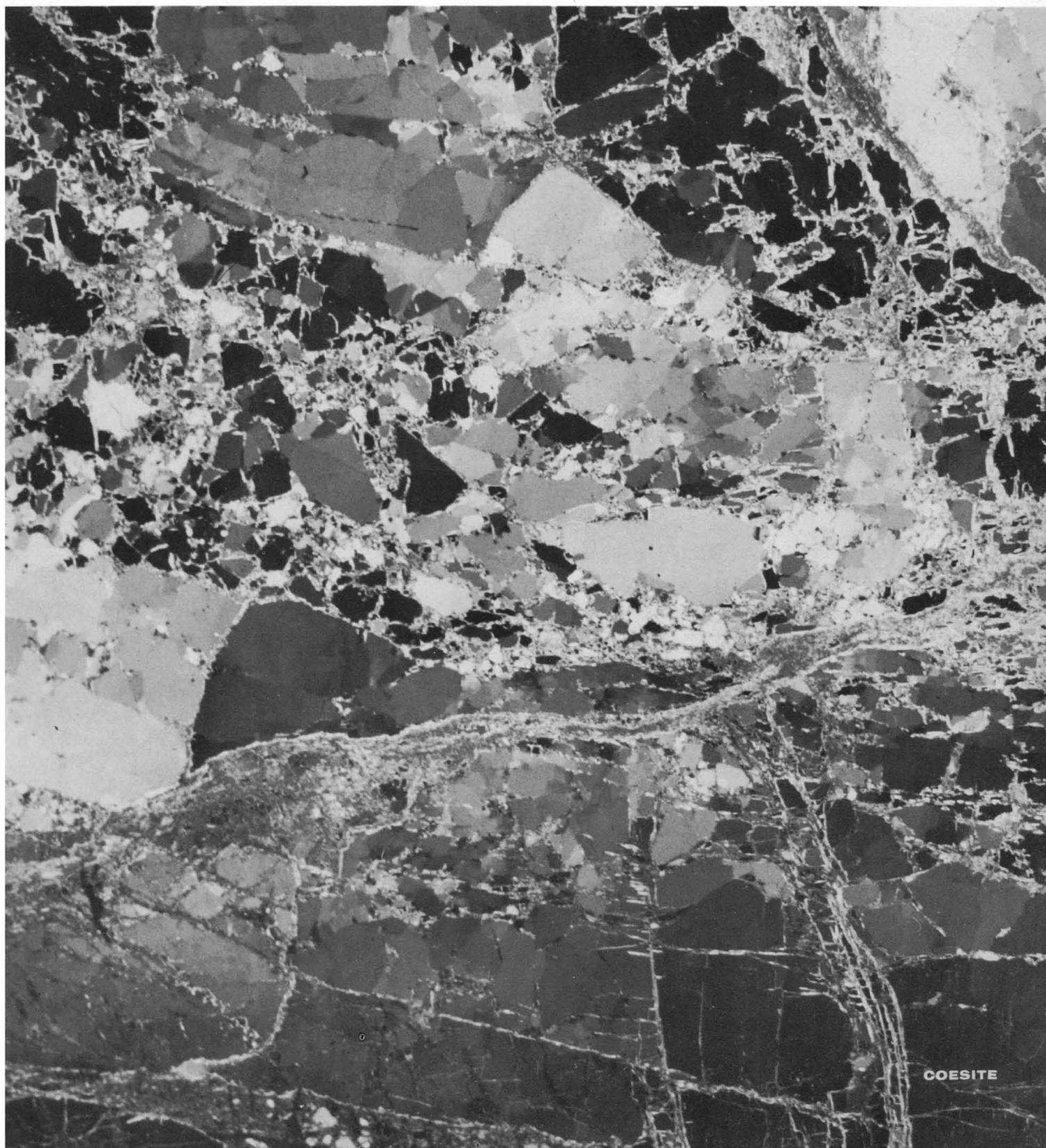


SCIENCE

18 October 1963

Vol. 142, No. 3590

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



IBM computers, science and you:



Digital trouble shooter for Titan

At Martin Company, systems engineers help assure success in operational missiles by continually checking product performance with the help of an IBM 7090 system.

Martin engineers have processed 200 miles of paper and 2 million punched cards through the 7090—a complete and continuous case history on the performance of every part in every missile built at Martin's Denver Division.

Take the Titan for example.

Once a month, the manager of systems engineering receives an 8-month record of Titan performance. A curve drawn by the computer pinpoints potential trouble areas, alerts Martin engineers

to parts that have started to drop in reliability.

The "trouble" might be just a loose wire, a minor drop in voltage or just a tired resistor. The point is they find and correct trouble before it aborts a mission.

That's pretty important—Titan II will boost Project Gemini into orbit, with a couple of astronauts aboard.

Reliability is pretty important in your product, too. It is to your customers anyway. And you can perform this type of quality control in your products, if you have an IBM computer handy. It doesn't always take a big 7090. Sometimes an inexpensive 1620 system is all you need.

Automatic maps help find oil

Geologists and geophysicists collect core samples and pressure readings and seismic data and dipmeter readings and other technical data.

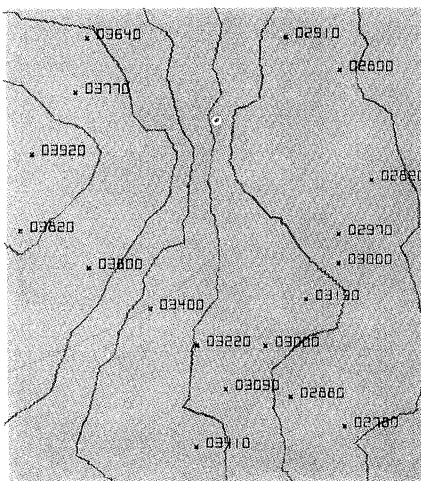
Then what? That's the rub.

Like most scientists, their problem is finding time to sift through it all...analyze it...and make it useful.

But not any more.

Now, a set of new IBM computer programs helps them process and analyze their data. The programs are tailored to oil exploration and production problems and the capabilities of the small, low-cost IBM 1620 computer.

The programs automatically stamp out quick contour maps that help petroleum experts avoid unpromising



fields and concentrate on fields that look like winners.

The new IBM programs also guide economic forecasts, casing design, water-flooding patterns and other activities.

You can handle all these problems on a 1620 with 20K core storage and automatic divide, a card read-punch and a paper tape reader adapter to handle an X-Y plotter (for the contour maps).

The programs, of course, are free. And so is the help of our petroleum industry specialists.

Our programs help cut the cost of operating the computer.

This is worthwhile if it helps geologists and geophysicists eliminate just one million-dollar dry hole a year.

Computer programs speed lens design

If you've ever designed a lens system—even a simple one—you know it's no snap assignment.

It can take several months if you're working on a complex system and doing all the work by hand.

But you can cut this to a few days and increase precision at the same time, with an IBM 1620 computer and a set of four IBM lens design programs.

The first program in this package does two things. First, it traces individual meridional and skew rays and fans of sagittal and tangential rays (up to 99 per fan). It also calculates third or-

der aberrations for the system and for individual surfaces.

The second program computes the vignetted aperture of the lens system, constructs a grid across this area and traces selected light rays through the system from this grid. This enables the designer to check the total usable path of light through the system. He may specify up to 999 rays.

The third program evaluates the output of the second program. It computes the radial distribution of light energy and provides focus and origin shifting, if desired.

The fourth program compares third order aberrations in the system with desired values. It automatically computes changes in system parameters and recalculates third order aberrations until the lens system performs within specified tolerance limits.

These lens design programs improve accuracy, help the designer improve lens system performance and make it possible for him to devise more sophisticated designs.

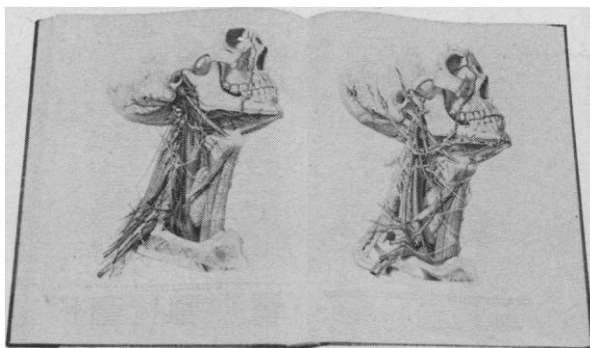
You can get these easy-to-operate lens design programs through your local IBM branch office.

A New Atlas—magnificently illustrated

Pernkopf—Atlas of Topographical and Applied Human Anatomy, Vol. I Head & Neck

Volume I of this new 2-volume Atlas brings you magnificent drawings on the head and neck beautifully reproduced from the plates in the celebrated 7-volume text and atlas by Dr. Eduard Pernkopf, one of the last representatives of the famed Viennese school of anatomy. You'll find superb anatomical views (most in vivid color) of every part of the head and neck—from the superficial to the deep layers. Precise labeling follows the 1955 Nomina Anatomica as amended in New York in 1960. Volume II on the Thorax, Abdomen and Extremities will be ready in January.

Edited by DR. HELMUT FERNER, Professor and Director of the Anatomical Institute, University of Heidelberg. Translated into English by DR. HARRY MONSEN, Associate Professor of Anatomy, Department of Anatomy, University of Illinois College of Medicine. Vol. I, 356 pages, 8" x 10", with 332 figures, 240 in color. \$32.50. Just Published! Vol. II, about 375 pages, 8" x 10", with about 375 illustrations, mostly color. About \$37.50. Ready January, 1964.

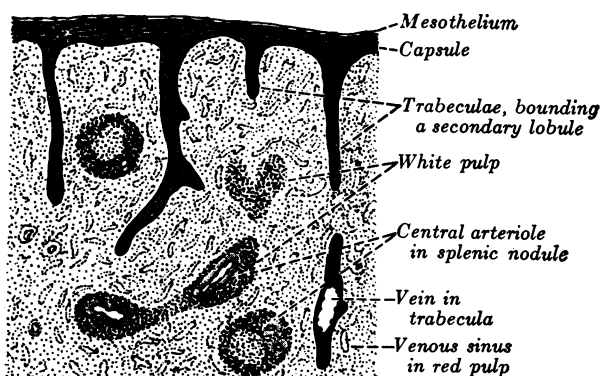


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Here is a beautifully illustrated outline guide through the complexities of histology. Information in this unique text is so arranged under heads and subheads that its skeleton framework gives orderly, logical organization to the entire field of histology. In keeping with the clear cut outline format, sentences are written in a crisp narrative style, mostly a single line long. The author has arranged these sentences into visual groups, progressively indented so you can see at a glance the facts of major importance. For each tissue the author describes the location, gross appearance, structure and functional correlations. Summaries of the regenerative capacities of both tissues and organs are included. A new feature of this revision is the series of 22 two-color plates which represent every tissue type the student is likely to encounter in the course.

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(From one of 22 full page plates.)

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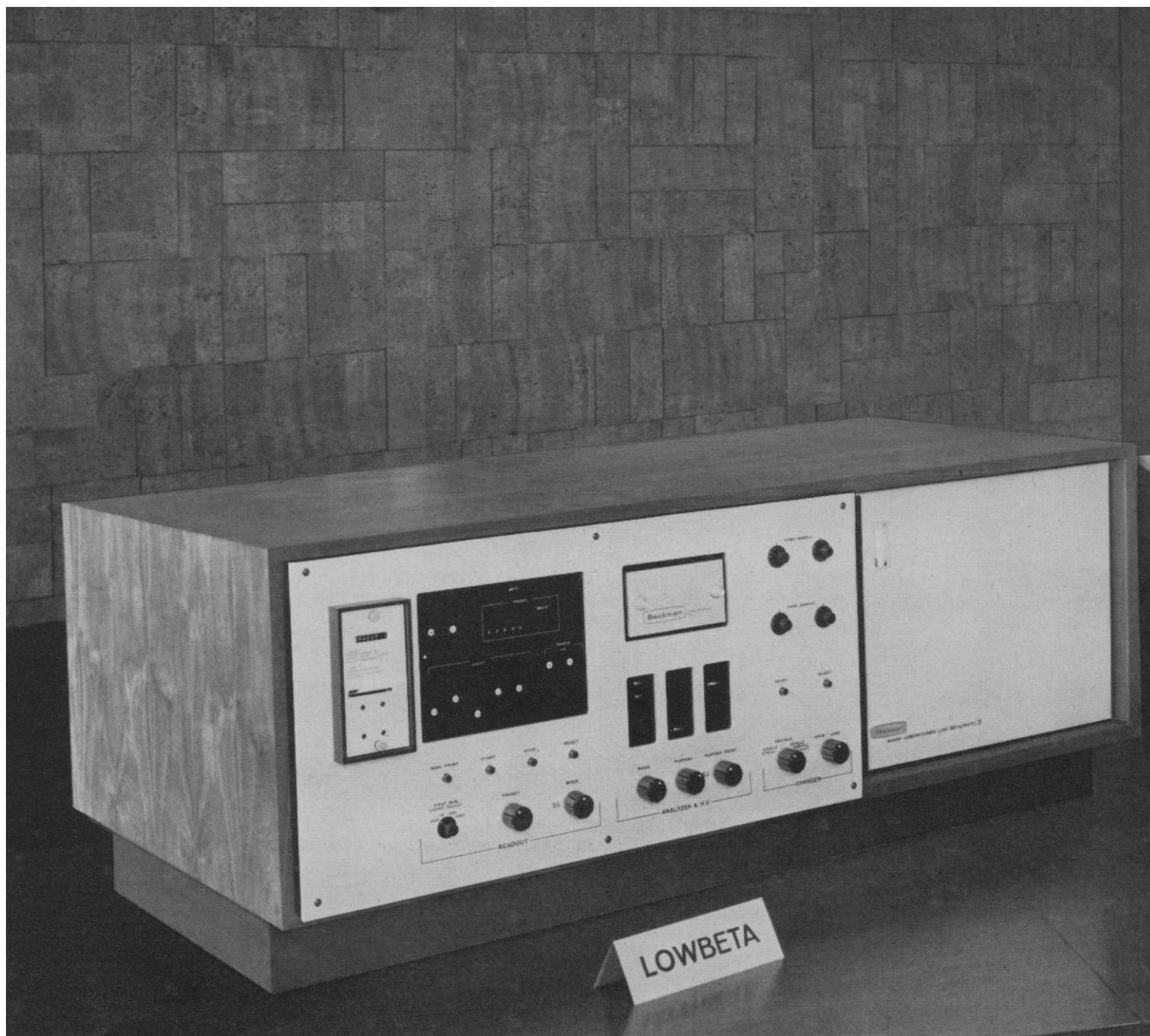
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COVER

Photomicrograph of a thin section of shattered, coesite-bearing quartz from Holleford Crater, Ontario, Canada. The severely fractured quartz and the high pressure quartz polymorph, coesite, are the products of hypervelocity shock generated by meteorite impact with the earth (Cross nicols, about $\times 13$). See page 379. [A. M. Reid]



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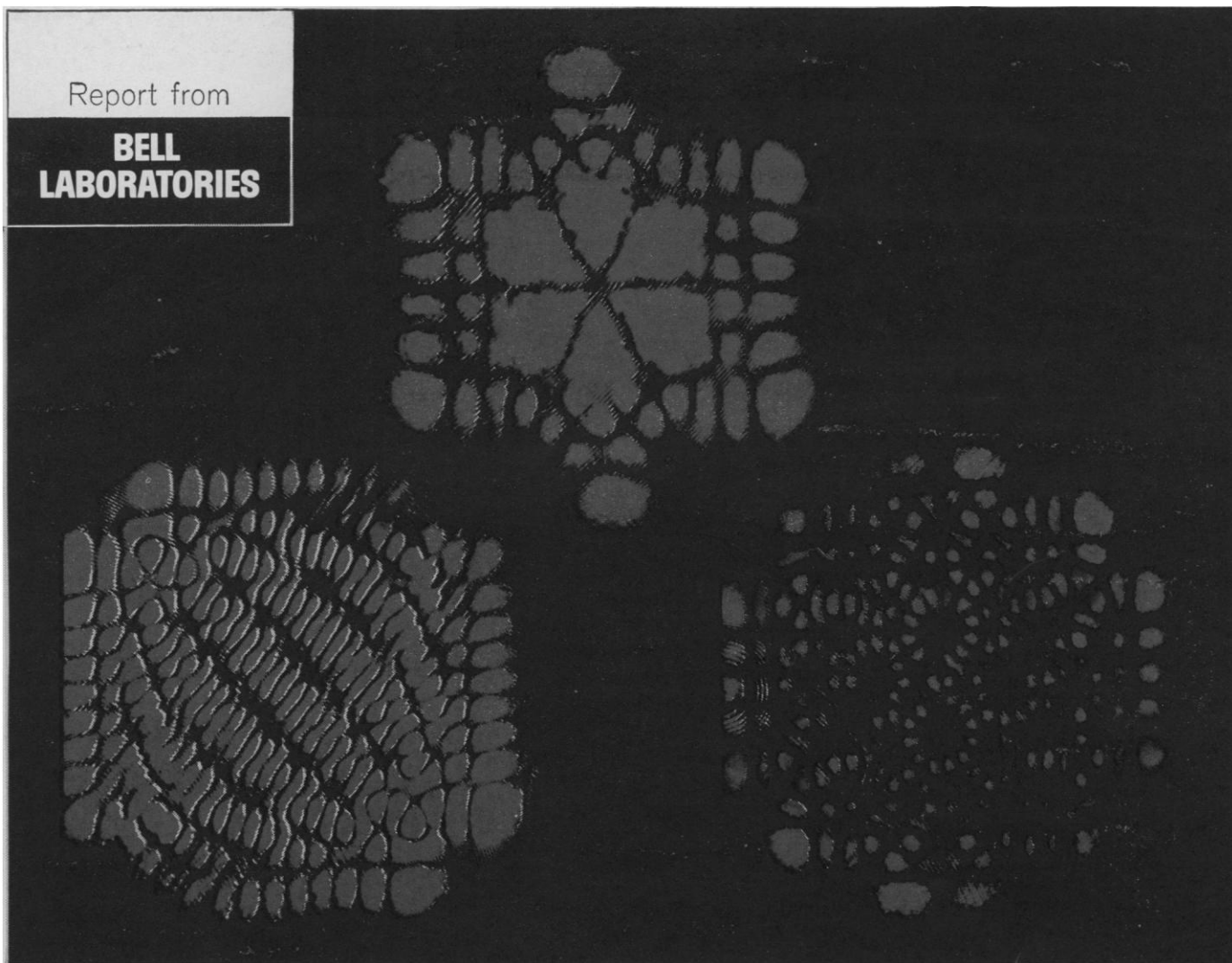
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Report from

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To produce these mode patterns, the normal operation of a helium-neon optical maser is perturbed by placing a pair of wire cross hairs in the cavity. These wires interact with the mode structure of the unperturbed cavity, suppressing some modes and, in certain cases, coupling others together. By changing the angle between the cross hairs, this interaction can be altered and different mode patterns, as shown, can be produced.

A STEADILY GROWING FAMILY OF OPTICAL MASERS

Scientists at Bell Telephone Laboratories are continuing extensive research programs to gain increased knowledge about optical maser (laser) action. The immediate goal of these investigations is more complete understanding of the phenomenon itself. In the long run, however, this knowledge will help us to evaluate better the communications applications.

One aspect of optical maser research is the study of the mode structures in laser cavities. The modes excited in a particular experiment can be identified by mode patterns, shown above, produced by directing the emergent beam onto a photographic plate.

Optical maser research at Bell Laboratories has resulted in a broad new field of radiation science. For instance, discovery of gas lasers also provided the first continuously operating laser. The active medium in this device is a mixture of helium and neon; its

operation depends on the excitation of neon atoms by collision with excited helium atoms. Originally, this system emitted infrared light, but recently it has been made to produce visible red and yellow light.

More recently, in another significant advance, our scientists have discovered two other new mechanisms for creating maser action in gases. One depends on the dissociation of oxygen molecules in mixtures of oxygen and neon or argon. The other takes place in pure noble gases—helium, neon, argon, krypton and xenon—and depends on a direct transfer of energy from accelerated free electrons to the gas atoms.

With these mechanisms and various gases or gas mixtures, we have achieved maser action at approximately 150 different wavelengths extending from 0.594 microns in the yellow region of the spectrum to 34.5 microns in the far infrared—and more are in prospect.



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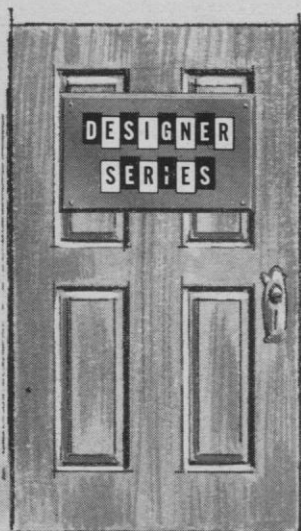
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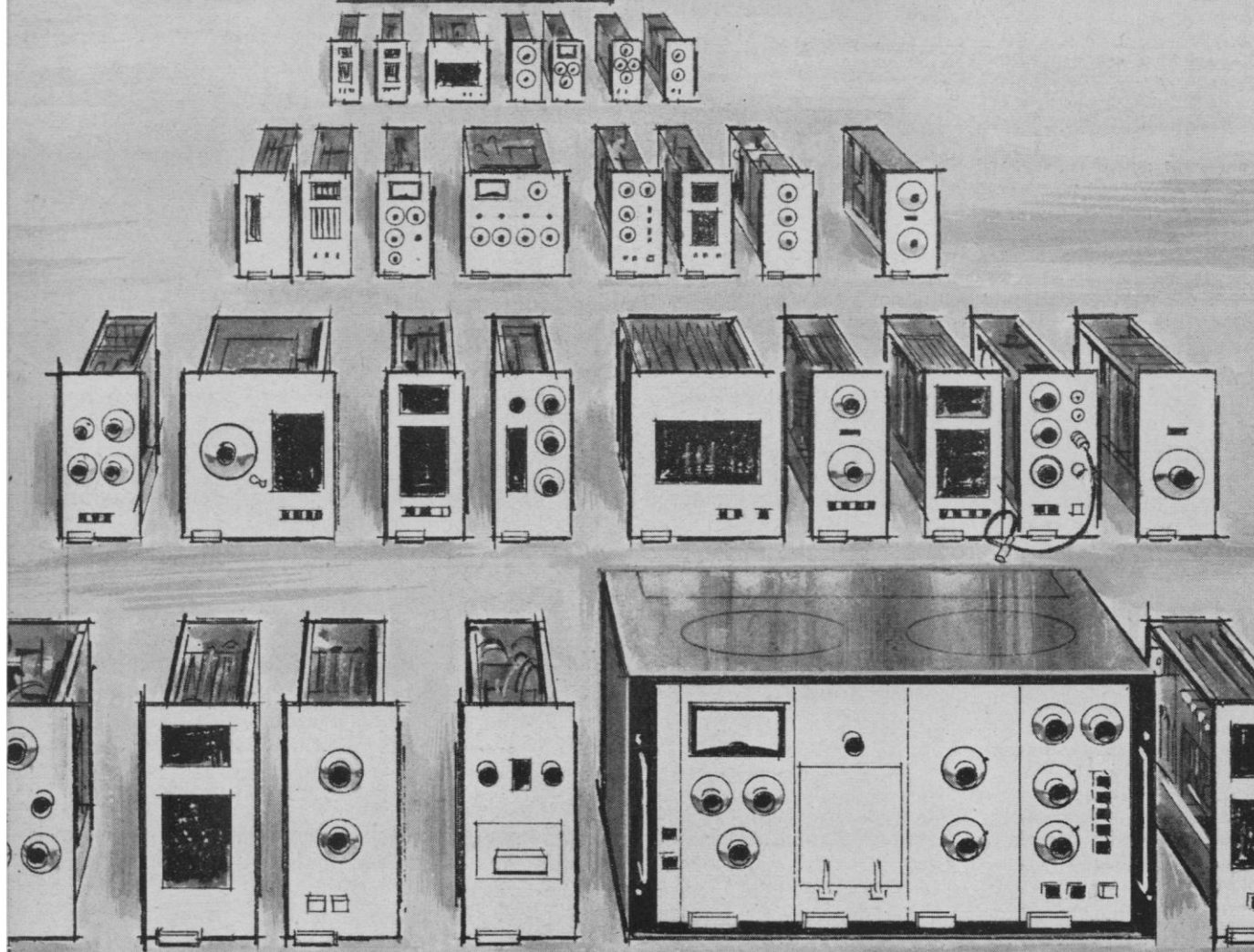
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Measuring Heats of Fusion of Salts with a Dynamic Adiabatic Calorimeter

Modification of and additions to known techniques have led to a fast and accurate method of measuring heats of fusion and specific heats of materials.

Fused salts are stable at high temperatures, have low vapor pressure, low viscosity and good electrical conductivity. They are also able to dissolve many different materials. Extremely useful in metallurgical processes, they have been used as heat transfer materials, power sources, control devices, and coolants and fuels in atomic reactors.

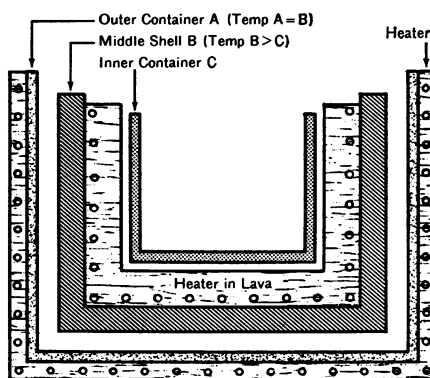
One area of interest to Honeywell scientists concerns heats of fusion of specific salts. Much older heat of fusion and specific heat data to be found in the calorimetric literature are inaccurate, particularly those on inorganic compounds with high melting points. At the same time present methods of obtaining accurate data are cumbersome, complex and time consuming.

Modifying and adding to known techniques, Honeywell scientists have developed a calorimeter that gives direct reading, highly accurate data in as little as two hours.

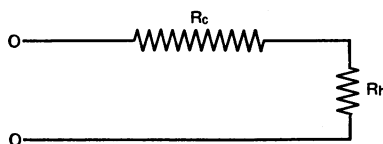
A conventional calorimetry equation is $q_h = q_s + q_c + q_1$ or the heat supplied to the system equals the heat absorbed by the sample (q_s) plus the heat absorbed by the calorimeter (q_c) plus any heat loss (q_1).

Honeywell's approach (see illustration) is to eliminate q_1 by maintaining adiabatic conditions between the outer shell (A) and the next or middle shell (B) and to maintain a constant temperature gradient between a higher temperature in the middle shell (B) and a lower temperature in the inner shell (C) containing the sample. The equality of temperatures at (A) and (B) forbids heat from passing from the middle (B) to the outer shell (A) so that after the middle shell temperature reaches its control point all heat must pass to the sample. The outer-middle shell adiabatic condition and the middle-inner constant temperature gradient condition are maintained with two feed-back control systems. If these conditions are met q_1 can be ignored

and $q_h = q_s + q_c$. If the sample is removed $q_h = q_c$ and q_c becomes known so that q_s can be determined by a simple subtraction. The problem then becomes how to accurately measure q_h .



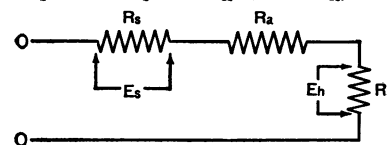
The problem $q_h = \int \text{watts} \times \text{time}$ or $\int \text{amps} \times \text{volts} \times \text{time}$ is simple to pose, but the integration is difficult without a constant current, voltage or wattage. To obtain a constant power (amps x volts), Honeywell borrowed an approach of Rosengren whose circuit is such that the



difference in power dissipated by R_h will be negligible between any two temperatures if $R_c = \sqrt{R_{h1} \times R_{h2}}$ where R_{h1} is resistance at temperature 1 and R_{h2} is resistance at temperature 2, whereas without R_c the power dissipation decreases inversely as R_h increases.

Desiring, however, to use an adjustable system to cover different temperature ranges, Honeywell separated R_c into R_a , an adjustable resistor, and R_s , a known standard resistance.

Then, adding a potentiometer to measure E_s across R_s and E_h across R_h ,



$E_s = R_s i_s$, where i_s is the same as i_h and R_s is known. Thus watts across R_h can be determined: $E_h E_s / R_s = \text{watts of constant power}$.

With a strip chart recorder measuring the temperature of the sample only when power is demanded, a direct readout of the heat of fusion (q_h) is possible. The chart reads time directly between any two points. Therefore, when temperature ceases to climb, fusion is taking place and when temperature rises again fusion is completed.

Since $q_h = \text{watts} \times \text{time}$, and watts ($E_h E_s / R_s$) is maintained constant, q_h becomes a known factor x time, so that by an easy conversion, time for fusion is in effect, q_h , the heat of fusion. By comparing plots with and without the sample, specific heat data are also easily obtained.

This chart, plotted automatically in two to three hours, replaces computations that took several weeks. Results have been impressive. In measuring the heat of fusion of benzoic acid in five runs, one was +1.7% above the Bureau of Standards figure, one +2% and three exactly on standard.

Work is continuing at Honeywell's Research Center. As heats of fusion of various salts are more readily measured and predicted, further uses are expected. If you are engaged in high temperature calorimetry and wish to know more about Honeywell's work in this area you are invited to write Dr. Cyril Solomons, Honeywell Research Center, Hopkins, Minn.

If you are interested in a career at Honeywell's Research Center and hold an advanced degree in any branch of science you are invited to write Dr. John Dempsey, Director of Research, at this same address.

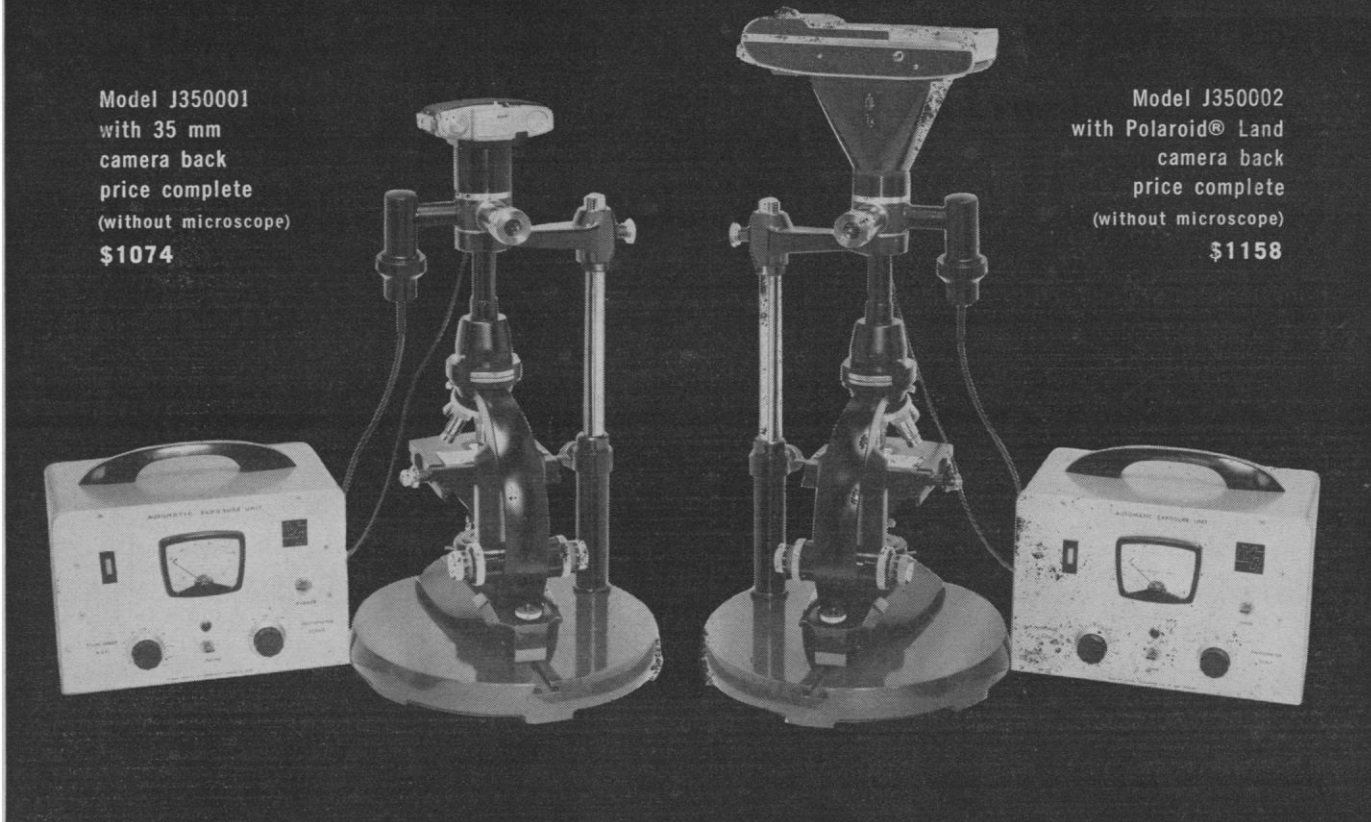


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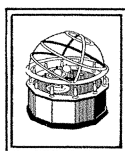
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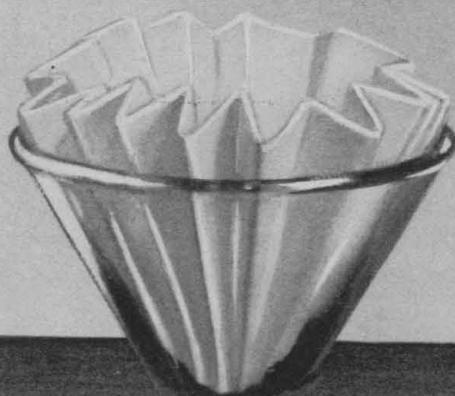
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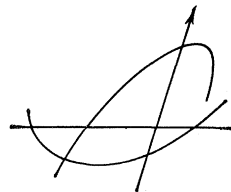


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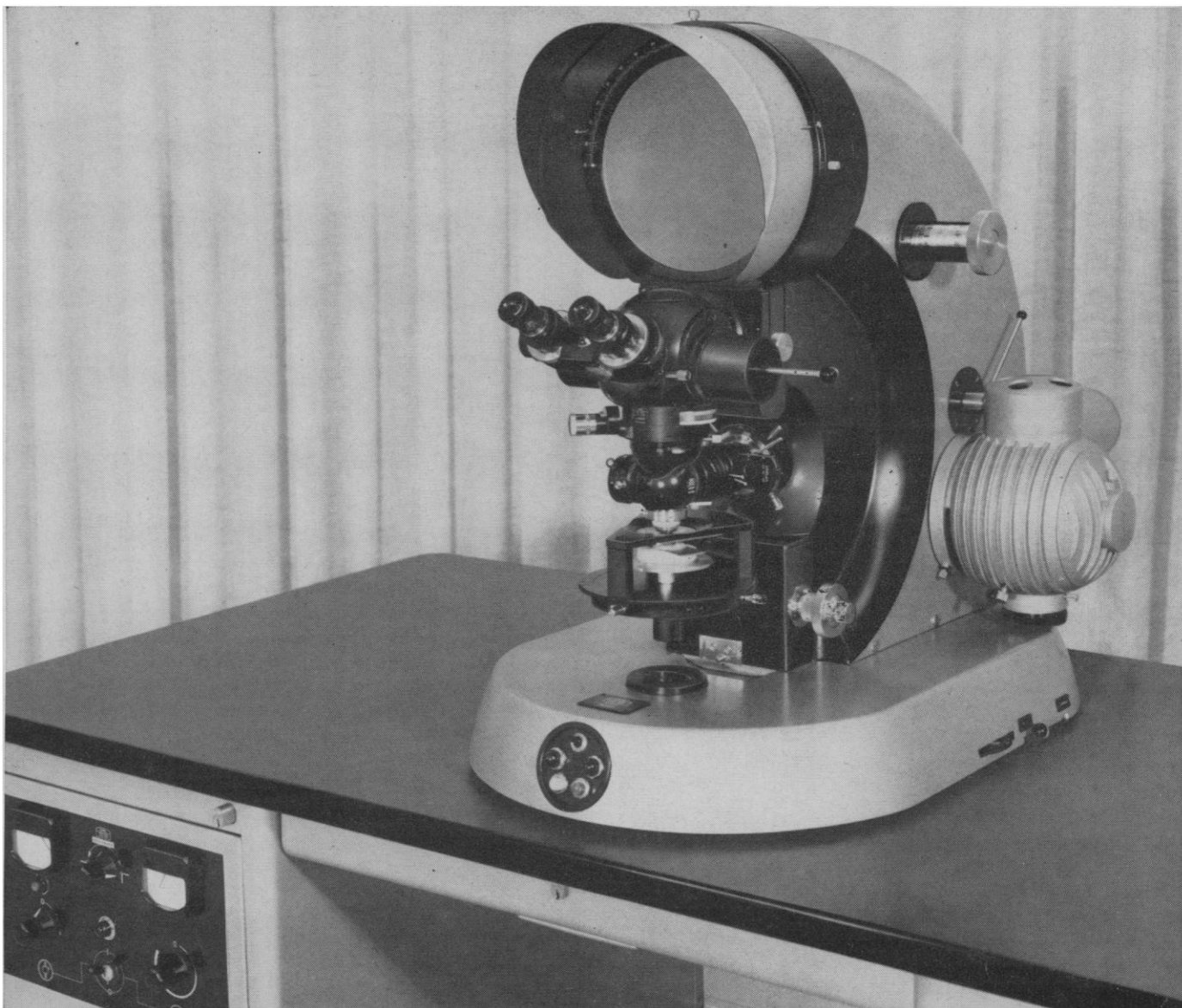
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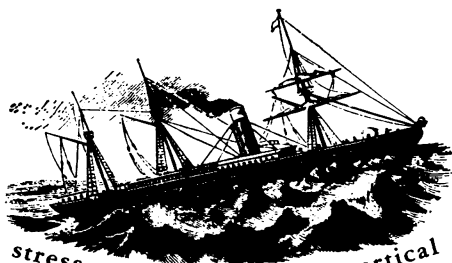
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Honeywell data acquisition system records stresses on ships at sea



The extremely low recording speed capability of a Honeywell Magnetic Tape System and the versatility of a Honeywell Visicorder Oscillograph have teamed up to report a new story of the punishment ships take at sea. Lessells and Associates, Inc., Boston, used the Honeywell system to measure the vertical longitudinal stresses induced in the hull each time a ship is pounded by a wave.

A Honeywell LAR 7460 Magnetic Tape Recording system was installed aboard the S.S. Hoosier State, and later aboard a sister ship, the S.S. Wolverine State. Both are 520-foot, 15,000 ton freighters operated by States Marine Lines of New York. Strain gages were attached to the port and starboard gunwales amidships to sense stresses produced by waves encountered over the turbulent trade routes of the North Atlantic.

The outputs of the gages were combined in a manner which would cancel the horizontal and transverse

stresses and permit only vertical bending stresses to be measured.

Data from the strain gages were then recorded at .3 inches per second on the 14-track LAR 7460 tape system. The extremely low speed capability of the recorder permitted 40 hours of data to be recorded on a single pass of a 10½-inch reel of tape. During the voyage, the ship's officers rewound the tape every 40 hours, permitting 160 hours of data to be recorded on a single reel of tape.

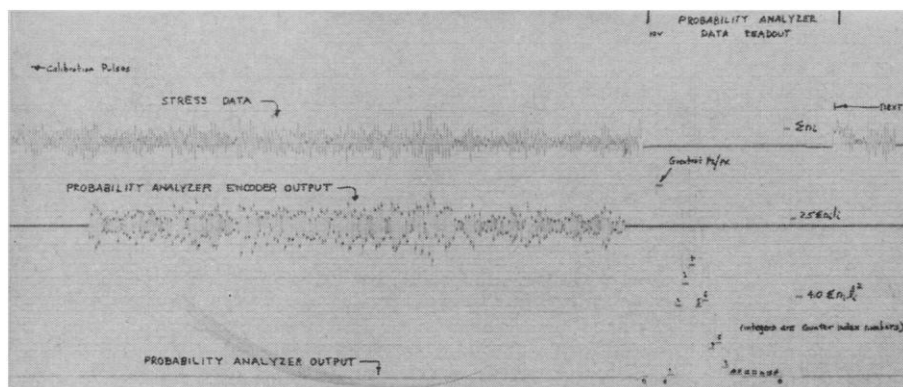
After the voyage, the tape was taken to Lessells' laboratory and played back from a Honeywell reproducing and amplifying system at 60 inches per second, or a speed ratio of 200 to 1. From the playback system, the data were recorded on a Honeywell Model 906 Visicorder oscillograph, operating at a paper speed of one inch per second.

The data were also fed through a probability distribution analyzer and this processed output was fed into the

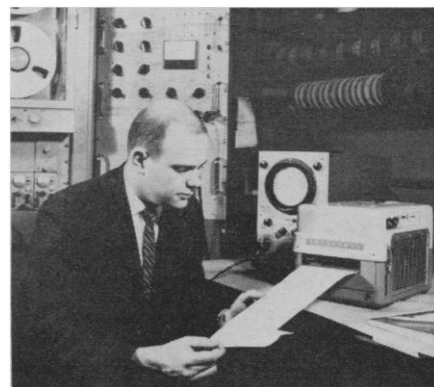
Visicorder to permit simultaneous observation of original and processed data. By being able to control both the recording speed and the playback speed, as well as the paper speed of the Visicorder, Lessells could obtain a permanent record of the data with any desired trace resolution.

Whatever your data acquisition requirements may be, Honeywell systems can meet your needs. Visicorder oscillographs are available with channel capacities from 1 to 36 and paper speeds from 1 inch per hour to 160 inches per second. Honeywell Magnetic Tape Systems range from the economical Honeywell 8100 portable recorder/reproducer to complete laboratory systems, with capabilities including FM, direct, digital, and incremental recording.

For complete information, call your local Honeywell representative. Or write or call Honeywell, Denver Division, Industrial Products Group, Denver 10, Colo. (303-794-4311)



Top trace: Stress data as recorded on ship. Middle trace: Probability distribution analyzer encoder output. Bottom trace: Probability distribution analyzer output. Work performed under NOBS Contracts: #88349, Ships Structures Committee; #88451, Office Chief of Transportation, Dept. of Army.

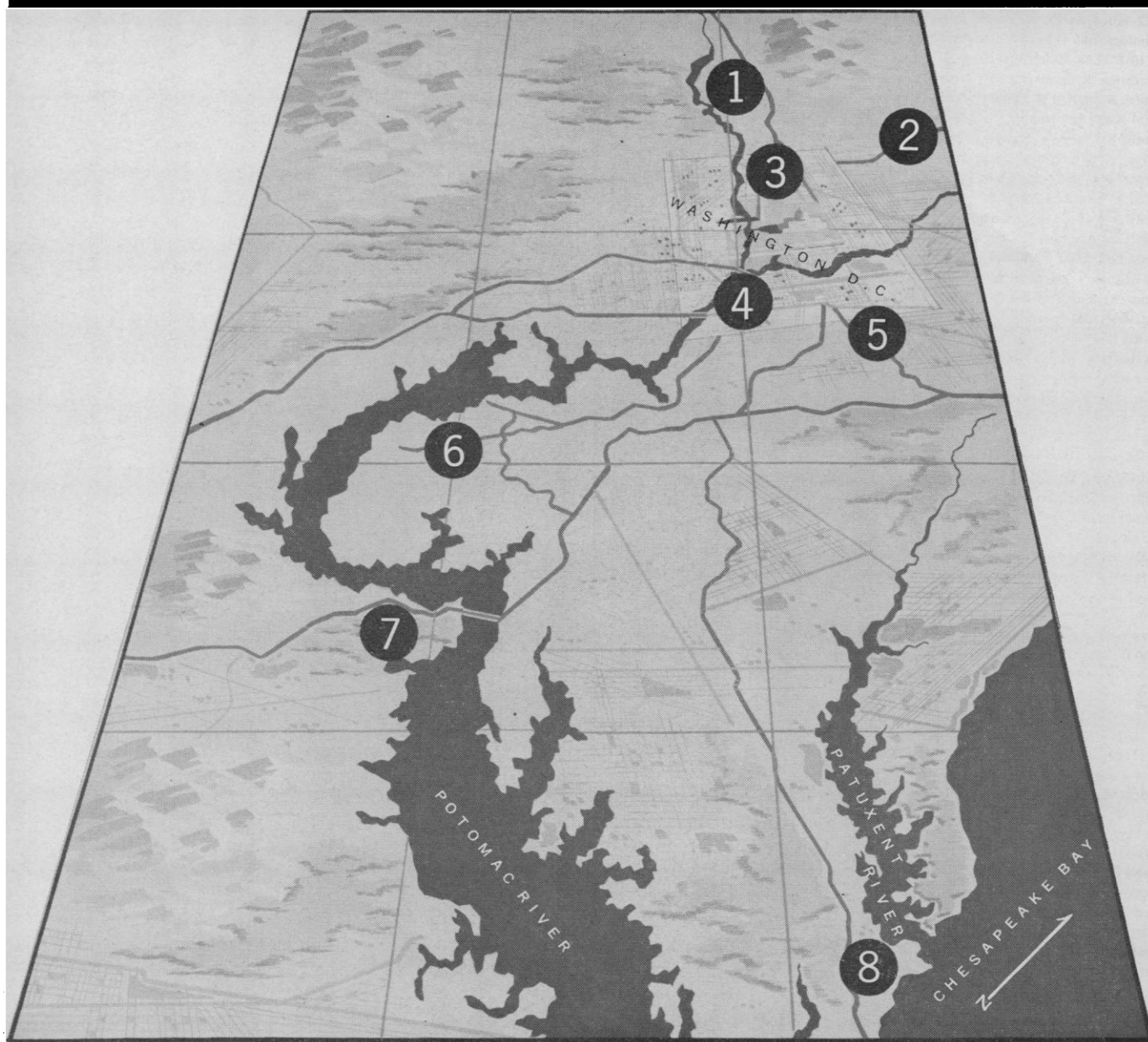


The Honeywell reproducing and amplifying tape system and the Model 906 Visicorder Oscillograph in Lessells' Boston laboratory.

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U. S. NAVAL LABORATORIES OF THE POTOMAC

The term "Research River" may seem just an alliterative coining, but is actually indicative of a fascinating—and still developing—situation. For there are today more than 200 government and private organizations along the Potomac, and in the Washington, D.C. area—making this one of the FOUR top R & D areas of the country. Foremost among these research organizations are the eight U.S. NAVAL LABORATORIES OF THE POTOMAC, including some 4200 professional scientists and engineers, and hundreds of in-house R & D projects.

Join us for a minute or two as we travel down the Potomac and meet these Naval research activities. Al-

though such meetings must be brief, you can easily see why each activity is renowned in its own right . . . and offers a unique blend of important, wide-ranging work, better-than-average compensation, and a promising future free from the job-permanence worries that plague the defense industry these days.

To explore career possibilities further, get in touch with the Employment Officer (Dep't SC) of the organization in which you are interested. If no local address is given, send your inquiry c/o Department of the Navy, Washington 25, D. C. Keep in mind the many benefits of Career Civil Service, plus the graduate degree programs offered by the Navy in cooperation with local universities.

U. S. NAVAL LABORATORIES OF THE POTOMAC



Starting 12 miles northwest of Washington, where the new Circumferential Highway crosses the Potomac, is the DAVID TAYLOR MODEL BASIN ①, a complex of four laboratories (Hydromechanics, Structural Mechanics, Aerodynamics & Applied Mathematics) conducting fundamental & applied research in submarine, surface ship, aircraft, and missile design concepts . . . applied mathematics . . . and related instrumentation. Moving from the River to White Oak, Maryland, we find the 875-acre NAVAL ORDNANCE LABORATORY ② where more than 1,000 graduate professionals (plus support personnel) originate, develop, and evaluate new ideas in surface, subsurface, air and space weaponry to a point where they will be reliable and effective with the fleet. More than 95 weapons devices developed at NOL are now in active use. Back towards the River, and delightfully situated on "Embassy Avenue" is the famous NAVAL OBSERVATORY ③ where astronomers and mathematicians pursue research in astrophysics, stellar positions, and celestial mechanics, as well as provide the almanacs and standards for time and frequency. Further southward along the River is the NAVAL RESEARCH LABORATORY ④, main basic research facility for the Office of Naval Research. NRL employs a wide variety of physicists, mathematicians, metallurgists, chemists, electronics and mechanical engineers—and is now adding advance laboratory facilities—to better investigate all the physical sciences with the end objective of improving materials, techniques, and systems for the entire Navy. Come away from the Potomac River again just east of the D.C. line, where the NAVAL OCEANOGRAPHIC OFFICE (formerly the Hydrographic Office) ⑤ conducts environmental investigations and develops new techniques and equipments in oceanography, hydrography, gravity, magnetism, instrumentation and related navigational science. Once more along the ever-widening Potomac, welcome to Indian Head, Maryland, and the NAVAL PROPELLANT PLANT ⑥ where chemists, chemical engineers, and related-area professionals research and develop processes, materials, handling devices and pilot plant operations of solid and liquid propellants. They manufacture, inspect, and test missile propulsion units as well. A few miles farther south and across the Potomac is Dahlgren, Virginia, home of the NAVAL WEAPONS LABORATORY ⑦. NWL performs two broad-ranging functions; first, in studying and analyzing ballistics, astronautics, and advanced weapons systems through basic & applied research in mathematics, physics and engineering . . . and second, in working on various classified DOD projects with the latest computer technology and systems. Finally, we reach the shores of the Chesapeake Bay and the NAVAL AIR TEST CENTER ⑧, Patuxent River, Maryland. Here, aerospace experts perform exhaustive flight evaluations of advanced aircraft, and of airborne weapons systems as well. Much thought is given to improving carrier-based operations (launch and recovery in particular) . . . and all kinds of aircraft systems (radar, radio, data link, iff, ecm, computers, etc.). Today, nearly half of the Center's professional efforts involve research.

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rapidly growing teratoid tumors unlike any he had ever observed after inoculation of untreated embryos.

It would seem that the ether-soluble substance described by Reinke may be similar to or the same as retene, as described by Szent-Györgi *et al.*

MILTON B. YATVIN

University Hospitals,
1300 University Avenue,
Madison 6, Wisconsin

References

1. Reinke, *Deut. Medizinzeitung* 28, 579 (1907); *Muench. Med. Wochschr.* 54, 2381 (1907).
2. W. H. Woglom, *The Study of Experimental Cancer: A Review* (Columbia Univ. Press, New York, 1913).
3. Askanazy, *Wien. Med. Wochschr.* 59, 2518, 2578 (1909); *Zentr. Allgem. Pathol. Anat.* 20, 1039 (1909).

Majority Opinion: Right or Wrong?

In a democracy so much emphasis is given to the majority opinion that it is generally assumed that the majority is right. "Fifty million Frenchmen can't be wrong." I would like to raise the question as to whether or not the opinion of the majority is almost always wrong.

History abounds with examples of popular opinion later proved to be incorrect and absurd. The Crusades of the Middle Ages are typical—especially the Children's Crusade in which thousands of young children were sacrificed for no purpose. The search for the Holy Grail and the Fountain of Youth involved large groups of so-called intellectuals. A mania for dancing in the streets was almost universal at one period of European history. The inquisition and witch burning have been popular enterprises. Wars in general have proved totally ineffective and unnecessary. Nothing was sillier than our own destructive Civil War which could have been averted if the opinion of a small minority had been given consideration. In more recent times the German slaughter of the Jews and our own experience with prohibition have furnished plenty of evidence that majority opinion has been found wrong after temporary emotions have subsided.

All this leads me to wonder if we are not engaged in another misdirected effort for man-in-space navigation. Unquestionably, the expenditure of hundreds of billions of dollars for these projects has the majority support of the public and Congress. In attempting to push these vast engineering projects by

a crash program, we are neglecting fundamental scientific work on properties of material and its environment and the determination of basic constants and knowledge that would lead to a more effective solution of the major enterprises if later they were still considered to be worth our effort. In fact what few real accomplishments have been made along basic research are suppressed if they tend to minimize the development of man-operated rocket ships. For example, there is plenty of spectroscopic evidence published by Kiess and colleagues that the atmosphere of Mars consists primarily of the oxides of nitrogen, yet propaganda is prevalent for a hundred billion dollar space landing in order to study the assumed vegetation and life which present evidence proves cannot exist. I believe these vast sums could be better spent in other ways, with just a few thousand dollars for spectroscopic work on planetary atmospheres by spectroscopists rather than publicity seekers. The future will undoubtedly disclose that the present majority opinion and enthusiasm for plunging into these costly space efforts were ill-advised, both from the scientific and from the political standpoint.

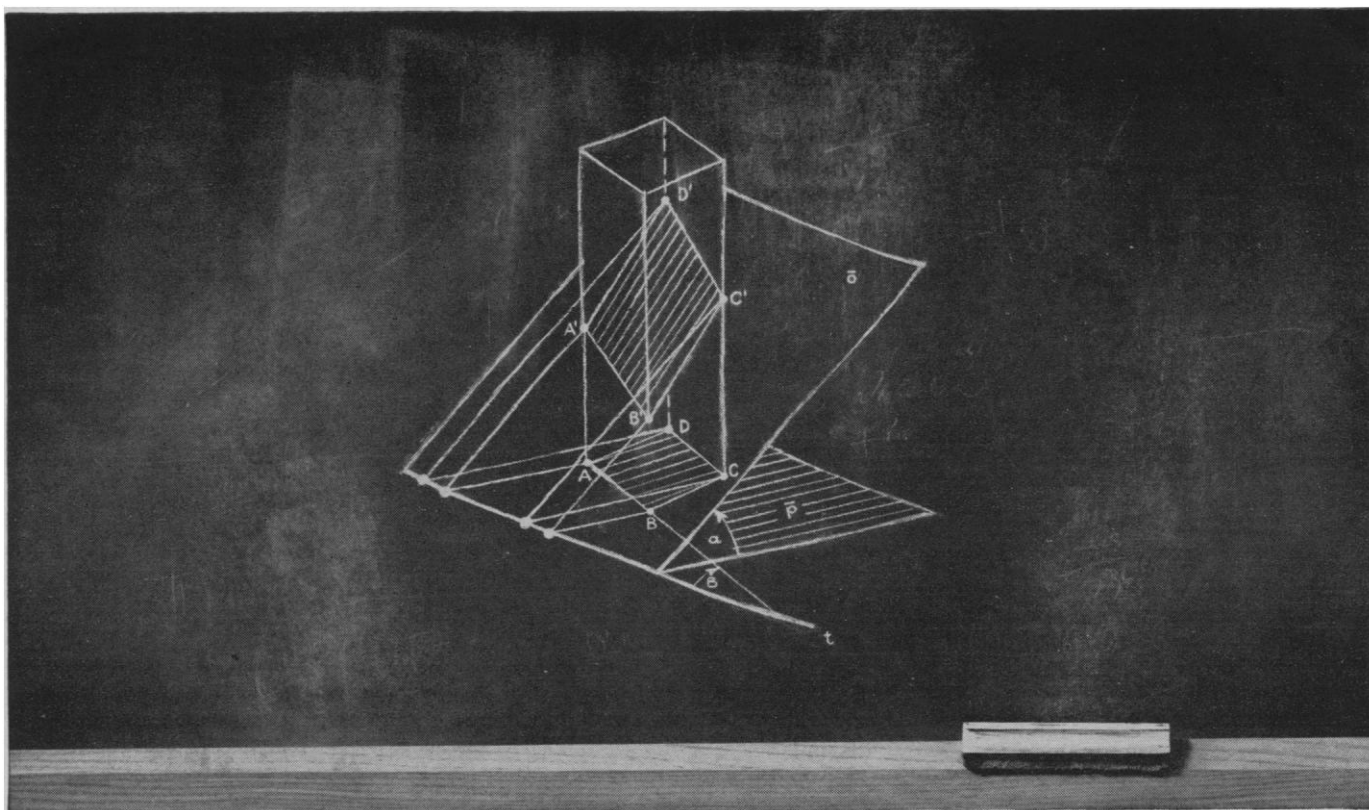
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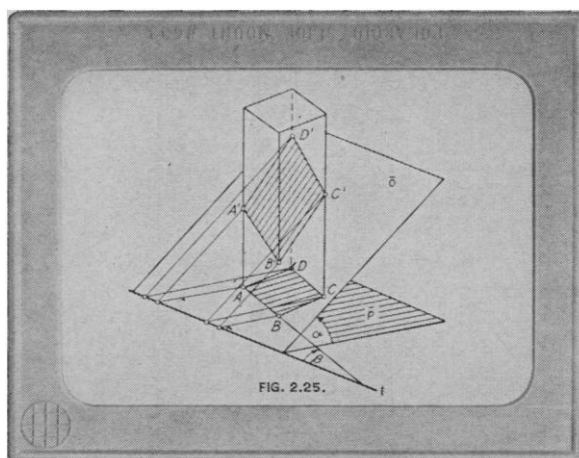
Clipping and Conflict

Each week *Science* places in conflict those of its readers who clip out articles and reports of particular interest in order to file them by topic. In the 30 August issue, for example, there were seven articles on behavior and behavioral mechanisms which were massed together on pages 820 to 831. It is impossible to separate all seven of these articles without mutilating many of them, and one is forced to decide which relevant articles to mutilate and which to save, even though he may want to save them all.

Readers would not have to face this conflict if articles and reports on closely related topics were not placed next to each other—that is, if reports on physical and chemical problems were alternated with reports on biological and behavioral problems. The two reports in that issue on the West Ford dipole belt might well have been left together, followed by one of the be-



15 minutes to copy it on a board?



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Why take the time to do it by hand (every time you need it) when you can make slides right from the original so easily? A Polaroid Land Camera and Polaroid Land transparency film are all you need.

Just aim the camera at your source material and click the shutter. Pull a

tab, count and peel a transparency from the back of the camera. Mount in a snap-together frame and you're ready to flash a big sharp transparency on the screen. Elapsed time: about 90 seconds. You only have to do it once and there's no chalk dust either.

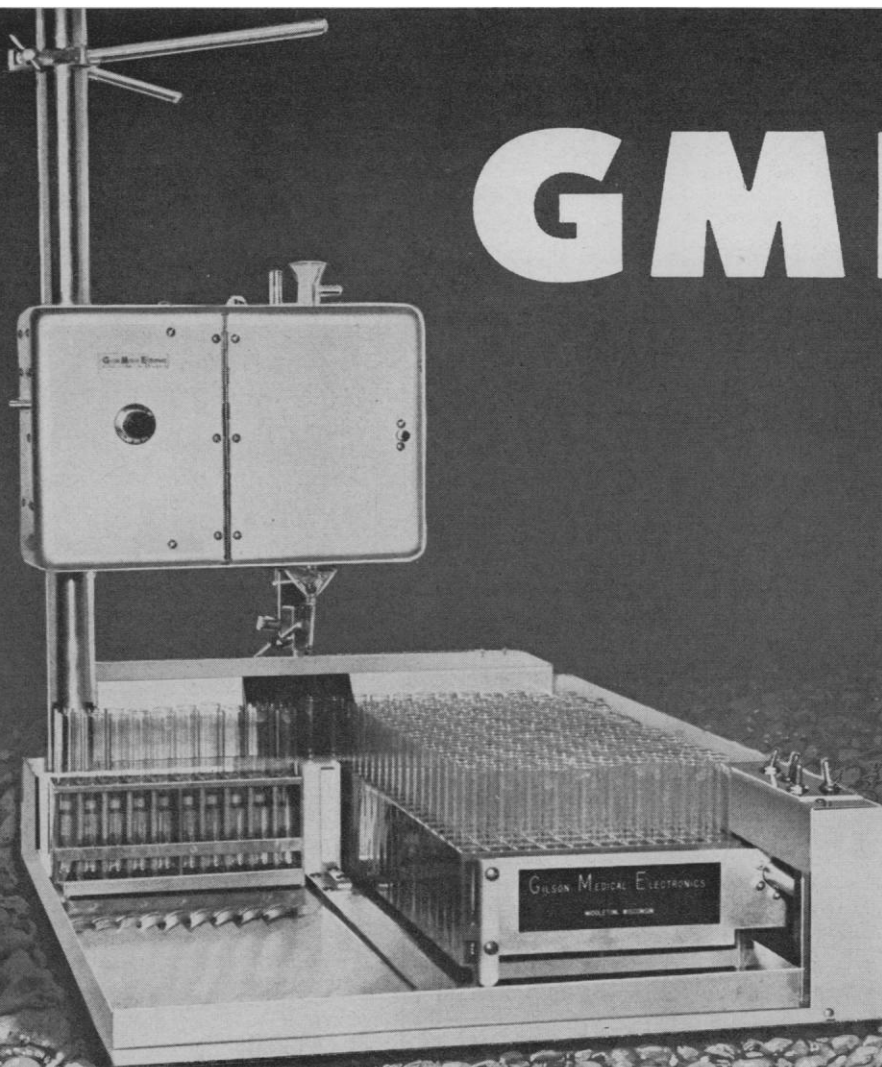
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GME



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as soon as they are collected, and 10 more, and 10 more, and 10 more —————→ ∞ . As long as empty test tubes in handsome red polypropylene racks (holding 10 each) are supplied on the right, the same may be removed from the left — with enclosed fractions, of course. Twenty (20) racks can be put in the apparatus for the period of unattended run. Write **GILSON MEDICAL ELECTRONICS**, Middleton, Wisconsin, for data on the

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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.

The Pacific Science Center

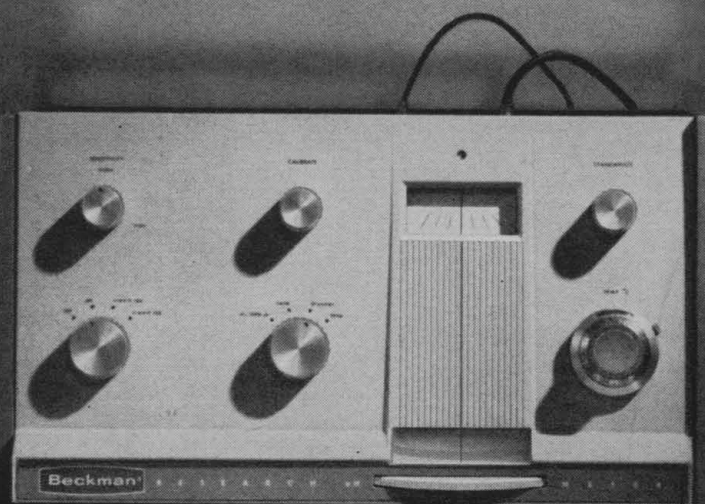
A year ago, on 21 October, the Seattle World's Fair came to a close, but not its star attraction, not what Murray Morgan, one of the fair's historians, called "The memorable attraction of the Seattle World's Fair—its Sally Rand and Little Egypt, the thing the old-timers will probably be talking about when the next century is a reality rather than a projection . . . the United States Science Pavilion. More than two out of three visitors (6,770,109 out of 9,609,969) sought out the exhibit that the pros had warned was black plague at the box office." From opening day onward, admiring visitors wondered what would happen to the science exhibit when the fair came to an end and commented that it was much too good to be allowed to shut down. Local business and educational leaders agreed, and formed a nonprofit corporation; the U.S. Government agreed, and provided a dollar-a-year lease for the land and buildings and an NSF grant to help with initial expenses. And so the Pacific Science Center was born.

Permanent financing is still a problem, for admission charges cannot meet all of the costs. But financial help is beginning to come from industry, local government, and private individuals, and there is optimism that the financial problem can be met if the other major problem is solved, that of converting the exhibit from one designed for a stream of one-time visitors to a permanent community science center. Taking tips from and hoping to improve upon other science museums here and abroad, staff, trustees, and a national advisory committee are planning a multiple-purpose institution to serve a variety of users. They want a science museum with gradually changing exhibits that will be of interest and educational value to students. They intend it to be of equal value to the large number of adults who want to learn some elementary things about science, things they did not learn in school. School teachers from the region are coming to the Center for discussions of science teaching, for help in locating or building teaching materials, and for ideas they can use in their own classes. Whole classes come for lectures, science films, guided tours, and the opportunity to use the specially designed and ingenious demonstration equipment. Possibilities are being explored of using the Center as a home and sponsor for amateur science groups. The serene and lovely buildings which Minoru Yamasaki designed for the U.S. Science Exhibit provide a setting of great beauty for exhibits relating science and the arts. And the acoustic perfection of one of the five great halls suggests exhibits and demonstrations linking science and music. Along these varied lines the staff and trustees are developing their ideas, planning a Center that will appeal to a variety of audiences and that will have a continually evolving program.

The public reception of the U.S. Science Exhibit taught a lesson to those who have claimed that science can be made palatable for a general audience only if it is candy-coated with gadgetry, breakthroughs, and artificially exciting treatment. Imaginative exhibits on basic science hold the interest of a large public audience if technical jargon is avoided and if clear explanations are given. The Pacific Science Center inherited an excellent set of exhibits and has the record of their effectiveness as a guide for future development. If the Center succeeds as well as did the U.S. Science Exhibit from which it grew, it can become a model that other communities will want to copy.

—D.W.

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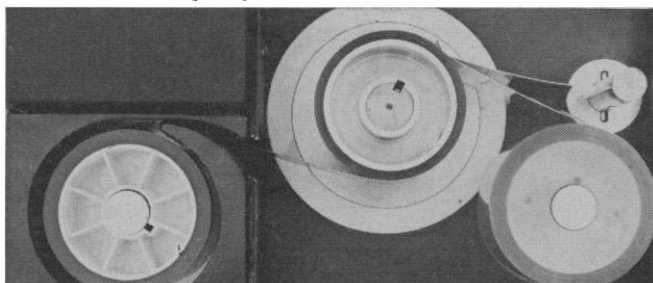
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Kodak reports on:

processing and printing long film by dampness... whole needles evenly distributed in a lasting binder on a sensible base... "G" for gas chromatography and green labels

Just roll them up together



This represents the principle of either intermittent or non-intermittent processing and printing of long rolls of film by dampness—mere dampness. The principle is quite simple and not quite revolutionary any more. In its new manifestation it delivers not only an immediate positive but a first-class negative for future positives. Perhaps the message will strike right between the eyebrows of some reader who has been struggling hard with the pesky details of apparatus for photographing our too rapidly shrinking planet for the ultimate

purpose of making it more livable for our burgeoning species and/or of peace-keeping. (Probably the peskiness of the details has diverted his attention from ultimate purposes.)

We are wide open. We can play guiding angel to this new but well proved technique for broadening the scope and feasibility of photographic surveys, supplying nothing more billable than hospitality and encouragement, hoping that the eventual consumption of our negative materials will reward us for improving the quickness and quality of aerial photography. We can, on a special order basis, supply just the KODAK BIMAT Film, which imbibes solution, applies it to the negative film, and comes away bearing the positive image. We can similarly supply just the KODAK BIMAT Imbibant. We can likewise supply suitable negative films. We can supply the whole works. We can design the hardware, build the hardware, or shake the hand of him who intends to prosper by proving in fair competition that he can outdesign or outbuild us.

Book an appointment for a preliminary discussion by a letter to Eastman Kodak Company, Special Sensitized Products Division, Rochester 4, N. Y.

Thoughts to buy tape by

There is a new magnetic tape. Intended for those who record sound for a living instead of just for fun, it is now coming into stock at electronics supply houses. These dealers, however, consider it none of their business whether the tape is needed for fun, profit, or the general betterment of the human race.

There are two main points of novelty:

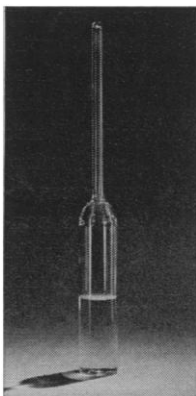
1. We suspend our iron oxide needles in a new binder, which is adaptable only to our highly proprietary and unbeatably clean and uniform method of manufacturing sound tape. Excellent as the generally used poly(vinyl chloride) may be for the purpose, our binder seems not only to age with demonstrably more grace but it forms a smoother top surface (which is widely known to reduce intermodulation distortion, for reasons never wholly understood). The needles do not aggregate in it in the usual wood-grain-like pattern, nor do they get battered and fractured in the attempt at homogeneity of distribution. Therefore print-through measures a whole 55 db down from the recorded signal in the standard test, and this

in turn greatly extends the time between periodic rewindings that tape-recordings should get.

2. The support is not the super-strength kind but cellulose triacetate, treated to make it stronger than triacetate has any business being. Amateur recordists generally don't realize when they buy super-strength that the low-tension equipment used in the home never requires it, though it costs something in audio uniformity and money. Professionals with their high-tension equipment, on the other hand, have long known that in case of trouble, a clean break is instantly apparent, remediable, and preferable to the treacherous stretch—over 70% before breaking—of the super-strength stuff. (Our treated triacetate stretches no more than 0.5%. We trademark it DUROL Base.)

Didn't you know we made magnetic tape? Ask for EASTMAN Type A303. (Type A304 has a thicker coating for higher output with less amplifier gain and its attendant noise. It is recommended only for commercial recording of originals on adjustable-bias equipment.)

5 ml of homogeneity



For around \$30 per vial, we take pride in offering 5 ml under N₂ of

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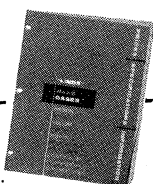
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Oceanography

Major aspects of the oceanographic program of the IGY were summarized at a National Academy of Sciences symposium on the results of the IGY-IGC. Los Angeles. Five papers were presented. Hence a comprehensive summary of the exploratory geology and geophysical expeditions, was obviously impossible. A typical expedition included two ships working together, traversing an area of several million square kilometers and using a variety of oceanographic instruments and techniques such as echo soundings, bottom cores, rock dredges, bottom photography, gravity meters, magnetometers, heat probes, seismic refraction, and others. A comprehensive review of such a wide-ranging program would either be very long or little more than a listing of names and places. R. W. Raitt (Scripps Institution of Oceanography) limited his discussion to exploratory work in the South Pacific by Scripps expeditions. Of particular interest have been the observations relevant to the problem of convective currents in the earth's mantle. Work was concentrated in the trenches that ring the Pacific basin, and on the East Pacific Rise which, in the South Pacific, runs in a general north-south direction along longitude 115°W. Spectacularly high heat flow has been recorded on the Rise, while lower than normal heat flow is the rule under the trenches. Lower than normal mantle velocities of 7.6 kilometers per second are recorded under the East Pacific Rise.

A second major program was the study of the deviation of sea level from the mean. In numbers of persons and countries participating it was probably the largest. Some old tide stations were reactivated, and many new ones were established. An effort was made to improve the geographical distribution of tide stations, and some were put on remote Pacific islands.

The analysis of the data has been done by relatively few researchers (E. Lisitzin, Finland; J. G. Pattullo, Oregon State University; and W. L. Donn, Lamont Geological Observatory). After subtraction of the astronomical tides, sea level at any given time may be the result of a combination of factors, including local wind and storm surges. On the average, however, sea level is apparently determined by two factors. One is the barometer effect: for every decrease of 1 millibar in

pressure, sea level rises 1 centimeter. The second is the volume effect: heated water expands and sea level rises. The barometer effect is predominant at high latitudes, the volume effect south of 40°N. The combination of the two accounts for most of the observed change. It has not yet been possible to identify clearly any seasonal change in mass, such as might be caused by redistribution of the water within the oceans, or between the oceans and the land.

The three remaining papers focused on different aspects (at least different geographic aspects) of ocean circulation. G. Dietrich (University of Kiel) spoke about the 25 ships from many countries which were engaged in the Polar Front Survey of the North Atlantic. It is at Dietrich's laboratory at Kiel that the summary atlas of this work is being prepared. Even though the region north of the Gulf Stream is near many of the countries which support major work in oceanography, few data have been obtained from the region in the winter, perhaps because, as Dietrich noted, the wind is force 8 or greater 50 percent of the time at that time of year.

Dietrich was not the first speaker, or the last, to note that the IGY raised more problems than it solved. There have been three expeditions in the area subsequent to the IGY for studying the convection and renewal of the deep water off Greenland and the flow of the cold, heavy water from the Norwegian Sea over the Faroe-Shetland ridge and into the deep North Atlantic.

The Polar Front Survey and subsequent work in the area was planned systematically. The work in Antarctica reported on by V. G. Kort (Institute of Oceanology, Moscow) was generally done in conjunction with Antarctic resupply expeditions. However, these expeditions did provide many more hydrographic data. Although Kort's summary of transport and heat budget estimates for the zonal and particularly the meridional currents is controversial, there was certainly general agreement with his belief that further progress in this region requires expeditions whose primary purpose is the study of specific features of Antarctic circulation.

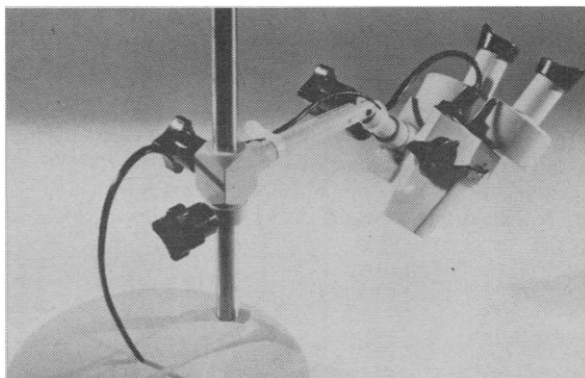
Until recently most of our knowledge of subsurface currents came from indirect measurements. During the IGY and since, more and more direct observations have been made, and the

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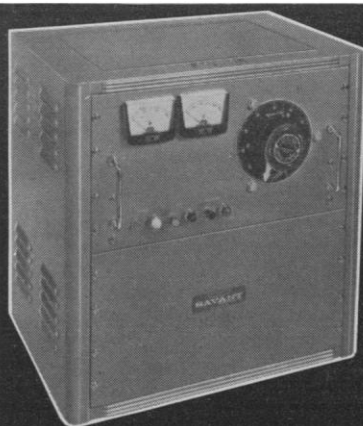
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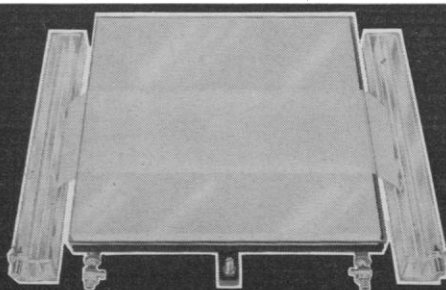
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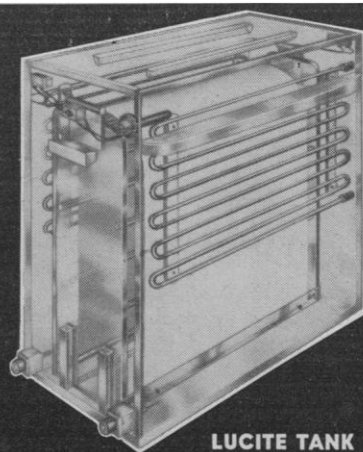
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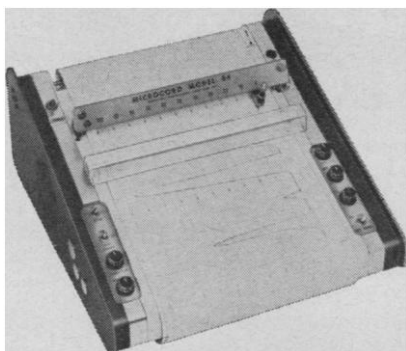
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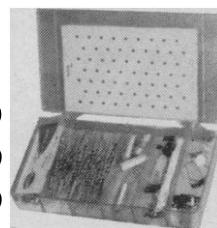
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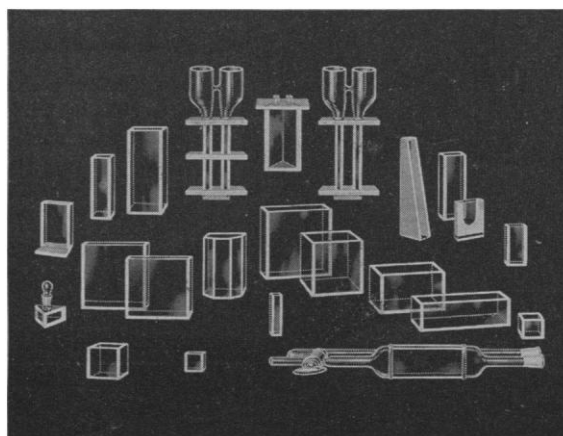


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results of several of these programs were discussed by J. A. Knauss (University of Rhode Island). One finding was the verification of a prediction by H. Stommel (Woods Hole) that there should be a southward-flowing western boundary current in the deep water of the North Atlantic. Such a current, flowing at speeds between 9 and 18 centimeters per second below 2000 meters, was observed off the Blake Plateau.

Of even greater interest, however, have been the more recent measurements of J. W. Swallow (England) which suggest that the deep water of the entire western North Atlantic is in a state of turbulent unrest. The role of these large-scale eddies is still unclear, but it appears possible that many of our ideas about the general circulation will have to be reexamined. Turbulent motion, on a scale greater than was expected, but still considerably less than that in the western North Atlantic, has been observed also in the eastern North Atlantic.

During the IGY and since, information on equatorial undercurrents has increased. These eastward-flowing currents with speeds of 1 to 1½ meters per second are found just below the surface along the equator and are among the largest currents in the ocean. They are also the most perplexing. The Cromwell Current has been traced for at least 10,000 kilometers across the Pacific. The Atlantic Equatorial Undercurrent appears to be analogous to the Cromwell Current. Recent attempts to find a similar current in the Indian Ocean have shown that there is a profound difference in the current structure at the equator between the two monsoon seasons. Such observations give additional credence to the idea that these undercurrents are wind-driven. During the northeast monsoon a weak undercurrent appears to develop, but during the southwest monsoon the current structure appears to be very unsteady.

JOHN A. KNAUSS
Graduate School of Oceanography,
University of Rhode Island, Kingston

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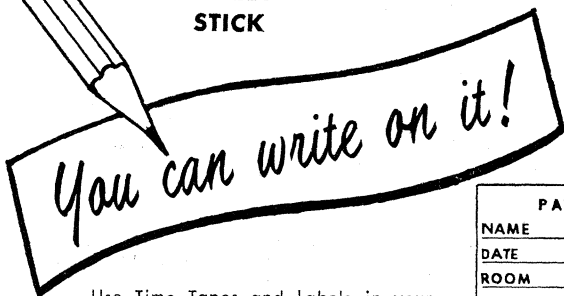
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