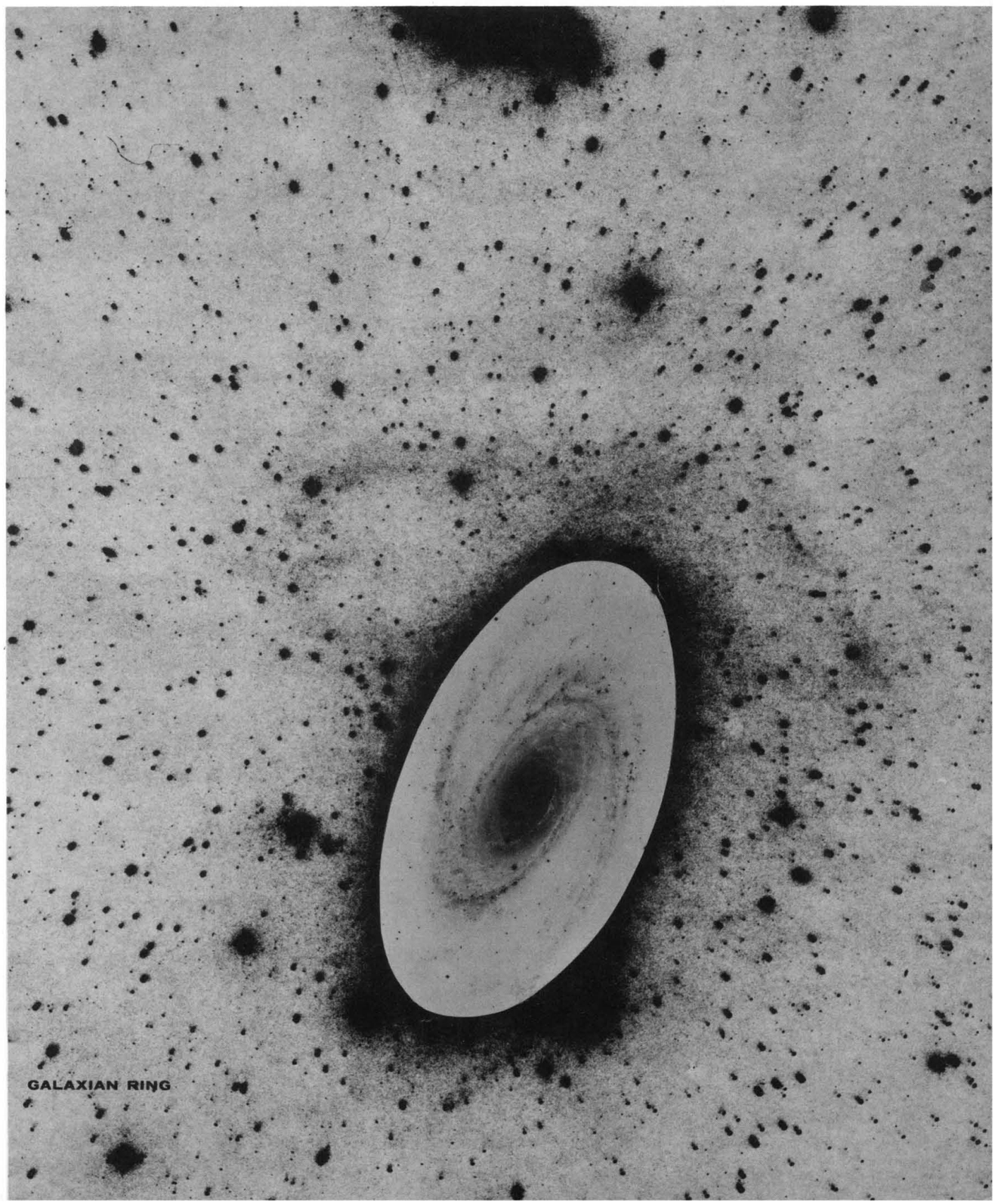
SCIENCE

16 April 1965
Vol. 148, No. 3668

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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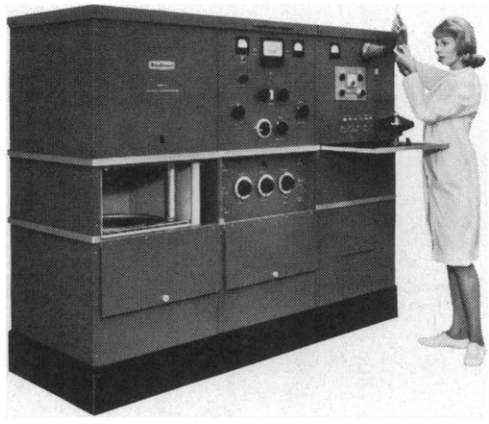
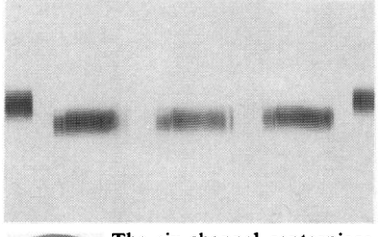


Those "shadows" of molecules moving through the analytical cell can now yield considerably more data than in the earlier days of analytical ultracentrifugation. And some of the exciting developments, both experimental and theoretical, reported in recent literature suggest that the potentialities of the technique have only begun to be explored.

Low Solute Concentrations



The six-channel centerpiece used by Yphantis reduces the time-consuming aspect of equilibrium centrifugation by permitting simultaneous study of three solvent-solute pairs.

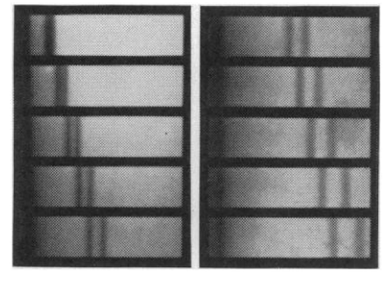
An equilibrium sedimentation technique that permits the study of unusually low initial concentrations with interference optics has been developed by Yphantis — and, in many cases, he has been able to estimate the size of the smallest macromolecular component present in disperse solutions. He employed about three times the usual centrifugal speed, so the concentration near the meniscus became virtually independent of position and could be neglected in comparison with initial concentration. Concentrations in the cell were then determined directly from the fringe patterns without the ambiguity inherent in relating fringes to absolute concentrations.

Some Theoretical Investigations

Adams and Williams have shown that the centrifugal behavior of interacting systems containing any number of macromolecular species can be calculated from the sedimentation equilibrium analysis. Nichol and Winzor have taken the sedimentation velocity approach: assuming an analogy between the behavior of polymerizing systems (as predicted by Gilbert) and rapidly reacting systems of the Type $A+B \rightleftharpoons C$, they suggest a method of evaluating equilibrium constants without assigning values to any velocity terms. Gilbert has extended his calculation for a reversibly aggregating substance to include concentration dependent sedimentation coefficients and the effects of impurity mixed with the aggregating substance.

Another Way to Use Density Gradients

Vinograd, Bruner, Kent, and Weigle have physically separated macromolecular components into discrete bands so that sedimentation coefficients and relative concentrations measured in the mixtures are free from the effects of interaction between components. In lieu of centrifuging macromolecules previously distributed through a density gradient, they layered a thin lamella of the macromolecular solution on top of a denser miscible liquid under centrifugal force. Photographed by absorption optics, the macromolecular components can be seen to separate into bands, which move at different velocities through the cell.



Band-forming centerpiece: macromolecular solution moves from circular channel to sector containing denser miscible liquid.

New developments in instrumentation, applications, and techniques are discussed regularly in "Fractions", a publication sent to owners of Beckman analytical and preparative ultracentrifuges, electrophoresis and diffusion instruments, and amino acid analyzers. If you would be interested in such news, we would be glad to send you a copy. More information about the centerpieces shown is also available. Write Beckman Instruments, Inc., Spinco Division, Stanford Industrial Park, Palo Alto, California.

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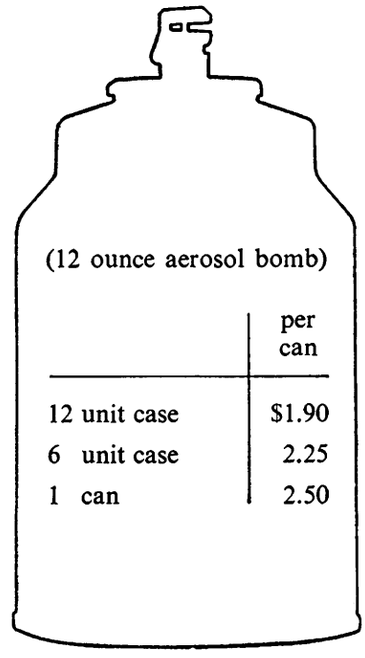

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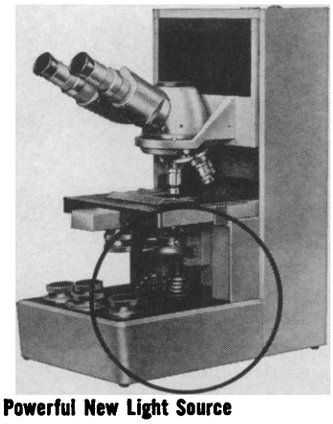
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Three long-exposure photographs, taken with the wide angle, 48-inch (120-cm) Schmidt telescope at Mount Palomar, are printed together to show a faintly luminous, previously unknown feature around one end of the spiral galaxy M81. The oval insert shows the spiral galaxy as it appears on a normal photograph taken with the 200-inch (500-cm) telescope. The whole inserted area and more is completely burned out on the combined print which shows the faint ring. The exploding galaxy M82 is at the top edge of the photograph. See page 363. [William Miller]

These six features, available only on the VICKERS M-32 Microscope/Camera System, give you new research capabilities unavailable with any other microscope!



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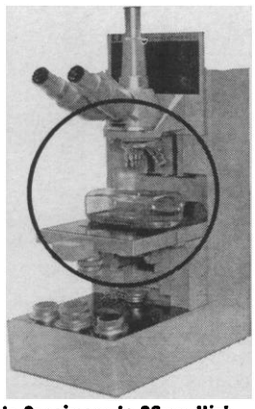

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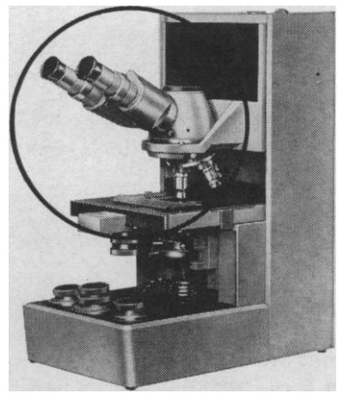
The microscope body can be raised on its slide to give a clearance which will accommodate very large objects such as tissue culture flasks and other special experimental set-ups.



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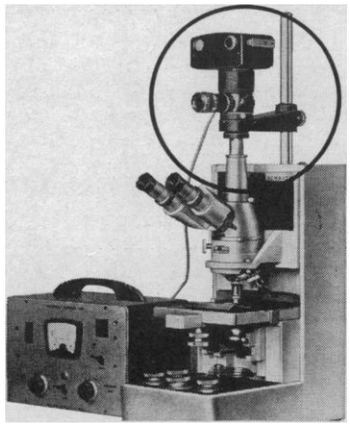

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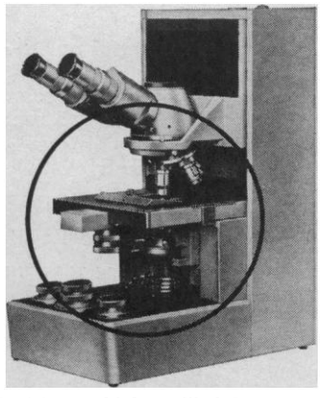

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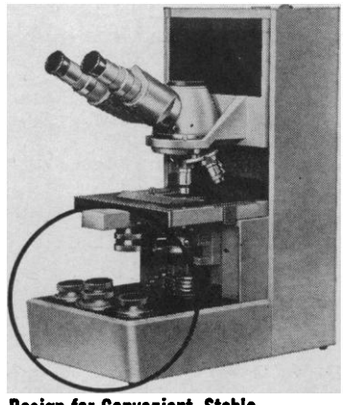

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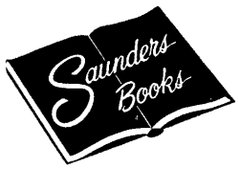

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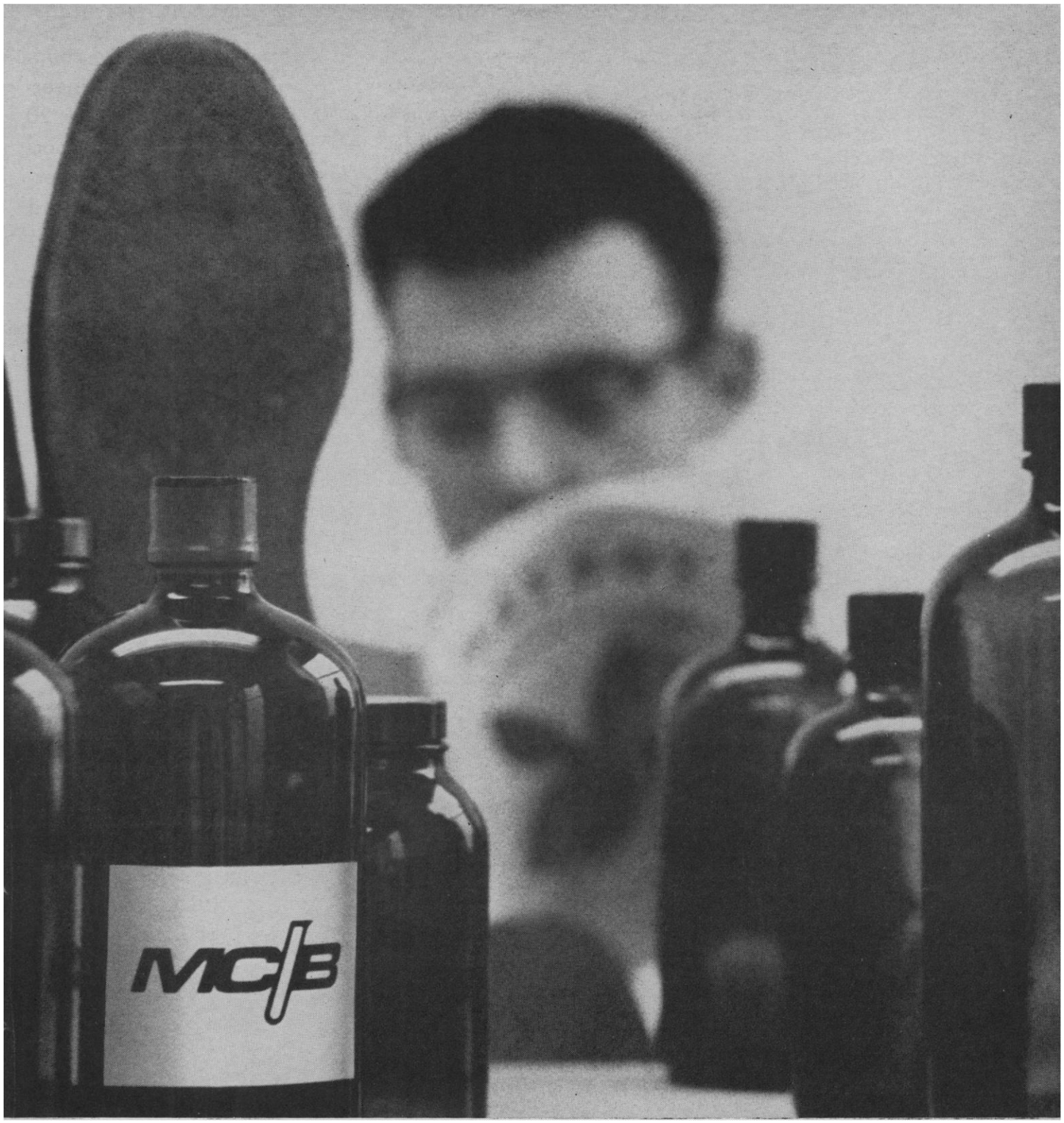

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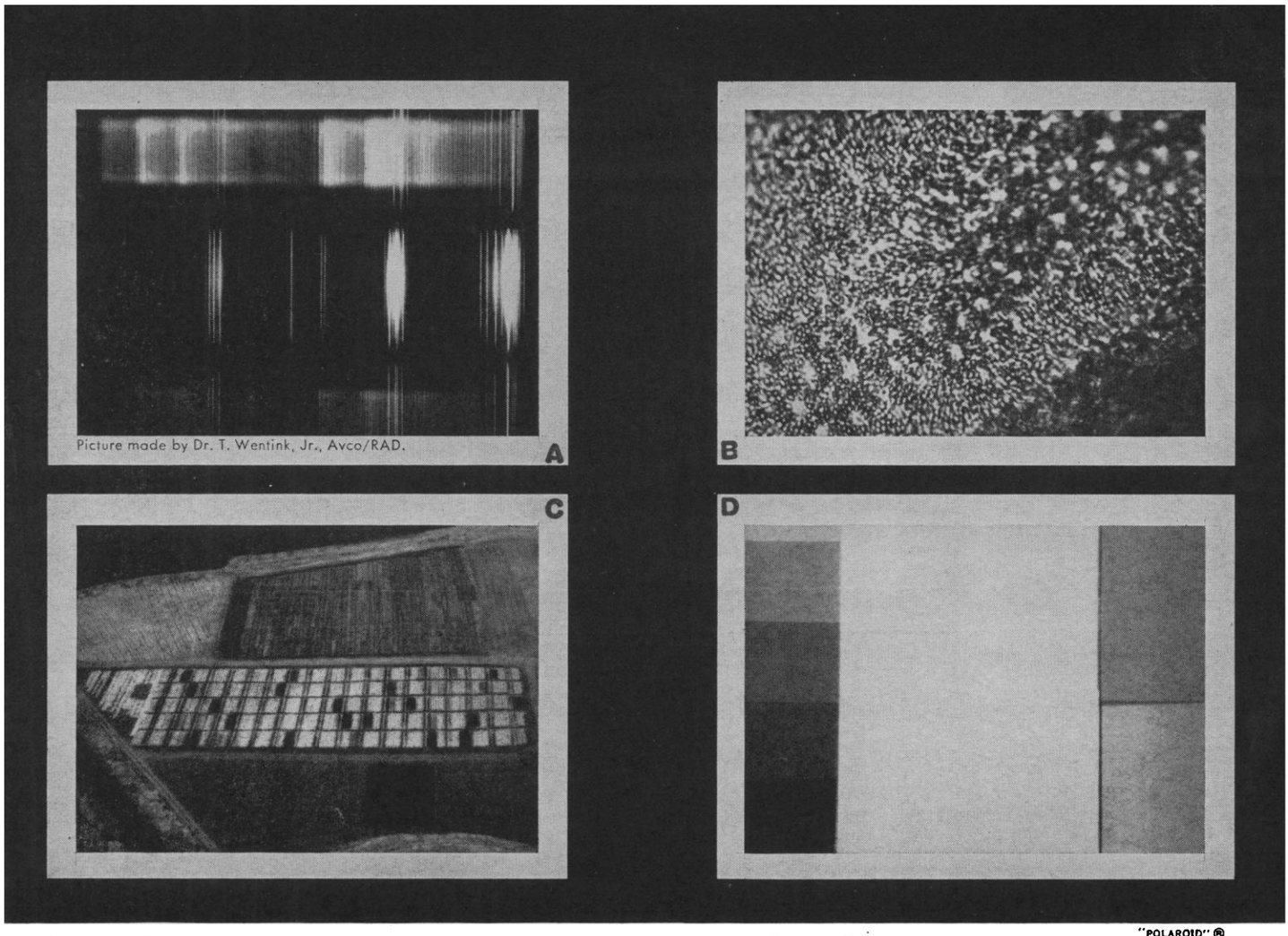

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Also, if your picture requires special or elaborate equipment, Type 413 film saves you the risk of having to set it up twice. **Picture B,** for example, a microspectrograph of the cones of the retina, required the use of infrared lighting because visible light causes bleaching of the pigments. The scientist who took it saw his results immediately and knew he had a perfect picture while his set-up was still intact.

While on-the-spot recording is the most important advantage of this remarkable new film, it isn't the only one. Type 413 film is also three times as sensitive as conventional infrared films. Its A.S.A. equivalent speed is 800 without filters. Since this permits faster shutter speeds and smaller lens apertures, the film is ideal for applications like aerial photography. In **Picture C**—an aerial shot of a potato field used for plant pathology testing—you can see how clearly the film was able to record the fungus-infected areas (dark rectangles) using an extremely fast exposure setting. Shot was made at f/32 and 1/300th of a second.

And Type 413 film is as easy to use as any other Polaroid Land film. It can be used in almost all standard Polaroid Land cameras and camera backs using Series 40 film and the procedure is the same. Just snap the picture, pull the tab, and peel off the finished print in 15 seconds. Because it's as simple as that to use, the film will enable technicians and other personnel who may not be trained photographers to take perfect infrared pictures whenever they're needed. **Picture D,** for example, a record of the infrared reflectance of concrete curing compounds, is a type of photograph often called for in materials testing—and any Sunday photographer could have filled in and done the job.

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Results from Tandem Research Program

The Tandem Research Group has made notable progress in the past year. Significant experimental results from the program are:

1. 250 mA high-brightness positive ion beam from an expanded-plasma source operating at 38 kv.

2. 270 μA analyzed beam of H_1^+ ions out of the Research Tandem with 320 μA H^- injection and water-vapor stripping.

3. 2.0 μA analyzed dc beam of He^- ions. The previous maximum current routinely available has been 0.1 μA with the EN source.

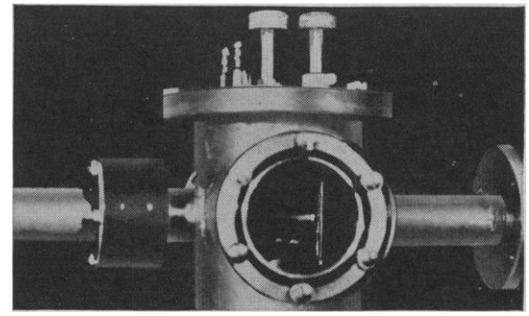
Doubly Charged Helium Ions

Components are now available for converting 3, 4 and 5 MeV machines to produce He^{++} ions at higher energies. Specifications: 30 μA at 5.0 MeV; 10 μA at 7.0 MeV; 5 μA at 10.3 MeV. More than double this current performance has been demonstrated but with some loss in stability and reliability. Multiple-charge states (2, 3 and 4) of neon, oxygen and nitrogen have also been produced with the new kit installed in a 3 MeV Van de Graaff. Beam energies from 50.4 MeV to 9.8 MeV and beam currents from 0.1 to 10 μA were observed. For details on the new HE^{++} kit and experimental results, write for Technical Note #13.

Optical Spectroscopy of Excited Atomic States

When an energetic beam of ions is passed through a thin foil, the charge state of the ion may change, either up or down. The emitted particles may be left in states of electronic excitation from which visible light is subsequently emitted during de-excitation. The emitted light spectrum is characteristic of the excited ion. When particle beams of approximately 0.4 μA or more are used, the light is sufficiently intense for spectroscopic analysis.

The refinement and application of this technique promises to be of major importance in the theory of atomic structure, in measuring hot plasma temperatures, and in acting for the means of energy loss in fast fission fragments in an absorber. Perhaps most importantly, it will help determine the relative abundance of the elements in the sun and other stars, which is the basis for theory of stellar evolution, the origin of the chemical elements, the age of astronomical objects and the nature of the stellar energy. For further details, ask for Technical Note #10.

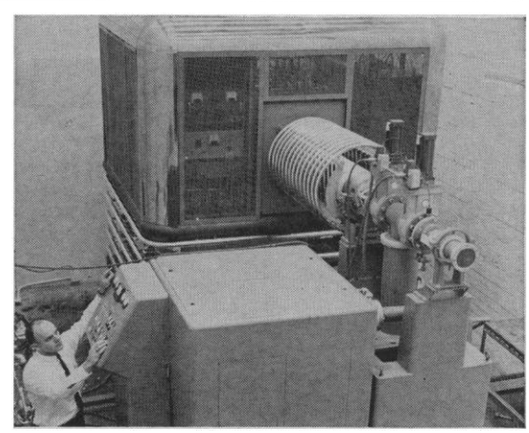


A nitrogen beam, 0.8 μA at 2 MeV, passes from right to left through a carbon foil approximately 9μg/cm² thick.

Intense Ion Beams at 500 kv

The ICT-500 keV positive ion accelerator now being built by High Voltage Engineering operates at energies from 100 to 500 keV dc and pulsed. In performance tests, the machine has produced analyzed ion beam currents from 4 mA at 100 keV to 10 mA from 300 to 500 keV. 10 mA dc positive ion beam currents of H^1, H^2, and D^1 have been produced at a target located 6 feet from the end of the acceleration tube. Beam diameter is 15 millimeters maximum for all particles over the entire energy range. Performance tests are now underway to achieve similar results at a target located 40 feet from the tube-end. Previous experience with a similar machine of 300 keV maximum energy showed 15 mA of d_2^+ and a 3 centimeter beam diameter. The ICT-500 positive ion accelerator is designed for dc and pulsed operation in the nanosecond and microsecond range with a minimum pulse length of 2 nsec. at a repetition rate of 2.5 Mc/s. Pulse content is 1 mA protons and 0.7 mA deutrons.

The particle source utilized with the ICT-500 positive ion accelerator is an expanded plasma type which has produced 70 mA total beam at 500 kv.



The high-brightness, intense ion beam produced by the ICT-500 accelerator is eminently suited for laboratory production of 14 MeV neutrons for cross-section measurements, dosimetry studies, weapons-effect simulation and special low-density target experiments.

16 April 1965, Volume 148, Number 3668

SCIENCE

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Science Books

Authors of varied background and quality write for the large and growing market for popular science books. The knowledgeable reader can select books that meet his own criteria, but other buyers—adults looking for a suitable present for a child, librarians who must purchase books in all fields, and teachers who cannot be expert in science or any other specialized area—have difficulty in discriminating between the good and the bad. For the past 10 years the AAAS has been trying to help some of these book buyers select accurate, interesting, informative books about science—its history, problems, research frontiers, applications, and personalities. The technique has been to publish guide-books containing brief evaluative descriptions of science books intended for student and general use. A measure of the welcome extended to these guide-books is the fact that since 1955 over 700,000 copies of the several editions have been distributed to librarians, teachers, students, and other interested persons.

The outpouring of popular science books extends from the very good to the very bad. Some contain errors of fact. One book for children stated several times that light travels at the rate of 186,000 miles per minute (instead of per second). Such gross errors of fact may be merely stupid and not very harmful, but other books more seriously misrepresent science by presenting it as solely a bag of magic tricks, or distort major principles and concepts—for example, in distinguishing between birds and animals as the two great groups of life forms. A few are potentially dangerous. One—inspired perhaps by some Charles Addams character—gives to its 13- to 16-year-old readers a number of recipes for making fireworks from such ingredients as potassium chlorate and sulfur, an explosive combination that commercial manufacturers of fireworks in England and a number of U.S. cities are not allowed to mix, store, transport, or discharge.

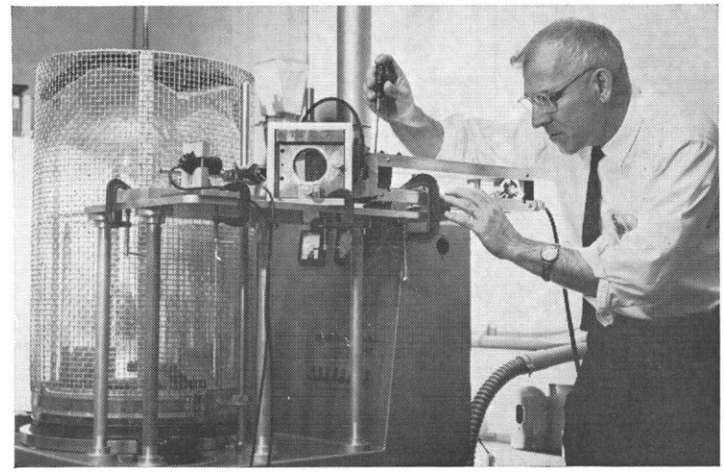
Fortunately, there is also much good popular science literature. To continue to help librarians and teachers to distinguish the good from the bad, the AAAS is now starting to publish a quarterly review entitled *Science Books* that is available by subscription. With the generous assistance of many scientists and some science librarians who serve as reviewers, we hope to provide those who buy books for school and general library use with critical and reliable judgments concerning quality, content, and appropriate age level of the new books shortly after they appear.

For long, perhaps as far back as A.D. 100 when the Library of Pantainos in the Athenian Agora displayed the inscription "No book shall be taken out for we have sworn it," the cynics have described libraries as places to *keep* books. Librarians chafe under this canard; they want good books to circulate and to be read. National Library Week, the last week in April, will focus attention on the value of reading as a constructive year-round activity for students and literate adults. Among all the specially designated days and weeks that crowd the annual calendar, this is one of the most widely and divergently supported. Many individuals and groups will have an opportunity to join in this concerted effort to encourage lifetime reading habits, to increase the use of libraries, and to expand and improve the nation's reading and library resources. We hope that *Science Books* will be a continuing contribution to the attainment of these objectives.

—DAEL WOLFLE

Report from

BELL LABORATORIES



D. L. Perry, who developed techniques for making high-reflectivity mirrors at Bell Laboratories, adjusts laser used for measuring thickness of dielectrics. The laser beam is split, and one part of the beam is compared with another part reflected from a monitor slide. High signal-to-noise ratio of laser system permits accurate measurement of quarter wavelength of layers.

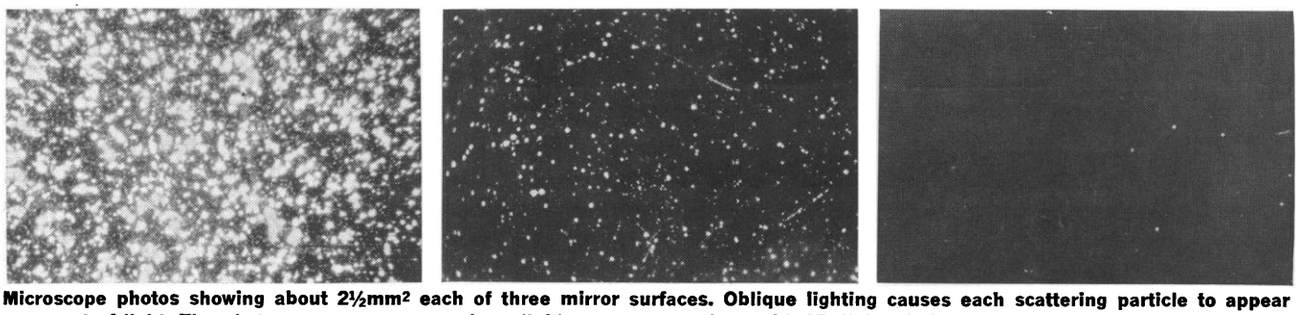
New techniques for making nearly perfect mirrors

Even the best mirrors scatter and absorb some of the light incident upon them. Because the power output of a laser depends importantly on this loss of light at mirrors, scientists at Bell Laboratories have sought to push the reflectivity of mirrors as nearly as possible to 100%. Preliminary measurements indicate that reflectivities of over 99.8% can be achieved at a given wavelength and that broadband mirrors are also possible spanning the visible spectrum (4200 to 7400 Angstroms) with reflectivities greater than 99.5% for all wavelengths in the band.

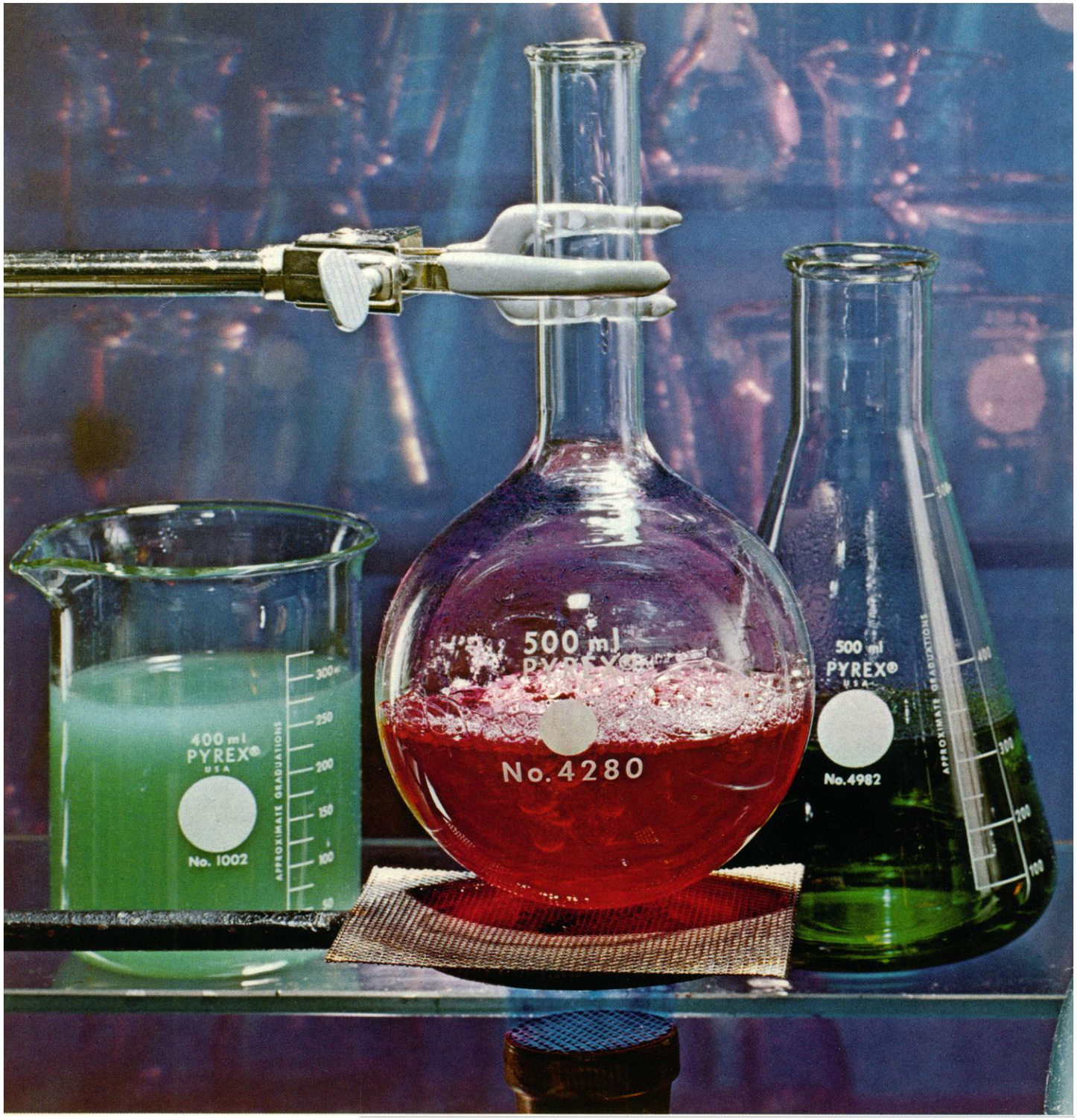
The best mirrors are made by applying many layers of dielectric material of precisely controlled thickness to the mirror surface. In the past the number of such layers has been limited to about 15. One reason is that "large" (order of a wavelength of light) particles accumulate in the layers; these act as scattering centers, so that additional layers decrease rather than increase the reflectivity.

At Bell Laboratories a method has been developed to apply 27 or more layers successfully, with consequent increase in reflectivity. This method involves strict attention to the cleanliness of the substrate, careful control of evaporation temperature at a point just below the melting point of the dielectric material, and precise measurement of layer thickness. The thickness measurements are performed using a continuously operating gas laser. One of the most significant findings was that some dielectrics, when used in a powder form, were causing the large particles to appear in the layers. Apparently entrapped gases within the powders were suddenly released on heating, causing small showers of particles to be projected into the layer—a difficulty corrected by using a properly prepared "chunk" form of the material.

Bell Telephone Laboratories
Research and Development Unit of the Bell System



Microscope photos showing about 2½mm² each of three mirror surfaces. Oblique lighting causes each scattering particle to appear as a spot of light. The photos compare a poor mirror (left), an average mirror with 15 dielectric layers which, in addition to scattering loss, will have a few tenths of a percent transmission loss (center), and a mirror with 27 layers made at Bell Laboratories with refined coating technique (right). The additional layers plus a nearly total absence of large particles result in a greatly increased reflectivity.



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Today's PYREX® brand beakers and flasks differ greatly from the first ones we made in 1915. In the subsequent 50 years of close association with the scientific community, we've continually revised our designs and refined our processes so you could be sure PYREX ware would perform efficiently the many tasks you asked of it. There is greater durability, convenience, and value in today's PYREX brand beakers and

1915-1965-PYREX® Ware—beginning another 50 years of leadership for science

flasks. Fifty years have taught us how to put extra glass throughout for physical brawn that doesn't sap thermal strength. Experience taught us just how to flow glass through contours and tricky radii. Suggestions from people like yourself resulted in graduations and heavy reinforcing beads. Once a major concern, the dependability of laboratory glassware is now taken for granted. That is the greatest compliment you have paid us, and one we shall strive to continue to deserve. Laboratory Glassware Dept., Corning Glass Works, 3902 Crystal St., Corning, N. Y. Write us if you are not now receiving our informative periodical, *Lab Report*.

Shown above: PYREX® brand Griffin beakers No. 1002—ruggedly made for long service with beefed-up rim and pourout, approximate graduations at no extra cost. PYREX brand Erlenmeyers, No. 4982, give you even glass distribution for even strength throughout walls, radii, and bottoms; the approximate graduations are yours without cost. PYREX brand boiling flask No. 4280—the classic in economic service, machine blown for complete uniformity. All available through your local PYREX brand labware dealer and combinable for discounts that can save you as much as 28 cents on the dollar.

CORNING

THE MAKERS OF PYREX® LABWARE

Kodak reports on:

high-priced drudgery diminished . . . holography

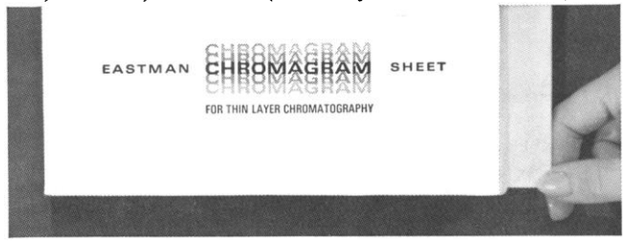
Thin-layer chromatography caught on about four years ago. Now anybody who claims knowledge of how to identify or synthesize substances and finds himself vague about TLC should worry a little. He has been washed up from the mainstream and had better take measures. He will not read far or listen long before the thought strikes that he should learn the technique for coating slurries and adsorbents like silica gel on glass plates. At chemical and biological labs the world around, a goodly chunk of the working time is now devoted to this art. Many fine tricks influence the homogeneity and isotropy of the coating and the level of activation imparted to it. No sooner having learned of them, he can now forget them.

He is just as well off as the eager beavers who couldn't wait until the messiness was eliminated by us, who got our start 85 years ago in relieving photographers of the need to coat their own plates.

Now we have a mighty force of chemists and respected technicians of our own. During recent months doubts have been deftly planted in their minds about the wisdom of drawing pay for such essentially mindless tasks as coating their own chromatoplates, except where some special technique still demands glass or an adsorbent other than silica gel bound with polyvinyl alcohol. They have been persuaded to weigh the importance of these special techniques against costs of preparing glass chromatoplates, of documenting the results shown by the chromatogram, of storing the bulky things for reference, of recovering the expensive edged glass for reuse.

For general work they have begun to standardize on a poly(ethylene terephthalate) sheet on which 100μ of fluorescent (or non-fluorescent), PVA-bound silica gel of our own preparation and control has been coated, not manually but by a manufacturing organization that owes its robust health largely to its precision in depositing thin layers of one thing on another.

As EASTMAN CHROMAGRAM *Sheet, this new polyester TLC medium —scissors-prone, conveniently flexible but not limp, unbreakable, sending up no clouds of siliceous dust to breathe—can now be obtained from a nearby lab supply house. If the price they quote for a box of twenty 20cm x 20cm sheets does not bring pangs of guilt about continuing to coat by hand, your problem is obviously one of excess staffing. If you hesitate only because you want to try it first, request a sample of* EASTMAN CHROMAGRAM *Sheet from Distillation Products Industries, Rochester, N. Y. 14603 (Division of Eastman Kodak Company).*



Photography by Fourier

Five years hence, most people reading this ad will have seen a hologram. Maybe. We are not sure. The prophecy will come true if some smart apple watching the stunt done with a He-Ne laser, a mirror or two, and a photographic plate will turn to his buddy and say, "Hey, Louis, do you suppose this would be any good in our—" and there he goes. It may have happened already. Perkin-Elmer showed holograms at the Physics Show, the Optical Society of America, and the I.E.E.E. Perkin-Elmer has been doing this to drum up trade for their lasers. We for our part are always drumming up trade for photography.

This is peculiar photography, where the photographic record is quite invisible to the naked eye and doesn't really depend on silver density. The photograph, if you want to call it that, is merely a representation of all the phases and amplitudes in a scene or collection of separate scenes. In the reconstruction, which is astonishingly simple and direct, you get a choice between a three-dimensional virtual image or a series of real images in different planes. You can read all about it in *J.O.S.A. 53*, 1377 (1963) and *54*, 1295 (1964) and accept it intellectually, but it wouldn't hurt to convince your own eyes. Looking at one of these plates, you recall wondering at an early stage in your career what kind of a dance is being executed by a molecule of air in your ear while listening to a full orchestra and chorus. Baron Fourier sure was ahead of his time.

Just because we are giving holography a little shove here, don't assume we offer the perfect photographic material to do it on. The early holographers have been using KODAK Spectroscopic Plates, Type 649-F, a red-sensitized product with the same capacity for detail as KODAK High Resolution Plates.* When they tell us they don't need all the super-resolution this type of emulsion can provide and would like to trade some of it off for a little more speed, we suggest KODAK Spectroscopic Plates, Type V-F. If this should all turn into more than a *succès d'estime*, it is most unlikely that either of these emulsions would remain the best choice.

If anybody is interested in speeding the advent of such a new and best choice, he had better keep in touch with Eastman Kodak Company, Special Sensitized Products Division, Rochester, N. Y. 14650.

*This has little to do with holography and more with detail rendition for microelectronics production, but KODAK High Resolution Plates now have an emulsion that is about 6μ thick before processing and 4μ after (hitherto 9μ and 6μ, respectively).

This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science

In spite of the high degree of catalytic stereospecificity shown by enzymes, Belleau went on, other observations indicate that their structural specificity can be much more limited. Thus alcohol dehydrogenase will dehydrogenate many straight-chain primary alcohols other than ethanol; the same applies to monoamine oxidase, which can oxidize a variety of primary amines. These observations suggest that enzyme stereospecificity is most marked in the catalytic step. Other recent investigations have established the ability of enzymes to direct stereospecifically the reaction of solvent protons with enzyme-bound substrates.

An observation by Niemann illustrates admirably the nature of the conformation imposed by the asymmetric screw pattern of the enzyme on the substrate molecules; it offers the possibility of a specific approach to the stereochemistry of enzyme-bound substrates. It has long been known that α-chymotrypsin is catalytically stereoselective for *N*-acyl or *N*-aroyl amino acid esters of the natural L-configuration. One of the best substrates is *N*-benzoyl-L-phenylalanine ethyl ester; the D-enantiomorph is hardly attacked by the enzyme. However, when the two phenyl rings are fused into one, as in a dihydroisocarbostyril analog, a substance in which no free rotation of the bonds is possible, the isomer of the D-configuration now behaves as an excellent substrate, while the L-enantiomorph does not. It seems probable that this phenomenon is related to the problem of the conformation adopted by the flexible substrates when imbedded in the asymmetric matrix of the enzyme.

A most striking example of enzyme stereospecificity which requires that flexible molecules be bound asymmetrically is the desaturation of stearic acid to oleic acid by certain aerobic microorganisms. Recently, Bloch *et al.* have found an enzymatic system which specifically attacks the molecule at the sites of carbons 9 and 10, and which also discriminates between the four chemically equivalent hydrogen atoms attached to these two carbon atoms. This may be close to the ultimate in enzyme stereospecificity; the discriminating power of the enzyme is such as to suggest the possible operation of special cooperative factors in the structural specificity of the enzyme. Since the 9-hydrogen of the D-configuration appears to be primarily involved in the desaturation reaction, one may tentatively conclude that the enzyme would

have easier access to this hydrogen if it occupied some kind of pseudo-equatorial conformation. On that basis, the screw pattern, which places this hydrogen in the pseudo-equatorial position, would be the one adopted by the enzyme-bound stearic acid molecule. A pseudo-cyclohexane mode of packing for these long-chain acids permits the prediction that palmitic acid (16 carbon atoms) should be also desaturated at positions 9 and 10; Bloch's observations confirm this, and it seems probable that we may be dealing in such instances with cooperative effects of solvent-substrate interactions that are superimposed on the structural specificity of an enzyme.

Nucleic Acids and Protein Synthesis

J. H. Spencer (McGill University) reviewed stereospecificity of nucleic acids in relation to protein synthesis; base-pair stereospecificity at five stages in the transcription of the genetic message and its translation to protein was examined. Base pairing, one of the major factors in the transfer of information from the genome, developed from the original theory that the complementarity of the bases in the DNA helix and the stability of the helix were due to hydrogen bonding between the bases. This was supported by studies of thermal denaturation and by the relation of guanine-cytosine content to T_m values. More recent calculations indicate that forces such as dipole interactions are large, and that hydrogen-bond energy may not be the major factor holding the strands of the helix together. However, hydrogen bonds are regarded as ensuring specific base-pairing, which underlies the mechanism for transcription of DNA by semiconservative replication on a DNA template.

The same mechanism of alignment of bases by base-pair interactions is conceived in the synthesis of RNA on the DNA template. Monod's concept of a messenger molecule requires it to be an exact base-sequence copy of the material containing the genetic information. Discovery of the DNA-dependent RNA polymerase, studies of hybridization, and isolation of DNA-RNA hybrids stable to ribonuclease support this theory. DNA–RNA hybrids of messenger-RNA (mRNA), soluble RNA, and ribosomal RNA have all been isolated; their formation experimentally can only be attributed to complementarity of their base sequence.

The study of mRNA and ribosome

interaction has been aided by the use of the synthetic polyribonucleotides, particularly polyuridylic acid (polyU). Takanami has shown that polyU binds to the 70*S* ribosome and 30*S* subunit of *Escherichia coli* ribosomes, but not to the 50*S* subunit. Optimum interaction of polyU with 70*S* ribosomes gives complexes of one polyU molecule and one or more ribosomes. When these complexes are treated with ribonuclease, a polyU component remains attached to each ribosome. Calculations indicate that this component is 27 residues long and is of the same order of magnitude (180 Å) as the 30*S* subunit. There is no evidence that the attachment of the polyU or mRNA and the ribosome is by base pairing. Watson has suggested that the phosphate of the mRNA may interact with the amino groups on the ribosome.

Recent exepriments by Leder and Nirenberg, Spencer said, have provided evidence of the minimum size of mRNA required for association with transfer RNA (tRNA) on the ribosome. By use of polyribonucleotide fragments of various sizes, nucleotide triplets were shown to be bound to ribosomes to the level of maximum binding obtained with polyU. The specificity of the triplets for binding the complementary tRNA's was also very high: for example, UUU for tRNA phenylalanine, AAA for tRNA lycine, CCC for tRNA proline. However, the hydrogen bonds between three complementary base pairs would not give enough stability for attachment of polyU, phenylalanine, tRNA, and ribosomes, so that some interaction between the tRNA and the ribosome must occur. This is supported by the fact that removal of the adenine from the CCA terminal of tRNA reduces the extent of binding of tRNA to ribosomes (U, uridine; A, adenosine; C, cytidine). Also, in Nirenberg's system, deoxynucleotide triplets are not bound to ribosomes, indicating possible involvement of the 2′-hydroxyl of the RNA codewords. Nirenberg has also shown that 5′-terminal phosphate groups are required for triplet attachment and suggests that 5′-terminal codewords may play a role in the phasing of codeword reading. The difference in chemical structure of 5′-terminal, 3′-terminal, and internal codewords allows postulation of possible operator-word function. Once again evidence supports base-pairing as the stereospecificity for transfer of information from the mRNA, but this is an oversimplification.

The experiments of Chapeville and Lipmann on the specificity of the mRNA for the tRNA and not the amino acid, in which cysteine tRNA was converted to alanine tRNA and incorporation of alanine at the cysteine site in hemoglobin was demonstrated, are fully explained by triplet complementarity. However, how tRNA recognizes the amino acid is a matter of speculation. Specificity of the aminoacyl synthetases would allow an explanation, but the observations of different specificities with enzymes from different sources and the apparent lack of specificity of tRNA's from different sources indicate that this is not the full explanation and also raise the question of the universality of the code.

ALEC SEHON

Department of Chemistry,
McGill University, Montreal

Forthcoming Events

April

25–28. American **Oil Chemists** Soc., Houston, Tex. (C. W. Hoerr, Durkee Foods, 2333 Logan Blvd., Chicago, Ill.)

25–28. Southeastern **Psychiatric** Assoc., annual, Southern Pines, N.C. (H. Brackin, Jr., 1918 Church Ave., Nashville 3, Tenn.)

25–29. American Assoc. of **Cereal Chemists**, Kansas City, Mo. (E. J. Bass, Intern. Milling Co., Inc., 1423 S. 4th St., Minneapolis, Minn. 55404)

25–29. American Soc. for **Microbiology**, annual, Atlantic City, N.J. (R. W. Sarber, ASM, 115 Huron View Blvd., Ann Arbor, Mich.)

25–29. International College of **Surgeons**, North American Federation, Las Vegas, Nev. (Secretariat, 1516 Lake Shore Dr., Chicago, Ill. 60610)

26–27. European Days of **Chemical Engineering**, Paris, France. (Societé de Chimie Industrielle, 28, rue St. Dominique, Paris 7)

26–27. **Electroanesthesia**, 2nd symp., Univ. of Tennessee, Knoxville. (C. E. Short, UT-AEC Agricultural Research Laboratory, 1299 Bethel Valley Rd., Oak Ridge, Tenn.)

26–27. **Environmental Health Problems**, 2nd AMA congr., Chicago, Ill. (Dept. of Environmental Health, AMA, 535 North Dearborn St., Chicago, Ill. 60610)

26–28. **Error in Digital Computation**, symp., Madison, Wis. (L. B. Rall, U.S. Army Mathematics Research Center, Univ. of Wisconsin, Madison 53706)

26–28. **National Acad. of Sciences**, 102nd annual, Washington, D.C. (Office of the Home Secretary, NAS, 2101 Constitution Ave., Washington 20418)

26–29. **Aerospace Medical** Assoc., 36th annual, New York, N.Y. (Gen. J. M. Talbot, Headquarters USAF, AFMSPA, Washington, D.C. 20333)

26–29. Mechanisms and Therapy of **Cardiac Arrythmias**, 14th Hahnemann symp., Philadelphia, Pa. (L. Dreifus, Dept. of Medicine, Hahnemann Medical College and Hospital, Philadelphia)

26–29. Society of **Economic Paleontologists and Mineralogists**, New Orleans, La. (D. M. Curtis, Shell Oil Co., Box 127, Metairie, La.)

26–29. American Assoc. of **Petroleum Geologists**, 39th annual, New Orleans, La. (G. Atwater, 424 Whitney Bldg., New Orleans)

26–29. American **Physical** Soc., Washington, D.C. (K. K. Darrow, APS, Columbia Univ., New York 10027)

26–1. **Geodetic Uses of Satellites**, conf., Athens, Greece. (Intern. Organizations Staff, Bureau of Intern. Commerce, U.S. Dept. of Commerce, Washington, D.C.)

28–30. **Hypnosis and Psychosomatic Medicine**, intern. congr., Paris, France. (H. C. Harding, 2050 NW Lovejoy, Portland 9, Ore.)

28–30. National Soc. for **Prevention of Blindness**, Houston, Tex. (J. W. Ferree, 16 E. 40 St., New York 10016)

28–1. **Biometric** Soc., Florida State Univ., Tallahassee. (E. L. LeClerg, 6804 40th Ave., University Park, Hyattsville, Md.

28–1. American **College Health** Assoc., Miami Beach, Fla. (R. E. Boynton, 5518 Merrick Dr., Coral Gables, Fla.)

29–30. **Space Navigation and Communications**, natl., Houston, Tex. (P. Schrock, Inst. of Navigation, 711 14th St. NW, Washington, D.C. 20005)

29–30. Association for **Symbolic Logic**, Chicago, Ill. (T. Hailperin, Dept. of Mathematics, Lehigh Univ., Bethlehem, Pa. 18015)

29–31. Southwestern Assoc. of **Naturalists**, annual, New Orleans, La. (H. Dundee, Tulane Univ., New Orleans)

29–1. American Assoc. of **Endodontists**, Detroit, Mich. (E. C. Van Valey, 9 Rockefeller Plaza, New York 10020)

29–1. American Assoc. for **History of Medicine**, Philadelphia, Pa. (J. B. Blake, Natl. Library of Medicine, 9600 Wisconsin Ave., Bethesda, Md.)

29–1. American Acad. of **Neurology**, annual, Cleveland, Ohio. (AAN, 7100 France Ave. S., Minneapolis, Minn. 55410)

29–1. Midwestern **Psychological** Assoc., 27th annual, Chicago, Ill. (F. A. Mote, Psychology Bldg., Madison, Wis. 53706)

29–1. American **Philosophical** Assoc., western div., Chicago, Ill. (L. E. Hahn, Dept. of Philosophy, Southern Illinois Univ., Carbondale)

29–2. Association of **Clinical Scientists**, New York, N.Y. (R. P. MacFate, ACS, 300 N. State St., Chicago, Ill. 60610)

29–2. **Pan American Medical** Assoc., 40th annual congr., Grand Bahama Island. (PAMA, 745 Fifth Ave., New York 10022)

29–2. **Roentgen**, 46th German congr., Nuremberg, Germany. (A. Jakob, c/o Strahleninstitut der Städt, Krankenanstalten, Flurstr. 17, 85 Nuremberg)

30–1. **Colorado-Wyoming** Acad. of Science, annual, Univ. of Denver, Denver, Colo. (C. Norton, Dept. of Botany and Plant Pathology, Colorado State Univ., Fort Collins)

30–1. **Indiana** Acad. of Science, Culver. (C. F. Dineen, St. Mary's College, Notre Dame, Ind. 46556)

30–1. **Nebraska** Acad. of Sciences, Lincoln. (C. B. Schultz, Morrill Hall 101, Univ. of Nebraska, 14th and U St., Lincoln 68508)

30–2. Society of **Biological Psychiatry**, New York, N.Y. (G. N. Thompson, 2010 Wilshire Blvd., Los Angeles, Calif.)

30–2. Academy of **Psychoanalysis**, annual, New York, N.Y. (A. H. Rifkin, 125 E. 65 St., New York 10021)

30–2. American **Psychosomatic** Soc., annual, Philadelphia, Pa. (APS, 265 Nassau Rd., Roosevelt, N.Y. 11575)

30–3. American **Psychoanalytic** Assoc., 52nd annual, New York, N.Y. (APA, 1 E. 57 St., New York 10022)

May

1–2. Academy of **Psychoanalysis**, New York, N.Y. (A. H. Rifkin, AP, 125 E. 65 St., New York 10021)

1–2. American **Psychosomatic** Soc., 22nd annual, Philadelphia, Pa. (E. Meyer, 265 Nassau Rd., Roosevelt, N.Y.)

1–4. Southern **Surgeons'** Club, 22nd annual, Louisville, Ky. (H. M. Carney, 619 Main St., Texarkana, Ark.-Tex.)

1–5. American Assoc. of **Medical Record Librarians**, Chicago, Ill. (Mrs. M. J. Waterstraat, 840 N. Lake Shore Dr., Chicago 60610)

1–6. American **Ceramic** Soc., 67th annual, Philadelphia, Pa. (ACS, 4055 N. High St., Columbus, Ohio 43214)

2. American Federation for **Clinical Research**, Atlantic City, N.J. (J. E. Bryan, 2000 P St., NW, Washington, D.C. 20036)

2–5. American Assoc. of **Plastic Surgeons**, Boca Raton, Fla. (R. M. McCormack, 260 Crittenden Blvd., Rochester, N.Y. 14620)

2–6. **Southwestern and Rocky Mountain Div., AAAS**, Flagstaff, Ariz. (M. G. Anderson, P.O. Box 97, University Park, N.M.)

2–6. **Arizona** Acad. of Science, Flagstaff. (H. B. Whitehurst, Arizona State Univ., Tempe)

2–6. **Student American Medical** Assoc., 15th annual, Chicago, Ill. (SAMA, 333 N. Michigan Ave., Chicago 60601)

2–8. **Stereochemistry**, conf., Bürgenstock, Switzerland. (A. Dreiding, Organisch-Chemisches Inst., Universität Zurich, Rämistr. 76, Zurich 7, Switzerland)

2–8. **Endodontia**, 3rd intern. symp., Barcelona, Spain. (J. N. Ferrero, Intern. Soc. of Endodontia, Via Layetana, Tapineria 10, 2° Barcelona 2)

3–5. **Automation Theory**, congr., Paris, France. (Comité de la Théorie, Assoc. Française de Régulation et d'Automatisme, 19, rue Blanche, Paris 19e)

3–5. **Industrial Research** Inst., Boca Raton, Fla. (The Institute, 100 Park Ave., New York 10017)

3–5. **Terrestrial Radioecology**, symp., Richland, Wash. (F. P. Hungate, Biology Dept., Battelle Memorial Inst., Pacific Northwest Laboratory, Richland 99352)

3–6. **Microbiology**, intern. congr., Parma, Italy. (The Congress, c/o Ente Provinciale per il Turismo, Piazza Duomo 5, Parma)

3–7. **Industrial Hygiene**, conf., Houston, Tex. (American Industrial Hygiene Assoc., 14125 Prevost, Detroit, Mich. 48227)

3–7. Molecular Basis of **Infectious Heredity**, U.S.–Japan cooperative science program seminar, Honolulu, Hawaii. (Office of Intern. Science Activities, National Science Foundation, Washington 25)

3–7. **Legal and Social Medicine**, intern. French-language congr., Coimbra, Portugal. (L. A. Duarte-Santos, Inst. de Medicina Legal de Coimbra)

3–7. American **Psychiatric** Assoc., 121st annual, New York, N.Y. (APA, 1700 18th St., NW, Washington, D.C.)

3–15. **Psychotherapy** Week, 15th, Lindau, Germany. (Secretary, Adalbert Stifter-Str. 31, Munich 27, Germany)

3–18. **Energy Policy** in Developing Countries, seminar, Bréau, France. (P. de Seynes, United Nations, New York, N.Y.)

4–6. **Genetics** Soc. of Canada, annual, Banff, Alberta. (C. O. Person, Dept. of Genetics, Univ. of Alberta, Edmonton)

4–6. Society for **Pediatric Research**, Philadelphia, Pa. (W. B. Weil, Jr., J. H. Miller Health Center, Univ. of Florida, Gainesville)

4–7. **Rubber Chemistry and Technology**, rubber chemistry div., American Chemical Soc., Miami Beach, Fla. (G. N. Vacca, Bell Telephone Laboratories, Murray Hill, N.J.)

4–7. **Industrial Communications** Assoc., 18th annual conf., Pittsburgh, Pa. (H. C. Granger, Pittsburgh Plate Glass Co., Pittsburgh 15222)

4–21. World **Health** Assembly, 18th annual, Geneva, Switzerland. (WHO, Palais des Nations, Geneva)

5. Association of American **Physicians**, annual, Atlantic City, N.J. (E. A. Stead, Jr., Duke Hospital, Durham, N.C.)

5–7. **Electronic Components**, conf., Washington, D.C. (B. Schwartz, IBM Components Div., Poughkeepsie, N.Y. 12602)

5–7. American Assoc. of **Genitourinary Surgeons**, Biloxi, Miss. (H. M. Spence, 4105 Live Oak, Dallas 21, Tex.)

5–7. **Microwave Theory and Techniques**, 10th symp., Clearwater, Fla. (J. E. Pippin, Sperry Microwave Electronics Co., Box 1828, Clearwater)

5–7. Society for **Experimental Stress Analysis**, spring natl. meeting, Denver, Colo. (D. H. Fietz, 70 Kalamath St., Denver 4)

5–8. **Programmed Instruction**, 3rd natl. conv., Philadelphia, Pa. (H. M. Shafer, Graduate School of Education, Univ. of Pennsylvania, Philadelphia 19104)

5–8. **Pulp and Paper Instrumentation**, 6th intern. symp., Instrument Soc. of America, Green Bay, Wis. (ISA, 530 William Penn Place, Pittsburgh 19, Pa.)

5–8. **Virginia** Acad. of Science, Richmond. (R. C. Berry, The Academy, P.O. Box 8203, Richmond)

5–9. **Laboratory Medicine**, congr., German Soc. of Specialists for Diagnostic Laboratories, Bad Kissingen. (W. Albath, 8700 Wurzburg, Katharinengasse 3, Germany)

6–7. Conference of **Biological Editors**, Philadelphia, Pa. (R. E. Gordon, Dept. of Biology, Univ. of Notre Dame, Notre Dame, Ind.)

6–7. **Cellulose**, 5th conf., State Univ. of New York, Syracuse. (Cellulose Research Inst., State Univ. College of Forestry, Syracuse Univ., Syracuse 13210)