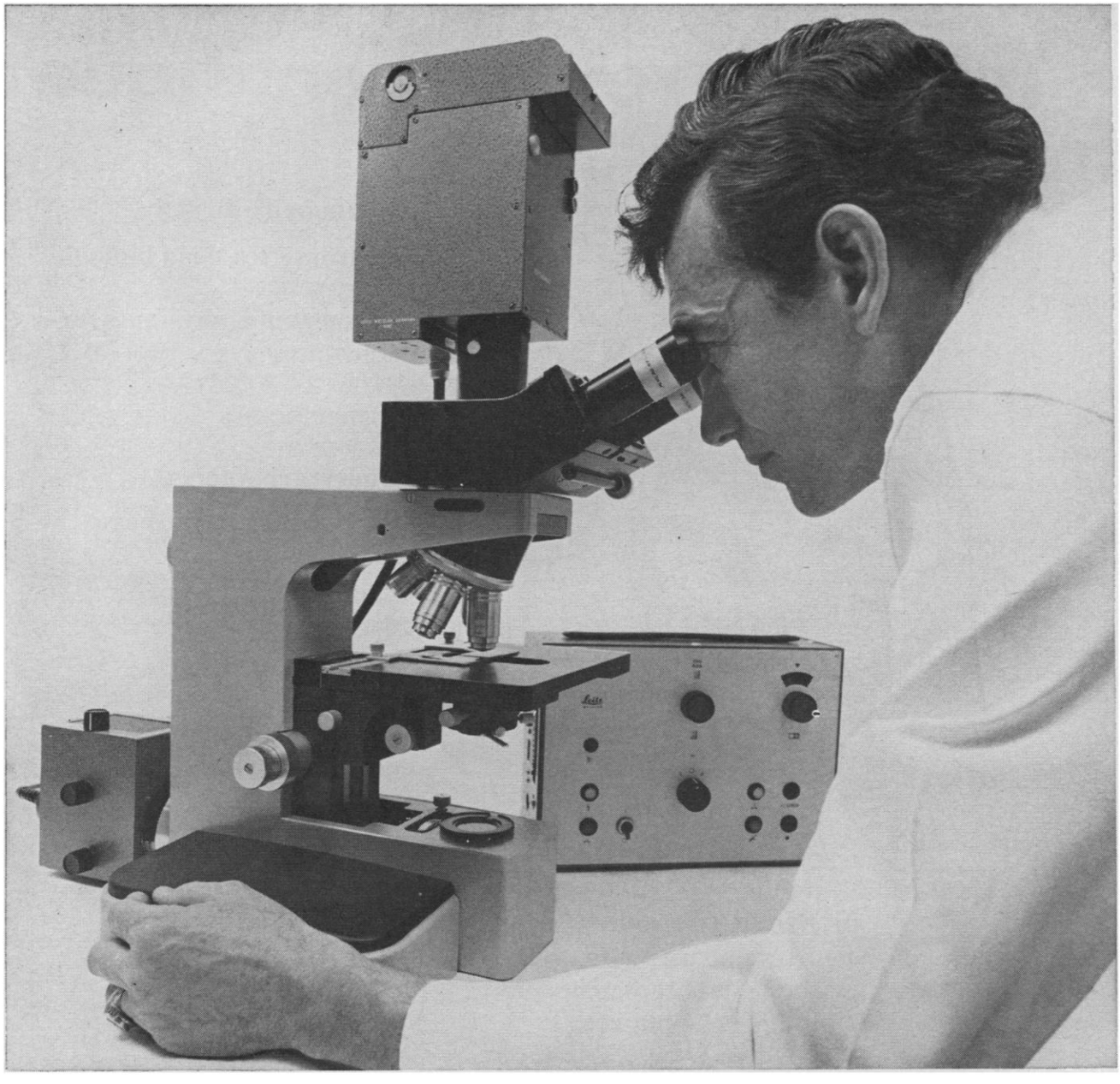

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However, the few we found have been included in the Leitz ORTHOMAT II Microscope-Camera. 78070

Leitz® E. Leitz, Inc., Rockleigh, N. J. 07647

30 October 1970, Volume 170, Number 3957

SCIENCE

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Sales: NEW YORK, N.Y. 10036: Robert S. Bugbee, 11 W. 42 St. (212-PE-6-1858); SCOTCH PLAINS, N.J. 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); MEDFIELD, MASS. 02052: Richard M. Ezequelle, 4 Rolling Lane (617-444-1439); CHICAGO, ILL. 60611: Herbert L. Burklund, Room 2107, 919 N. Michigan Ave. (312-DE-7-4973); BEVERLY HILLS, CALIF. 90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-2772)

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Phone: 202-387-7171. Cable: Advancesci, Washington. Copies of "Instructions for Contributors" can be obtained from the editorial office. See also page xv, *Science*, 25 September 1970. ADVERTISING CORRESPONDENCE: Room 1740, 11 W. 42 St., New York, N.Y. 10036. Phone: 212-PE-6-1858.

Pollution by Organic Chemicals

A survey of efforts to secure a livable environment leaves one with the impression that progress is being made in a number of respects. One area that has not received as much attention as it should is pollution by organic chemicals. Of particular concern should be the large group of molecules that are fat-soluble and only slowly biodegradable. Organic chemicals that are fat-soluble often tend to be accumulated in living systems. If not biodegradable, they may be concentrated by the food chain or other mechanisms so that their level in tissue comes to exceed that in the environment by orders of magnitude.

An example of a fat-soluble, slowly degradable compound is DDT. Its tendency to be accumulated by fish, birds, and humans has been repeatedly discussed. A large number of chlorinated aromatic hydrocarbons and chlorinated phenols and their derivatives are also concentrated in living forms. Many of these chemicals are known to have adverse biological effects. The most toxic chlorine-containing compound known is 2,3,7,8-tetrachlorodibenzodioxine ($C_{12}H_4O_2Cl_4$), often called dioxin. The acute oral LD_{50} dose of dioxin in male guinea pigs is about 10^{-6} g/kg. Other animal experiments have resulted in a variety of pathologic phenomena, including neurological disturbances and birth defects. Dioxin is an unwanted contaminant* of the herbicide 2,4,5-T. When manufacture of the herbicide is carefully controlled, the dioxin content is less than 1 part per million. Higher concentrations have been noted, however. Dioxin was identified in 1962, after 5 years of dedicated research. In 1957 a mysterious disease had caused millions of dollars of damage and the death of uncounted numbers of chicks. Careful chemical detective work ultimately pointed to dioxin as the culprit. Apparently the herbicide 2,4,5-T or derivatives of it had been taken into plants and had ultimately appeared in vegetable oils. These were processed at high temperatures to liberate fatty acids, but inadvertently some dioxin, which has extreme thermal stability, was formed. Once the problem was identified, the chemical process was modified. Oddly enough, in spite of its great toxicity, the behavior of dioxin in the food chain has not been worked out.

The broad-scale and dramatic deleterious effects of dioxin were manifested in chicks. How much damage has this substance caused in humans? We know that all of us carry substantial quantities of DDT. How much damage has been caused by other related fat-soluble compounds?

When we use DDT and 2,4,5-T, presumably we obtain benefits that tend to balance, or even more than compensate for, the hazards attending them. Moreover, we can test the toxicity of manufacturers' products and be alert to possible problems. However, how do we cope with other possible dioxins? We are manufacturing thousands of chemicals. In their preparation, side reactions are producing many thousands of unwanted and even unidentified substances. To what extent are these strangers being discarded into rivers, lakes, and the sea? To what extent are such substances finding their way into humans? Modern analytical techniques could furnish at least part of the answer. We need much better monitoring of food, water, and human body constituents.

Companies producing fat-soluble, nonbiodegradable, organic chemicals should give careful attention to the question of what they may responsibly set loose on the environment. Failure to act now will surely lead to some new tragedy, aroused public opinion, and harsh federal regulations.

—PHILIP H. ABELSON

* *Effects of 2,4,5-T on Man and the Environment*, Hearings before the Subcommittee on Energy, Natural Resources, and the Environment of the Committee on Commerce, United States Senate, Ninety-first Congress, Second Session, 7 and 15 April (Serial 91-60, U.S. Government Printing Office, Washington, D.C., 1970).

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