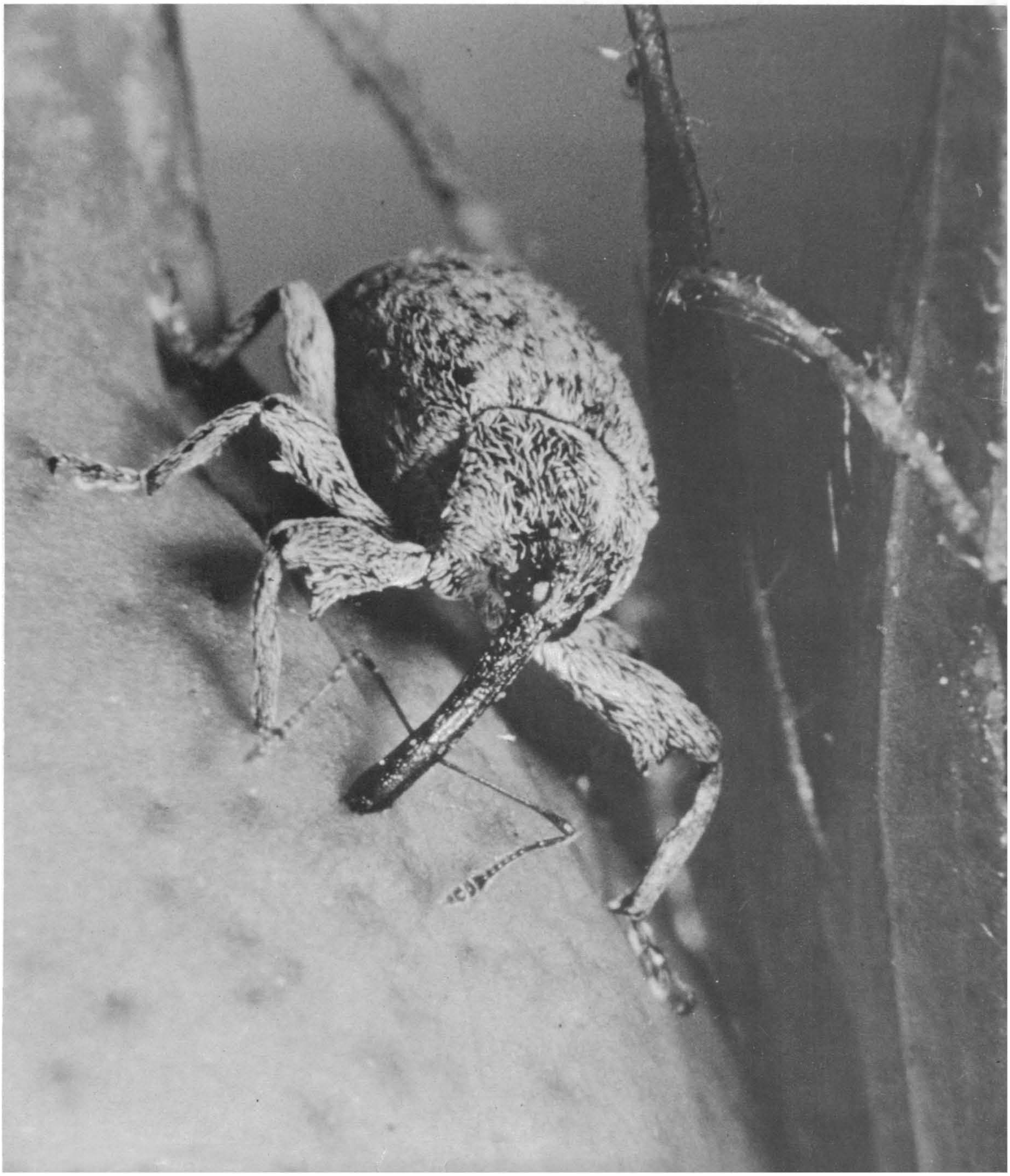
SCIENCE

22 November 1968

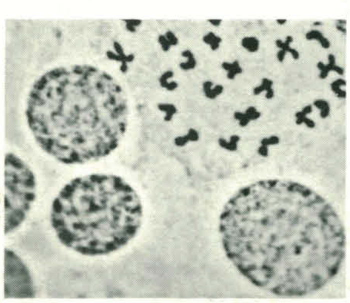
Vol. 162, No. 3856

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Take almost any kind of subject and the Polaroid MP-3 camera will take almost any kind of picture of it in seconds.

Polacolor picture of a giant Cicada.



Photomicrograph of chromosomes: original magnification 1,000X.

Whatever the subject: gross specimen, production sample, wall chart, biological specimen, original artwork, metallurgical sample, stress analysis record, immunoelectrophoresis or anything else you can think of...

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Macrophotograph of wing attachment.

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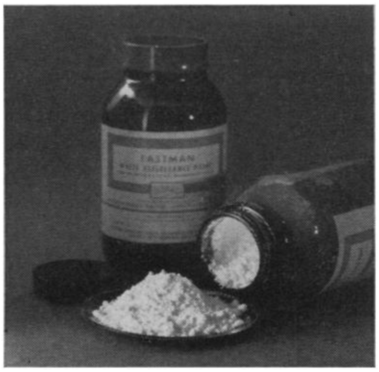
The Polaroid MP-3 Multipurpose View Land Camera.

Kodak

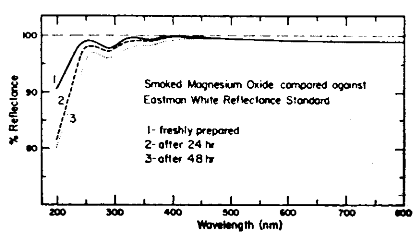
In hope of doing each other some good



Better than smoking

For a very long time, the standard laboratory way to prepare a white surface for spectrophotometric or colorimetric purposes has been to burn some magnesium and catch the MgO smoke. A deposit of it can be considered white for hours afterwards, particularly if the concept of whiteness is not stretched down into the UV below 380nm.

Now there is something better, a very specially purified $BaSO_4$ to be known as EASTMAN White Reflectance Standard. Curves 1, 2, and 3 compare MgO smoke coatings with our product as represented by the 100% line.



It is difficult to imagine a closer approach to perfection in a diffuse reflector of light, UV, and IR over the span from 200nm to 2500nm than this powder of ours. We also offer EASTMAN White Reflectance Holders, acrylic blocks into which to pack the powder to make 2-inch standard plaques for insertion into the port of the integrating sphere in a spectrophotometer.

For spray-painting the sphere as either the original or replacement coating, we recommend use of the same $BaSO_4$ embodied in EASTMAN White Reflectance Paint. Coatings of this too show essentially no change in 6 months of exposure to "normal" atmosphere.

Details from Distillation Products Industries, Rochester, N.Y. 14603 (phone 716-458-4080, ext. 25).

Big accelerator in the sky

We take on no R&D contracts for photographic materials. Not that we see anything wrong in them. It's just that we prefer a riskier course. Nevertheless, since we do have on hand a fair amount of talent for performing R&D on photo materials, it would be inappropriate arbitrarily to withhold that talent from the service of mankind. When presented with what seems like a worthy challenge, the talent goes to work, and we take our chances on an eventual payout through cash on the barrelhead for merchandise received, even when prospective demand seems unlikely to attain the breadth expected, let us say, by a successful marketer of dog food.

Project HAPPE (High Altitude Particle Physics Experiment) seems like a worthy challenge and a bargain besides. If Prof. Luis W. Alvarez' idea works out, mankind will be able to pursue fundamental truth to the 5000-GeV level or better and leave an extra gigabuck or two for causes that more of mankind are capable of appreciating.

Professor Alvarez and a crew of 60 at the Space Sciences Laboratory of the University of California at Berkeley want to hitch up the cosmos for use as an accelerator. It's back to balloons, with support from NASA. Up where energetic cosmic primaries abound, one carries a cubic meter of 10-kilogauss magnetic field. The present state of the art of superconductivity permits it to be airborne. Before 1947 such field strength hadn't even been attained with superconductors on the ground; but it isn't much for deflecting the 70 GeV-and-up particles to which a Cerenkov counter sensitizes the device.

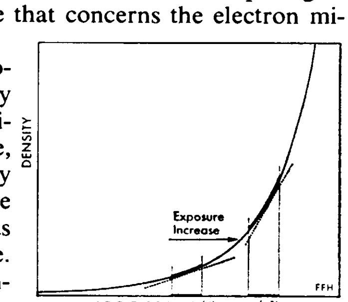
Because cut-price particles come unlabeled, the deflections give the energy information necessary to do physics with them. Since the deflections are small, to measure them takes high precision in locating the tracks before and after the magnetic field. That is why we have been called upon to coat 200μ of nuclear-track emulsion on both sides of plates 36 inches in diameter—a formidable undertaking for us and worse for the HAPPE crew to try themselves. Good ways to pack for shipment were not immediately obvious either. They have been worked out. Two plates are needed to ride above the magnet and two below. One side of each plate has "optically flat" pins sticking up through the emulsion to permit monitoring the exact location of the plates relative to each other during a 10-hour flight. After processing, positions of the tracks are measured relative to the pins by a marvelous laser-controlled readout machine. For tracks qualified by the Cerenkov counter and located by spark chamber, the machine knows within about one square millimeter where to look. Its microscope objective oscillates vertically through 200μ faster than the critical flicker frequency to obliterate from consideration all silver grains not part of a track straight through the emulsion. The point at which the track intersects the glass becomes a data point good to 1μ. Repeat for the seven other emulsion layers.

There will be no charge for the first big plate delivered, despite the man-years of work we have put into it. Let's just see if the product catches on.

Boosting contrast in electron micrography

Those who have gone into electron micrography with a sound understanding of the behavior of the photographic emulsion know all about the classic H&D curve of density vs. log exposure with its straight-line portion, its toe, and its shoulder. They know that the way to raise contrast is to increase development, which pivots the curve upward to a higher angle.

Forget that part. Hurter and Driffield weren't exposing to 50-KeV electrons. The curve that concerns the electron micrographer has this shape:



Gaining contrast by exposure increase is the best way to gain contrast—if the specimen will stand it—because, while contrast rises linearly with exposure, noise in the electron image rises only as the square root of exposure. Other ways of boosting contrast, such as more development or a contrastier printing paper, don't help the signal-to-noise ratio.

Try not to be bothered if the negative is darker than you would choose for viewing on the illuminator, as long as maximum density does not exceed 2.5. It may take a little more printing exposure, but the added information content may be worth it. If you have too many negatives to print and want to step up your production rate, see your dealer about the KODAK EKTAMATIC Processor, Model 214-K.

EASTMAN KODAK COMPANY An equal-opportunity employer

22 November 1968

Vol. 162, No. 3856

SCIENCE

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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

The cotton boll weevil is not a newcomer to cotton. A well-preserved adult female boll weevil (*Anthonomus grandis* Boheman) was discovered in fragments of a cultivated cotton boll, dated about A.D. 900, near Mitla, Oaxaca, Mexico (actual size, 7 millimeters). See page 911. [U.S. Department of Agriculture]

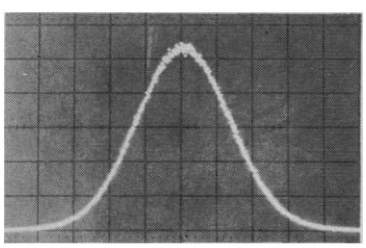
Tame complex scientific data... produce useful information directly

How to See Through 1000 Windows at a Time

Since the early days of the Manhattan Project, the study of nuclear phenomena has been on a steep rise. Not surprisingly, this started a train of responses by the instrumentation industry to answer the need of research scientists for analytical data about radiation. Of most service have been instruments to measure the gamma radiation that originates in the unstable nuclei of radioactive isotopes as they decay to stable states.

It's not really difficult, with today's more sophisticated electronic instrumentation to measure accurately the energy of a discrete gamma ray and the time of its occurrence. But that's only a small part of the information that the nuclear scientist needs to know. Usually the radiation 'signature' that identifies a material consists of a variety of gamma rays at characteristic energy levels, and it's precisely the knowledge of this *variety*—or spectrum—that interests the scientist.

Initially the nuclear scientist measured the gamma spectrum by looking at voltage pulses derived from the overall radiation through a series of energy "windows", one window at a time. He built the "frame" for each window using a high and a low voltage discriminator, each with adjustable threshold, thus being able to look only at pulses whose peak value fell between the two levels. Since an adequate measure of the gamma spectrum may require that the scientist look at it through more than a thousand different windows, this one-at-a-time procedure is often inadequate. Not only is it laborious, it is also so slow as to be useless where the decay rate (half-life) is very short.



Probability density display of Gaussian noise

Enter the multichannel analyzer (MCA), newest of which is the H-P 5400A. The MCA looks at gamma radiation through as many as 1024 windows, *simultaneously* sorting the pulses into as many amplitude groups. It counts and totalizes the pulses in each group and stores the results in memory for live or static display on the built-in cathode ray tube, for readout on a paper record or for input to a computer.

Speed, the essential characteristic of an MCA, reaches its peak in the 5400A. Employing a new analog-to-digital converter with a clock rate of 100 MHz, the 5400A sorts and digitizes input signals into one of 1024 categories in no more than 13 microseconds.

In its present state of refinement, the 5400A MCA has not only met the nuclear scientist's need for a gamma spectrum analyzer, but has also attracted the attention of analytical scientists in other disciplines. Biochemists for example have used it as a multichannel scaler to accumulate time/rate curves of activity for uptake/clearance studies in nuclear medicine. Design engineers have performed probability density analysis of continuous input signals with the 5400A to isolate signal and noise characteristics. Other solutions of complex measurement problems are described in the March 1968 issue of the *Hewlett-Packard Journal*, yours on request.

Designing for the Electronics-Shy Analyst

Natural strangers to the complex world of electronics, chemists and other analysts have long since been trapped in it because of their seemingly insatiable appetite for analytical instruments that are essentially electronic creations. Both readily admit the impossibility of doing their analytical work at today's speed and accuracy standards without electronics. But upon introspection they also acknowledge a deep yearning somehow to exclude the whole complicated world of transistors, diodes and integrated circuits from their laboratories.

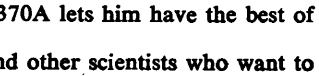
Yet exactly the reverse is happening: as the scientist uses more and more instruments in his quest for analytical speed, he produces greater and greater quantities of analog chart recordings, each of which he must laboriously interpret if he is to decode its analytical message. Bogged down in this task, the analyst once again has had to turn to the electronic designer . . . this time for a device which automatically interprets the *analog* output of such analytical instruments as the ubiquitous gas chromatograph, and translates it into *digital* data, the stuff of which quantitative analysis is made.

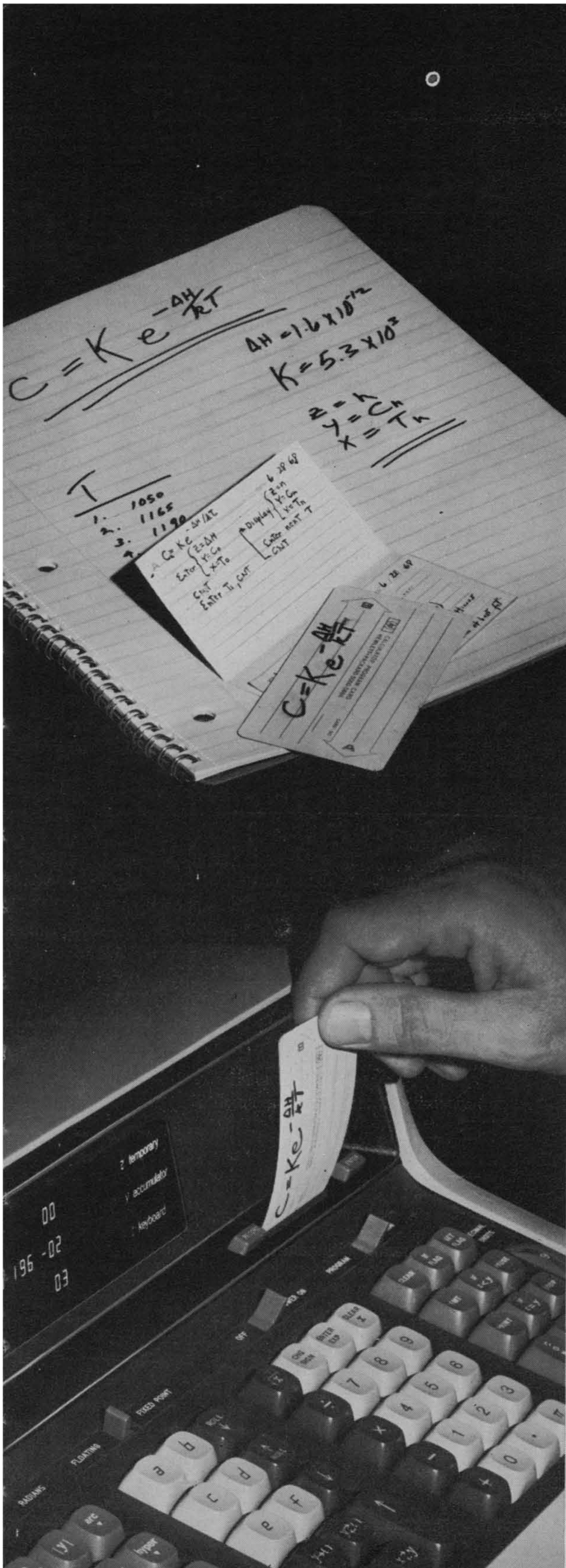
The device which does this job best—the digital integrator—employs even more complex electronic circuits than does the gas chromatograph. And it requires frequent adjustments of a dozen or more programming controls, each somewhat mysterious to the electronics-shy analyst.

For many, this is the last straw. Consequently they have refused to admit into their laboratories the one electronic device that, ironically, can do more than any other to speed their analyses and simplify their routine.

Aware of this problem in human engineering, a team of H-P chemists and electronic engineers together have recently completed the design of an integrator that can be programmed for an almost unlimited variety of analytical conditions just by pushing buttons. No longer must the recalcitrant analyst make the difficult choice of plunging into the strange world of integrator programming, or living in a world bereft of the benefits of digital integrators. The H-P 3370A lets him have the best of both worlds.

For electronics-shy chemists and other scientists who want to know how this was accomplished, we offer a new Bulletin 3370A, on request.





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fundamentalist students. Galileo showed that truly scientific concepts could not be heretical. He said:

> We bring new discoveries not to confuse minds, but to enlighten them, not to destroy science, but to put it on a sound foundation . . . The Bible speaks as the people of the time looked upon matters . . . In science man must begin not with the authority of the Bible, but with observations and proof. . . . The Bible cannot be at variance with the facts because God cannot contradict himself. It were risking the authority of the Bible, if when once facts are proved, the Bible were not interpreted to fit all these facts, rather than that man should go counter to the facts and proofs of nature (*3*).

In other words this is God's world. Fully applied I believe this doctrine would do much to resolve the conflicts between theology and science.

Pope Leo XIII used these principles in 1893. But Pope Paul VI does not mention them among the guidelines he would recommend to those who oppose his ban on artificial birth control. If the Pope were to consider the question of birth control in this light he might, in Father McMullin's words, "clarify points of faith and confusion" that seem to be splitting the Catholic world.

Catholic institutions would more easily gain the confidence of non-Catholic scholars if they were to follow the example of one Jesuit university, Xavier, at Cagayan de Oro, Philippines, which has put the names of Galileo and Copernicus with others in gold letters high on its new science building. There can be no doubt that Galileo is honored there for the sake of the ideas he was compelled to recant.

HOWARD MCCULLY
4 Hermosa Place,
Menlo Park, California 94025

References

1. A. Wolf, *A History of Science, Technology, and Philosophy in the 16th and 17th Centuries* (Harper, New York, 1959), vol. 1, p. 35.
2. H. Kramer and J. Sprenger, *Malleus Maleficarum*, M. Summers, Transl. (Associated Booksellers, Bridgeport, Conn., 1951).
3. M. Ornstein, *The Role of Scientific Societies in the Seventeenth Century* (Univ. of Chicago Press, Chicago, 1938), pp. 3 and 28.

Australia: Too Many Ph.D.'s

Singer's editorial, "Matching education to jobs in developing nations" (7 June, p. 1067), is directly relevant to a situation that has developed in Australia. An unawareness of the need to match the training of physical scientists to the job opportunities available in this country has led to a glut of doctoral graduates—a glut attested to by the number of Australian Ph.D.'s who continue to live in the United States for longer periods than they originally intended (*1*).

A decade ago Australian universities could not fill all their staff vacancies in the physical sciences, and the student working toward a higher degree had little doubt that he would obtain a research and teaching appointment when he graduated. Today the picture is totally different. The excellence and international standing of our universities attract a large number of foreign scientists to permanent positions here. Meanwhile the Australian graduate (who follows the traditional pattern of spending his early postdoctoral years outside Australia) is frequently unsuccessful when he returns home and attempts to get a job. Australian industry employs very few doctoral graduates and neither government-sponsored research organizations nor the colleges of technology can accommodate all those who are seeking employment. Thus it is not surprising, in view of the restricted opportunities, that the expatriate considers himself stranded overseas with little chance of returning to Australia.

An opinion frequently expressed by university teachers is that their responsibility lies in giving the student the best possible training. In the Australian context this generally means training him for basic research. At the same time, sometimes, he develops a distaste for applied science. Many of us working in universities welcome graduate students to assist our research. It speeds our own productivity, but it also means that more and more new Ph.D.'s, qualified in areas irrelevant to the nation's needs, find themselves seeking specialized jobs which are already scarce.

Undoubtedly Australian industry must find a place within its structure for basic research, but there is a necessity also for "coordination between academic curricula and economic development" (to quote Singer), fostered by the desire of the universities to engage in work that is important to the national economy. We may then have some relevance between supply and demand.

RODNEY L. S. WILLIX
11 Milson Street,
South Perth, Western Australia

Reference

1. I. D. Rae, *Proc. Roy. Aust. Chem. Inst.* **35**, 201 (1968).

2 NEW AAAS SYMPOSIUM VOLUMES

• Biology of the Mouth • Folk Song Style and Culture

Biology of the Mouth

Editor: Philip Person, Chief, Special Research Laboratory for Oral Tissue Metabolism, Veterans Administration Hospital, Brooklyn.

320 pp., electron micrographs and other illustrations, bibliog., index, 1968.

Price: $10.00. AAAS members' cash orders: $8.75.

A collection of comprehensive, multidisciplinary articles dealing with problems of the biology of the mouth and of oral disease and also the borderlands where fundamental approaches and investigations in physics and chemistry relate to, and can be brought to bear on, such problems. Among the disciplines represented are comparative anatomy and histology (light and electron microscopy), comparative molecular biochemistry, anthropology, paleontology, neuroanatomy and neurophysiology, zoology, botany, solid-state physics, and chemical physics. An attempt is made to integrate these varied contributions, to provide a broad perspective in which important mutual interests are identified and explored. This perspective includes the classical disciplines of Darwinian biology and the more recent disciplines of molecular and quantum biology, as well as their relationships to diseases of the mouth and oral structures. A feature of the volume is a highly original and significant contribution by Professor J. Z. Young dealing with the influence of the mouth upon the evolution of the brain.

Contents

Foreword: Place of Dentistry in Science.

Biology of Oral Tissues and Oral Disease: Darwin and Quantum.

Influence of the Mouth on the Evolution of the Brain.

Bone, Dentin, and Enamel and the Evolution of Vertebrates.

Tooth and Jaw in the Assessment of the Origins of Man.

Cleaning Symbiosis and Oral Grooming on the Coral Reef.

Lactoperoxidase, the Peroxidase in the Salivary Gland.

Biochemical Processes in Macromolecular Environments: Plant Cell-Wall Matrix in Lignin Polymer Foundation.

A Physicist Looks at Biology.

Role of Water in Some Biophysical Properties of Skeletal Tissues.

Biological Significance of Water Structure.

Water and Electrolyte Balance in Cells and Tissues.

Molecular Evolution of Connective Tissue.

Comparative Ultrastructure and Organization of Inorganic Crystals and Organic Matrices of Mineralized Tissues.

Folk Song Style and Culture

A Report on Cantometrics by the Staff of the Cantometrics Project of Columbia University, Alan Lomax, Project Director.

384 pp., 80 illus., 87 tables, bibliog., index, 1968.

Price: $16.75. AAAS members' cash orders: $14.50.

Working with a large sample of recorded songs and filmed dances from all culture areas of the world, the Cantometrics Project has discovered some of the ways in which song and dance style vary by culture area. Strong statistical relationships have been established between a set of basic factors of social and economic structure and performance style. The book reports on an imaginative yet rigorous exploration of the paralinguistic and parakinesic realms and a thoroughgoing test of the hypothesis that factors of cultural style are primary forces in shaping all human behavior. Performance style here becomes a psychocultural indicator, and, for the first time, the social and cultural import of the expressive act is firmly established.

Contents

The Stylistic Method; The Cantometrics Experiment; The Cantometric Coding Book; The World Song Style Map.

Consensus on Cantometric Parameters: A. Consensus Testing; B. The Paralinguistic Framework.

Song as a Measure of Culture; Social Solidarity; Self-Assertion, Sex Role and Vocal Rasp; Effects of Infantile Stimulation on Musical Behavior.

Dance Style and Culture; Choreometric Profiles; The Choreometric Coding Book; Folk Song Texts as Culture Indicators; Cantometrics in Retrospect.

Appendixes: Data Systems and Programming; Statistical Notes; Summodal Profiles for Nine World Song Style Regions.

Bibliography. Folk Song Text Sources. Film Sources.

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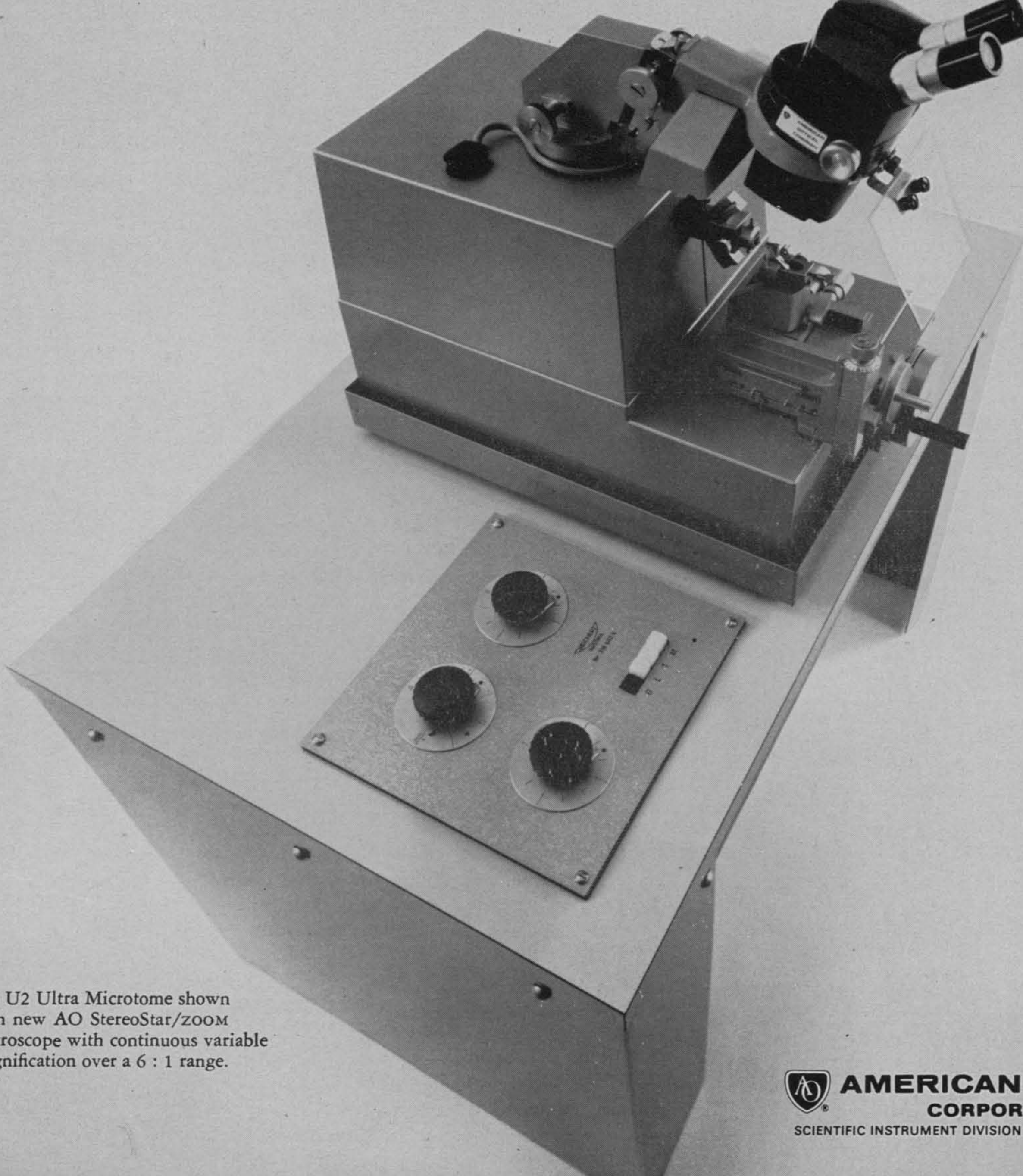


Om U2 Ultra Microtome shown with new AO StereoStar/ZOOM Microscope with continuous variable magnification over a 6 : 1 range.

AMERICAN OPTICAL CORPORATION
SCIENTIFIC INSTRUMENT DIVISION • BUFFALO, N.Y. 14215

22 November 1968, Volume 162, Number 3856

SCIENCE

Computer-Assisted Instruction

In a complex, evolving society, demands for education continue to expand. The education enterprise has an annual budget of more than $50 billion. Even so, there are important unfilled needs, such as that for continuing education. There is also persistent pressure for improvement in teaching effectiveness. The educational system has been slow to improve its methods and in some areas may have retrogressed, for most teaching is performed by those of moderate gifts or experience. One cynic has said, "There has been no major invention in education since the printing press." With costs growing rapidly and taxpayers and students discontented, education is ripe for major change.

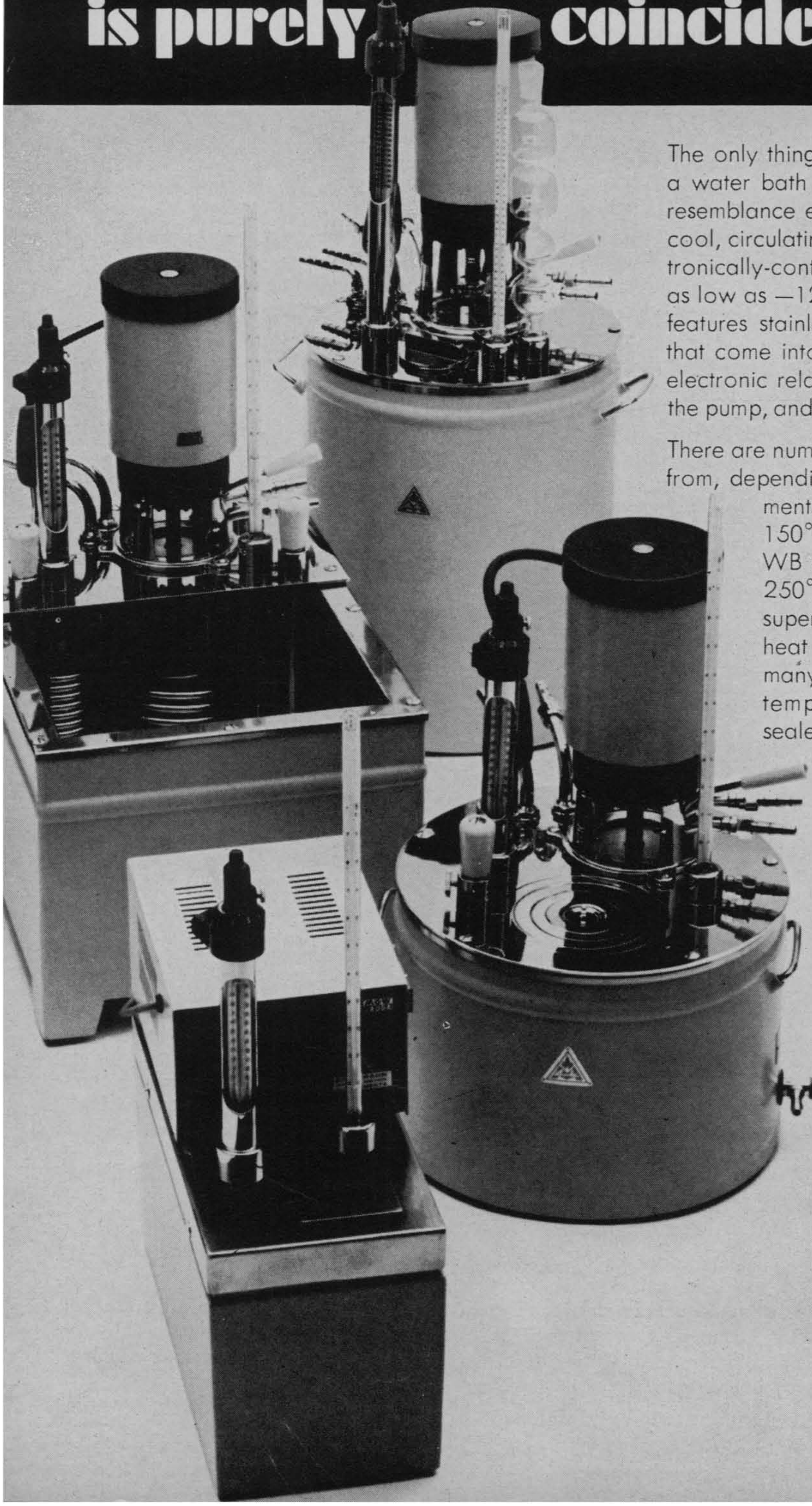
The forces now visibly fostering change may soon be overshadowed by the emergence of an even greater force—technological development in the form of computer-based education. The full impact of the new technology will not be felt for many years. Great developments in hardware, in software, and in understanding the learning process must yet be accomplished. However, enough has occurred to make Donald Bitzer of the University of Illinois feel confident that "computer-assisted instruction is destined to have an impact on society of a magnitude comparable to that of the automobile."

If computer-assisted instruction (CAI) is to have such impact, it must provide high-quality instruction at low cost and great convenience, and it must make possible unique training experiences. One of its major advantages is the ability to provide individualized instruction, so that the student can learn in his own way and at his own pace. Students respond very well to this matching of their needs. They work very diligently with the computer. If the student is bright he moves ahead rapidly. If he is slow, he does not feel lost. This advantage has been particularly apparent in those aspects of learning that require drill and practice. For example, competence in performing arithmetical operations has been achieved through CAI in a third to a fifth the time required by conventional means. The programming and perfecting of techniques for teaching a variety of advanced courses will require more time. However, the developers of CAI point to an important asset that they utilize. While the computer is teaching it records the student's responses. These responses determine what material is presented next. They also guide improvements in the curriculum.

The CAI equipment at present available is expensive in terms of cost per student per hour of use and can service only small classes. Some of the equipment performs functions that can be served in cheaper, simpler ways. If CAI is to be used widely, new equipment must be invented and perfected. Under development at the University of Illinois is a facility aimed at exploiting the great time-sharing potential of the CDC-6600 computer. If developmental work is successful, the facility will eventually include about 4000 consoles, some of them at Urbana but many in junior colleges, grade schools, and high schools around the state. The hoped-for cost per student per hour of use is 25 cents.

If the development comes up to expectations, the present educational system will be faced with great tensions and opportunities. However, experts in CAI feel that the usefulness of the computer will be most revolutionary in teaching children aged 3 to 6 and in the area of continuing education. They predict that it will become feasible for individuals and families to have computer terminals in their own homes and to tap course material covering a broad spectrum of subjects.

—Philip H. Abelson



Polymers

Charles L. Segal and Jack R. Knox are chairman and vice chairman, respectively.

27 January. (J. Johnson, discussion leader): H. Mark, "Recent progress in polymer chemistry and technology"; A. Eisenberg, "Some physical properties of non-crystalline organic ionic polymers." (W. MacKnight, discussion leader): R. Simha, "Polymer solids at very low temperatures"; M. Shen, "Low temperature thermal expansion of polyethylene unit cell."

28 January. (S. Atlas, discussion leader): J. Stille, "Polyphenylenes"; H. Levine, "Polybenzimidazoquinazolines." (G. Pezdirtz, discussion leader): H. Schroeder, "Boron-based polymers with high temperature stability"; P. Hergenrother, "Poly-*as*-triazines: synthesis and preliminary stability evaluation."

29 January. (R. Conley, principal speaker and discussion leader): Open panel discussion on thermal decomposition; (D. Vincent, discussion leader): I. Goldfarb, "Kinetics of thermal decomposition of model aliphatic and aromatic polyimides."

30 January. (W. McDonald, discussion leader): J. Halpin, "Property-structure concepts in composite materials"; R. Bacon and R. Didchenka, "Interface problems in resin/graphite fiber composites." (F. Bailey, discussion leader): J. Lando, "Crystallization and polymerization on graphite surfaces"; R. Lundberg, "Poly-ε-caprolactone: polymerization and application studies."

31 January. (J. Knox, discussion leader): M. Huggins, "A new theory of intermolecular interactions in polymer solutions"; M. Goodman, "Conformational analysis of stereoregular polymers."

Calendar of Events—Courses

Immunology, Lake Forest College, Lake Forest, Ill., 14–26 July. Sponsored by the American Association of Immunologists and supported by a training grant to the University of Illinois, the course is intended primarily for university or college instructors who require more breadth of knowledge of immune mechanisms for teaching and research. Selection of participants (limited to approximately 50) will be on a competitive basis and will be decided by the Committee on Admissions. Applications must be received not later than *1 April 1969* and should be accompanied