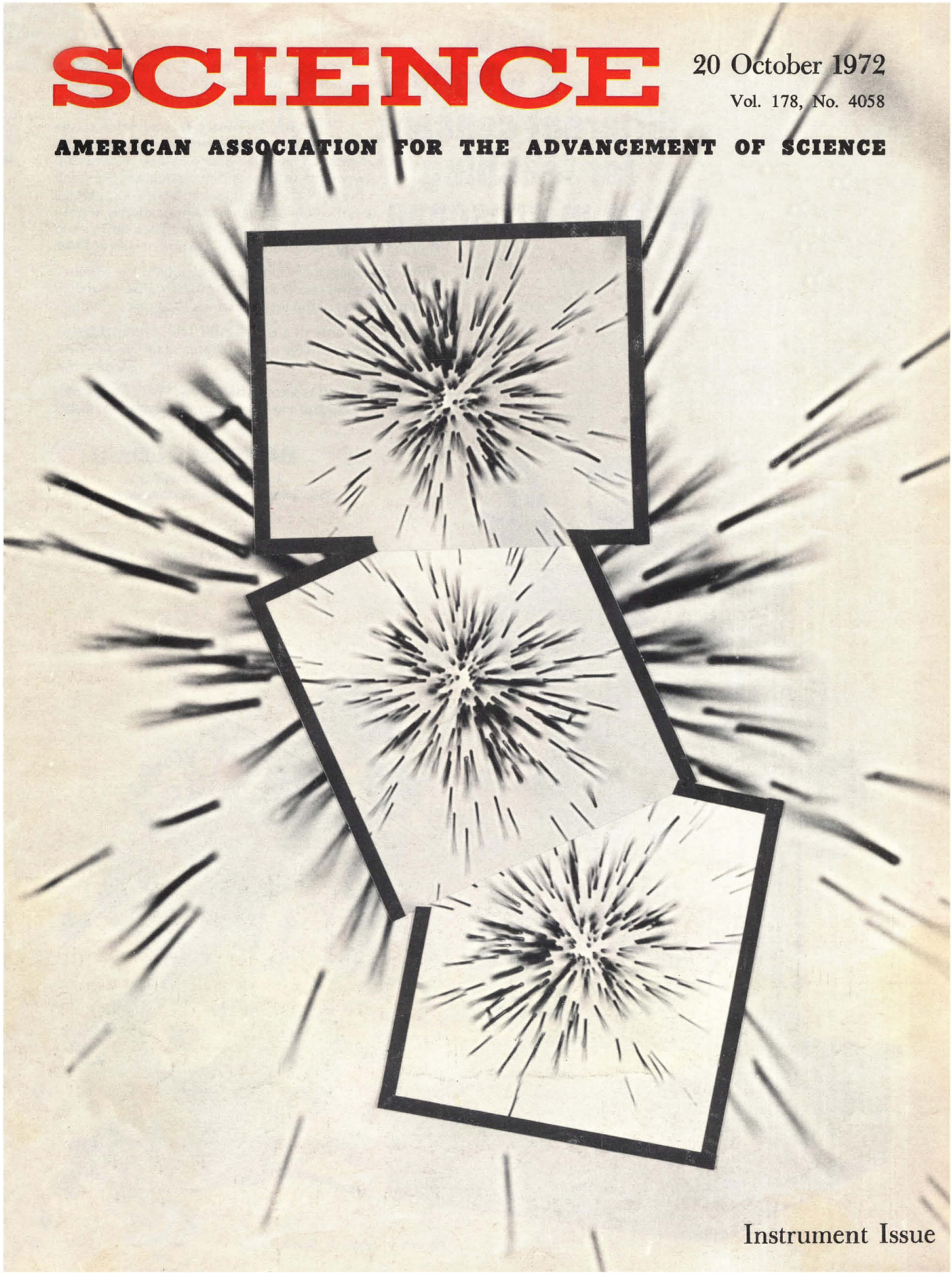
# SCIENCE

20 October 1972

Vol. 178, No. 4058

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Instrument Issue

# NOW... A wholly different concept for teaching with the microscope

It looks different. It is different. It's totally designed for science teaching. Academic StereoZoom Microscope by Bausch & Lomb lets science students relate to the specimen being studied without having to take a course in microscopy first.

This unique Bausch & Lomb microscope combines stereovision with an exclusive zoom magnification that makes for a natural relationship between the student and the specimen. Scanning the field at low magnification or zooming to a specific detail at higher magnification is as non-technical as watching a quarterback on TV. And list prices for this American-made instrument start at $144.

There is no longer an illumination problem. The turn of a knob allows selection of reflected light, transmitted light or a combination of the two, and it uses just one light bulb!

These new instruments are well built, with every safeguard to prevent damage to assure long, maintenance-free, lifetime use.

**You have a need to know what's new. Write for the new catalog 31-2395 and our free demonstration offer, today.**

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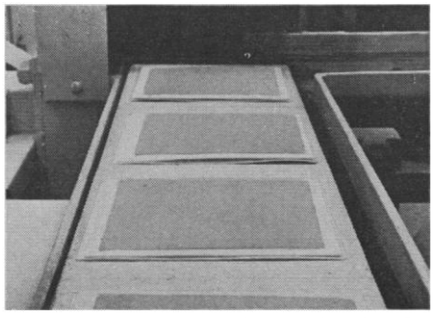
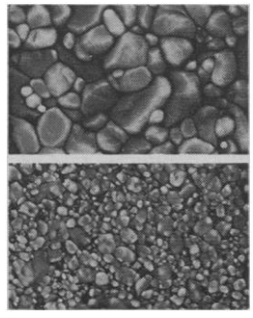
StereoZoom. Reg. T.M. Bausch & Lomb

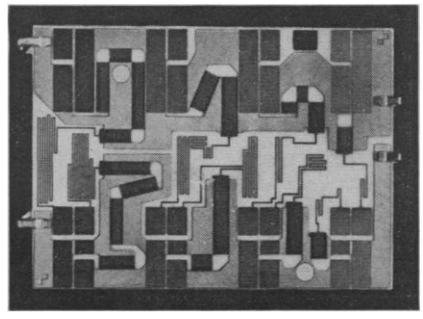
# WESTERN ELECTRIC REPORTS



**1500° C furnace** was specially designed to fire these new substrates. The relatively low temperature results in smooth substrate surfaces for practically fault-free thin film bonding.



**Electron micrographs** show the great difference in grain size between new ceramic material (lower) and the previous material (upper).



**Thin film integrated circuit** shown here is part of a resistor network. It is one of many that benefit from the improved substrate. Metal leads on sides are bonded by thermocompression to tantalum nitride resistor film.

## Smoothing the way for perfect thin film bonding.

Aluminum oxide, or alumina, is considered to have the best combination of properties for thin film circuit substrates. Until recently, however, the bonding of metal elements to gold-coated tantalum nitride resistor film on alumina was somewhat unpredictable.

Now, an advance at Western Electric has made it possible to get practically fault-free bonding of these materials.

This new perfection in bonding came through the development of finer grained alumina substrates.

The process has four basic steps: milling, casting, punching and firing.

During milling, alumina is combined with magnesium oxide, trichlorethylene, ethanol and a unique deflocculant. For 24 hours, this mixture is rotated in a ball mill. In a second 24-hour period, plasticizers and a binder are included.

The deflocculant plays a major role by dissipating the attraction forces that exist between the highly active alumina particles. This prevents thickening, which would ordinarily make an active alumina mixture unworkable.

The 48 hours of milling is followed by casting. When the material comes off the casting line, it is in the form of a flexible polymer/alumina tape, dry enough to be cut into easily handled sections.

After casting, a punch press cuts the material into the desired rectangles or other shapes. Holes can be punched at the same time.

Finally, because of the use of active alumina, the material is fired at an unusually low temperature which results in smooth substrate surfaces for reliable thin film bonding. The finished substrate is then ready for the various processes of thin film circuit production.

In developing this new process, engineers at Western Electric's Engineering Research Center worked together with engineers at the Allentown plant.

**Conclusion:** This new way to produce substrates is a truly significant contribution for thin film circuit production.

The ultimate gain from this smoother substrate is for communications itself. For through the achievement of nearly perfect bonding of metal leads to tantalum nitride, thin films can be produced with even greater reliability and economy.

**Western Electric**

**We make things that bring people closer.**

20 October 1972

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# SCIENCE





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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



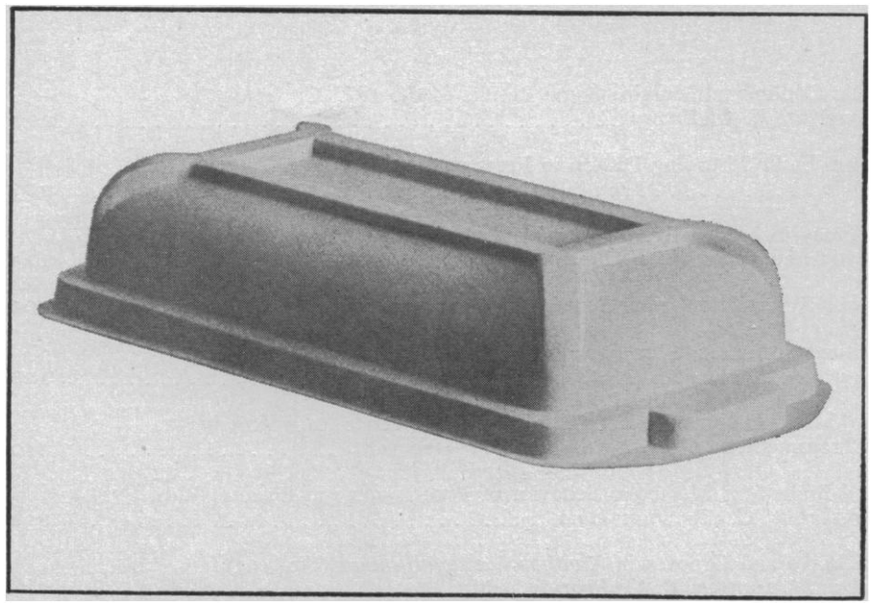


The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding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

**COVER**

Fission track sunbursts from dust particles record the uranium concentration and size of the particle. The tracks are from fission induced by irradiation of a dust particle on a piece of mica and are revealed by chemically etching the mica in hydrofluoric acid (about × 2200 for background; × 750 for insets). See page 255. [P. B. Price and R. M. Walker, *Journal of Geophysical Research*, **68**, 4847 (1963)]

# New Econo-Filter Covers improve animal production, protect long-term experiments



Improved breeding rates; greater protection for long-term experiments; generally healthier animals. These are some of the benefits you get by using Econo-Filter Covers on your animal cages. Molded in one piece from non-woven spun polyester, they are the simplest, most effective way to protect animals against airborne infection, cross contamination and environmental stress. Econo-Filter Covers meet all published standards for porosity, air-permeability, and filtration of air-borne organisms, dust and other contaminants. They are available for all standard Econo-Cages and are reusable.

**Positive Filtration.** Econo-Filter Covers effectively remove air-borne contaminants without inhibiting the proper exchange of air. They can measureably reduce the incidence of contamination and diseases such as infantile diarrhea. This means that now both short-term and long-term programs can maintain a "clean" cage environment without instituting new lab procedures.

**Environmental Control.** Environmental stability promotes animal health. Econo-Filter Covers reduce fluctuations in temperature and humidity, eliminate drafts and minimize $CO_2$ and ammonia buildup.

**Increased Animal Production.** Healthier animals produce stronger litters and show greater fertility. Econo-Filter Covers can make a profitable difference in production by promoting more successful breeding while, at the same time, reducing infant mortality.

**Economy and Efficiency.** Few filter systems of equal efficiency are as economical as Econo-Filter Covers. They are reuseable; withstanding normal sterilization cycles in both steam and gas autoclaves. One-piece Econo-Filter Covers can be installed without special attachments or adapters.

What do you want? Healthier animals; increased animal production; or more protection for long-term experiments. You get them all with Econo-Filter Covers. For all the facts, contact your Econo-Cage/Econo-Filter Distributor or write the Scientific Division, Maryland Plastics, Inc., 9 East 37th Street, New York, New York 10016.

MP

EDFC-1

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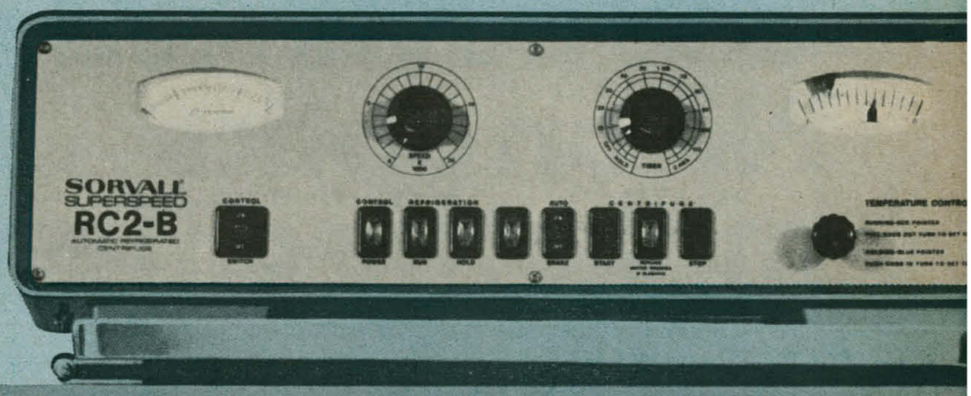
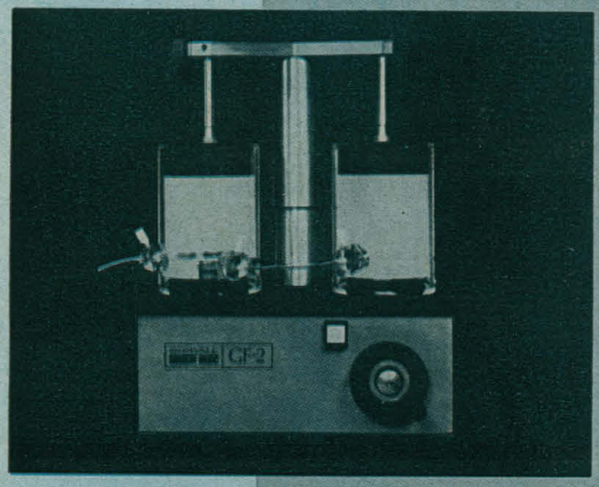
# THE COMPLETE SYSTEM

## FOR ZONAL AND CONTINUOUS-FLOW CENTRIFUGATION

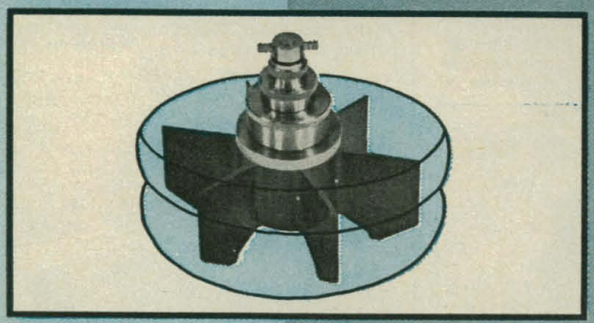
**The Sorvall RC2-B Automatic Superspeed Refrigerated Centrifuge.** When it comes to a complete centrifugation system, nothing else comes close to this Sorvall combination. It begins with the RC2-B. Speeds up to 20,000 RPM. Forces to 48,200 x G with a 400 ml rotor — and without vacuum. Ultra-smooth separations. Reason: Sorvall's exclusive, patented Gyro-Action Direct Drive.



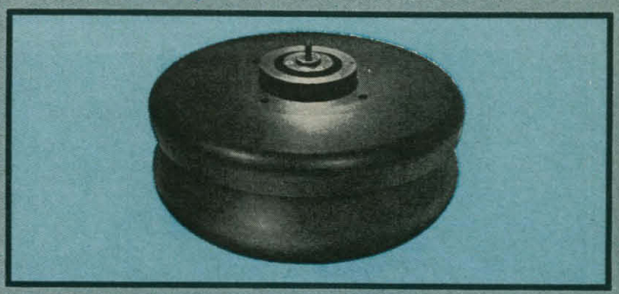




**The new Sorvall Gradient Maker.** Not only new, but unique. This piston-action, two-chamber instrument lets you generate linear, concave or convex exponential (logarithmic) gradients for zonal centrifugation, chromatography, electrophoresis and other techniques. Provides positive or negative linear gradients of any selected slope. And here's the best news of all — its performance equals instruments costing two or three times as much.

**The SZ-14 with our new GK Continuous-Flow Converterkit.** Continuous-flow work flows along easily — when you work with the SZ-14, the Sorvall GK Converterkit, and the RC2-B. You'll get flow rates up to 1,400 ml per minute — that's 84 liters an hour — and collect up to 800 ml of sediment in one run.



**The Sorvall Peristaltic Pump.** Use it to introduce density gradients into — and remove them from — the Sorvall SZ-14 Zonal Rotor (shown below). This exceptional pump can produce continuously variable flow rates up to 138 ml per minute.

**The Sorvall SZ-14 Reorienting Density Gradient Zonal Rotor.** Different from all other zonal rotors. No rotating or complex seal assemblies. Only four major parts. So it's easy and economical to clean and maintain. What's more, it can be loaded statically or dynamically, and unloaded at rest following gradient reorientation. Accommodates up to 1,350 ml of gradient and sample. Up to 19,500 RPM (40,500 x G). Sediments most subcellular particles, larger particles and whole cells. No overlay or dense displacing solutions required. And consider this: the SZ-14 plus our RC2-B cost little more than most other zonal rotors *alone*.

**Choose your collector or detector.** The Sorvall system is not only total but versatile. It's a handy help in collection and detection, readily compatible with a variety of instruments including continuous-flow UV scanning equipment, sucrose gradients through a refractometer, fraction collectors, and manual collection in tubes.

So why settle for less than everything? Write or phone us today for complete details about *the* complete centrifugation system. No obligation, of course. Ivan Sorvall, Inc., Norwalk, Conn. 06856. (203) 847-2491.

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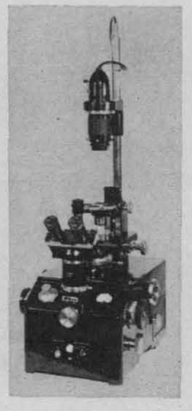
# For routine analysis and advanced research, Nikon optics make the difference.

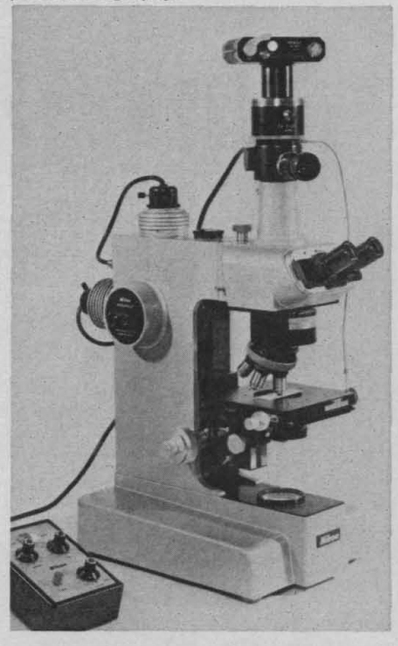
**Nikon M Inverted Microscope,** the world's most sophisticated optical instrument for tissue culture studies. Highly recommended for automatic time-lapse cinemicrography. Utilizes long working distance phase-contrast optics. Accepts wide variety of Nikon specially designed attachments as well as standard attachments. Suitable for wide range of biological and metallurgical studies. **Circle No. 127**



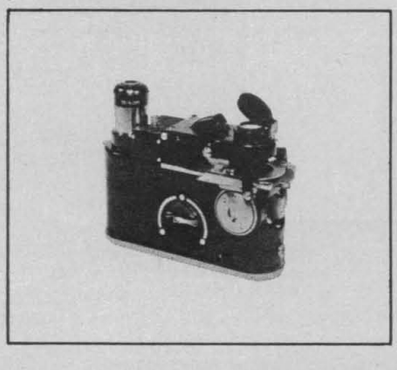
**Nikon L-Ke,** the most sophisticated and versatile member of the standard series microscopes. Features built-in true Koehler illumination, unusual ease of handling, interchangeable nosepieces and centerable condensers. Recommended for photomicrography. Now available with quartz halogen lamp. **Circle No. 128**

**Polarizing Research Microscope POH-2,** designed for observation, measurement and analysis of birefringent specimens. Features interchangeable, centerable, rotating nosepieces, built-in substage illumination or epi-illumination, graduated Babinet compensator and universal 4-axis stage. Available with trinocular eyepiece for photomicrography. Equipped with special depolarizer. **Circle No. 129**

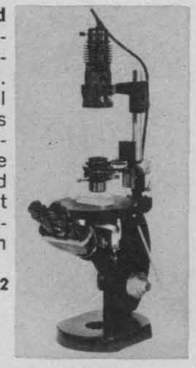
**Nikon Apophot,** our advanced universal research microscope has built-in zoom-Koehler illumination for transmitted and reflected light, magnification changer and focusable Bertrand Lens. Permits use of special light sources such as tungsten, high-pressure mercury arc, xenon arc, quartz halogen and CSI. Accepts full range of Nikon accessories, including all format photomicrography. **Circle No. 130**



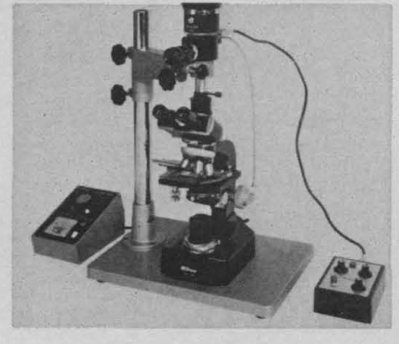
**Model H,** a portable hand microscope for field use. No larger than a 35mm camera, it is a sophisticated precision instrument. Wide range of accessories for special applications include phase-contrast and polarization. **Circle No. 131**



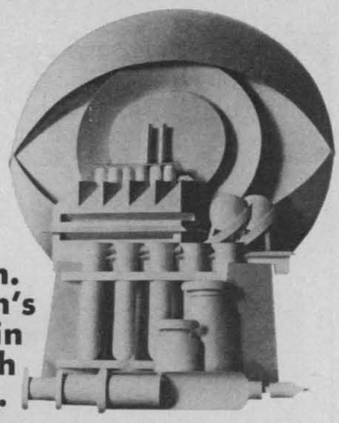
**Nikon MS Inverted Microscope,** a simplified, lower-cost version of the Model M. It utilizes almost all Model M accessories including the photomicrographic. Available with both transmitted and reflected light and quartz iodine illumination. Has built-in photo tube. **Circle No. 132**



**Nikon Kt Compact,** versatile laboratory microscope with built-in transformer, continuously variable light intensity control, and inbase voltmeter. Features brilliant Koehler type illumination and full range of accessories. **Circle No. 133**

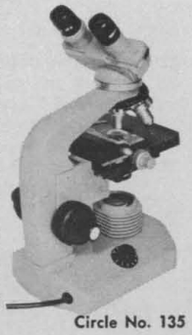


**Fluorescence Illuminator** equips Nikon S Series for fluorescence microscopy: antigen-antibody, acridine-orange, auramine and other fluorochromes and combined phase fluorescence. **Circle No. 134**



# Nikon. Extending man's vision in science, research and industry.

**Nikon Model CL Classic Microscope,** precise, yet ruggedly built, especially for student use. Many safety features. High quality Nikon optics, locked-in interchangeable components, harmonic drive mechanism for smooth, reliable coarse and fine focus adjusting. Accepts many Nikon accessories. Easy on the budget.



Circle No. 135

**Teaching Head attachment** equips any standard microscope for simultaneous viewing of a specimen by two observers. Essential for both teaching and consultation in science, industry and education. Has built-in, illuminated movable pointer.


Circle No. 136

**Nikon 6-C Micro-Comparator,** a precise optical measuring instrument used widely for inspecting and measuring ultracentrifuge as well as electrophoresis and electron micrographic plates. Also useful for a multitude of biological specimens. Available with electronic digital stage micrometers for direct read-out and computer interfacing.

**Nikon Micropan Microprojector** for seminar or lecture room projection of microscope slides. Superb Nikon optics include zoom projection lens, built-in pointer, micrometer and field selector reticles. All controls located within convenient reach. Illuminated magnification indicator. Ozone-free 450W Xenon lamp. Sharp images edge to edge. Precise magnification change: choice of five prealigned objective/condenser matched combinations. Cold mirrors and heat filters for added specimen safety.

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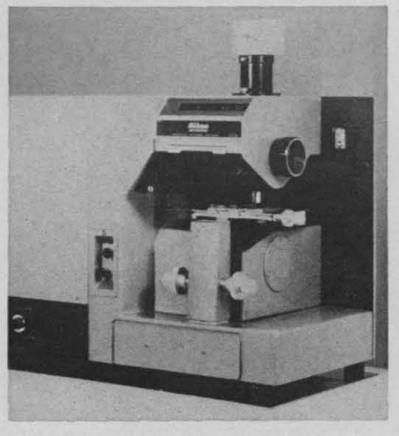

**Modular Focusing Mount,** with extremely flexible design for precision microscopy at moderate cost. Adapts easily for wide variety of applications in production, inspection and research. Coarse and fine focusing on both sides with revolving nosepiece. Accepts all Nikon S accessories including Type R (Francon-Yamamoto) Differential Interference Attachment for microscopic studying of opaque surfaces seen as interference color and contrast differences.

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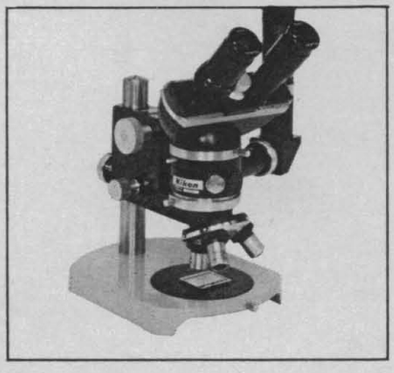

**Nikon SMZ Stereo Zoom Microscope** has a total magnification range from 4x to 120x. Provides 5-time zoom range without change in focus or working distance. Exceptional range of accessories.

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**Epi-illuminator** fits any standard Nikon microscope. Designed for observation of opaque specimens. Provides collimated on-axis illumination with field and aperture control. Dark field reflected light systems also available.

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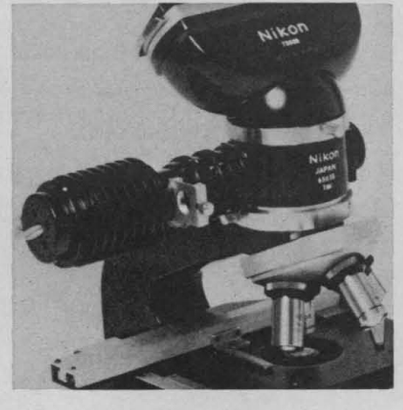


**Comparison Projector Model CP-6,** shows two magnified images on single 6" x 12" screen for side-by-side comparison. Especially easy to use without strain. Horizontal and vertical bullet and cartridge manipulators. Fiber optics illuminators transfer no heat to specimens. Design permits observation of large objects and simultaneous viewing by students or consultants. Screened image photographable with any camera.

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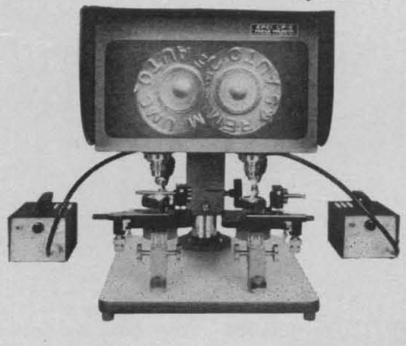
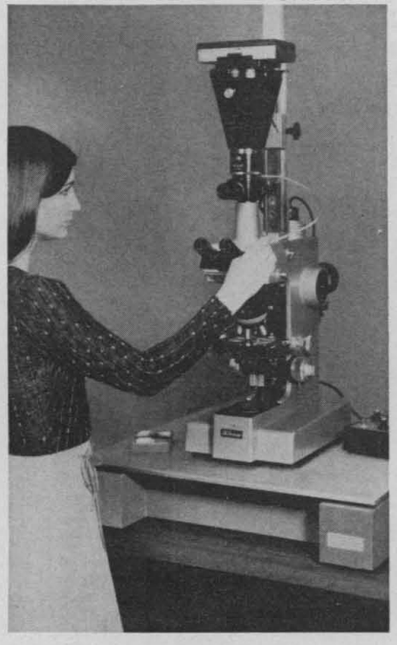
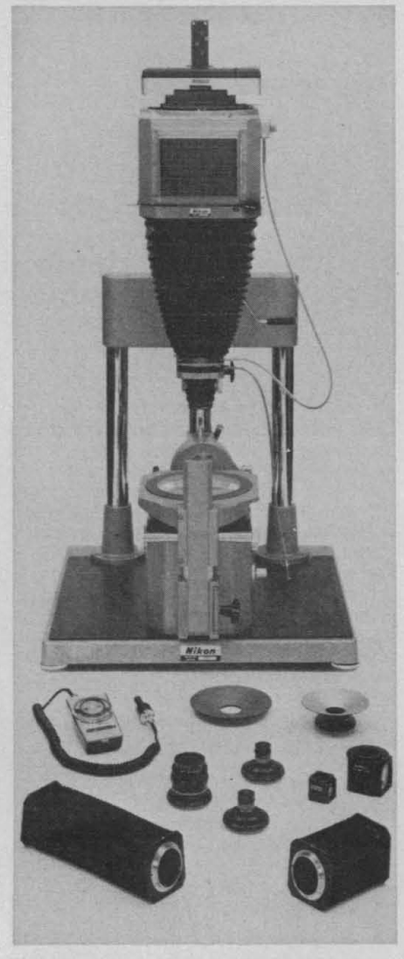


# Photomicrography and Photomacrography by Nikon.

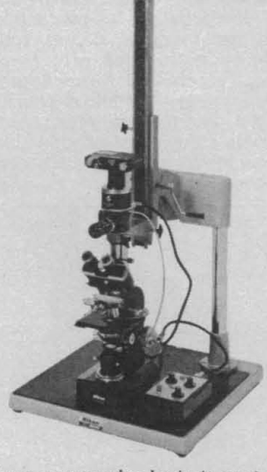
**VIT Vibration Isolation Table,** for stabilizing sensitive instruments used in photomicrography, metrology, holography, laser equipment and micromeasuring devices. Isolates 90-98% of environmental vibrations. Also available as VIT Console and VIT Stand. Table shown here with cine stand and Apophot microscope with automatic microflex. **Circle No. 142**



**Full complement of film formats**
Polaroid® M-100 Film Back for use with Polaroid 3¼" x 4¼" packs. Polaroid 3¼" x 4¼" rollfilm back. 120 roll film, 4" x 5" cut film or plates. **Circle No. 143**



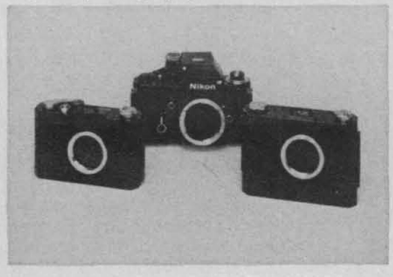
**Multiphot,** our large, sturdy, universal photomacrographic stand, equally suitable for photomicrography and cine micrography. Accepts wide variety of quickly interchangeable accessories. Newly designed Macro-Nikkor lenses with matching, color-coded condensers for unusual resolving power. 4 x 5 inch mirror reflex housing and special low vibration self-cocking shutter.* **Circle No. 144**



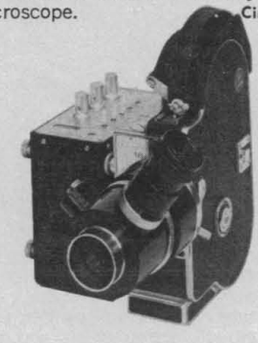
*Unique accessories include spot photometer, half reflecting mirror, and Lieberkuehn mirror. **Circle No. 145**

**3 Microflexes:** Standard PFM, prism reflex attachment with viewfinder and low vibration shutter; Semi-automatic EFM with built-in CdS photocell coupled to exposure control system; Automatic AFM with sensitive CdS light sensor and solid state analog computer control unit that calculates correct exposure and sets shutter timing automatically. **Circle No. 146**

**Three 35 mm Camera Backs:** M-35-S for 35 mm full and half-frame exposures, includes Nikon F, Nikkormat or Nikon F2 Body; M-35-A, motorized to advance film automatically. Bi-cam adapter to hold 2 35 mm backs interchangeable for b & w or color photography. **Circle No. 147**



**Cine Microflex CFMA,** the only time-lapse motor-drive cine-micrographic system with automatic exposure control. Designed for use with the current model Bolex H-16 cine camera mounted on any standard microscope. **Circle No. 148**



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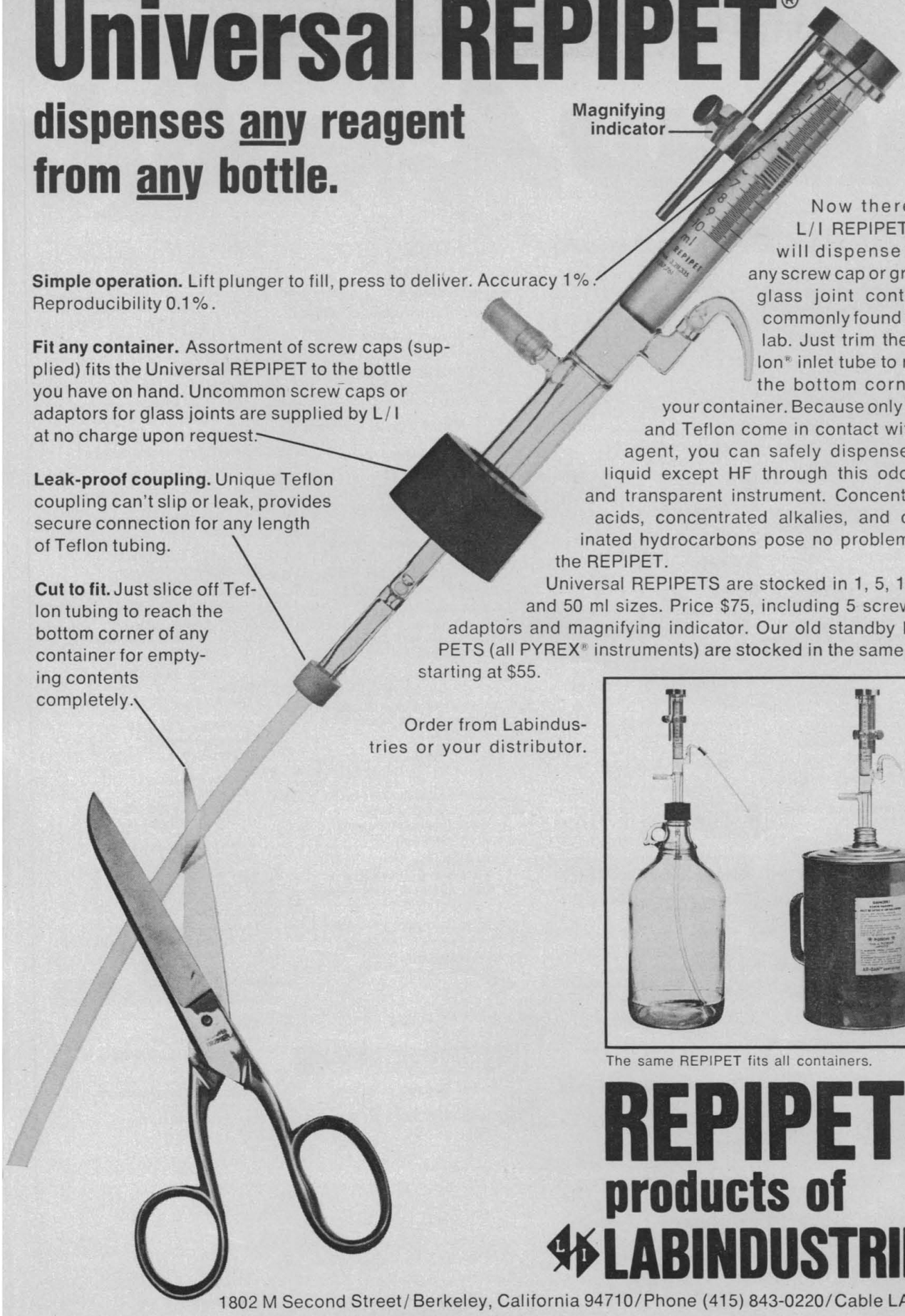
## dispenses any reagent from any bottle.




**Simple operation.** Lift plunger to fill, press to deliver. Accuracy 1%. Reproducibility 0.1%.

**Fit any container.** Assortment of screw caps (supplied) fits the Universal REPIPET to the bottle you have on hand. Uncommon screw caps or adaptors for glass joints are supplied by L/I at no charge upon request.

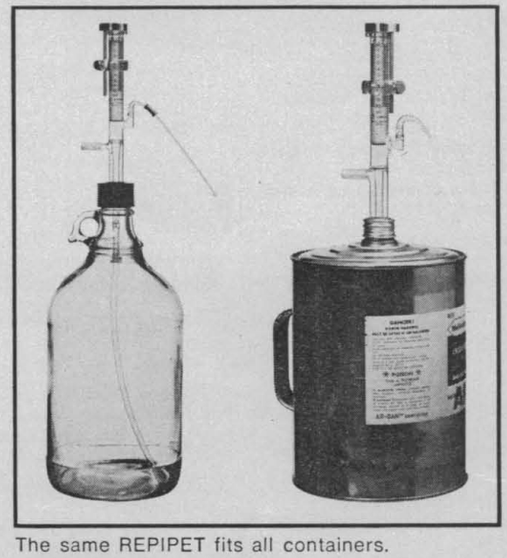
**Leak-proof coupling.** Unique Teflon coupling can't slip or leak, provides secure connection for any length of Teflon tubing.

**Cut to fit.** Just slice off Teflon tubing to reach the bottom corner of any container for emptying contents completely.

Now there's a L/I REPIPET that will dispense from any screw cap or ground glass joint container commonly found in the lab. Just trim the Teflon® inlet tube to reach the bottom corner of your container. Because only glass and Teflon come in contact with reagent, you can safely dispense any liquid except HF through this odorless and transparent instrument. Concentrated acids, concentrated alkalies, and chlorinated hydrocarbons pose no problems for the REPIPET.

Universal REPIPETS are stocked in 1, 5, 10, 20, and 50 ml sizes. Price $75, including 5 screw cap adaptors and magnifying indicator. Our old standby REPIPETS (all PYREX® instruments) are stocked in the same sizes starting at $55.

Order from Labindustries or your distributor.



The same REPIPET fits all containers.

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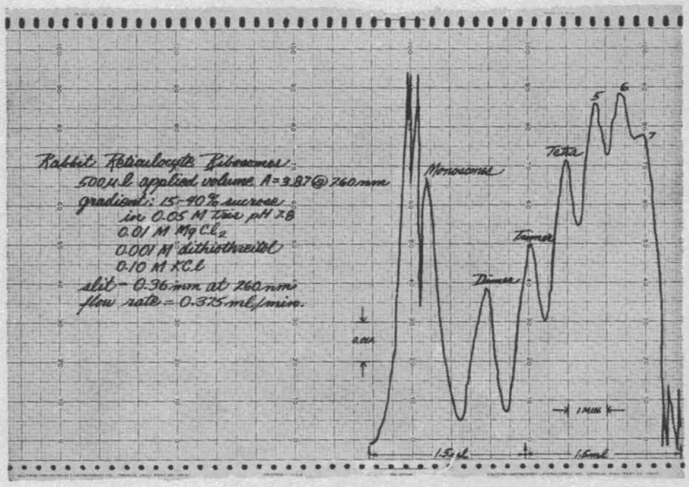


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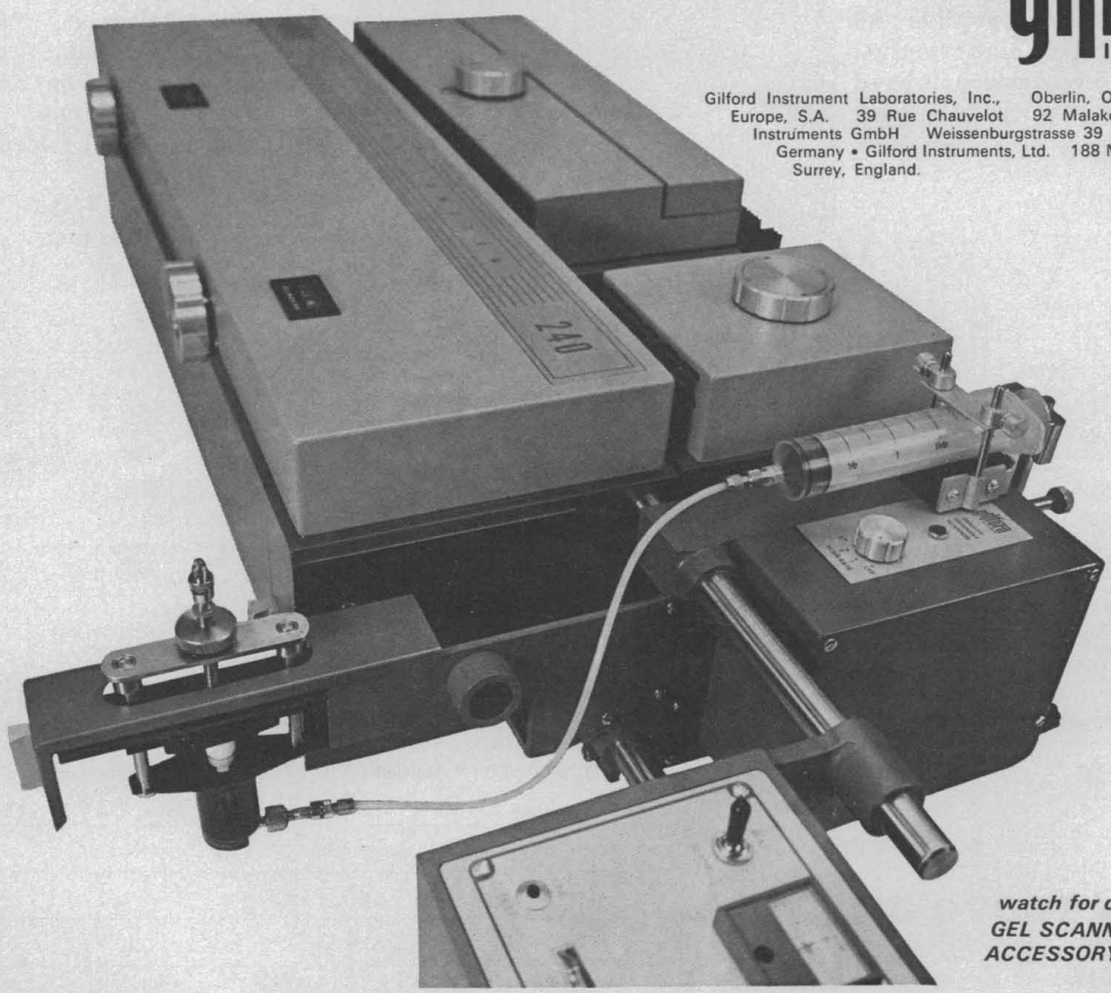


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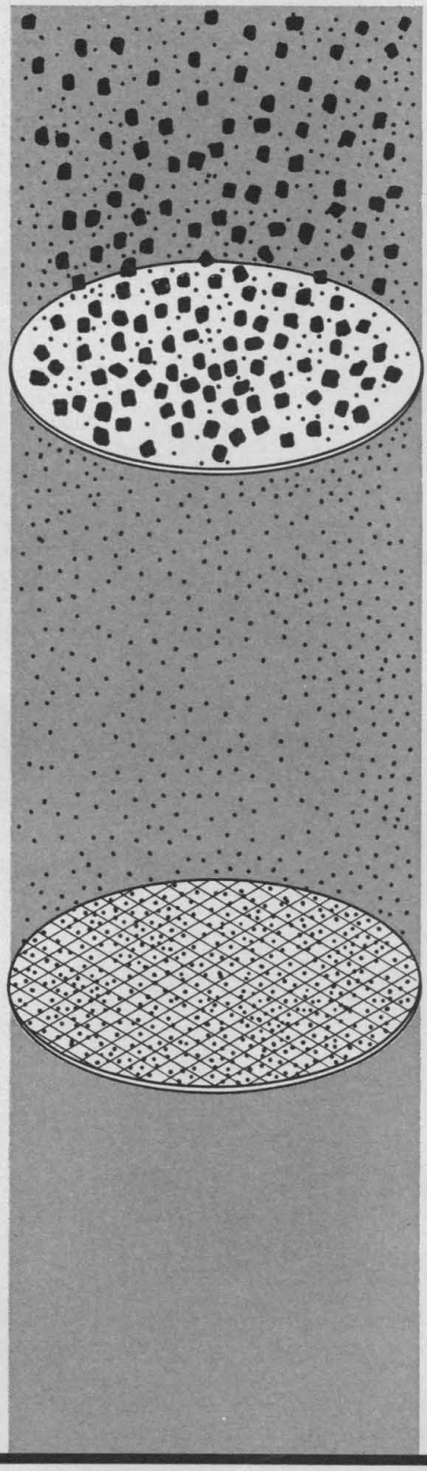

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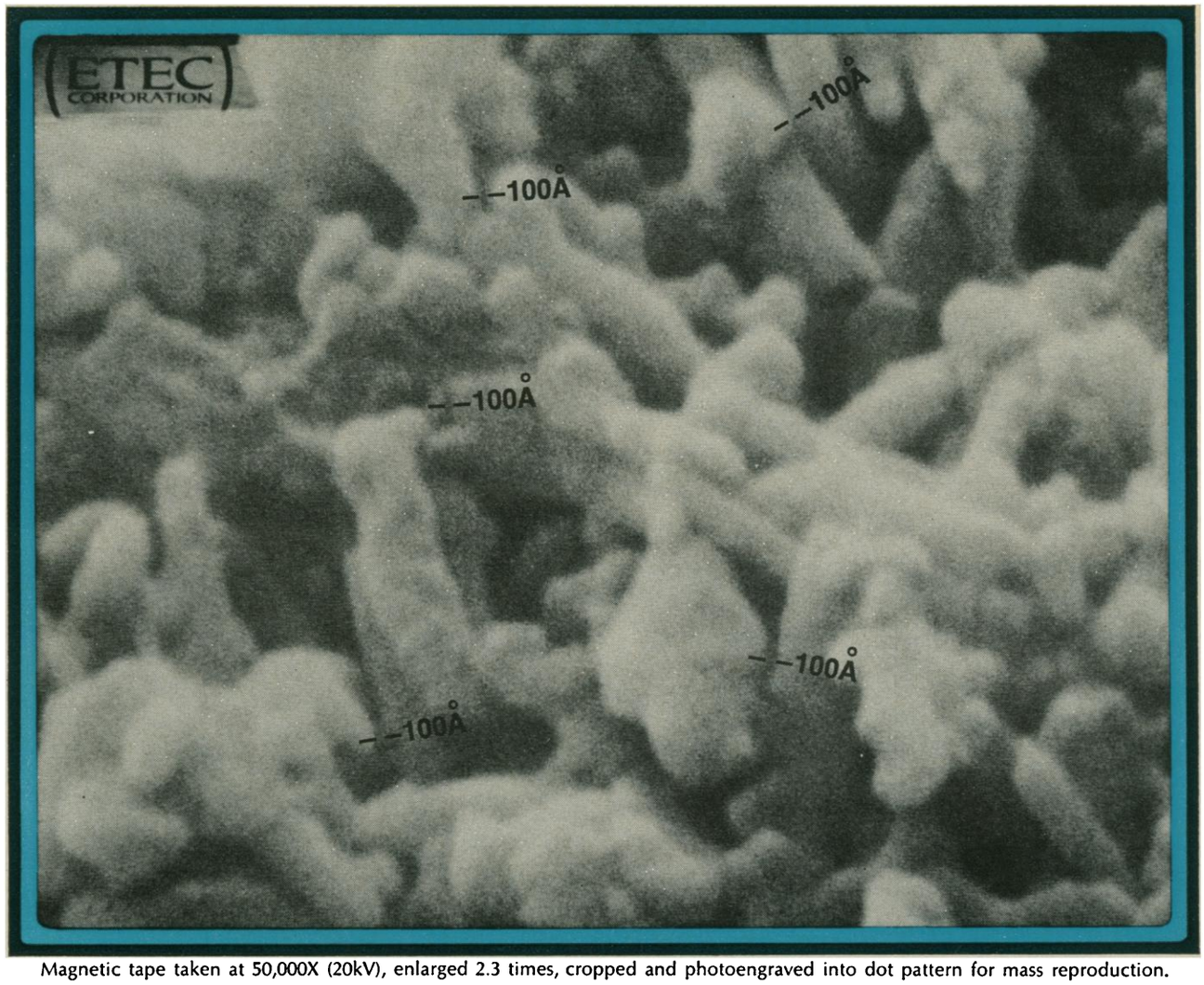


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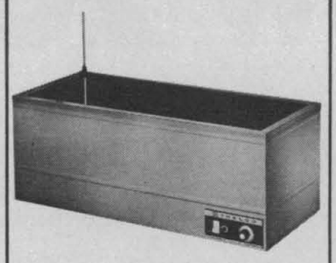

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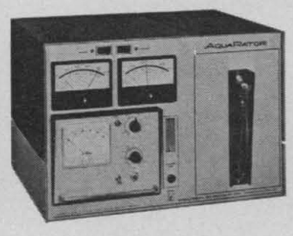

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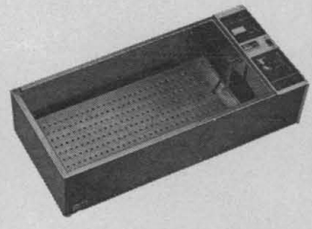

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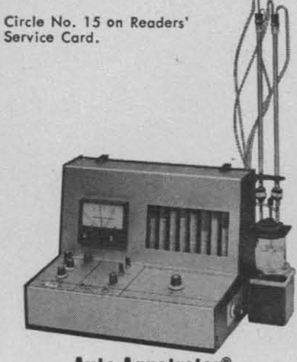

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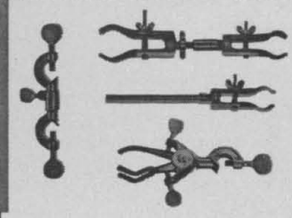

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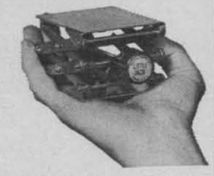

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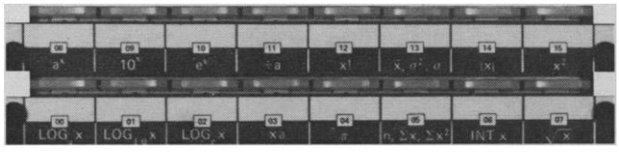

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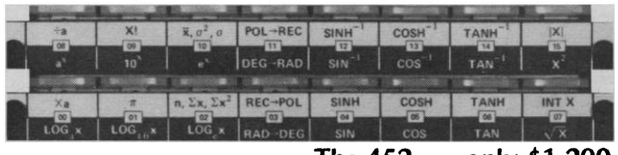

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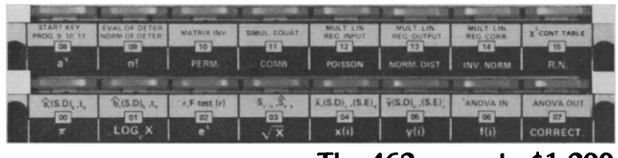

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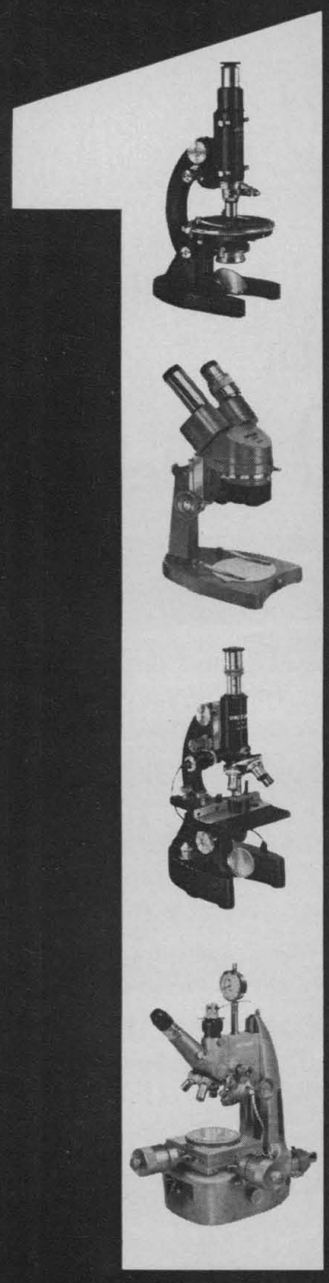

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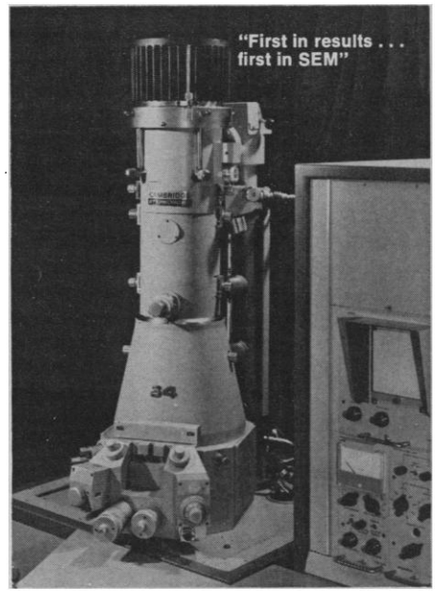


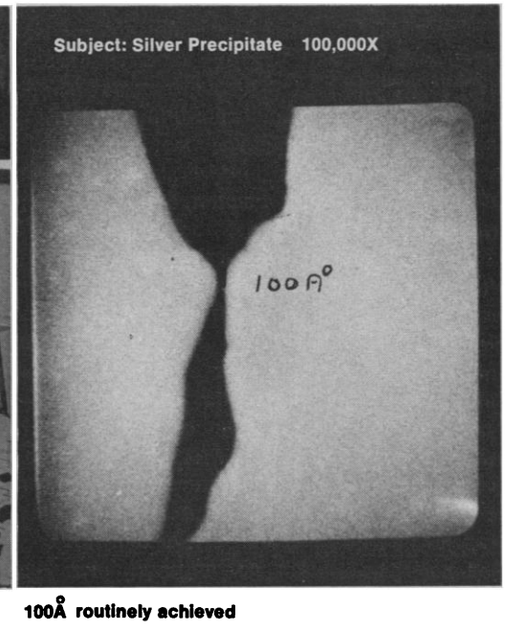


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who had no scores, one can only caution that the sample represents 89 rather than 100 percent of the regular public school twin population between 7 and 18 years of age.

A second possible source of unrepresentativeness lies in the correlation coefficients themselves, as sampled from a universe of coefficients that could be obtained from the same tests on the same populations at other points in time. Since the analyses were done on only one sample of tests, it is impossible to show empirically how reliable the coefficients are in representing possible results. The magnitude of the sample, however, increases the probability of obtaining similar results on other occasions.

Third, the pattern of results in the disadvantaged groups seems unrepresentative of the general twin study literature, which always reports higher MZ than DZ correlations for measures of intelligence. At least three possible explanations occur to me: first, no other study has specifically dealt with genetic variance in the IQ scores of lower-class twins, and therefore there are no other studies with which to compare this one; second, heritability studies of IQ with no results are not published; and, third, the results of my study have more limited generalizability than Dawes thinks I impute to them.

The first point is simply true to my knowledge. There are no other reports of genetic variance in the IQ scores of disadvantaged groups. The second point is true in nearly all fields; there are few published reports of null results unless a major theoretical point is at issue. I, for one, obtained the same correlation (.61) for blood-grouped MZ and DZ twins on an individually administered test of nonverbal IQ and did not submit the results for publication (because no one would believe that MZ twins were not more similar than DZ twins, there were only 60 pairs, and so on).

The third point of self-criticism is more serious: How generalizable to other measures are the results of a study whose scores were obtained from teacher-administered group tests of scholastic aptitude? Dawes believes that if questions of race, social class, and IQ must be phrased in terms of specific tests, then interest in the answers diminishes rapidly. I am far more conservative than that. In behavior genetic studies, results are always specific to the measures, the population, and a point in time. I tried extensively to explain the composition of the tests, precisely in order to limit the generalizability of any results to teacher-administered group tests, of Philadelphia children (or at most children in an eastern urban area) in 1969 (maybe 1968 and 1970 as well).

Does the specificity of the results cause most people to lose interest in them? Perhaps. That is a matter of personal taste. I am tempted to caution patience until more results are available from which to generalize. The fact is that millions of school children are given group intelligence tests yearly, and decisions about their futures are made on the basis of their scores. I would suggest that information on the (low) proportion of genetic variance in the (low) scores of disadvantaged urban children may be encouraging to those who would act to improve their educational environments and their aptitude scores. Interest in the results of this and similar studies is probably greater than Dawes suggests.

### Validity of IQ Tests

Dawes's third major criticism raises the question of whether "the particular tests she used were simply more precise indices of intelligence for whites than for blacks." The issue of precision can refer to the statistical measurement characteristics of the tests or to more metaphysical concerns with what IQ tests "really" measure in various populations. I dealt with measurement validity by correlating aptitude test scores with criterion tests of academic achievement. The results, as reported in table 4, showed similar correlations for the two racial groups and for the social-class groups within each race. (Only the white below-median group had somewhat lower correlations between aptitude and achievement scores.) Many would like to claim that the low average IQ scores of disadvantaged children result from measurement invalidity, but I find no support whatsoever in my data for this assertion. The fact is that children who score poorly on aptitude tests also tend to score poorly on achievement tests, as is to be expected when the criteria for successful performance are so similar.

Distress over low aptitude scores comes primarily, I think, from the erroneous belief that IQ tests measure a fixed level of "native intelligence" (a slippery construct if there ever was one). IQ tests are a sample of problem-solving behavior and cultural knowledge at a specific point of time. They

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are simply indicators of current levels of performance on intellectual tasks designed to predict to similar criterion situations in school, jobs, and the like. One could argue that IQ scores *ought* to show heritable differences in all populations because the lack of heritability indicates either a less-than-optimum expression of genotypes in phenotypes or a social environment that is less relevant for the development of important skills. I suggested both these explanations in the discussion section.

An expansion of the cultural differences argument may speak to the issue of test precision. If the content of the test items is inappropriate for some children because they speak a different language, or if the test situation is inhibiting, then one could argue that the "precision" of the test is reduced. Cross-cultural studies (*1*) often search for culturally appropriate methods, materials, and settings in which to test intellectual behavior. The goal is to estimate intellectual competence, which can be inferred from behaviors in any setting that optimizes performance.

There are severe limitations to what can be learned from the different-test strategy, as there are in the same-test strategy. The use of different tests in every group, or with every child, makes comparisons of performance by different children and groups very difficult. The use of the same test in every group, and with every child, makes inferences about what the test measures very difficult. These two strategies represent two profoundly different approaches to the study of intelligence.

The most important contrasts, I think, between cognitive-developmental approaches to intelligence and psychometric ones are that (i) the former concern themselves with the stage-sequence model of development with little attention to individual variation from the modal pattern, whereas the latter concern themselves particularly with the distribution of individual differences; (ii) the former attempt to explain qualitative changes in intelligence over time, the latter seek to minimize qualitative changes in favor of predicting consistent levels of intelligence over time; (iii) the former are incidentally concerned with rate of acquisition and speed of performance, the latter are primarily concerned with these aspects of intelligent behavior, especially as they relate to school achievement. The more sophisticated psychometric people know that much of the consistency in the rank order of children's scores over time rests on (i) the consistency of both their genotypes and their environments (which if poor when the children are four years old are likely to be poor when they are ten) and on (ii) nonintellective aspects of performance.

From a psychometric point of view, nonintellective factors are all part of performance on IQ tests, as they are of performance in school. From a cognitive-developmental point of view, intellectual organization is conceptually distinct from situational and personal factors which may detract from performance. Thus, cognitive-developmental measures are usually given repeatedly, with varied materials, and under the best possible conditions to elicit the child's optimum performance. IQ tests are typically timed and given in a stereotyped and impersonal manner. The contrast in administration rests not on the sadism of psychometricians but on the predictive validity that can be achieved by standard conditions approximating traditional academic conditions. To the extent that academic and occupational performance in this society are better predicted by IQ tests, they remain important measures of "effective intelligence." Even if adequate cognitive competencies can be shown to exist in nontest situations, the intellectual performance of some children may still be deficient in socially important settings like jobs and schools.

One conclusion that might be drawn is that schools should be changed to give every child an optimum setting in which to use his cognitive competence; for example, rate of acquisition should be de-emphasized, varied modes of learning should be available, criterion measures of progress should be given priority, and everyone should appreciate the blessings of diverse talents. In that case cognitive-developmental measures might be better predictors of achievement. If cognitive-developmental measures could be constructed within a more rigorous psychometric frame, then their theory base would make them infinitely preferable to the empirically selected items of present IQ tests. If a child passed items at a given level of cognitive development, then we might be able to predict which skills he could be helped to develop next.

A related point, and an extremely important one, has been raised by Kagan (*2*). Can we not assume that almost all children are able to learn the basic skills that society seems to require? Reading at a fourth-grade level,

elementary arithmetic, and a complete grasp of concrete operational thought should be within the ability of 98 percent of the population. Yet many children do not acquire these minimum skills either at home or in school. There seems to be no excuse for the failure of any but defective children to reach minimum performance levels.

### Indirect Approaches to Racial Studies

Willerman criticizes the two indirect approaches to the study of racial differences: the admixture and regression methods, which were proposed in my book review.

The admixture approach, he says, will probably yield ambiguous results because of a sizable covariance between high degrees of Caucasian admixture and the provision of good rearing environments. In the rare case which he cites of a contemporary interracial mating, disentangling social-environmental factors from genetic ones is difficult but possible. Children with one white parent could vary in admixture from 50 to more than 90 percent, because the black parent is unlikely to have total African ancestry. The children of interracial matings are, however, a socially different population from the children of two black parents, even though they fall within the same admixture distribution. One could meet Willerman's objections by correlating variations in admixture, skin color, and IQ within the population of interracial children, but their numbers are so few and the range of admixture variation so restricted that the study would be less valuable than a similar study of children with two black parents.

Let us look at the other 99 percent of the children socially defined as black. Their degrees of white admixture can vary from less than 10 percent to more than 90 percent even though both parents call themselves black. The children will vary in serological estimates of admixture, in skin color, and in IQ scores; it is not a difficult statistical problem to intercorrelate three linear variables partialing out one at a time.

One could still argue, as Willerman suggests, that higher degrees of white admixture in children may covary with better rearing environments, and that good environments, not admixture, may produce higher IQ scores. The hypothesized covariance is subject to empirical test. Within the contemporary black population, the slogan "Black is beautiful" connotes a far greater acceptance of black heritage than was

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The oft-quoted National Science Foundation report (*1*) mentioned by Abelson provides data on the status of respondents to a questionnaire which was sent to the respondents of a previous questionnaire (*2*). It is doubtful whether this kind of sample is a representative one.

A 1971 study (*3*) by the Engineers Joint Council (EJC) identifies some of the inadequacies of a companion NSF report on engineers (*4*) and indicates substantially higher unemployment rates than does the NSF report. But even the EJC's method of selecting respondents results in limitations in the applicability of the data.

U.S. Department of Labor figures, as well as those of individual states, have inherent problems of classification as well as sampling technique. In Massachusetts, for example, extrapolation techniques developed for use in "normal" times are of questionable value when used during a period of prolonged unemployment. These techniques resulted in an official unemployment figure for scientists and engineers in mid-1971 of 4200 (*5*). Others have estimated that there were between 10,000 and 20,000 unemployed scientists and engineers in Massachusetts at that time, and between 100,000 and 200,000 in the nation (*6*); these estimates correspond to an unemployment rate of about 10 percent, which is more consistent with my own observations.

During the past year, an inordinately large number of frustrated, disillusioned, and desperate scientists and engineers have accepted underproductive and unrewarding employment. But government questionnaires (*7*) have not been designed to elicit data on underemployment, and government analyses ignore it. This accounts in part for the questionable credibility of government figures and analyses.

Abelson suggests that researchers enter the overcrowded arena of technology-oriented companies as a step toward solving the researcher's employment problem. The answer to their problem does not lie in displacing others from their jobs or in scrambling for the meager scraps that are being strewn among us for political mileage. This approach results in the community of scientists and engineers being divided and conquered, as it is at present.

The current administration made a conscious decision to permit the unemployed, including scientists and engineers, to bear the brunt of controlling inflation. This was implemented despite the severe human cost and the long-term compounding of national problems.

The federal government, and the Administration in particular, control the purse-strings that must be adjusted to promote employment, increase productivity, and address the pressing problems of national concern, toward which technology can contribute substantially. These goals are in the interest not only of scientists and engineers, but of the nation as a whole. We must not be sidetracked by cautions against overindulgence, while ignoring the continuing unemployment and underemployment crisis. Current economic practice, which inevitably results in personal disaster for many of us, is unacceptable.

EPHRAIM WEISS
*Association of Technical Professionals, Box J, Wayland, Massachusetts 01778*

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## Old-Fashioned Virtues

Maesen and Maesen (Letters, 28 July, p. 293) suggest that universities return to "such 'old-fashioned' virtues as academic competence, high intellectual standards, and far-reaching preparation, rather than 'the customer (student, public, and so forth) is always right' mentality." I am unable to decide whether this is a serious comment or whether it was meant ironically. It closely parallels numerous passages in C. P. Snow's books, in which he describes the reactions of Greek and Latin scholars to the demand for relevance by their students, who had the temerity to insist that science should be added to the university curriculum.

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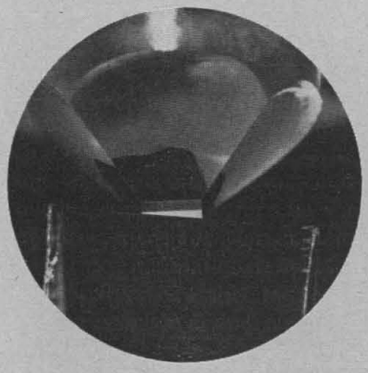

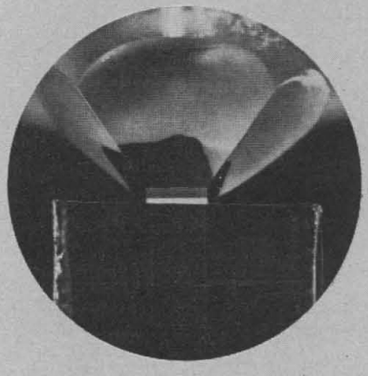

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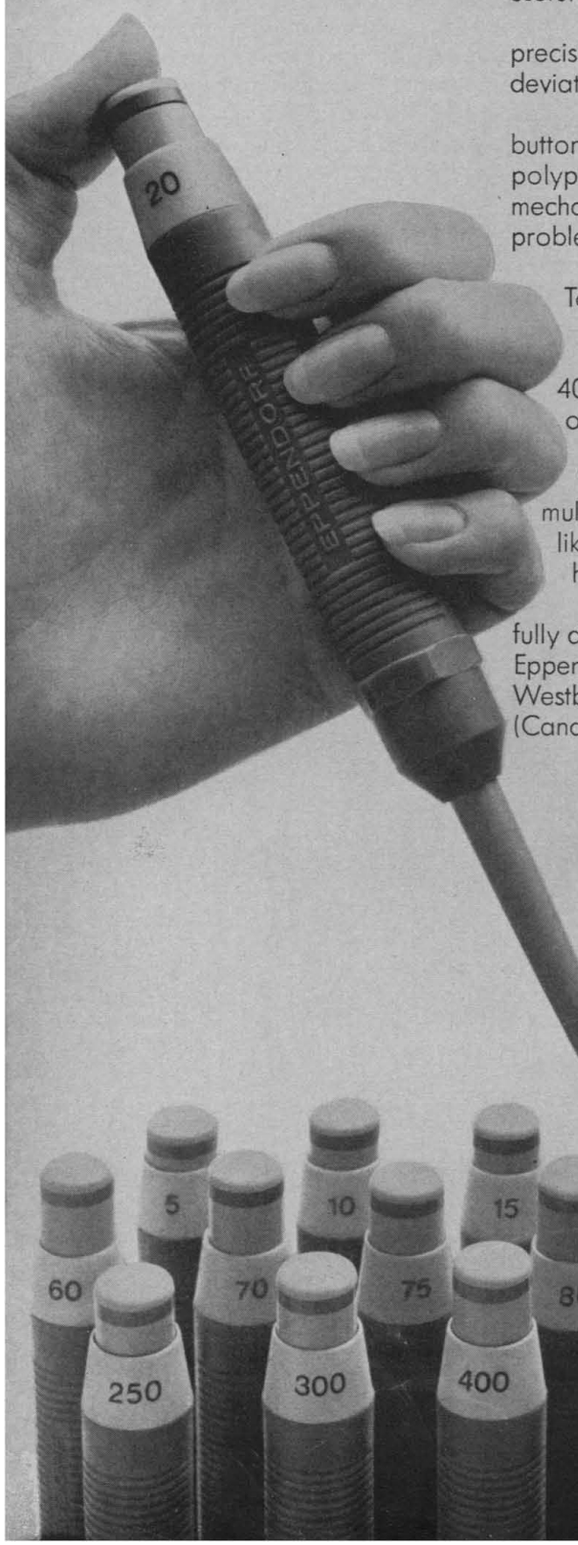


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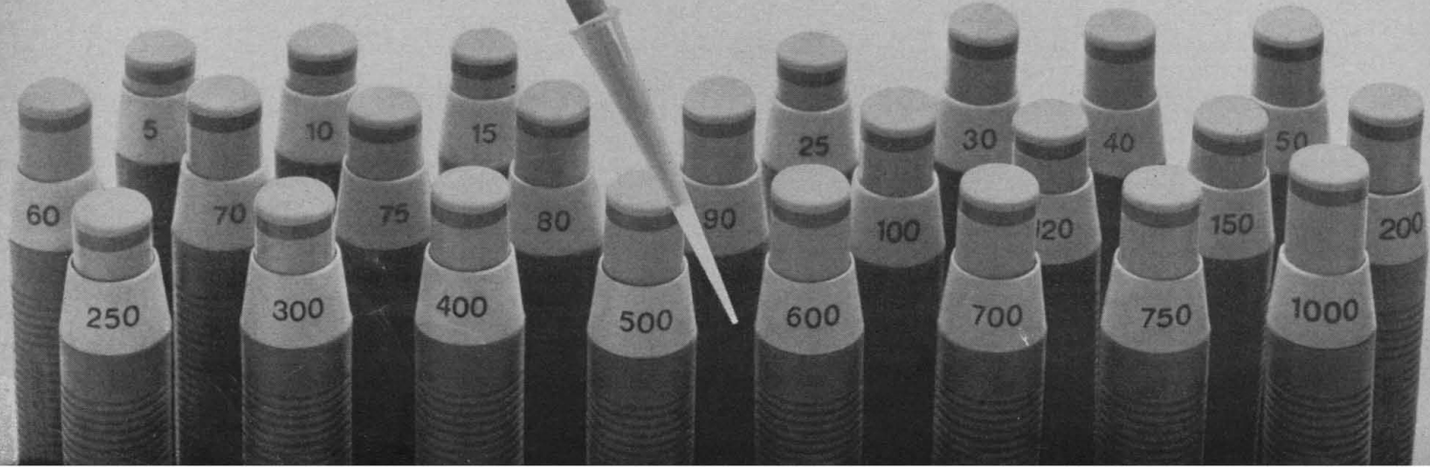


20 October 1972, Volume 178, Number 4058 **SCIENCE**



# A Philosophy for Technology

We are told that an aura of antitechnology abounds in many areas and is spreading. Especially, we are told, this is true among the young people. I am in no position to prove that this is not true, but the evidence is not all that convincing to me.

Virtually everyone within my ken, regardless of age or of the opinions they profess to hold, continues—almost without thinking—to rely on technology as the mainspring of their well-being.

Let me inquire, for example, what would happen if progressive technology were no longer available to assist in the production of food, clothing, and shelter, health care, education, transportation, employment, and recreation.

I think it is safe to say that, if most of us were denied the *opportunity* to enjoy the benefits that technology has created for us in these categories, we would raise merry hell.

I am not overly worried that the antitechnology fad, to whatever extent it exists, will take us to the point of breaking up the material base of modern civilization. Long before that happens, it seems to me, we are likely to feel the pinch of *inadequate* technology to such a degree and in such a way as to stimulate a counterdemand for *improved* technology. This is already happening, in some measure, in all of the fields I have mentioned. We are in fact struggling to stay on the treadmill of adequate nourishment, housing, medical care, and the like.

My apparent preoccupation with technology is not intended to denigrate the social sciences or the arts and humanities. I take it for granted that progress in the latter is equally as important as progress in technology and that advances in these fields are quite as necessary as advances in the field of science. I assume further that we must learn to handle issues arising from the interaction of all these fields.

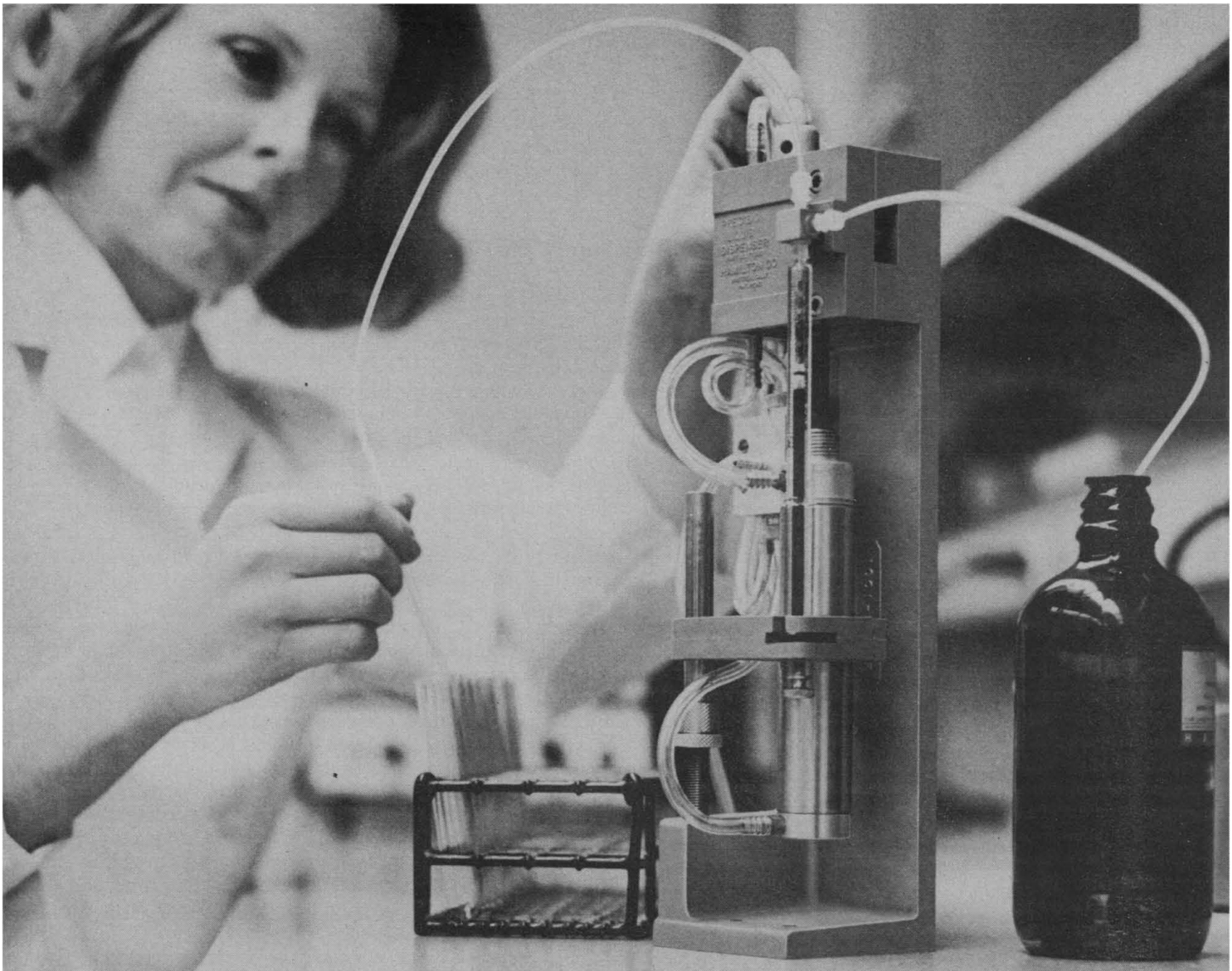
For example, as we look ahead at what is developing through biomedical research and what some call genetic engineering, we can see that a host of nonscientific issues are bound up with the scientific ones. These issues are legal, political, ethical, economical, even religious.

Yet I can see now, having survived for more than eight decades, certain things that were not apparent to me when I was younger. One of these is that mankind was never destined nor intended to get along without problems. As man has increased his capabilities, so has he increased his problems. What lies ahead for civilization is obviously going to be far more complex than the conditions that confronted civilization when I was born and far more intricate than the conditions that face us today. I take it that this pattern is not going to change.

Whatever else he may be, man is at once a problem-creating system and a problem-solving tool. If he sits around for very long without any serious problems, man goes out and makes some. Apparently, he considers this superior to the alternative—which is something akin to vegetating. Such a tendency may perhaps seem a cause for despair, since it leads to conflicts, some of them severe, and, historically speaking, even to wars. All of my reading of history, however, and all of my personal experience, leads me to the observation that it is through this arrangement that the human species is gradually seeking its goal and fulfilling its destiny—which is the discovery of truth and how to live with it.

—GEORGE P. MILLER, *Retiring Chairman of the House Committee on Science and Astronautics*

Adopted from an unpublished paper given at the North Atlantic Treaty Organization Advanced Study Institute, Milan, Italy, September 1972.



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