SCIENCE

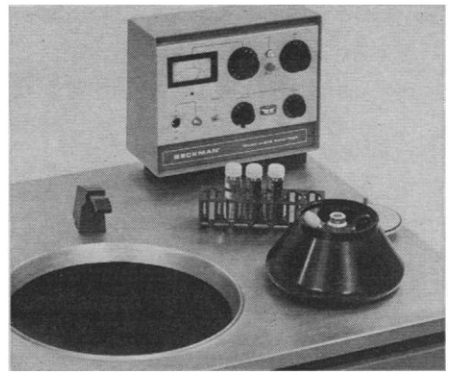
1 December 1972

Vol. 178, No. 4064

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

New Beckman J-21B

Centrifuge



The technical superiority is there—as you would expect from the people who make most of the world's ultracentrifuges. But that's not all the new J-21B Refrigerated Centrifuge offers.

The first thing you'll notice is the relative quiet. This 21,000 rpm centrifuge cuts down amazingly on the whine and noise you've had to live with before. Sound tests in a laboratory environment showed that lab personnel were subjected to only a fraction as much noise from the J-21B as from its major competitor.

Of course, the J-21B's clean styling is immediately apparent. But the good looks have a purpose, too. This design gives you free working space on the instrument itself to load or unload rotors. Now we've made it stainless steel for added utility.

One thing you don't see is the J-21B's partial vacuum which cuts wind friction dramatically. J-21B rotors don't have to fight their way to top speed—they get there quickly. And they get your work done faster.

For even larger volume separations, there is the remarkable JCF-Z rotor with interchangeable cores for separations by continuous flow, zonal and reorienting gradient techniques. It gives ultracentrifuge-like results, but is simpler to use.

The touches of color we added just for you to enjoy—like the quiet that surrounds this superior machine.

Brochure SB-366C describes the new J-21B. Send for your copy to Beckman Instruments, Inc., Spinco Division, 1117 California Avenue, Palo Alto, Calif. 94304.

Its superiority is something you also see and hear

Beckman
INSTRUMENTS, INC.

1 December 1972

Vol. 178, No. 4064

SCIENCE

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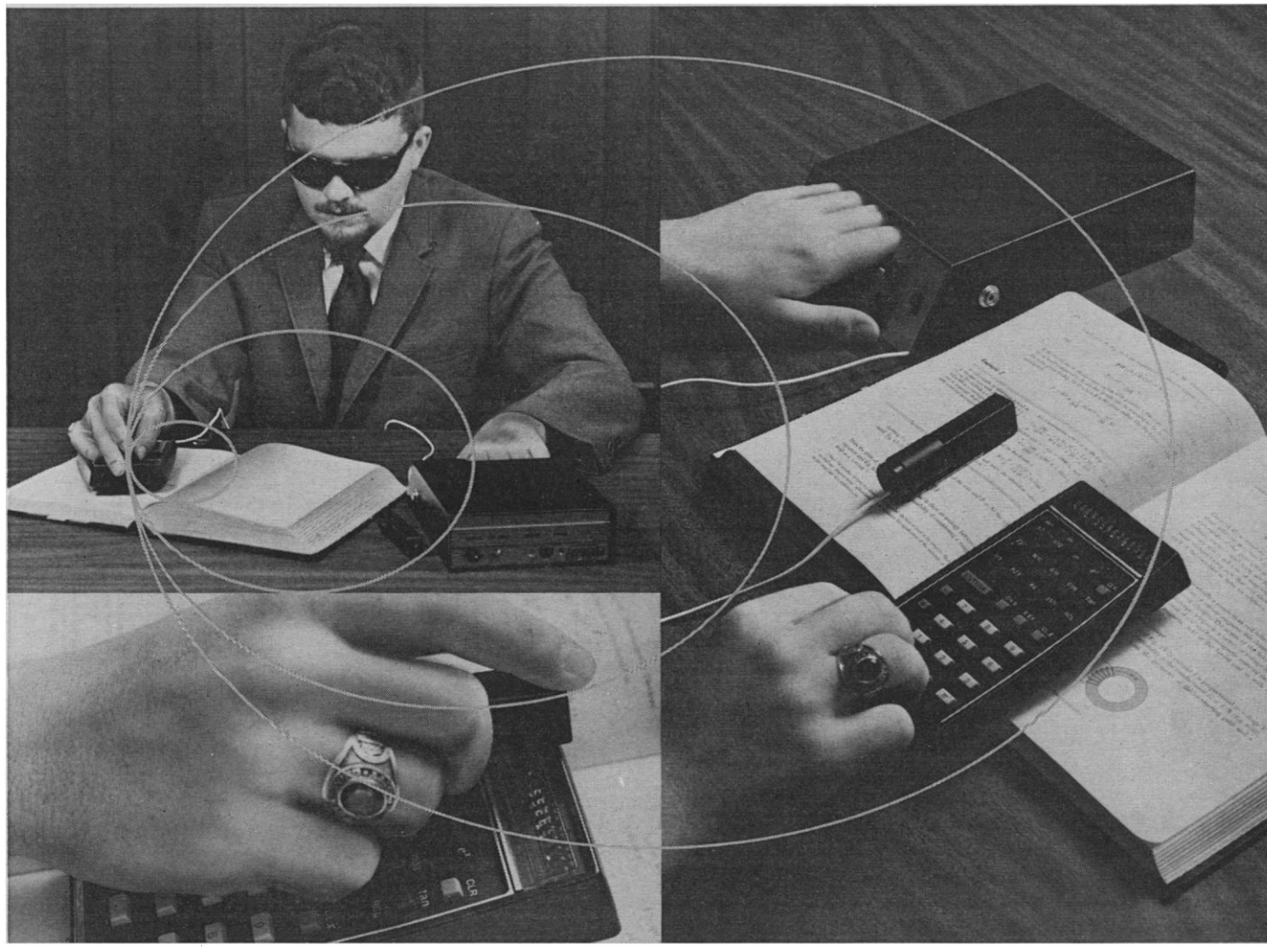
COVER

Lunar topography. The edge of the moon appears as the curved edge at the top of the photograph with the earth some distance off in the same direction. Lighter shades of gray indicate higher elevations. One of the interesting features is the height of the floor of the large crater Ptolemaeus at the top of the map, higher than the large mare to the left. Other large craters below Ptolemaeus are Alphonsus and Arzachel, with the smaller but very deep Alpetragius just to the left and below Alphonsus. See page 977. [Stanley H. Zisk, Haystack Observatory, Westford, Massachusetts]

Some things are changing for the better.

Many people know us as an instrument manufacturer: we make more than 2,000 products for measurement, test and analysis. Others know us as a computer company: more than 10,000 own our calculators and computers. We prefer to think that our business is to serve your measurement and computation needs.



A better chance for the blind.

When we took this picture of Loren Schoof, he was reading the answer to a complex problem that he had just worked out on the HP-35 Pocket Calculator. Unassisted. And Loren is blind.

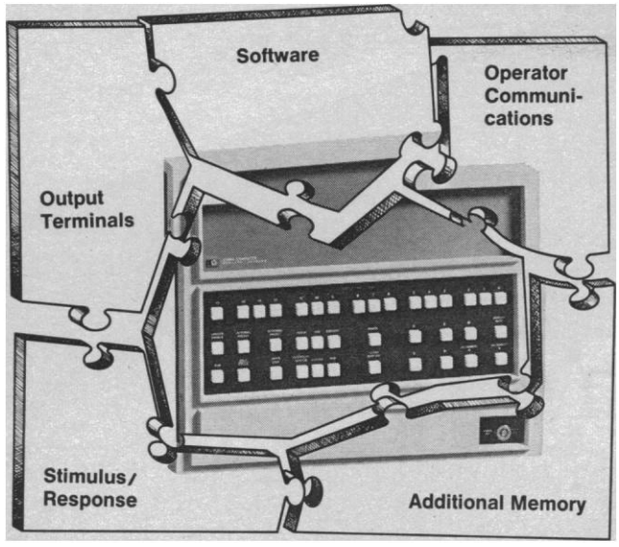
There was no magic about it. Only the technological wizardry of the Optacon, a portable reading aid for the blind developed at Stanford University, added to the computational capability of the HP-35. The Optacon converts the visual image of a printed character or illuminated display directly into a tactile image that can be felt with one finger.

A miniature camera activates an array of 144 tiny rods, each one vibrating individually, re-creating the image seen by the camera. With his index finger on the vibrating rods as he moves the camera across the calculator display, Loren feels exactly what the camera sees.

Besides giving him computational capability with the HP-35, the Optacon has given Loren access to a world of information beyond the reach of braille editions. Loren can "read" practically everything we can—books, class notes, phone directories. With the HP-35 Calculator, the result is classically synergistic; log, trig, exponential and mathematical functions are available with single keystrokes, intricate equations are reduced to a logical series of keystrokes without the need to record intermediate steps, and the answers are accurate to 10 digits. Let no one tell you that Loren Schoof is not mathematically competitive in the sighted world.

The HP-35 is also proving a boon to many thousands of sighted scientists and engineers who are using it in the lab and on the road. Here are some additional reasons why: ten-digit accuracy between 10^{-99} and 10^{99}, automatic decimal point positioning with floating point or scientific notation, operational stack of four registers plus storage register, blanking of insignificant zeroes, battery or AC operation, nine-ounce portability and advanced computational capability. All for a price, in the U.S., of $395 (plus tax).

We'll be glad to send you a full description of the HP-35 and forward your request for information on the Optacon to its manufacturer, Telesensory Systems, Inc.



Making the computer fit your problems.

The problem with many computer systems is that you have to make too many trade-offs between what the system can do and what you want to have done.

We believe you should have freedom to tackle problems your way, and not be forced to accept someone else's methodology. So Hewlett-Packard computers and systems are designed to help you be the master of how they're configured and used.

With HP's versatile 2100 computer, you can assemble a system that's right for your job. You determine how much and what kind of memory it should have, how you want to talk to it, and how you want it to provide your answers. The software to focus all this capability on your problem is equally flexible.

Want to hook up instruments? You choose from more than 75 standard HP stimulus/response instruments that plug directly into our computer.

But most important of all, we begin by giving you the training you need to understand and run what you have. If you need special assistance, systems analysts in our Data Centers are available for consultation.

Finally, every element of an HP computer system is fully supported from 172 sales and service offices in 65 countries. After the warranty, we can continue to maintain your system under a customer service agreement, or show you how to do it yourself.

Basically, it's all up to you. And most of our customers wouldn't have it any other way. Information on the HP 2100 will be sent upon request.

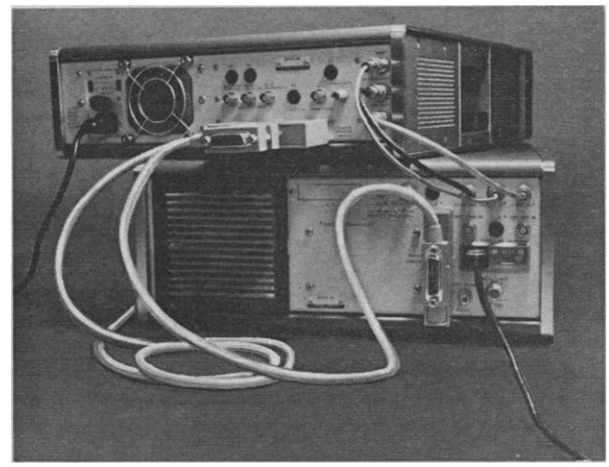
The new non-instrument that's making measurements easier.

Automated measurements have long been seen as a way to improve productivity, both in scientific research and in industry. But establishing local centralized control of measuring instruments hasn't been easy. Although some progress has been made over the years, each instrument typically has its own provision for external control. Assembling several instruments into an automated system often takes a system expert and a lot of costly interface equipment in addition to the instruments themselves.

This picture is now changing fast. Engineers throughout Hewlett-Packard have agreed to design their products using a consistent interface system, so that a instruments, no matter what their function, can be controlled by connecting them to a common interconnecting cable. Thanks to low-cost integrated circuits, even inexpensive instruments can have the new interface, and the cost of an automatic system need be little more than the sum of the costs of the instrument in it.

Instruments interconnected through the new interface communicate on a "take turn" basis: (one talks while the others listen). The benefits:

- Low-cost systems can be assembled with no special interface equipment.
- System management can range from simply one instrument controlling another, up through control by calculators and computers.
- System operation is simplified since control can be passed from one device to another.
- The system is flexible in speed, language, and size. Messages and data can be transmitted at up to one megabyte rates.



Now one common cable system is all that is required to interconnect instruments digitally.

This interface is going to enhance the usability of many of our new products and substantially reduce the rigors of making complex measurements. To obtain a more complete description write for the October 1972 issue of the Hewlett-Packard Journal.

For more information on the products described in these pages, fill out the coupon or write to: Hewlett-Packard, 1502 Page Mill Road, Palo Alto, California 94304; Europe: P.O. Box 85, CH-1217 Meyrin 2, Geneva, Switzerland; Japan: Yokogawa—Hewlett-Packard, 1-59-1,Yoyogi, Shibuya-Ku, Tokyo, 151.

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Please send me information on the following:
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Thymidine 5′-triphosphate, tetra (triethylammonium) salt [α-^{32}P] NEG-005
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References

1. D. H. Meadows, D. L. Meadows, J. Randers, W. W. Behrens III, *The Limits to Growth* (Potomac Associates–Universe Books, New York, 1972).

Nature's Highways

R. G. Lynch (Letters, 6 Oct., p. 11) hopes that "biologists can describe the needs of mammalian offspring generally, and the needs of *man's* [italics mine] offspring specifically." Is it one of "the highways nature intended" that the "love, discipline, and care" he and I agree are among those needs be provided exclusively or even predominantly by a woman? Lynch answers this question, which he never asks, with an unequivocal "yes." My children, my wife, and I disagree.

ETHAN BOLKER
Department of Mathematics, University of Massachusetts–Boston, Boston 02116

It is difficult to argue in a logical way with the letter from R. G. Lynch. It contains many of the clichés frequently used to suppress women and members of minority groups. Appealing to "nature's laws" is a time-honored and traditional way of preventing change. As a reproductive biologist, I recognize that natural laws exist. Those which are relevant to the issue at hand, namely, the equality of opportunity for women, are rather small in number. They include the fact that women, not men, become pregnant; that women, not men, carry children until birth; and that if it is desired by the parents that the child suckle, it is the woman who plays this role. I do not know of any other natural laws which are relevant to the issue. No one has described how many hours a day for how many months a given woman needs to be with a given child. Furthermore, there is another "law" which Lynch does not recognize. Every child has two parents, the mother and the father. This is a biological as well as a sociological fact. There is no natural law that says that child care must be only the responsibility of the mother. Therefore, the question of extended maternity leave should be an individual decision of the parents of a child, perhaps in consultation with experts.

Lynch says that "Women certainly deserve fair and enlightened treatment." The women in our country, both professional and nonprofessional, have learned a simple truth; in order to get fair and enlightened treatment, we must act together and get it for ourselves. We are very pleased that the American Association for the Advancement of Science has recognized at its meetings and in the columns of *Science* that the women's movement, specifically as it is related to science, is here to stay. We are pleased that there are an increasing number of stories about the movement. There may be times when individual women may disagree with individual stories, or, indeed, when an entire women's professional association may disagree. Nevertheless, we think this is a problem which is important not only to women, but to men, and that it needs to be looked at openly. We hope that the AAAS will continue to increase its interest and not permit letters such as those from Lynch to deter them from this exceedingly important issue.

NEENA B. SCHWARTZ
Association of Women in Science, Department of Psychiatry, College of Medicine, University of Illinois, Chicago 60680

More Parts per Million

With reference to the letter "One part per million" by William W. Porter II (11 Aug., p. 477), I should like to quote from the fourth edition of *Toxicology of Drugs and Chemicals* (*1*). The following appears in the front of the volume on page VI:

Parts Per Million

1 ppm is equal to 1 inch in 16 miles,
1 ppm is 1 minute in 2 years,
1 ppm is a 1-gram needle in a ton of hay,
1 ppm is 1 penny in $10,000.00,
1 ppm is 1 ounce (30 gm) of salt in 62,500 pounds (28,375 kg) of sugar,
1 ppm is 1 large mouthful of food when compared with the food a person will eat in a lifetime,
1 ppm is the theoretical concentration that 1 teaspoon of DDT will impart to the hay when spread on 5 acres of alfalfa,
1 ppm is 1 drop in 16 gallons, or in 80 "fifths," a very dry martini indeed!

W. E. MACDONALD
School of Medicine, University of Miami, Coral Gables, Florida 33124

References

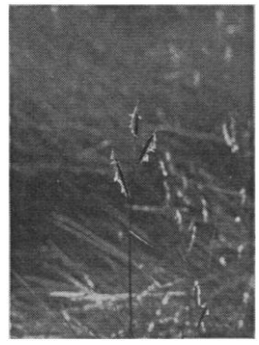
1. W. B. Deichmann and H. W. Gerarde, *Toxicology of Drugs and Chemicals* (Academic Press, New York, ed. 4, 1969).

We want to be useful ...and even interesting

Wetlands telebotany

Little by little the public overcomes its ancestral antipathy to swamps and marshes. The need to extirpate them in the interest of public health, safety, and progress is no longer accepted as self-evident, even though the botanist who took this picture to illustrate spikerush *(Juncus roemerianus)* inadvertently stepped on the back of a five-foot Sapelo Island (Georgia) alligator in doing so.

The University of Georgia Marine Institute



There was no alligator hazard in southern Maine, where another botanist did this illustration of wiregrass *(Spartina patens)* in salt meadow. On the Louisiana coast that same botanist finds the association of these same two species to be a reliable indicator of the otherwise difficult-to-locate intertidal zone. Down there the pesky salt marsh mosquito *(Aedes sollicitans)* lays its eggs on non-submerged soil, but the eggs hatch only in water. Therefore, to control this pest with least waste of insecticide either on higher ground or on shallows that do not drain out and contribute significantly to the primary food supply of the whole Gulf, it is well that charts should accurately indicate the labyrinthine intertidal zone in the vast expanse of flat Gulf coast.

The gentleman who frightened the alligator reports that on *his* coast *J. roemerianus* occurs mostly in pure stands. His particular salt marsh research can guide land use, such as major highway construction, to avoid areas of high biological productivity, as represented in stands of *J. roemerianus* and *Spartina alterniflora.*

Still other investigators, working on the New Jersey coast, find *S. patens* growing almost exclusively *above* areas of daily tidal inundation. The contrast with *S. alterniflora,* which needs tidal flooding for vigor, provides an easily interpretable key for drawing a mean high tide line to submit in litigation.

Obviously the wetlands botanists have a big job ahead of them, too big to do on foot. Which is why they have to know a lot about aerial photography and why, as a manufacturer of technical color photographic products, including color infrared film for detecting plant signatures from aloft, we call attention to the 320-page "Proceedings of a Symposium on Coastal Mapping" published by American Society of Photogrammetry, 105 N. Virginia Ave., Falls Church, Va. 22046.

Deeper and deeper in liquid crystals

Only ten years ago a man exploring liquid-crystal phenomena at a large technology-based company risked boring his boss or, somewhat worse, being suspected of having fun on company time. Today he has an outside chance of simultaneously earning a high honor in Stockholm for himself and honors from the investment community for the business sagacity of his company's management—a rare conjunction of honors. Liquid crystals generate such visions.

Only nine months ago Kodak announced "Nematic Mixture, Dynamic Scattering." We advertised that when a 12μm thickness of this product is hit with more than 4 volts dc, it turns turbid; that at 60 Hz, 200 v peak-to-peak, only 0.1% of the light flux in an entrant parallel beam remains within the forward $f/34$ cone of solid angle, as compared with 78% where there is no field. The resulting contrast between field and no field yields "sophisticated" means of graphic display with ambient light and of image formation. Very convenient as long as the temperature stays above 5°C.

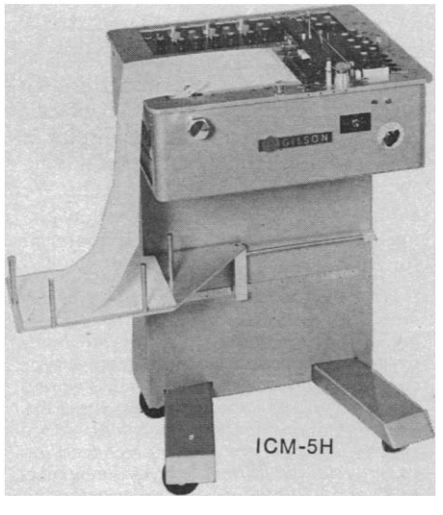
Now we offer "Nematic Mixture, Dynamic Scattering, II" (EASTMAN 11880). That 5°C changes to −20°C. Important for devices that ought not give up on a frosty morning in Minnesota. The upper limit is above 100°C. Another big improvement occurs in contrast, provided excitation is done with 30-Hz square waves at only 30 v peak-to-peak. They are as readily come by in tiny packages today as sine waves. Where higher voltage can be provided, higher contrast is realized than with our original product, and as before, rise time shrinks to a few milliseconds.

"Nematic Mixture, Field Effect" (EASTMAN 11900), with a working range from −7°C to 100°C, is new and works by a different principle. Without field it rotates the plane of plane-polarized light; with as little as 4 v dc across the 12.5μm film thickness, rotation is prevented. Resistivity being some fivefold that of the dynamic scattering mixture, power drain is proportionally more negligible. Hence "field effect." Furthermore, some think the display is better-looking, at the expense of adding two sheets of polarizer to the train. We claim no credit for the discovery, aspiring only to supply a superior material for utilizing it.

All this, we hope, is scarcely a beginning. Papers on liquid crystals are appearing at such a rate that our private bibliography in its various arrangements for convenient reference occupies a whole reel of microfilm. If enough interest turns up, we might consider selling copies. More eagerly awaited are inquiries concerning commercial quantities of the two new mixtures and of liquid-crystal preparations to customer-specified parameters and specs. Such inquiries, perhaps preceded by requests for data sheets, should be directed to Richard Hapeman, Eastman Organic Chemicals, Kodak, Rochester, N.Y. 14650.

Kodak

Firm footing



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Reliability of Consumer Goods

On a recent visit to the United States, Mstislav V. Keldysh, president of the U.S.S.R. Academy of Sciences, remarked favorably on the reliability of U.S. technology. Since most of us have had occasion to complain about the quality of our consumer goods, this was a welcome but unexpected remark. In recent years there have been frequent recall campaigns for automobiles and warnings of defects in other products, and the impression is rife that quality of goods and workmanship has been deteriorating. Such an impression is not totally accurate. Although there seems to have been some decline in workmanship, industry is improving many products. This is being achieved through better designs, through designs that take into account possibilities of human failures, and through widespread use of computers, both for control of in-process materials and for testing of assemblies and subassemblies.

The industrial quest for reliability does not arise from some newfound altruism. It comes rather from pressures now being exerted by consumers. For their part, consumers are outraged at the cost and unreliability of repairmen and want goods that are dependable in the first instance. A company that sells defective goods faces possible damage suits as well as bad public relations.

Prospects for further improvement in reliability are good. Techniques and approaches that were developed to meet exacting reliability requirements of such items as computers, jet planes, and space vehicles are now being transferred to the civilian economy. Virtually every major company has a sizable group assigned to quality control and reliability. A sample of their work can be seen in a volume* distributed by the Institute of Electrical and Electronics Engineers (IEEE).

Not all the techniques of aerospace are transferable to consumer goods. The superlative reliability of space vehicles was achieved through painstaking, repeated tests of each individual component, subassembly, and assembly. Further assurance of reliability was obtained through redundancy. Those who have worked with space vehicles say that any desired degree of reliability can be obtained, though at great expense.

Few consumers are willing to pay the prices that excellence would entail. Nevertheless, much improvement can be obtained without excessive increase in cost. An engineer from one of the largest automobile companies has told me of new complex machines that turn out parts having great precision; performance of the machine is constantly monitored by automatic means.

The IEEE symposium volume provides many examples of efforts to improve reliability. One is a description of procedures to be used in checking reliability and quality of electric ranges. The program is expected to provide a computer evaluation of on-line tests and assurance both that proper tests have been set up, run, and passed and that results have been permanently recorded. This record on each unit, combined with a history through warehousing and field service, is intended to yield a total story of the unit's performance. The summation of these data would be fed back to the plant, resulting in corrective actions and improved performance.

The current efforts to improve reliability are important, and they merit the attention and good wishes of all. It seems possible that reliability and longevity of consumer goods can be substantially enhanced without sharp increases in costs. Thus we may be able to maintain or improve our present standard of living while diminishing industrial use of energy and cutting the consumption of scarce raw materials.—PHILIP H. ABELSON

* *Proceedings of the 1972 Annual Reliability and Maintainability Symposium* (Institute of Electrical and Electronics Engineers, Inc., New York, 1972).

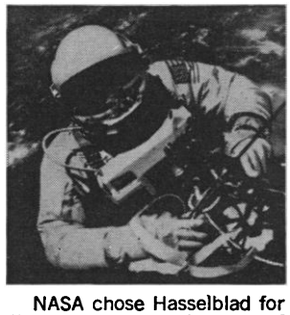
To do many different jobs NASA chose many different cameras. Hasselblad.

500 C

In 1962 NASA chose Hasselblad to be used by the Astronauts on manned spaceflights.

The first Hasselblad to go up was the 500C, aboard the Mercury Spacecraft Sigma 7. The camera has an 80mm Zeiss Planar f2.8 lens and 12-exposure magazine. All components are interchangeable.

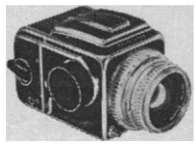
The famous first walk in space by Astronaut Edward White, aboard Gemini 4, was recorded by Command Pilot James McDivitt, using a 500C.



NASA chose Hasselblad for the space program because of its legendary reliability, quality of results, ease of operation (Astronauts are not professional photographers) and scope as a photographic system. These same characteristics have made Hasselblad the choice of discriminating photographers on earth.

A Hasselblad camera is what you make of it. Snap on a super wide angle Zeiss Distagon 40mm lens, a 24-exposure magazine and an eye-level prism finder, and it becomes one thing. Switch to a Zeiss Tele-Tessar 500mm lens, a 70-exposure magazine, a pistol grip—and it becomes something else again.

That's why photographers of all kinds—commercial, advertising, news, scientific, industrial, amateur—all satisfy their diverse photographic needs within the Hasselblad System.



500 C/M

Super Wide C

For four years and eight manned spaceflights, the 500C was *the* Hasselblad space camera.

Then in 1966, a second Hasselblad was added. The wide angle Hasselblad SWC, with its 38mm Zeiss Biogon lens.

It made its first flight aboard Gemini 9, where Astronaut Eugene Cernan used it on his 2 hour space walk. During that walk the camera operated flawlessly in total vacuum.

An exciting glimpse of life inside the capsule was also made possible by the SWC, because of its sweeping 90-degree angle of view and great depth of field.

On earth the SWC is used by industrial, architectural, landscape and amateur photographers. The SWC allows them to work indoors and out, at extremely close quarters, with extraordinary sharpness from corner to corner and incredible depth of field (from 26 inches to infinity at f22).

News and sports photographers make interesting use of the unique features of the SWC by presetting it, snapping on 70-exposure film magazine, then using it to take grab shots when there isn't time to focus.

The versatility of the SWC is extended by the use of interchangeable film magazines and other components of the Hasselblad System.

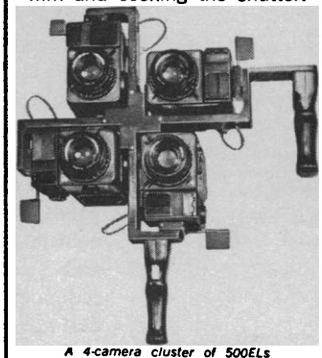
Super Wide C

500 EL

Two and a half years later, in December 1968, a third Hasselblad joined the space program—the electrically-driven 500EL. The event was the flight of Apollo 8. Two 500ELs went along—one with an 80mm lens, the other with a Zeiss Sonnar 250mm lens—plus 7 interchangeable 70mm magazines.

This was the first time that men journeyed from earth to orbit another world. The photographs from this voyage were essential in planning the forthcoming lunar landing.

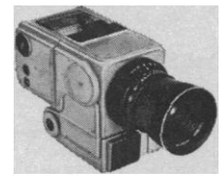
The Hasselblad 500EL allowed more photographs to be taken with less effort, because no film winding was necessary. After each exposure the 500EL automatically readies itself for the next shot by advancing the film and cocking the shutter.



A 4-camera cluster of 500ELs used for scientific photography in space

This Hasselblad is the only electrically-driven 2¼" camera on earth. Because of its automatic features, it can be successfully operated from a distance, freeing the photographer from the camera and allowing him to work more with his subject. That's part of the reason why the Hasselblad 500EL/M has won the esteem of advertising and publicity photographers, as well as sports, wildlife, industrial and scientific photographers.

500 EL/M



500 EL Data Camera

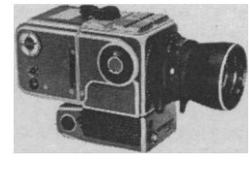
But the first camera to be used on the moon wasn't the Hasselblad 500C, or the SWC, or even the 500EL. It was a fourth Hasselblad—the 500EL Data Camera, with Reseau plate and Zeiss Biogon 60mm f5.6 lens. A photogrammetric camera, whose tiny cross-shaped index marks appear on the negative, making it possible to measure distances and heights with great accuracy.

When Astronaut Neil Armstrong took man's first walk on the moon, on July 20, 1969, the Hasselblad 500EL Data Camera was there with him, attached to his chestpack.

The 500EL Data Camera proved so valuable that an earth version—the MK70—was developed and is the newest addition to the System.

The MK70 fills a need for a small, easy-to-handle photogrammetric camera capable of producing exceptional results. The MK70 is the ideal photographic tool for use in applied engineering and construction work, as well as for mapping, architectural, industrial and medical photography.

For a free copy of the 48-page Hasselblad catalog, describing all the different cameras and accessories of the Hasselblad System, write Paillard Incorporated, 1900 Lower Road, Linden, N. J. 07036. Other products: Bolex movie equipment, Hermes typewriters and figuring machines.



MK70

It takes more than one camera to make a system.

HASSELBLAD®