

# SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Jan. 1611  
1612.

February. 6. 24. 50.  $7\frac{1}{4}$ . ( $7\frac{1}{2}$ . 12

Thomson's thick eye somewhat misty  
the light of the sun being of good  
temper. I saw two spots and no  
more. That westerly, dimmer & not  
so black as the day is before. That  
easterly fayer & black and now  
almost round. Their position is as  
in the first figure.

London.

February. 7. 9. 50. 9. ( $11^{\circ}$ .

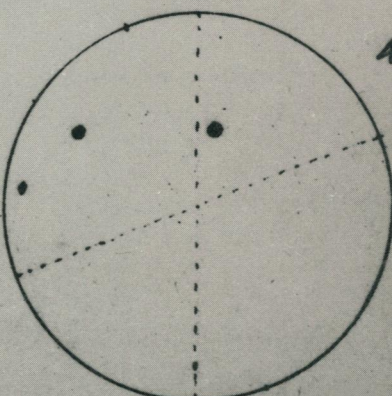
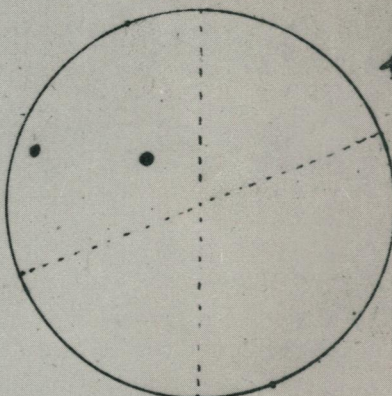
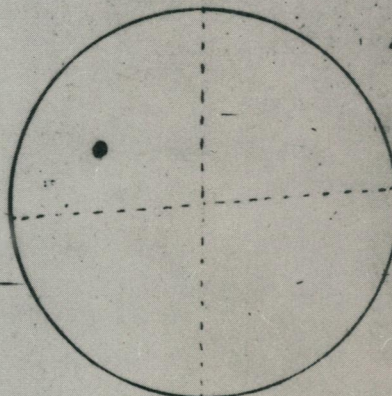
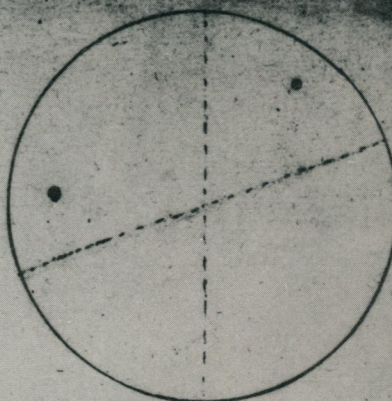
Thomson's thin clouds with 10  
& 20. I saw but one spot, which  
was fayer & great & also round.  
His position as in the 2 figure.

February. 9. 0. 50.  $7\frac{1}{3}$ . ( $7\frac{1}{2}$ .  $4\frac{1}{2}$ .

Thomson's misty eye, the sun being  
very fayer; we saw two fayer spots.  
That westerly the bigger & round. The  
other easterly not so black as the other,  
& somewhat small. Their position  
as in the 3 figure.  $\frac{15}{1}$ .  $\frac{20}{1}$ .

February. 11. 07. 50.  $7\frac{1}{3}$ . ( $7\frac{1}{2}$ .  $11\frac{1}{2}$ .

Thomson's misty eye, with the  
sun being very fayer without  
beams. we saw 3 spots and no  
more. So also Thomson's thin clouds  
between  $11^{\circ}$  &  $12^{\circ}$ . Their position as  
in the 4 figure. That most easterly  
somewhat dim, long & the smallest.  
The two other fayer & black. The  
most westerly the greatest & round. (22.)





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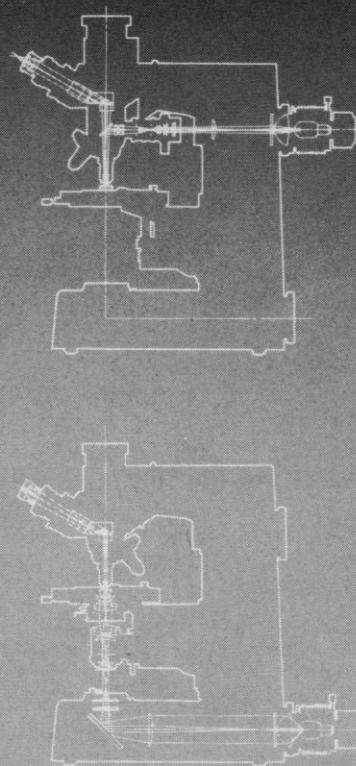
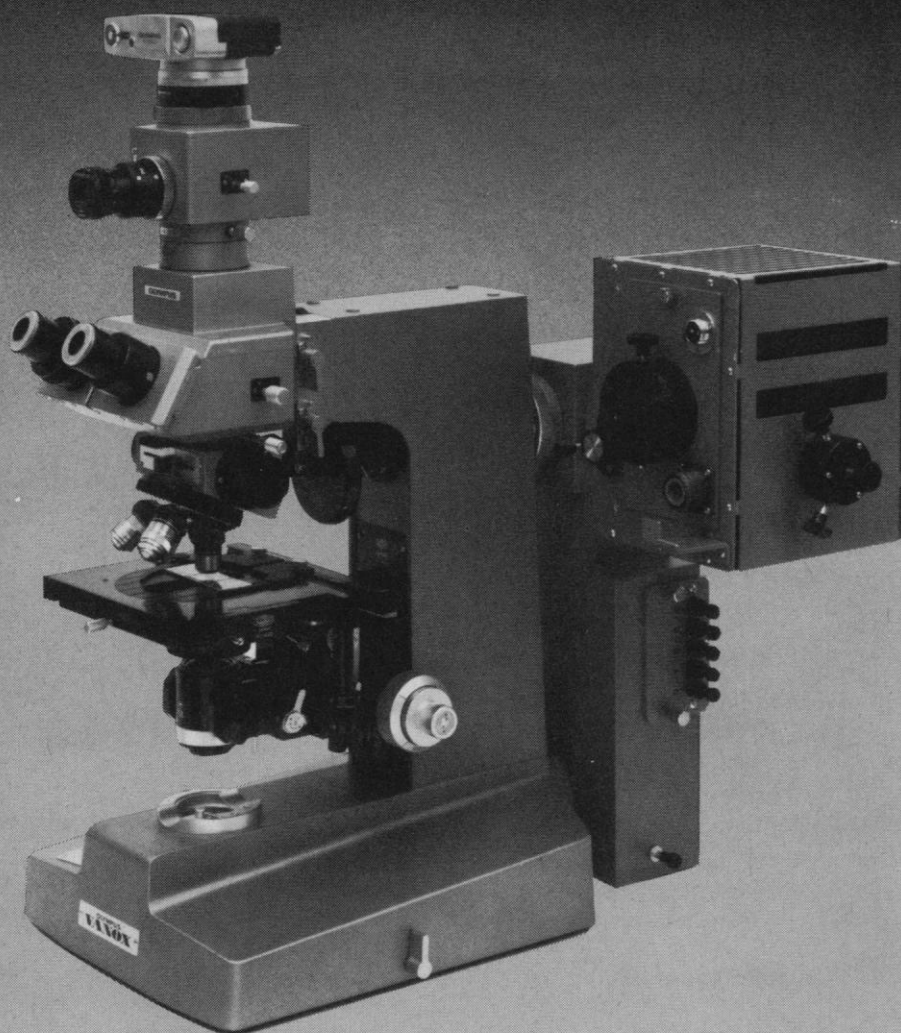
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<b>LETTERS</b>	Handicaps and Careers: <i>N. S. Sharpless</i> ; Nitrosamines in Animal Feed: <i>W. Lijinsky</i> ; The Effectiveness of NEPA: <i>P. J. Culhane</i> ; <i>R. A. Liroff</i> ; <i>S. K. Fairfax</i> . . . . .	1034
<b>EDITORIAL</b>	Margaret Mead . . . . .	1043
<b>ARTICLES</b>	Radiological Impact of Airborne Effluents of Coal and Nuclear Plants: <i>J. P. McBride</i> et al. . . . .	1045
	Gene Amplification and Drug Resistance in Cultured Murine Cells: <i>R. T. Schimke</i> et al. . . . .	1051
	A Proposal to Modernize the American Antiquities Act: <i>R. B. Collins</i> and <i>D. F. Green</i> . . . . .	1055
<b>NEWS AND COMMENT</b>	A General as Arms Control Chief: Opera Buffa or Brilliant Stroke? . . . . .	1060
	Voice from the Dead Names New Suspect for Piltdown Hoax . . . . .	1062
	Harvard, Science, and the Company of Educated Men and Women . . . . .	1063
	Follow-up on the Budget . . . . .	1064
<b>RESEARCH NEWS</b>	Restriction Enzymes: Prenatal Diagnosis of Genetic Disease. . . . .	1068
	The 1978 Nobel Prize in Physiology or Medicine: <i>S. Linn</i> . . . . .	1069
<b>ANNUAL MEETING</b>	Tours and Cultural Events . . . . .	1072
<b>BOOK REVIEWS</b>	Social Standing in America, reviewed by <i>L. A. Coser</i> ; Food Webs and Niche Space, <i>S. L. Pimm</i> ; Mathematical Foundations of Quantum Theory,	

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A. S. Wightman; Evolution of Insect Migration and Diapause,	
C. G. Johnson; Books Received . . . . .	1074

<b>REPORTS</b>	Solar Rotation Determined from Thomas Harriot's Sunspot Observations of 1611 to 1613: <i>R. B. Herr</i> . . . . .	1079
	Sieve Areas in Fossil Phloem: <i>E. L. Smoot</i> and <i>T. N. Taylor</i> . . . . .	1081
	Rapid Light-Induced Changes in Near Infrared Transmission of Rods in <i>Bufo marinus</i> : <i>H. H. Harary, J. E. Brown, L. H. Pinto</i> . . . . .	1083
	Mediterranean Water: An Intense Mesoscale Eddy off the Bahamas: <i>S. E. McDowell</i> and <i>H. T. Rossby</i> . . . . .	1085
	Kainic Acid Injections Result in Degeneration of Cochlear Nucleus Cells Innervated by the Auditory Nerve: <i>S. J. Bird</i> et al. . . . .	1087
	Feedback Inhibition of Brain Noradrenaline Neurons by Tricyclic Antidepressants: $\alpha$ -Receptor Mediation: <i>T. H. Svensson</i> and <i>T. Usdin</i> . . . . .	1089
	Angiotensin Regulates Release and Synthesis of Serotonin in Brain: <i>V. E. Nahmod</i> et al. . . . .	1091
	Halohydrocarbon Synthesis by Bromoperoxidase: <i>R. Theiler, J. C. Cook, L. P. Hager</i> . . . . .	1094
	Subsynaptic Plate Perforations: Changes with Age and Experience in the Rat: <i>W. T. Greenough, R. W. West, T. J. DeVoogd</i> . . . . .	1096
	Hippocampal Aging and Adrenocorticoids: Quantitative Correlations: <i>P. W. Landfield, J. C. Waymire, G. Lynch</i> . . . . .	1098
	Memory Impairment in Epileptic Patients: Selective Effects of Phenobarbital Concentration: <i>C. M. MacLeod, A. S. Dekaban, E. Hunt</i> . . . . .	1102
	<i>Technical Comments: Controlled Clinical Trials: D. W. Alling, M. Halperin, J. H. Ware; J. W. Tukey; Models for Carcinogenic Risk Assessment: C. C. Brown et al.; C. McGaughey; K. S. Crump; J. Neyman; E. Scherer and P. Emmelot; J. Cornfield; Atmospheric Carbon Dioxide in the 19th Century: C. D. Keeling; M. Stuiver</i> . . . . .	1105

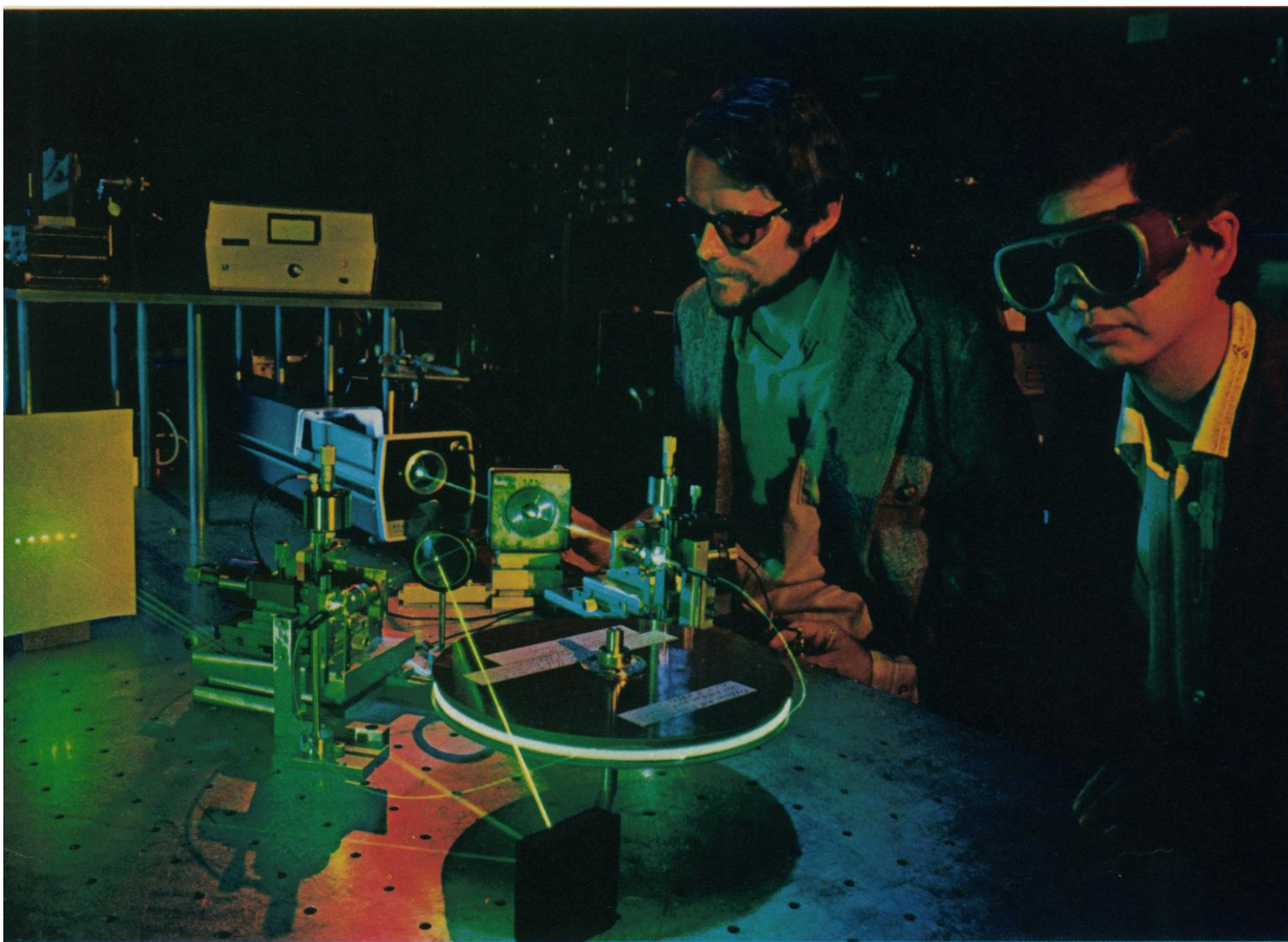
<b>PRODUCTS AND MATERIALS</b>	Atomic Absorption Spectroscopy Lamps; Digital Thermometer; Modular Laboratory Computer; Modular Dry Bath; Sodium Electrode; Image Analyzer; Gel Permeation Chromatograph; Literature . . . . .	1110
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<p>The American Association 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 foster scientific freedom and responsibility, 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.</p>			

## COVER

Page from Harriot's manuscript showing drawings of the sun numbered 41 through 44. The first observation is from his residence at Syon House, 6 February 1612 (Julian calendar, year beginning 1 January). The symbol following the date identifies the weekday as Thursday; the hour is 7<sup>1</sup>/<sub>4</sub>. The subsequent three observations are from the London house of his close friend Sir Walter Raleigh. Harriot, elsewhere, has noted this to be 8 miles north and 4<sup>1</sup>/<sub>4</sub> miles west of Syon. See page 1079. [By permission of Lord Egremont and Leconfield, Petworth House, Sussex]

# The longest in our long line of laser firsts...



Bell Laboratories  
Murray Hill, New Jersey 07974

Bell Labs scientists Roger Stolen and Chinlon Lin work with a fiber Raman laser, one of a new class of light sources that use optical fibers—up to a kilometer long—to produce tunable laser light. At left, the laser's output—which contains multiple Raman-shifted wavelengths—is taken off a beam splitter and dispersed by an external grating to show the broad range of wavelengths that can be tuned.

Bell Labs has developed some of the world's most transparent glass fibers to *carry* light for communications. We've also devised a way to make these highly transparent glass fibers *generate* light. In fact, they are the basis for a new class of tunable light sources called fiber Raman lasers. They're among the latest, and by far the longest, of many lasers invented at Bell Labs, beginning in 1957 with the conception of the laser itself.

Since the new fiber lasers work best at wavelengths at which they are most transparent, we can make them very long. The longest active lasing medium ever built, in fact, was a fiber Raman laser over a kilometer in length. Studying the ways light and glass interact over such distances is part of our research in lightwave communications.

In these new light sources, a glass fiber with high transparency and an extremely thin light-guiding region, or core, is excited by a pump laser. The pump light, interacting with the glass, amplifies light at different wavelengths through a phenomenon known as stimulated Raman scattering. This light is fed back into the fiber by a reflecting mirror. If gain exceeds loss, the repetitively amplified light builds up and "lasing" occurs.

Fiber Raman lasers have conversion efficiencies of about 50%, operate in pulsed and continuous wave modes, and are easily tunable over a broad wavelength range in the visible and near infrared regions of the spectrum.

We've used these lasers to measure the properties of fibers and devices for optical communications; and studies of the lasers themselves have revealed a wealth of information on frequency conversion, optical gain, and other phenomena. Such knowledge could lead to a new class of optoelectronic devices made from fibers, and better fibers for communications.

## Looking back

These long lasers come from a long line of Bell Labs firsts:

**1957:** The basic principles of the laser, conceived by Charles Townes, a Bell Labs consultant, and Bell Labs scientist Arthur Schawlow. (They later received the basic laser patent.)

**1960:** A laser capable of emitting a continuous beam of coherent light—using helium-neon gas; followed in 1962 by the basic visible light helium-neon laser. (More than 200,000 such lasers are now in use worldwide.) Also, a proposal for a semiconductor laser involving injection across a p-n junction to generate coherent light emitted parallel to the junction.

**1961:** The continuous wave solid-state laser (neodymium-doped calcium tungstate).

**1964:** The carbon dioxide laser (highest continuous wave power output system known to date); the neodymium-doped yttrium aluminum garnet laser; the continuously operating argon ion laser; the tunable optical parametric oscillator; and the synchronous mode-locking technique, a basic means for generating short and ultrashort pulses.

**1967:** The continuous wave helium-cadmium laser (utilizing the Penning ionization effect for high efficiency); such lasers are now used in high-speed graphics, biological and medical applications.

**1969:** The magnetically tunable spin-flip Raman infrared laser, used in high-resolution spectroscopy, and in pollution detection in both the atmosphere and the stratosphere.

**1970:** Semiconductor heterostructure lasers capable of continuous operation at room temperature.

**1971:** The distributed feedback laser, a mirror-free laser structure compatible with integrated optics.

**1973:** The tunable, continuous wave color-center laser.

**1974:** Optical pulses less than a trillionth of a second long.

**1977:** Long-life semiconductor lasers for communications. (Such lasers have performed reliably in the Bell System's lightwave communications installation in Chicago.)

## Looking ahead

Today, besides our work with tunable fiber Raman lasers, we're using other lasers to unlock new regions of the spectrum in the near infrared (including tunable light sources for communications), the infrared, and the ultraviolet.

We're also looking to extend the tuning range of the free electron laser into the far infrared region—where no convenient sources of tunable radiation exist.

We're working on integrated optics—combinations of lightwave functions on a single chip.

Lasers are helping us understand ultrafast chemical and biological phenomena, such as the initial events in the process of human vision. By shedding new light on chemical reactions, atmospheric impurities, and microscopic defects in solids, lasers are helping us explore materials and processes useful for tomorrow's communications.

Also under investigation is the use of intense laser irradiation in the fabrication of semiconductor devices. The laser light can be used to heat selective areas of the semiconductor and anneal out defects or produce epitaxial crystalline growth. Laser annealing coupled with ion implantation may provide a unique tool for semiconductor processing.

We've played an important part in the discovery and development of the laser—an invention making dramatic improvements in the way our nation lives, works and communicates.



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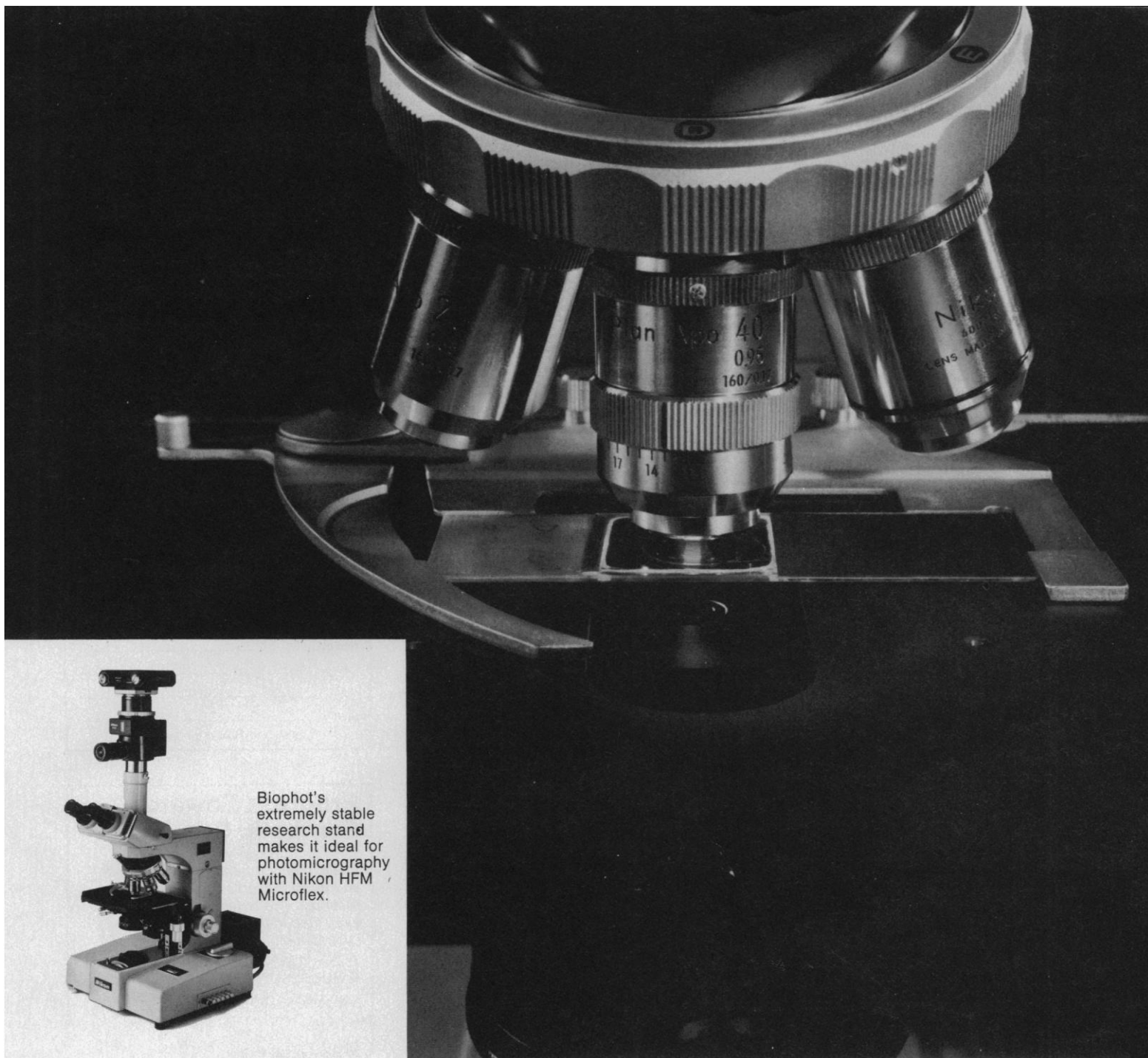
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95 Figures

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Length: 125 Minutes  
47 Figures

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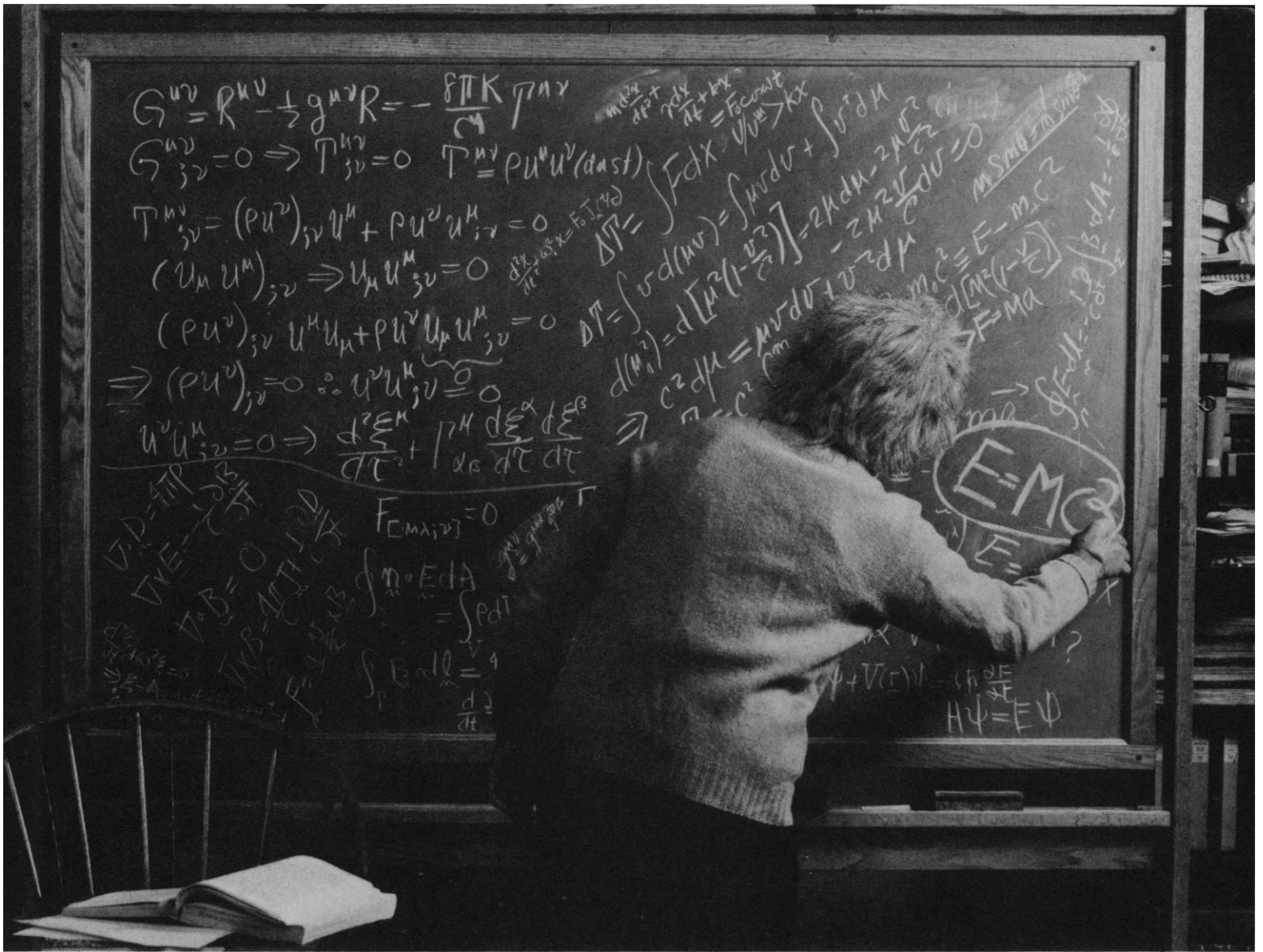
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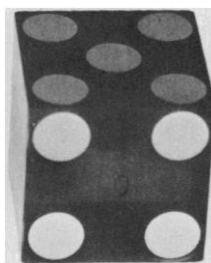
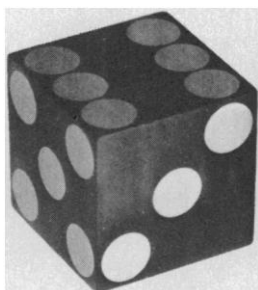
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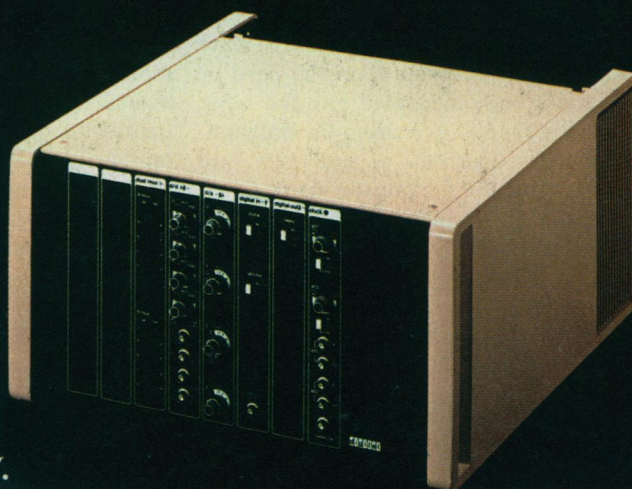
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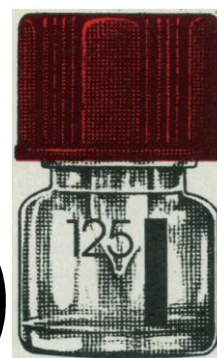
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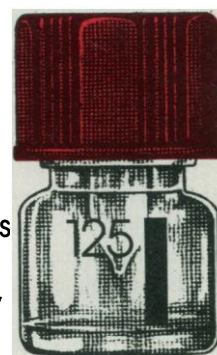


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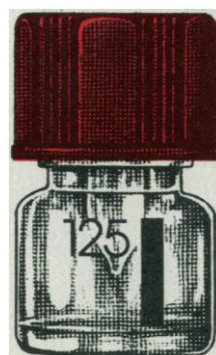


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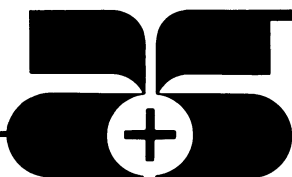


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<sup>1</sup>Rotrock, J.T. et al. *Science*, Vol. 179: 588, 1973.

<sup>2</sup>Cone, J.E. et al. *J. Biol. Chem.*, Vol. 252: 5337, 1977.

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ing standing—that NEPA expanded the “zone of interests to be protected”—is arguable. However, because environmental, esthetic, and amenity values were already included in the zone after the *Scenic Hudson I* and Mineral King (Sierra Club v. Morton, 405 U.S. 727) decisions, as I argued and Liroff concedes, I am not sure what NEPA added to the zone. Liroff relies on the *SCRAP* case to show that NEPA gave *needed* reinforcement to the expanded standing already achieved. This point is both debatable and marginal.

Culhane concurs with my arguments regarding rational decision-making. Liroff does not, but it is not clear why he finds them “misdirected.” I argued that NEPA elaborators erred by assuming that environmental decision-making by federal agencies “is rational, or can be.” Liroff suggests that I misrepresented the elaborators’ assumptions but then appears to support my analysis. The difference between us is that Liroff appears to believe the EIS can make decision-making less incremental and more rational, while I see the EIS’s simply becoming a part of the inherently incremental process.

Liroff and I seem to agree that NEPA has little to do with the Freedom of Information (FOI) Act, but we disagree about whether the FOI right to agency documents is more important than the requirement that agencies publish relevant information in an EIS. This may be best resolved by consideration of appropriate tactics in specific situations, although Liroff’s point that proceeding under the FOI Act requires considerable citizen effort is certainly well taken. I would counter, however, that the right to demand is critical both for obtaining information not published in an EIS which might otherwise be unavailable, and for expanding the information which agencies now make available “voluntarily,” knowing that they may be forced to release it. If the EIS’s do become significantly shorter because of the regulations proposed recently by the Council on Environmental Quality, this distinction may become more important.

Liroff’s comments on pure versus applied research do not reflect my major points regarding data. Perhaps I invited trouble by using those terms. My concern was with adversarial research—science used to support a preferred outcome in a short time in an advocacy situation—as much as with basic research. That point was a small part of a larger issue. Moreover, I do not blame NEPA for the inadequacies of the “youthful” field of ecology; but the fact that the

tools to do the analysis required by the EIS concept are unavailable raises important questions about the EIS. Liroff seems to concur, at least in part. My main point is that simply amassing and circulating data, inaccurate or otherwise, is not necessarily productive. In the specific area of influencing agency policy-making, the utility of circulating data must be weighed against the decision-maker’s ability to absorb it; the need to make value judgments about competing economic, social, and political goals; and the tendency to select and interpret data in terms of existing ideas and biases. Data do not reveal the “correct” decision, and there is a limit to how much data we can use, especially in decisions typically and appropriately based on many nontechnical considerations.

Liroff and Culhane both take exception to my discussion of public involvement. I continue to believe, however, that if we are urged to applaud NEPA because it has improved citizen access to agency deliberations, it is more than a “legalistic” point to ask whether the EIS process is necessary to accomplish the goal or whether other approaches are preferable or adequate; and whether EIS-based discussions are meaningful and an improvement over previous public involvement programs. Both critics concede the obvious, that public involvement was well under way before NEPA was passed (Liroff) and that other statutes and programs provide a more comprehensive base for public involvement (Culhane). If pointing out these facts “seems to debunk NEPA public participation,” as Culhane states, then I can only respond that it is about time. Culhane further argues that “wider public access is . . . important as the predecessor of a more balanced set of public constituencies of the natural resources agencies.” I agree, and made the same point in the article: “The citizen involvement movement of the 1960’s broadened agencies’ focuses” because “new groups representing new values” participated in agency deliberations. I was neither questioning the importance of diverse constituencies nor missing the “logic of public participation” but asking whether NEPA supplemented the movement of the 1960’s or undercut it. Although Culhane describes my analysis as “belittling” agency efforts, he states that the exercise is often “frustrating” and “mundane.” I believe that NEPA replaced the developing opportunity for open, informal dialogue with formal, repetitious, and adversarial proceedings that frequently resemble elections rather than discussions.

Finally, both Liroff and Culhane make the point that the environmental movement did not shut down from 1970 to 1978 and concentrate on EIS processing. Of course not. I never suggested that it did. I simply stated that preoccupation with the EIS wastes effort that could better be spent in more substantive pursuits.

These letters indicate that the time is ripe for fundamental critique and assessment of the EIS process. Liroff and Culhane are among the most familiar and articulate of NEPA advocates. Yet, after sorting through my article, their criticisms, and what each or both of them conceded, I find that much of the ground traditionally claimed for the EIS is surrendered and many of the most fundamental aspects of the process are exposed to serious question. This is more significant, I hope, than counting coups in the Letters section. My hope is encouraged by the fact that no one has taken issue with the two major points in my article, which I identified as "questionable assumptions" underlying all the claims about the virtues of the NEPA process. First, the assumption that environmentally unsound decisions are the result of a bureaucratic system that fails because administrators lack information and do not want to make sound decisions; and second, the assumption that the public and the courts are capable of identifying environmentally correct decisions or forcing the agencies to do so. If these are indeed acceptable as assumptions underlying the EIS process, then the whole enterprise is in doubt. It is clear, in my opinion, that the causes of environmentally unsound decisions are more complex and profound than bureaucratic incompetence. Moreover, I see nothing to suggest that either the public or the courts are relatively more competent—less biased, better informed, or less implicated in the profundity and complexity of our problems—to make environmentally sound decisions.

If this analysis is correct—and I believe it is—then we should reflect more closely than in times past on the utility of the EIS, transcending the issue of how to improve the documents and focusing on such questions as, What are the goals of this process? What problems do we seek to solve? Are they the real problems? And can we solve them in an easier, cheaper, or better way?

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## Margaret Mead

If anything is certain, it is that Margaret Mead did not go gently into the night. At 77, there was too much still to be done, too many budding young scholars needing a push or a grant from her earnings from writing and lecturing, and too much human and political foolishness to be scolded. Life was her great adventure and she went to the ends of the earth to find its meanings. A determined popularizer of the human side of science and a foe of pretentiousness, she waited all too long before the establishment unbent and granted her belated honors.

Margaret Mead, despite her deep religious sense, would not welcome a churchyard eulogy. She would tell us that if we really cared, we would take up where she left off. Continuity of her work and interests would mean something, particularly the encouragement of field research on the life-styles and social systems of remote and depleting communities bending before the rising winds of modernism. She spoke often and with feeling about how little time there was left, not knowing how little remained for herself. In what she wrote, she fused her scholarship with a cross-cultural message that helped her own countrymen to understand themselves.

Science and humanities came together at Margaret Mead's hands. Science was a method for seeing, in an ordered pattern, the elements of social behavior in diverse environments—not simply as sterile reporting but as capturing the human experience. She used her discipline to articulate dignity and reverence for life and the universal human struggle. And this led her straight to sensing the interdependence of cultures, to the view that we must hang together through the bridging of philosophies, traditions, arts, literature, and institutions. She did not decry the progress of science and technology but hailed the possibilities of satellites, computers, and aerospace technology as tools of science for sharing education, knowledge, beauty, and communication on the global scale. Margaret Mead could bury herself in a fishing village of 100 souls and still keep her perspective of a swarming and predatory larger world with equal capacities for goodness and mischief, and dream that it might yet save itself.

When Margaret Mead made up her mind that something was worth doing, she gave it all that she had. Such was the case with the AAAS. Through the years of her service on committees and on the Board of Directors, and later as president, board chairman, and retired president, she was at the forefront of efforts to beat off parochialism in science and to get the most out of interdisciplinary thought and communication. The regularity of her attendance at board meetings was phenomenal, and one remembers how she would fly nonstop from the other side of the world, fighting fatigue and sickness, to take her seat at the table on time. She had made a promise, and her promises were her bond.

Margaret Mead's death came as the Board of Directors of the AAAS arrived in Peking for a visit and an experience that would have absorbed her completely. Science, which for years had been underground in China, suddenly was in the foreground. More than once in the first days of the visit, Chinese scholars broke the ice with references to Margaret Mead and her work as a scientist with a knack for getting through to people. And when the telegram came, the sadness was not confined to the visiting Americans. Margaret Mead would have understood, better than most, the traumas through which China has gone in what must seem an endless century. She would have grasped the implications of overlaying instant modernization on a system that in countless ways is still rooted in the ages. What a field laboratory for a cultural anthropologist!

In the attic rooms of the American Museum of Natural History, where for 55 years Margaret Mead dispensed learning, opinion, and an occasional thunderbolt, an ending is fused with a beginning. An extraordinary vitality is stilled and some light has dimmed. The unfinished notes and memorabilia lie all about. The continuity is interrupted. It need not be broken, if we care enough. The idea of moving "Towards a Human Science," the theme of Margaret Mead's presidential address to the AAAS in 1976, is there to be seized.—WILLIAM D. CAREY

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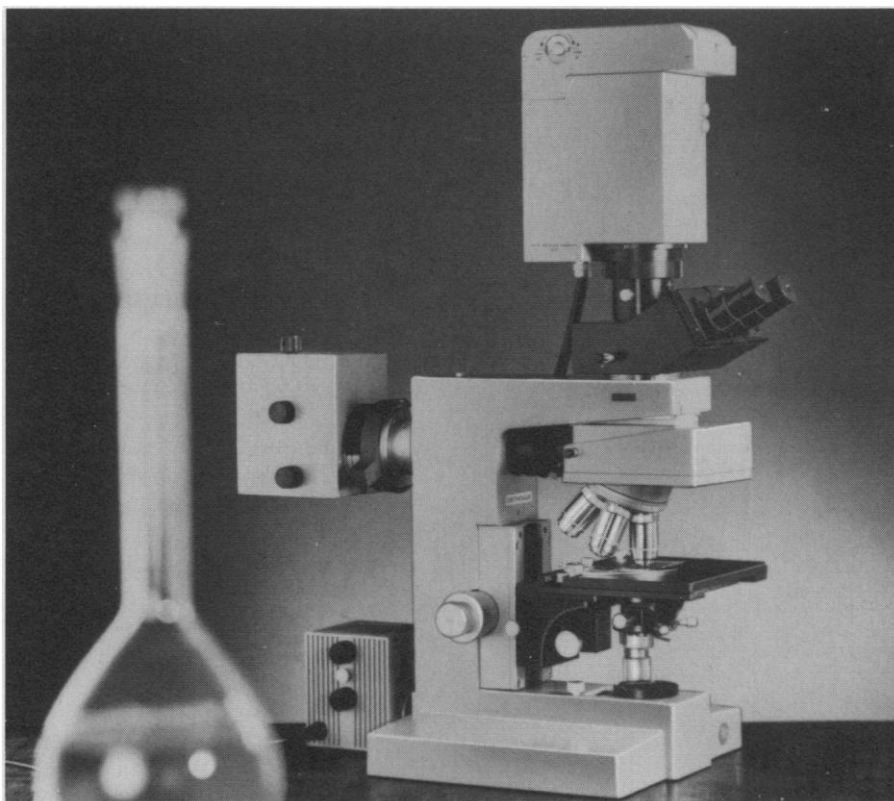
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## Literature

*Infrared Spectroscopy Supplies* includes hardware, recording materials, transmission windows, cells, accessories, mills, presses, and many other items. Wilmad Glass. Circle 701.

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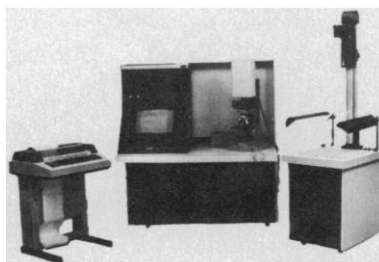
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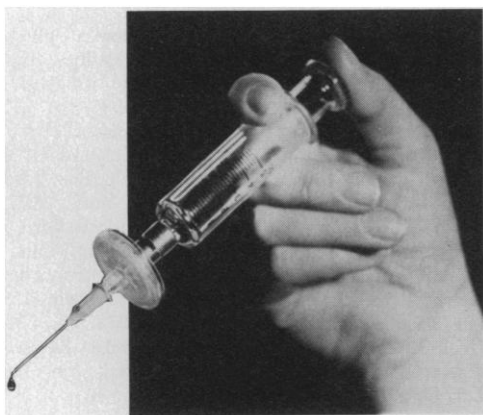
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## BOOKS RECEIVED

(Continued from page 1078)

**Nutrition and Drug Interrelations.** Papers from a symposium, Ames, Iowa, Aug. 1976. John N. Hathcock and Julius Coon, Eds. Academic Press, New York, 1978. xxii, 928 pp. \$55. Nutrition Foundation Monograph Series.

**On Aesthetics in Science.** Judith Wechsler, Ed. MIT Press, Cambridge, Mass., 1978. xii, 180 pp., illus. \$12.50.

**On Human Communication.** A Review, a Survey, and a Criticism. Colin Cherry. MIT Press, Cambridge, Mass., ed. 3, 1978. xviii, 374 pp., illus. \$17.50. Studies in Communication.

**Optical Shop Testing.** Daniel Malacara, Ed. Wiley, New York, 1978. xx, 524 pp., illus. \$29.95. Wiley Series in Pure and Applied Optics.

**Optimal Control and Differential Equations.** Proceedings of a conference, Norman, Okla., Mar. 1977. A. B. Schwarzkopf, Walter G. Kelley, and Stanley B. Eliason, Eds. Academic Press, New York, 1978. xii, 336 pp. \$17.

**Orbital Motion.** A. E. Roy. Halsted (Wiley), New York, 1978. xiv, 490 pp., illus. \$29.95.

**Ordre et Dynamique du Vivant.** Chemins de la Biologie Moléculaire. Antoine Danchin. Editions du Seuil, Paris, 1978. 382 pp., illus. Paper, 95 F.

**Orientation Effects in Solid Polymers.** Proceedings of a conference, Budapest, Apr. 1976. G. Bodor, Ed. Interscience (Wiley), New York, 1978. vi, 426 pp., illus. Paper, \$19. *Journal of Polymer Science: Polymer Symposium*, No. 58.

**Our Southern Highlanders.** A Narrative of Adventure in the Southern Appalachians and a Study of Life among the Mountaineers. Horace Kephart. University of Tennessee Press, Knoxville, 1976. xlviii, 470 pp. + plates. \$12.95. Reprint of 1922 edition with a new introduction.

**Patty's Industrial Hygiene and Toxicology.** Vol. 1, General Principles. George D. Clayton and Florence E. Clayton, Eds. Wiley-Interscience, New York, ed. 3, 1978. xx, 1466 pp., illus. \$75.

**Phospholipases and Prostaglandins.** Claudio Galli, Giovanni Galli, and Giuseppe Porcellati, Eds. Raven, New York, 1978. xii, 206 pp., illus. \$22. Advances in Prostaglandin and Thromboxane Research, vol. 3.

**Photoemission and the Electronic Properties of Surfaces.** B. Feuerbacher, B. Fitton, and R. F. Willis, Eds. Wiley, New York, 1978. xviii, 540 pp., illus. \$48.

**Physics for Engineers and Scientists.** D. Elwell and A. J. Pointon. Horwood, Chichester, England, and Halsted (Wiley), New York, ed. 2, 1978. xiv, 356 pp., illus. \$35.

**Plant Proteins.** Papers from a school, Nottingham, 1976. G. Norton. Butterworths, Boston, 1978. xii, 352 pp., illus. \$32.95.

**Populations of Small Mammals under Natural Conditions.** Papers from a symposium, Pittsburgh, May 1976. Dana P. Snyder, Ed. University of Pittsburgh, Pymatuning; Laboratory of Ecology, Linesville, Pa., 1978. xiv, 238 pp., illus. \$8.50. The Pymatuning Symposia in Ecology. Special Publication Series, vol. 5.

**The Porphyrins.** Vol. 2, Structure and Synthesis, Part B. David Dolphin, Ed. Academic Press, New York, 1978. xx, 438 pp., illus. \$46.50.

**Potentiometric Water Analysis.** Derek Midg-

ley and Kenneth Torrance. Wiley-Interscience, New York, 1978. xii, 410 pp. \$42.

**Power and Authority in Adolescence.** The Origins and Resolutions of Intergenerational Conflict. Formulated by the Committee on Adolescence. Group for the Advancement of Psychiatry, New York, 1978. pp. 49-276. Paper, \$6.50. GAP Publication No. 101.

**Power System Control and Protection.** B. Don Russell and Marion E. Council, Eds. Academic Press, New York, 1978. x, 290 pp., illus. \$15.

**Prehistoric Patterns of Human Behavior.** A Case Study in the Mississippi Valley. Bruce D. Smith with a contribution by Wilma Wetterstrom. Academic Press, New York, 1978. xxii, 266 pp., illus. \$19. Studies in Archeology.

**Proceedings of the 1978 Heat Transfer and Fluid Mechanics Institute.** Pullman, Wash., June 1978. Clayton T. Crowe and William L. Grosshandler, Eds. Published for the Heat Transfer and Fluid Mechanics Institute by Stanford University Press, Stanford, Calif., 1978. xiv, 330 pp., illus. \$28.50.

**The Processing of Memories.** Forgetting and Retention. Norman E. Spear. Erlbaum, Hillsdale, N.J., 1978 (distributor, Halsted [Wiley], New York). xiv, 554 pp., illus. \$29.95. The Experimental Psychology Series.

**Prostaglandins and Perinatal Medicine.** Papers from a symposium, Toronto, Mar. 1977. Flavio Coceani and Peter M. Olley, Eds. Raven, New York, 1978. xvi, 412 pp., illus. \$35. Advances in Prostaglandin and Thromboxane Research, vol. 4.

**Psychology of Learning and Behavior.** Barry Schwartz. Norton, New York, 1978. xx, 412 pp., illus. \$13.95.

**Purpose in a World of Chance.** A Biologist's View. W. H. Thorpe. Oxford University Press, New York, 1978. xii, 124 pp., illus. \$9.95.

**Quantification in Cultural Anthropology.** An Introduction to Research Design. Allen W. Johnson. Stanford University Press, Stanford, Calif., 1978. xvi, 232 pp., illus. \$12.50.

**Renal Function.** Papers from a conference, Feb. 1977. Gerhard H. Giebisch and Elizabeth F. Purcell, Eds. Josiah Macy, Jr. Foundation, New York, 1977 (distributor, Independent Publishers Group, Port Washington, N.Y.). viii, 322 pp., illus. \$10.

**Reviews of Neuroscience.** Vol. 3. Seymour Ehrenpreis and Irwin J. Kopin, Eds. Raven, New York, 1978. viii, 230 pp., illus. \$19.75.

**The Revisionists Revised.** A Critique of the Radical Attack on the Schools. Diane Ravitch. Basic Books, New York, 1978. xii, 194 pp. \$8.95.

**Second-Language Acquisition in Childhood.** Barry McLaughlin. Erlbaum, Hillsdale, N.J., 1976 (distributor, Halsted [Wiley], New York). xiv, 240 pp. \$14.95.

**Semiconductor Circuit Design for A.F. and D.C. Amplification and Switching.** J. Watson. Halsted (Wiley), New York, ed. 3, 1977. xii, 536 pp., illus. \$17.95.

**The Sensitive Scientist.** Report of a British Association Study Group. David Morley. SCM Press, London, 1978. xii, 132 pp. Paper, £1.95.

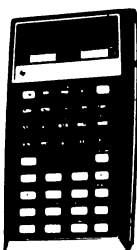
**Sex, Evolution, and Behavior.** Adaptations for Reproduction. Martin Daly and Margo Wilson. Duxbury Press (Wadsworth), North Scituate, Mass., 1978. xii, 388 pp., illus. Paper, \$8.95.

**Shelter Provision in Developing Countries.** The Influence of Standards and Criteria. A. L. Mabogunje, J. E. Hardoy, and R. P. Misra. C. Ian Jackson, Ed. Published for the Scientific

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