SCIENCE

3 November 1972
Vol. 178, No. 4060

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

How to choose the right preparative ultracentrifuge

If you need maximum centrifugal forces, select the Beckman L2-75B: 75,000 rpm, 500,000 g's, superb temperature control over the range of 0 to 40 C. The finest preparative ultracentrifuge in the world.

If you don't need the extra force and wider temperature range, choose the L2-65B: 65,000 rpm, forces to 400,000 g. The largest selling model in the world. You can also update it later to the capabilities of the L2-75B.

For intermediate speeds and forces, the choice is L3-50: 50,000 rpm, forces to 300,000 g. It gets to speed rapidly, has precise temperature control for density gradient separations—an outstanding combination of performance and price.

For routine preparative work at speeds to 40,000 rpm and forces in the 200,000 g range, select the economically priced L3-40. It can be updated at any time to the status of a Model L3-50.

What else does Beckman offer? The longest line of rotors and accessories; the most experience; direct sales and service throughout the United States, Canada, and around the world; applications and technical support.

Write for Data File UCF-4 to Spinco Division, Beckman Instruments, Inc., 1117 California Avenue, Palo Alto, California 94304

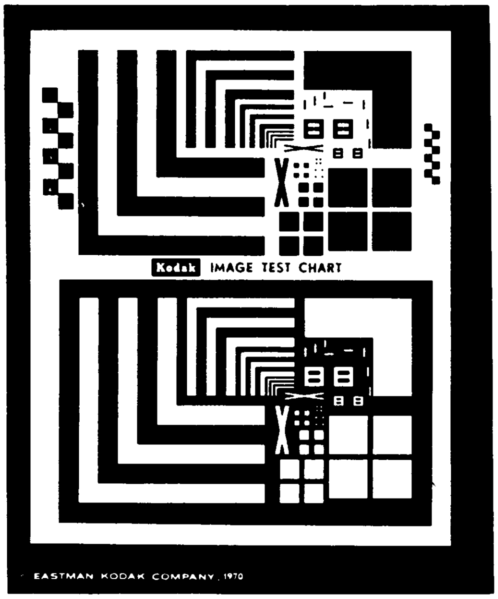
Beckman®

INSTRUMENTS, INC.

INTERNATIONAL SUBSIDIARIES: AMSTERDAM; CAPE TOWN; GENEVA; GLENROTHES, SCOTLAND; LONDON; MEXICO CITY; MUNICH; PARIS; STOCKHOLM; TOKYO; VIENNA

Helping science and industry improve the quality of life.

We want to be useful ...and even interesting



Note the vertical strips of checkerboard at upper left and upper right. The left-hand columns of black squares in both sizes contain clear-on-black numerals. What's more, the numbered squares vertically overlap by increasing amounts the diagonally adjacent unnumbered ones. On the original they do, anyway. When the target is photographed, on the negative the overlap shrinks. This gives a measure of the effective exposure for high-resolution materials. If the overlap is gone on the negative at square 2, one speaks of a No. 2 exposure.

How sharp

A hand magnifier will show you here a test of the reproduction chain that ends on this printed page, a test to the point of failure. The purpose here is not to question the quality of the printing in this magazine* but to offer the KODAK Image Test Chart. It comes on film in 96 x 116mm size as KODAK Publication P-301 and in 20 x 24-inch size as P-303. Whatever size original is convenient in testing a system involved in precision photography, the chart is intended to show limitations that come into play as the size of the reproduction goes down.

This yields a different kind of story from a mere statement of "resolving power" and perhaps a fuller story but not quite as quantitative.

If you bang your fist on the table and demand a simple answer to the question how many lines per millimeter, don't test with this chart. If you are interested in additional dimensions of photo-optical performance—rendition of corners, what you would gain and what you would lose by a small shift in focus, more or less exposure, a processing change, stray-light shielding—this chart and plenty of patience may provide the detailed answer that the table-banger has already rejected.

We devised the chart for the modern electronic-circuit manufacturing industry, which makes its microscopic products by photography. It can be ordered from dealers in technical photographic products.† (For more information, see Solid State Technology *for November, 1971, p. 34.)*

*Depends, for example, on whether your copy was printed early or late in the press run.

†Or at $1 for P-301, $20 for P-303, from Dept. 454, Kodak, Rochester, N.Y. 14650. Prices subject to change without notice.

Strange cations

About 20 years ago patents started flowing through the photographic industry for replacement of some of the silver ions in silver halide crystals by other cations. A few years later products appeared on the market which permitted a beam of light in an oscillograph to write at very high speeds without need for chemical development. Mere room light caused the written record to pop up. Then, despite the room light, the record stayed legible for longer than needed. The aerospace industry in full bloom consumed such paper voraciously.

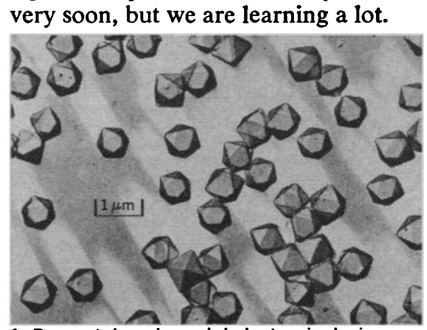
Though the newer cations continue to free the photographic process of old limitations, silver is not about to go. Though we and everybody else are trying, silver is very hard to beat.

In silver halide many cations wander interstitially through the lattice; one in every 10^7 Ag^+ ions is on the loose. If somewhere in the lattice there sits an electron that had somehow been lifted into the conduction band, perhaps by a photon of light, and has since been trapped at an anomaly, a wandering Ag^+ will join it soon. *This will deepen the trap for a subsequent photoelectron.* If none comes along within 10 seconds or so, the newly made neutral silver atom will give up the electron and wander off again. If the deepened trap does catch a second silver atom and then a third, a cascade starts that renders the entire crystal developable. Note that the need for that crucial second photoelectron makes the whole thing act like a coincidence circuit. Otherwise silver centers would soon form all over the crystal, light or no light.

For these reasons, silver halide emulsions can cover 15 orders of magnitude in light intensity—a picosecond laser flash or an atlas of the faintest astronomical objects perceptible by present technology.

Designing a photographic emulsion for short exposure or long, for high contrast or low, for one kind of processing or another or none at all, for one virtue or another, usually requires control of where the photoelectrons shall collect and where the holes shall collect that they leave—on the surface of the crystal, inside, in one place, or many places.

If this sounds something like the task of the creators of those tiny modern electronic devices, it is. That bunch have been inserting their strange atoms by diffusion. Lately they have been placing them more precisely by implanting them as ions. That's what is now being tried at the Kodak Research Laboratories. We can't see it becoming a practical production technique for us very soon, but we are learning a lot.



AgBr crystals, micromini electronic devices

Photographically basic

3 November 1972

Vol. 178, No. 4060

SCIENCE

SCIENCE is published weekly, except the last week in December, but with an extra issue on the fourth Tuesday in November, by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Now combined with **The Scientific Monthly**®. Second-class postage paid at Washington, D.C. Annual subscription $20; foreign postage: Americas $3; overseas $5; air freight to Europe, North Africa, Near East $16; single copies $1 (back issues, $2) except **Guide to Scientific Instruments** which is **$4**. School year subscription: 9 months, $15; 10 months, $16.75. Provide 4 weeks notice for change of address, giving new and old address and zip codes. Send a recent address label. SCIENCE is indexed in the **Reader's Guide to Periodical Literature.**

REPORTS

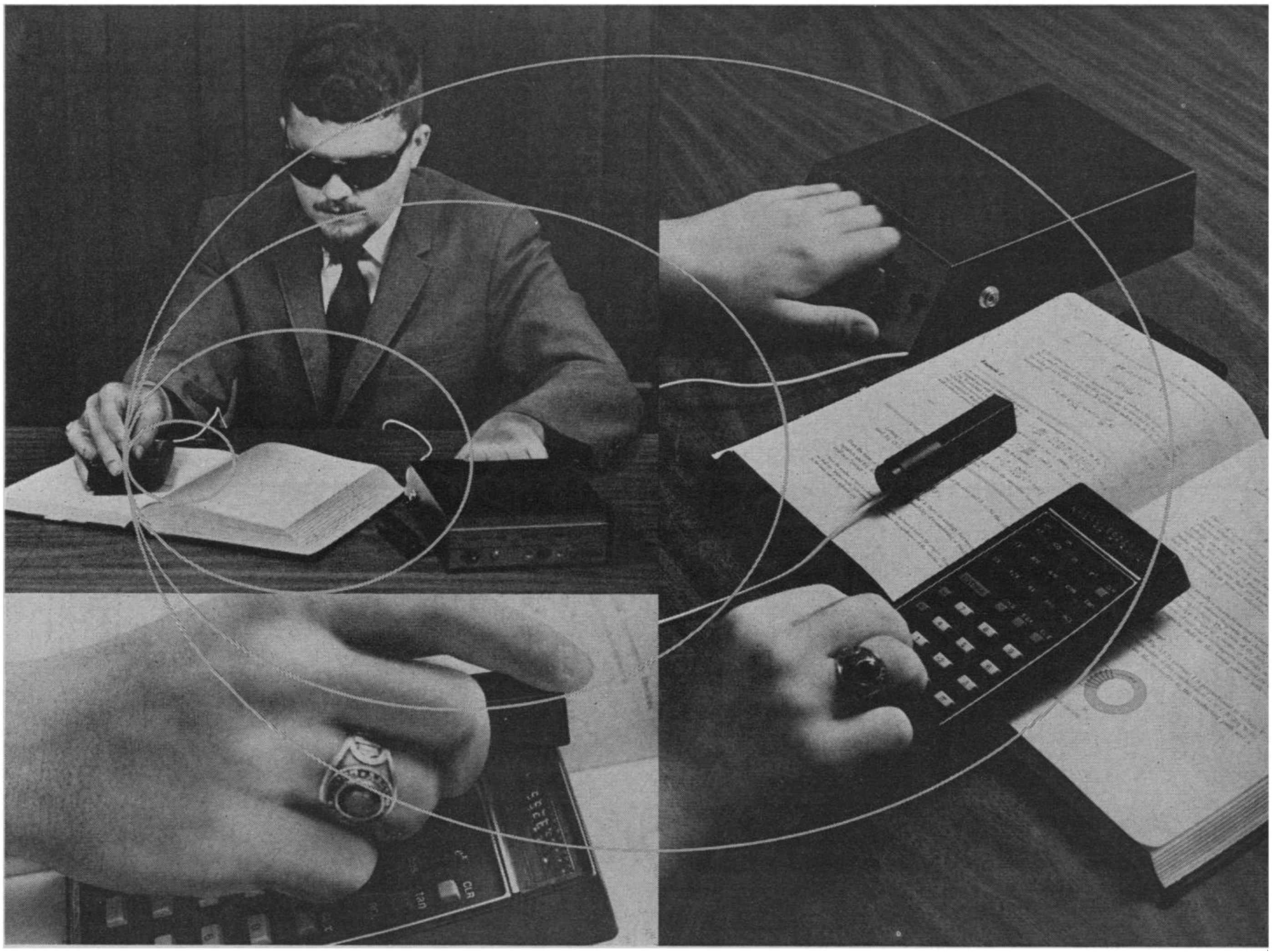
AAAS ANNUAL MEETING

COVER

Artificial cloud formed by introducing 5 kilograms of Dry Ice powder into a layer of clear air having more water vapor than would be present at ice saturation. As Dry Ice powder was released from an aircraft, cloud cells were formed which later merged into a uniform cloud. Cloud shown was photographed 20 minutes after seeding. See page 504. [T. Ohtake, Geophysical Institute, University of Alaska, Fairbanks]

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.

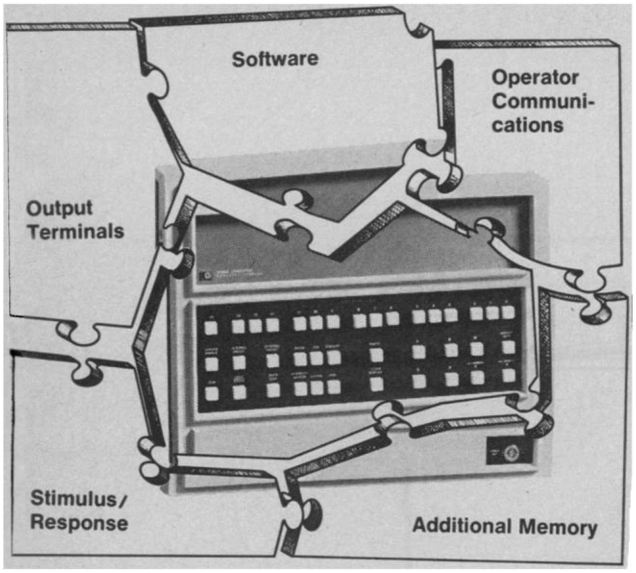
There was no magic about it. Only the technological wizardry of the Optacon, a portable reading aid for the blind developed at Stanford University, added to the computational capability of the HP-35. The Optacon converts the visual image of a printed character or illuminated display directly into a tactile 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 it 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 gaining you need to understand and run what you have. 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, It 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.

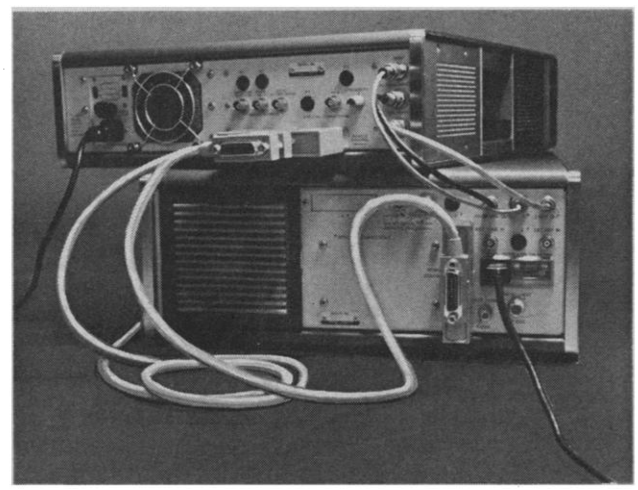
The new non-instrument that's Making measurements easier.

Automated measurements have long been seen as a way to improve productivity, both in scientific research and industry. But establishing local centralized control of measuring instruments hasn't been easy. Although some progress has been made over the years, each instrument topically 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 all 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.

3 November 1972, Volume 178, Number 4060

SCIENCE

Science and Values

Last April, seeking to bridge the gap between scholarship and public affairs, the National Endowment for the Humanities inaugurated an annual lecture series—the Jefferson Lecture in the Humanities—addressed to a national audience. The series was so named because Thomas Jefferson epitomized both theory and action; he was president of the American Philosophical Society as well as president of the United States. Lionel Trilling, a writer and teacher with an international reputation, was chosen as the first lecturer.

In a superb address, "Mind and the modern world," Trilling examined our society's diminished confidence in mind and in the concept (and value) of objectivity. The humanistic disciplines, he observed, have suffered. And we have lost confidence in science as well, which now "lies beyond the intellectual grasp of most men" except for the suspicion that it is dehumanizing.

Trilling was critical but not apocalyptic. He argued for objectivity and rationality, for upholding the mind's full values: intentionality, coherence, inclusiveness. He cited Wordsworth's well-known antagonism to science and the ultimate transmutation of that antagonism: "Poetry," Wordsworth said, " . . . is the impassioned expression which is on the countenance of all science."

Today we must turn to minds capable both of mobilizing a sense of the past and affirming our evolutionary destiny. If we hunger for values beyond those of the megamachine, we ought, with Lewis Mumford, to invoke William James's perception that the human being has always been the "starting point for new effects." If technological excess threatens to provoke an antiscience crusade, we can support Rene Dubos in urging that science help shape a truly human concept of technology—a science of humanity.

We do not lack resources. The return of confidence is within our grasp—if we reassert humanistic values, if we seek the restoration of ethical criteria in human enterprise, and if we propose the renewal of rationality. The appeal is addressed equally to scientists and humanists, in terms that virtually define certain larger objectives of the Humanities Endowment.

Endowment grants-in-progress include a number focused on ethical problems of genetic counseling, medical ethics and legislation, social effects of technology and proposed reforms, humanistic studies in engineering, and the like. The Endowment and the National Science Foundation are collaborating in programs on the ethical and human value implications of science and technology. In a word, new opportunities are being thrown open for the use of mind.

Whitehead wrote that "you cannot think without abstractions," but warned against neglect of "the remainder of things." Characteristically, he saw philosophy as the necessary critic of abstractions and believed an active school of philosophy to be essential to a healthy society. Health demands wholeness, and I see it as a drawing together of the sciences and the humanities.—RONALD S. BERMAN, *Chairman, National Endowment for the Humanities, Washington, D.C. 20506*