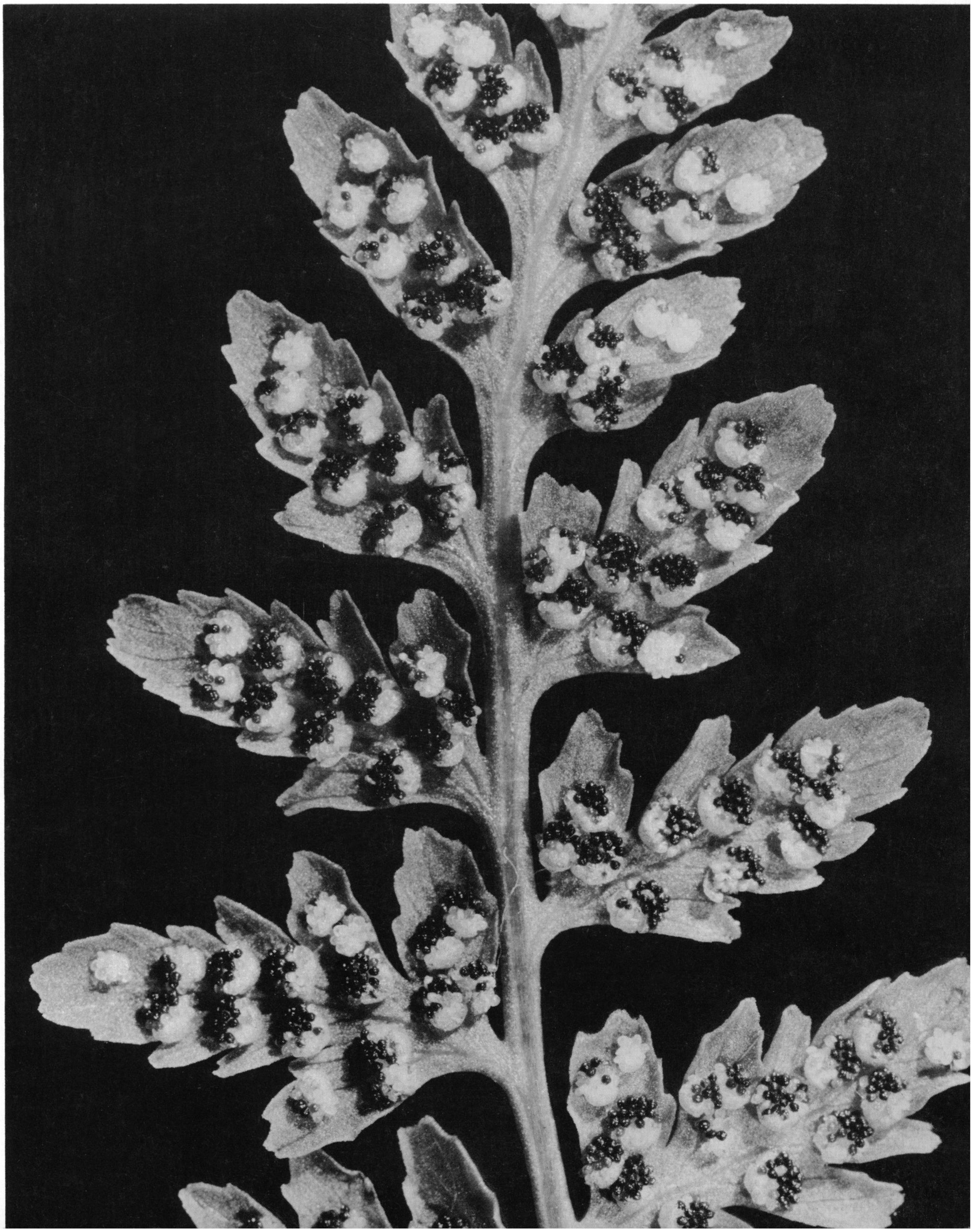
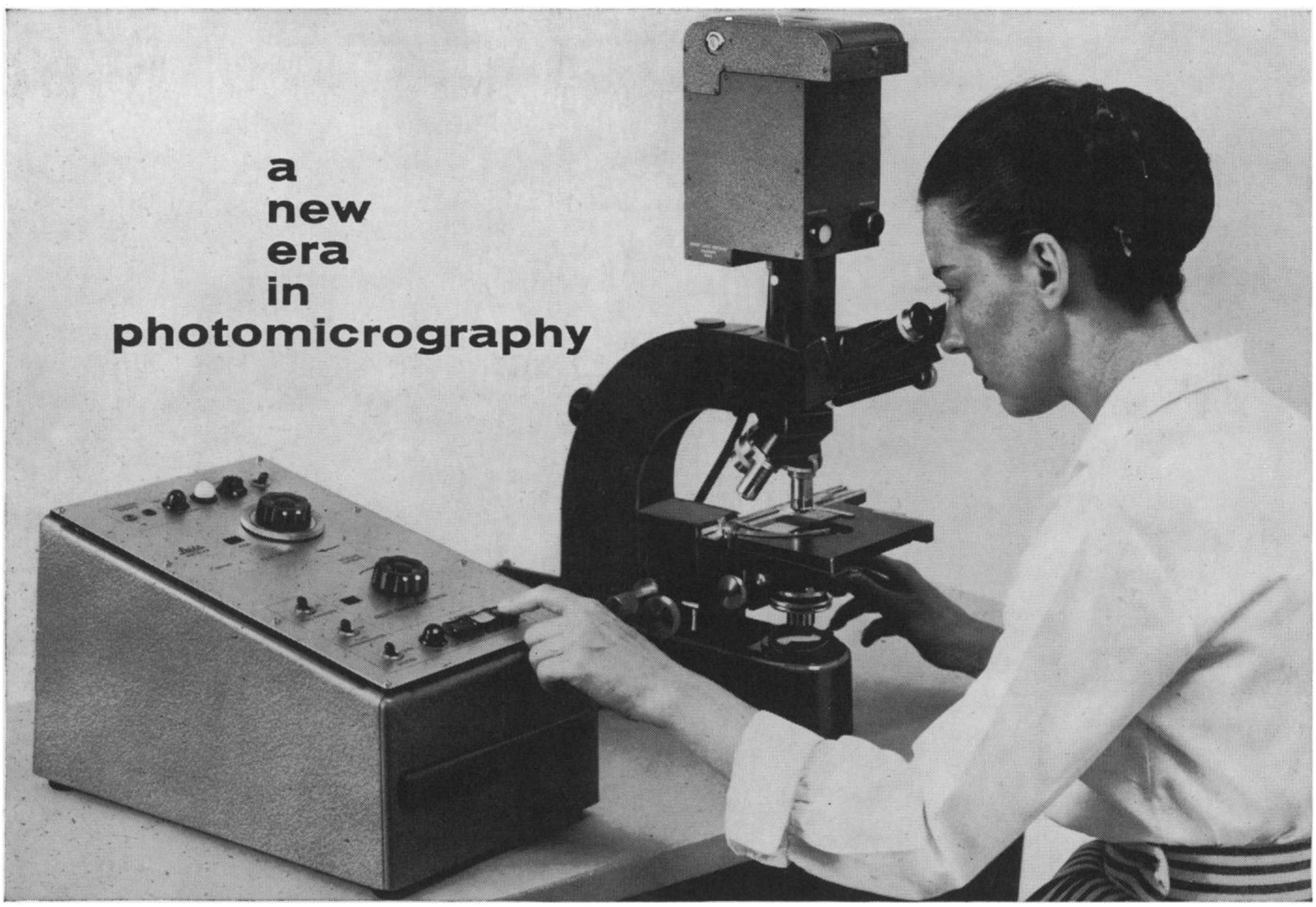
SCIENCE

6 October 1961
Vol. 134, No. 3484

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE





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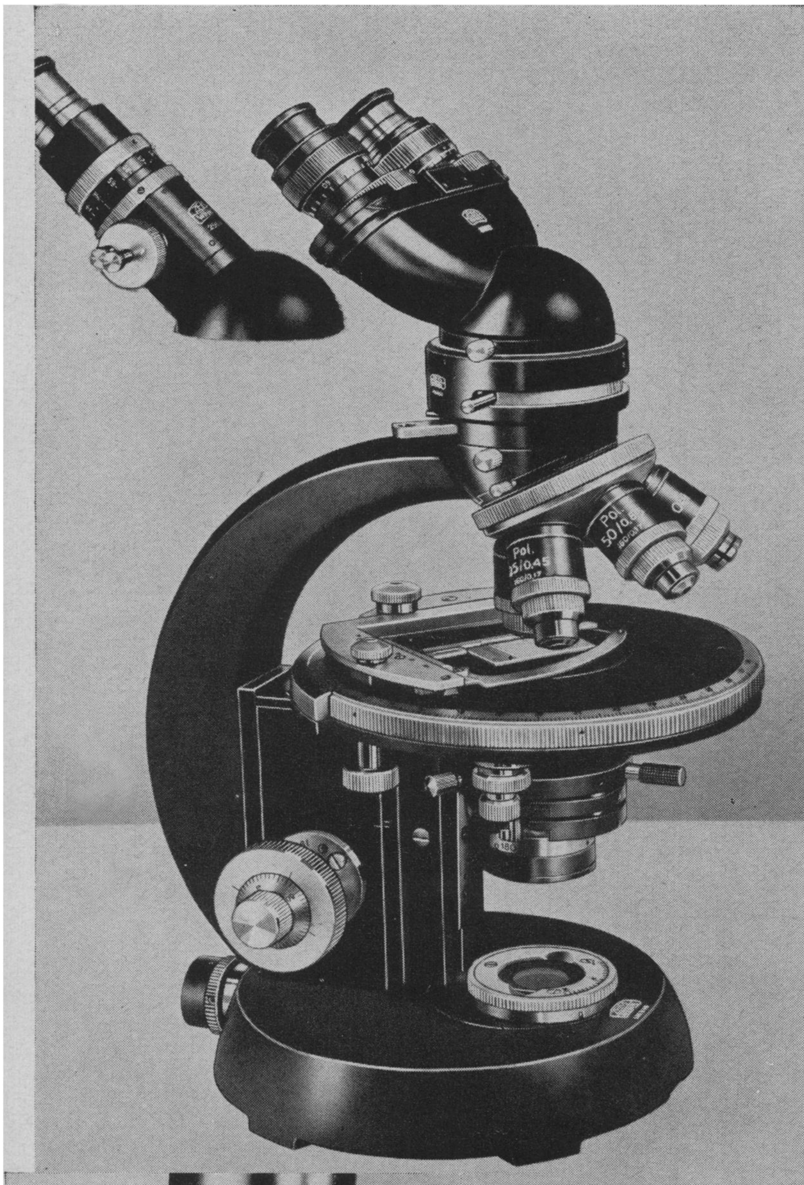
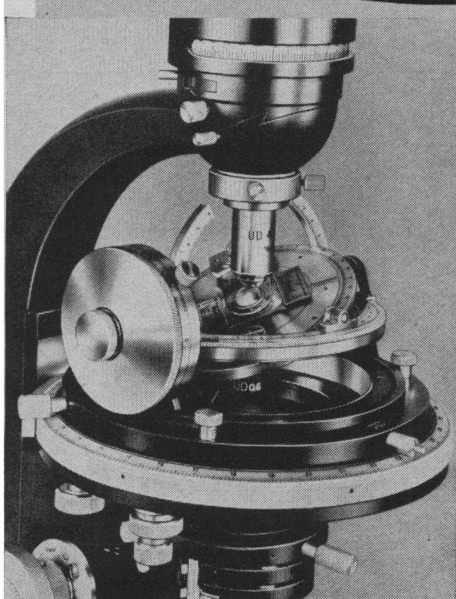
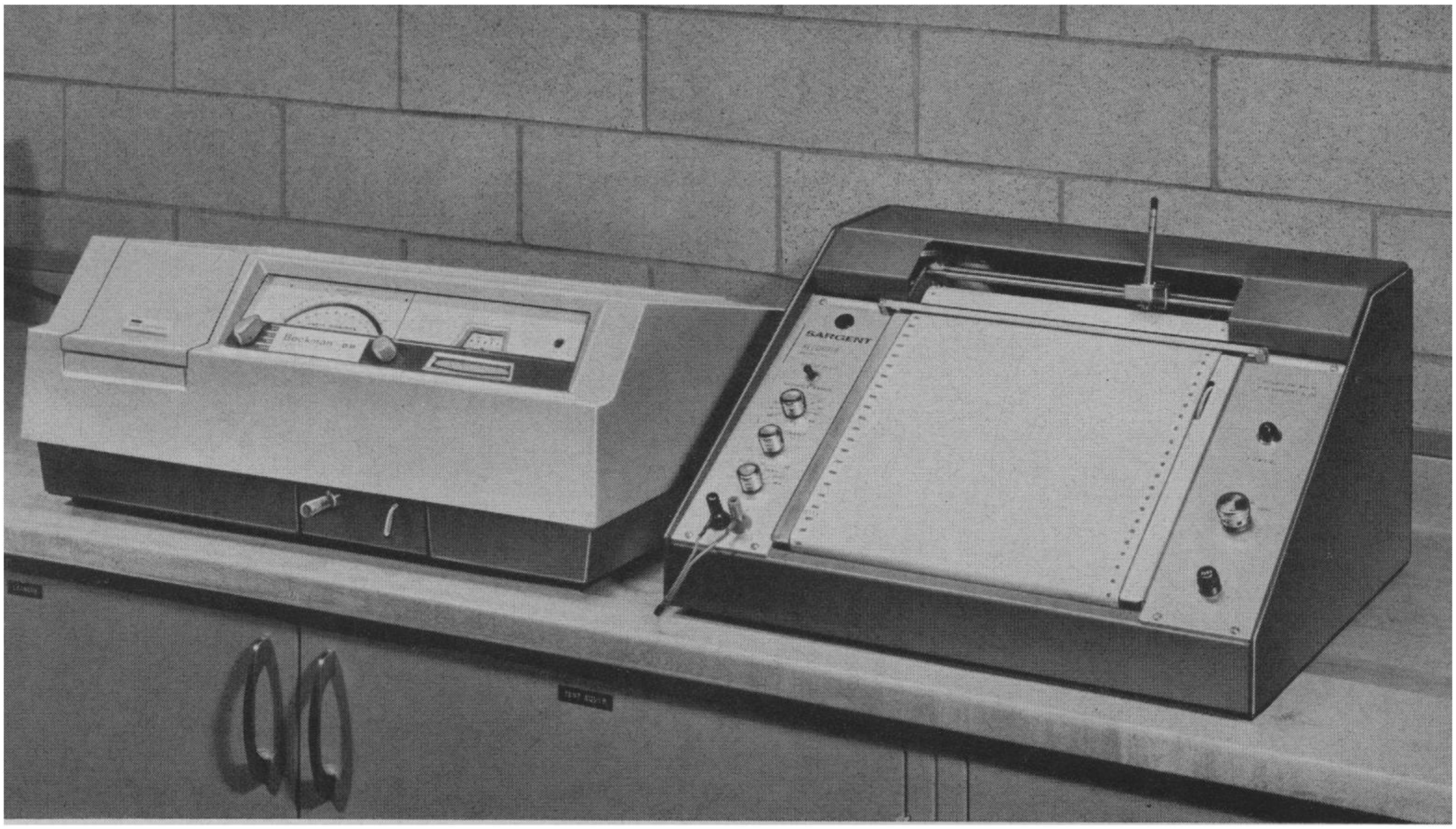
6 October 1961, Volume 134, Number 3484

SCIENCE

Cover Fertile specimen of Tennessee fragile fern, *Cystopteris fragilis* var. *tennesseensis* (about × 9). [Charles Neidrof, Fair Lawn, N.J.]







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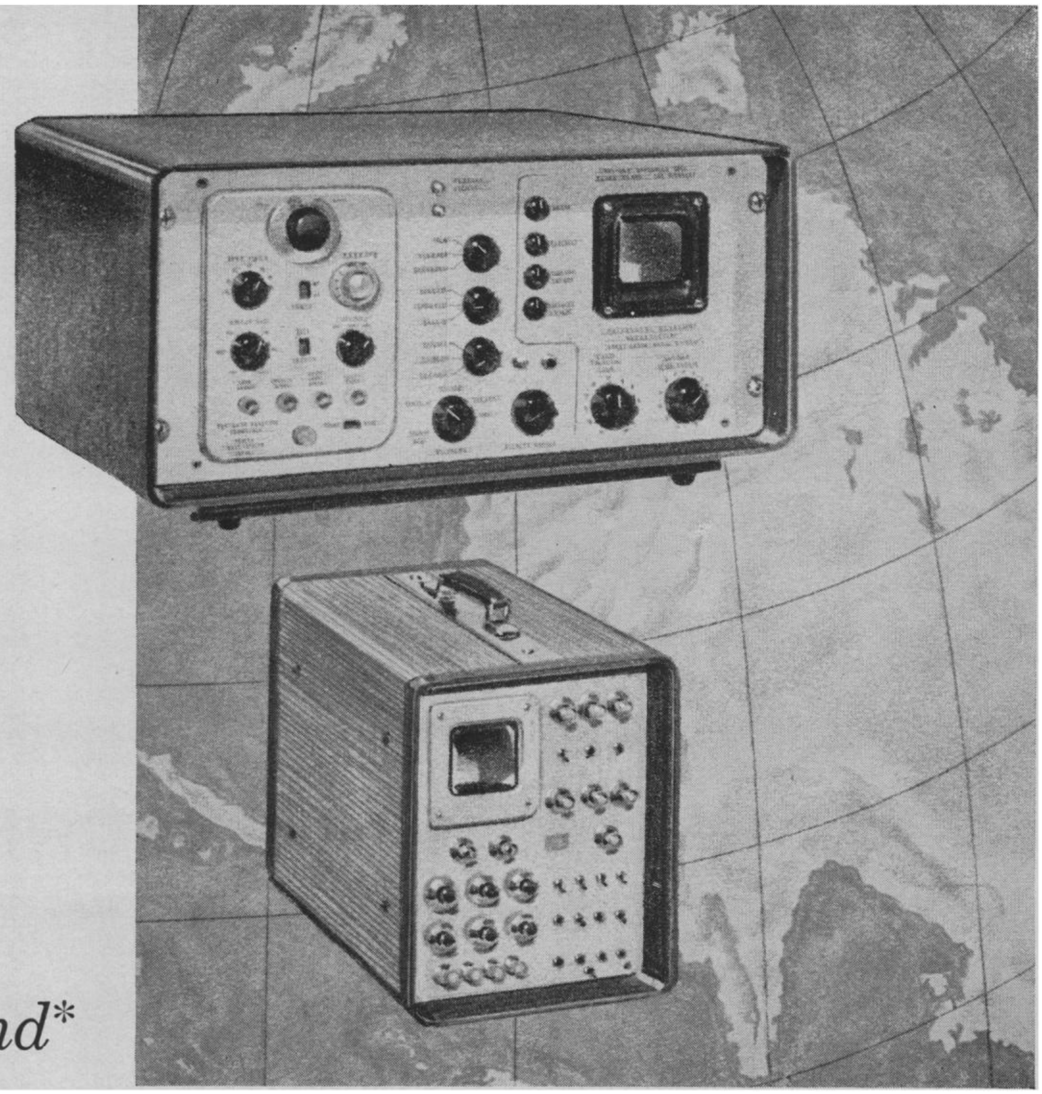

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The Stowe Conferences on Science and World Affairs

The resumption of nuclear weapons testing, announced just before the Stowe Conferences opened, immediately made it doubtful that the conferences could be held at all. It is consequently all the more significant that the participants were able, in spite of a stormy atmosphere, to arrive at constructive recommendations (see page 984). As befits scientists, views from East and West were exchanged with frankness and reasonable objectivity.

The first of the two conferences, being the less controversial, more quickly attained agreement on certain measures. If carried through, the resulting international cooperation in science ought to help lessen international tensions. With the example of the I.G.Y. before us, one may readily hope for constructive action in such joint enterprises as mapping the ocean floor and surveying the changing waters and life of the seas; drilling through the earth's crust; forecasting weather and natural catastrophes on a world-wide basis; increasing the fresh-water resources of the lands; developing food resources and farming the oceans; exploring space and internationalizing the moon; using satellites for communications systems; preserving and promoting health; grappling with human pollution and waste of the natural environment; exploring molecular biology; building a 300 billion electron volt accelerator and the world's greatest computer; and establishing in a strategic place—some persons propose in Berlin—a great international cluster of science laboratories and institutes. Nor was scientific aid to the less-developed countries forgotten, or the value of greatly extended and freer exchanges of scientific personnel and information overlooked.

Nevertheless, in the fine glow of such hopes, every mind harbored the unspoken recognition that none of these joint efforts could germinate in a world on the eve of nuclear war. The success of the Eighth Conference, on the subject of Disarmament and World Security, hence reflected the world's desire for an ultimate resolution of tensions and enmity. For the participants, it was not easy to speak without mutual recrimination or anger. Nor does the final public statement express much more than a common hope for peace.

All the more remarkable, then, is the fact that at least three working groups, each including leading experts from East and West, found it possible to agree upon measures for the cessation of the production of fissionable materials for military purposes and the elimination of stockpiles of nuclear weapons; for the similar and parallel elimination of long-range missiles, bombers, submarines, and other means of delivery; for staging the first phase of disarmament so that inspection and control can increase as disarmament progresses, and so that each side may retain security in the process. A hard look at the kind of world that would exist after complete and general disarmament clearly indicated the need for an international police force and a system for the settlement of disputes between countries, in order to prevent rearmament and to permit peaceful accommodation.

These working papers, which so far exceed in extent of agreement and explicitness the former bases of negotiations at Geneva, may perhaps, both sides willing, bring us closer to the ultimate goal declared by the leaders of the world to be the hope of every nation, the banishment of war.—BENTLEY GLASS, *Johns Hopkins University*

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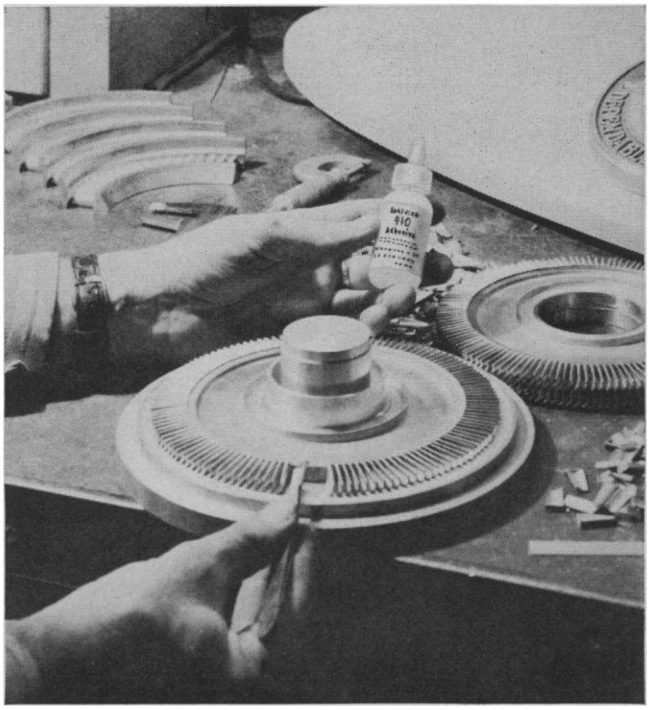

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THIS paper

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Few overhearing her would know what the poor soul is talking about, yet she speaks the truth. With research and development activity now constituting such a respectable fraction of the Gross National Product, oscillographs probably outnumber pickle barrels in this country at the present time. Oscillographers are correspondingly numerous. Methods that one sect of oscillographers prefers above all else another sect can't see for dirt. One sect prefers automatic oscillogram processors. Paper manufacturers like us find their favor worth competing for. Therefore we announce a new advance in media for their use.

An advance in the old art of papermaking came first. Then new emulsions were devised to work properly with the new base. Then proper processing chemicals were devised for the new emulsions. Then the combination was extensively proved out under practical conditions of use by parties interested only in end results and hardly at all in the how and why. They found that

1. THIS paper dries thoroughly at high processor speeds *without creases.* ***180 in./min. is not too fast.***
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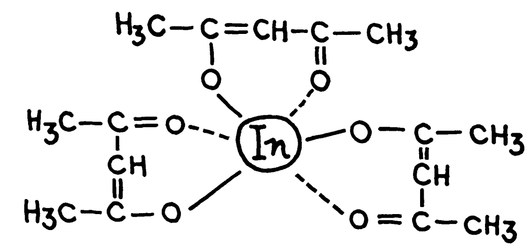
4. THIS paper is rugged. ***No cracking, no crumbling.***
5. THIS paper holds its dimensions. ***Justifies careful measurement.***

"THIS" won't do for a trademark. (The code name for the field trials was "Kind 1534.") Let's call it Kodak Ektaline Paper. *It comes in the two usual speeds for oscillographs,* Kodak Ektaline 16 Paper *and* Kodak Ektaline 18 Paper. Kodak Ektaline Chemicals *come as liquids. The stabilization principle used in the automatic oscillogram processors came from Kodak, too. An inquiry to Eastman Kodak Company, Photorecording Methods Division, Rochester 4, N. Y., puts everything in place right up to the moment.*

A speculation in indium



We may look back upon *Tris(2,4-pentanediono)indium* (Eastman 8015) as marking one more stage along chemistry's road from cookbook to quantum mechanics. Must be close to half way by now.

Our story about the indium chelate of acetylacetone starts with a strong kitchen flavor. We made it as a tag for tagging silicone lubricants to facilitate spectrographic identification of suspicious spots. Such detective stunts are part of the way of life in a film factory. Then it occurred to us that others—perhaps some engaged in the mysteries of setting up catalyst beds—might like an indium compound of definite composition and solubility properties. Perhaps they think more in terms of electron configuration than of recipes. Perhaps they might find the effect of enolate resonance on the normal $5s^25p^1$ configuration of the indium atom puts it in the right condition to join the rest of a catalyst system, after which the organic accoutrement of the indium is burned off and reaction rates shoot way, way up and everybody has a wonderful time. Perhaps and perhaps not.

Some 3900 Eastman Organic Chemicals can be ordered from Distillation Products Industries, Rochester 3, N. Y. (Division of Eastman Kodak Company), who will gladly supply a catalog of them. The reasons why it seemed necessary to add a given compound to the catalog are sometimes a little hard to follow.

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

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Meetings

Limnology and Oceanography

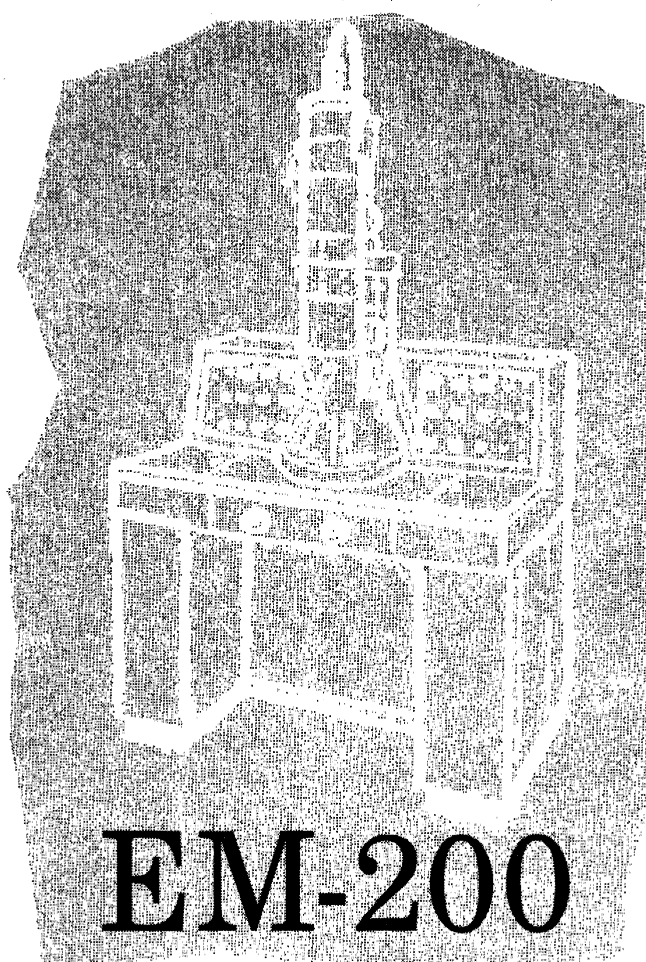
Symposia on two subjects of highly scientific and social significance were prominent in the two-and-a-half-day program of the Pacific Section of the American Society of Limnology and Oceanography (ASLO), during the 42nd annual meeting of the Pacific Division of the AAAS, at Davis, California. Earlier in the meeting the wide scope of scientific disciplines involved in studies of the aquatic world was illustrated in sessions for contributed papers. Topics ranged from physical and chemical conditions in a California lake, through observations of temperature variations and fish behavior from a fixed tower in the ocean, to laboratory studies of the respiration of individual sardine eggs and larvae.

The first symposium, on the scientist's responsibility in the nuclear age, jointly sponsored by ASLO, the AAAS Committee on Science in the Promotion of Human Welfare, and the Scientists' Committee for Information on Radiation (San Francisco area), was chaired by George E. Pake, of Stanford University. The participants were Robert B. Brode and Arthur Rosenfeld (University of California), Leonard A. Herzenberg (Stanford University), Lester Breslau (California Department of Public Health), and Halsted Holman (Stanford University). For background, the participants reviewed research developments in the fields of physics, medicine, and genetics that have arisen as a result of the development of the nuclear age. They stated their conviction that the scientist has a duty to communicate to the public the results of his research, in terms understandable to nonscientists, and his informed opinion on the significance to society of the scientific developments. They further discussed the scientist's role in the formulation of public policy. Agreement that the scientist has such a role was general, but opinions differed on how he should participate in policy-decision-making, ranging from the view that he should be completely involved, by running for political office or accepting political appointments, to the view that he should remain quietly in the laboratory until asked for his advice on a specific subject.

The need for the scientist to communicate to the nonscientific public, and the manner in which this could be accomplished, were major topics in the ensuing discussion. Reporter Brown of the Sacramento *Bee* came to the defense of the newspapers after somewhat derogatory remarks had been directed against them. He felt that the scientist should approach this communication problem scientifically by learning more about the manner in which newspapers must operate, and that by so doing he would be better able to give the proper information to the reporters and much less critical of the way it came out in the newspapers. He believed that scientists were too much concerned with the opinion a colleague might draw from a newspaper article and not concerned enough with the problem of transmitting the essential "kernel" of information to the general public.

The more specific symposium, on biological implications of radioactive isotopes in the sea, was organized and chaired for ASLO by William Aron, of the University of Washington. William Royce (Fisheries Research Institute, University of Washington) discussed the rapid increase in the use of food from the sea, pointing out that not only may radioactive pollution be harmful but that the mere suspicion of harmful effects can create international problems of high propaganda potential. B. H. Ketchum (Woods Hole Oceanographic Institution) showed that marine organisms, by concentrating chemical elements and by horizontal and vertical migration, could cause as much transport of radioactive isotopes upward or downward as the physical mixing processes in the ocean. From investigations at Rongelap Atoll, Edward Held (University of Washington) indicated the qualitative distribution of radionuclides in the flora and fauna 5 years after contamination from a single fallout event. There are distinct differences in concentration between the terrestrial and the marine environments, and levels in man reflect both the terrestrial and the marine sources of his food.

Data from monitoring low-level radioactive wastes flowing into the Irish Sea from the British reactor at Windscale were reviewed by Michael Waldichuk (Fisheries Research Board of Canada Biological Laboratory, Na-



EM-200

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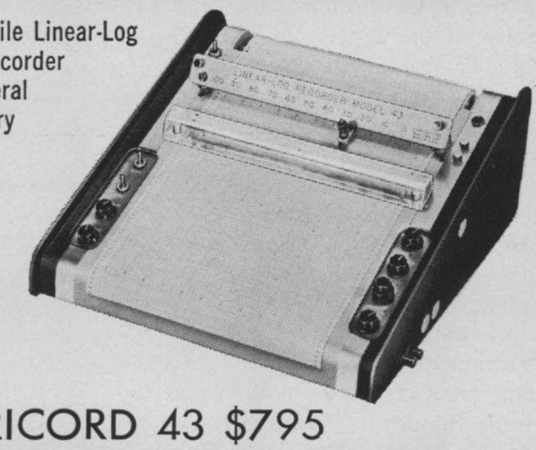

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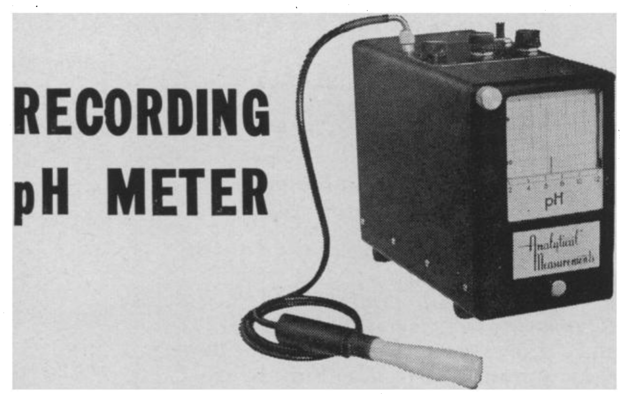

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naimo, British Columbia) as a basis for summarizing the oceanographic problems encountered in attempting to predict levels of radioactive pollution. Joel Hedgpeth (Pacific Marine Station, Dillon Beach, California), well known exponent of the dangers of disturbing an ecological balance, surprised the group by conceding that some radioactive pollution in the sea appears to be inevitable, and noted that a certain amount of radiation background may even be essential to life. However, he stressed that we should learn much more about the effects on the biota itself, as distinct from use of the biota by man, before tampering very much with the environment. O. E. Sette (Bureau of Commerical Fisheries Biological Laboratory, Stanford, California), in summarizing and correlating the highlights of the talks, pointed out that there may be one quite beneficial side effect of the radioactive pollution problem—the stimulation of many phases of instrumentation and research in oceanography, especially of research on interrelations in the biological food web in the sea.

J. F. T. SAUR
Bureau of Commercial Fisheries, U.S. Fish and Wildlife Service, Stanford, California

Forthcoming Events

October

23–24. Institute of the Aerospace Sciences and the Canadian Aeronautical Inst., Ottawa, Ont., Canada. (H. Harris, IAS, 2 E. 64 St., New York 21)

23–28. Congress of Chemical Engineering, 1st, San Juan, P.R. (R. Munoz, Apartado 47, Estación de Río Piedras, San Juan)

24–25. Shallow Water Research Conf., Gulf Coast, 1st natl., Tallahassee, Fla. (D. S. Gorsline, Oceanographic Inst., Florida State Univ., Tallahassee)

24–26. Aerospace Nuclear Propulsion, intern. symp., Las Vegas, Nev. (P. M. Uthe, Lawrence Radiation Laboratory, Univ. of California, Box 808, Livermore)

24–27. American Dietetic Assoc., 44th annual, St. Louis, Mo. (Mrs. T. Pollen, ADA, 620 N. Michigan Ave., Chicago 11, Ill.)

26–27. American Soc. of Tool and Manufacturing Engineers, Toronto, Canada. (A. Cervenka, Vanderbilt Blvd., Oakdale, L.I., N.Y.)

26–27. Instrumentation Facilities for Biomedical Research, symp., Omaha, Neb. (H. G. Beenken, Univ. of Nebraska College of Medicine, 42 and Dewey Ave., Omaha)

26–27. New Mexico Acad. of Science, Albuquerque. (K. G. Melgaard, P.O. Box 546, Mesilla Park, N.M.)

26–28. Professional Group on Electron Devices, annual meeting, Washington, D.C. (I. M. Ross, Technical Program Chairman, Room 2A-329, Bell Telephone Laboratories, Murray Hill, N.J.)

26–30. American Soc. for Aesthetics, Detroit, Mich. (J. R. Johnson, Cleveland Museum of Art, Cleveland,6, Ohio)

27–28. Shallow Water Research Conf., Pacific Coast, 1st natl., Los Angeles, Calif. (D. S. Gorsline, Oceanographic Inst., Florida State Univ., Tallahassee)

27–29. Association of Clinical Scientists, annual, Washington, D.C. (R. P. MacFate, Secretary, ACS, 323 Northwood Rd., Riverside, Ill.)

28. American Mathematical Soc., 583rd meeting, Cambridge, Mass. (E. Pitcher, Lehigh Univ., Bethlehem, Pa.)

29–31. Photoelasticity, intern. symp., Chicago, Ill. (P. D. Flynn, Illinois Inst. of Technology, Chicago 16)

29–1. Marine Biology, intern. conf. (by invitation only), Princeton, N.J. (Mrs. E. Purcell, Interdisciplinary Conference Program, Rockefeller Center, Time & Life Bldg., New York 20)

30–1. American Oil Chemists Soc., Chicago, Ill. (W. O. Lundberg, Hormel Inst., Univ. of Minnesota, 801 16th Ave., NE, Austin)

30–1. Society of Rheology, annual, Madison, Wis. (J. D. Ferry, Univ. of Wisconsin, Madison)

31–2. Interscience Conf. on Antimicrobial Agents and Chemotherapy, 1st, American Soc. for Microbiology, New York, N.Y. (ASM, 19875 Mack Ave., Detroit 36, Mich.)

November

1. Rheumatic Fever, symp., New Haven, Conn. (E. A. Sillman, Connecticut Heart Assoc., 65 Wethersfield Ave., Hartford 14, Conn.)

1–3. Alkaline Pulping, 15th conf., Houston, Tex. (Technical Assoc. of the Pulp and Paper Industry, 360 Lexington Ave., New York 17)

1–3. Experimental Mechanics, 1st intern. congr., New York, N.Y. (Soc. for Experimental Stress Analysis, P.O. Box

168, Central Sq. Station, Cambridge 39, Mass.)

1–3. High Magnetic Fields, intern. conf., Cambridge, Mass. (H. H. Kolm, Lincoln Laboratory, Massachusetts Inst. of Technology, Lexington 73)

1–3. Transplantation, CIBA Foundation symp. (by invitation), London, England. (CIBA Foundation, 41 Portland Pl., London, W.1)

1–4. American Soc. of Tropical Medicine and Hygiene, Washington, D.C. (R. B. Hill, 3575 St. Gaudens Rd., Miami 33, Fla.)

1–4. Society of Economic Geologists, Cincinnati, Ohio. (E. N. Cameron, Science Hall, Univ. of Wisconsin, Madison 8)

2–3. Cancer Chemotherapy, clinical symp., Washington, D.C. (T. P. Waalkes, Chemotherapy Natl. Service Center, NIH, Bethesda 14, Md.)

2–4. American Soc. for Cell Biology, 1st, Chicago, Ill. (H. Swift, Dept. of Zoology, Univ. of Chicago, Chicago 37)

2–4. Geochemical Soc., Cincinnati, Ohio. (F. R. Boyd, Jr., Geophysical Laboratory, 2801 Upton St., NW, Washington 8)

2–4. Geological Soc. of America, Cincinnati, Ohio. (F. Betz, Jr., GSA, 419 W. 117 St., New York 27)

2–4. Inter-Society Cytology Council, annual, Memphis, Tenn. (P. A. Younge, 1101 Beacon St., Brookline 46, Mass.)

2–4. National Assoc. of Geology Teachers, Cincinnati, Ohio. (D. J. Gare, Principia College, Elsah, Ill.)

2–4. Paleontological Soc., Cincinnati, Ohio. (H. B. Whittington, MCZ, Harvard Univ., Cambridge 38, Mass.)

2–4. Society for Industrial and Applied Mathematics, Washington, D.C. (Chairman, Program Committee, SIAM, P.O. Box 7541, Philadelphia 1, Pa.)

2–5. Mathematical Models in the Social and Behavioral Sciences, conf., Cambria, Calif. (F. Massarik or P. Ratoosh, Mathematical Models Conf., Graduate School of Business Administration, Univ. of California, Los Angeles 24)

3–4. Central Soc. for Clinical Research, Chicago Ill. (J. F. Hammarsten, Veterans Administration Hospital, 921 N.E. 13 St., Oklahoma City 4, Okla.)

4. Society for the Scientific Study of Sex, New York, N.Y. (H. G. Beigel, 138 E. 94 St., New York 28)

5–8. American Speech and Hearing Assoc., Chicago, Ill. (K. O. Johnson, 1001 Connecticut Ave., NW, Washington 6)

5–9. Society of Exploration Geophysicists, 31st annual intern., Denver, Colo. (C. C. Campbell, Box 1536, Tulsa 1, Okla.)

5–11. Stomatology of Peru, intern. congr., Lima, Peru. (A. Rojas, Avenue Pershing 155, San Isidro, Lima)

5–15. Japanese Chemical Engineers Soc., 25th anniversary congr., Tokyo and Kyoto, Japan. (Kagaku-Kogaku Kyokai, Shunichi Uchida, 609 Kojunsha Bldg. No. 4, 6-Chome, Ginza, Chou-Ku, Tokyo)

5–18. Latin American Phytotechnical Meeting, 5th, Buenos Aires, Argentina. (U. C. Garcia, Rivadavia 1439, Buenos Aires)

6–8. Association of Military Surgeons of the U.S., 68th annual, Washington, D.C. (R. E. Bitner, AMSUS, 1726 Eye St., NW, Washington 6)

6–8. Cell in Mitosis, 1st annual symp., Detroit, Mich. (L. Levine, Dept. of Biology, Life Sciences Research Center, Wayne State Univ., Detroit 2)

6–8. Chemical Engineering Div., Chemcal Inst. of Canada, Toronto, Ont. (CIC, 48 Rideau St., Ottawa 2, Ont.)

6–9. Atomic Industrial Forum–9th Hot Laboratories and Equipment Conf., Chicago, Ill. (O. J. Du Temple, American Nuclear Soc., 86 E. Randolph St., Chicago)

6–9. Southern Medical Assoc., Dallas, Tex. (R. F. Butts, 2601 Highland Ave., Birmingham 5, Ala.)

8. American Acad. of Arts and Sciences, Brookline, Mass. (J. L. Oncley, 280 Newton St., Brookline 46)

8–10. Nondestructive Testing in Electrical Engineering, conf., London, England. (Secretary, Institution of Electrical Engineers, London W.C.2)

8–11. Acoustical Soc. of America, Cincinnati, Ohio. (W. Waterfall, American Inst. of Physics, 335 E. 45 St., New York 17)

8–11. Institute of Management Sciences, San Francisco, Calif. (W. Smith, Inst. of Science & Technology, Univ. of Michigan, Ann Arbor)

8–11. Plasma Physics, American Physical Soc., 3rd annual, Colorado Springs, Colo. (F. Ribe, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, N.M.)

9–10. Operations Research Soc. of America, 20th, San Francisco, Calif. (P. Stillson, 115 Grove Lane, Walnut Creek, Calif.)

9–11. Gerontological Soc., Pittsburgh, Pa. (R. W. Kleemeier, Washington Univ., Skinker and Lindell, St. Louis 30, Mo.)

9–12. Pacific Coast Fertility Soc., Palm Springs, Calif. (G. Smith, 909 Hyde St., San Francisco 9, Calif.)

9–20. Photography, Cinematography, and Optics, 3rd intern. biennial, Paris, France. (Comité Francais des Expositions, 15 rue de Bellechasse, Paris 7)

12–17. Bahamas Conf. on Medical and Biological Problems in Space Flight, Nassau, Bahamas. (I. M. Wechsler, P.O. Box 1454, Nassau)

13–14. Exploding Wire Phenomenon, 2nd intern. conf., Boston, Mass. (W. G. Chace, Thermal Radiation Laboratory, CRZCM, Geophysics Research Directorate, Air Force Cambridge Research Laboratories, Bedford, Mass.)

13–16. Magnetism and Magnetic Materials, 7th annual intern. conf., Phoenix, Ariz. (P. B. Myers, Motorola, Inc., 5005 E. McDowell Rd., Phoenix 10)

13–17. American Public Health Assoc., 89th annual, New York, N.Y. (APHA, 1790 Broadway, New York)

13–17. Gulf and Caribbean Fisheries Inst., 14th annual, Miami Beach, Fla. (J. B. Higman, Marine Laboratory, Univ. of Miami, 1 Rickenbacker Causeway, Virginia Key, Miami 49)

13–18. European Conf. on the Control of Communicable Eye Diseases, Istanbul, Turkey. (World Health Organization, Palais des Nations, Geneva, Switzerland)

14–16. American Meteorological Soc., Tallahassee, Fla. (Executive Secretary, AMS, 45 Beacon St., Boston 8, Mass.)

14–17. Corrosion in Nuclear Technology, symp., Paris, France. (European Federation of Corrosion, Société de Chimie Industrielle, 28 rue St. Dominique, Paris 7e)

14–18. Puerto Rico Medical Assoc., Santurce. (J. A. Sanchez, P.O. Box 9111, Santurce)

15–17. Eastern Analytical Symp., New York, N.Y. (A. Rekus, EAS, Research Dept., Baltimore Gas & Electric Co., Pratt St., Baltimore, Md.)

15–18. Society of Naval Architects and Marine Engineers, annual, New York, N.Y. (W. N. Landers, SNAME, 74 Trinity Pl., New York 6)

16–18. American Psychiatric Assoc., Milwaukee, Wis. (J. D. McGucken, 756 N. Milwaukee St., Milwaukee 2)

16–18. Etiology of Myocardial Infarction, intern. symp. (by invitation), Detroit, Mich. (T. N. James, Section on Cardiovascular Research, Henry Ford Hospital, Detroit)

16–18. Southern Thoracic Surgical Assoc., Memphis, Tenn. (H. H. Seiler, 517 Bayshore, Blvd., Tampa 6, Fla.)

16–19. American Anthropological Assoc., Philadelphia, Pa. (S. T. Boggs, 1530 P St., NW, Washington, D.C.)

17–18. Southern Soc. for Pediatric Research, Atlanta, Ga. (W. G. Thurman, Dept. of Pediatrics, Emory Univ. School of Medicine, Atlanta)

17–31. National Soc. for Crippled Children and Adults, annual conv., Denver, Colo. (NSCCA, 2023 W. Ogden Ave., Chicago 12, Ill.)

19–22. International College of Surgeons, Western regional, San Francisco, Calif. (W. F. James, 1516 Lake Shore Drive, Chicago 10, Ill.)

22–27. Automation and Instrumentation, 5th conf., Milan, Italy. (Federezione delle Societa Scientifiche e Techniche di Milano, via S. Tomaso 3, Milan)

22–1. Radioisotopes in Animal Biology and the Medical Sciences, conf., Mexico City, D.F. (International Atomic Energy Agency, 11 Kärntner Ring, Vienna 1, Austria)

Letters

Coconut Water

I would like to make a suggestion on coconut (*Cocos nucifera*, L.) terminology. Many scientists have been attracted to the use of coconut liquid endosperm because of its nutritive properties for plant tissue-culture work and sporulation of fungi. Readers are somewhat confused with the terms used to indicate the liquid found when a coconut is opened. American workers refer to it as coconut milk; others, as coconut water.

In most Asian countries the term *coconut milk* refers to the milky-white sap expressed from grated nut meat or solid endosperm, *coconut water* to the liquid endosperm. Many more uses of the latter are likely to develop. I therefore suggest, for uniformity in terminology, that only one term—*coconut water*—be used to refer to the liquid endosperm, in order to avoid confusion.

CONCEPCION L. VALERA

College of Agriculture, University of the Philippines, College, Laguna

Modern Biology

I began Commoner's article "In defense of biology" [*Science* **133**, 1745, 1961] in the peace and quiet, almost the somnolence, of a comfortable armchair and it wasn't until the bottom of the second column that it broke upon me that biology was being defended against none other than myself. Commoner is concerned, it seems, over the attitude taken toward biology in my book, *The Intelligent Man's Guide to Science*, and, in particular, is horrified at my statement that "modern science has all but wiped out the border-line between life and non-life."

In response, Commoner says: "Since biology is the science of life, any successful obliteration of the distinction between living things and other forms of matter ends forever the usefulness of biology as a separate science. If the foregoing sentence is even remotely correct, biology is not only under attack; it has been annihilated."

I could not help but be moved by the anguish clearly detectable in this *cri de coeur*, and I long to assure Commoner that he need not fear. Biology will not be annihilated even if the boundary between life and nonlife vanishes.

There was, after all, a time when astronomical advance removed the boundary between earth and the other planets, and that did not annihilate geology as a separate science. The advance of knowledge in biology removed the boundary between man and other species, and that has not annihilated sociology as a separate science. In fact, both geology and sociology became more meaningful when both could draw upon and, in turn, enlighten, a broader field of inquiry.

If the distinction between life and nonlife vanishes, the science of biology will persist as the study of a particular collection of material systems that we will *still* call "life" for simplicity's sake, just as we still speak of "organic chemistry" more than a hundred years after the distinction between organic chemistry and inorganic chemistry vanished.

In fact, the importance of biology will be heightened when physicists and chemists come to realize that biology's deepest insights will be of direct service to their own fields of specialization.

Science is a unit, and if it seems broken up into arbitrary divisions, that is the fault of the age of intellectual overspecialization in which we live. Scientists who labor to make these artificial partitions between the arbitrary divisions impenetrable and unsurmountable are doing science a great disservice. Nor are they truly serving their own fields by their careful shielding of them from all contact with outside thought.

Commoner is also annoyed at my statement: "All of the substances of living matter—enzymes and all the others, whose production is catalyzed by enzymes—depend in the last analysis on DNA."

His statement, opposing that, is: "life is unique and . . . it cannot be reduced to the property of a single substance or of a system less complex than a living cell."

With reference to this remark (which he labels his "chief argument"), I can only applaud his courage, not his judgment, in declaring anything at all to be unique. There was a time when the earth was considered unique, as the only motionless object in the universe; when each species was a unique creation; when the organic chemical was uniquely a product of life, and the "organized ferment," uniquely a creature of the intact cell. Where are these uniquenesses and a hundred others? The history of science is filled with the bleached bones of uniqueness, dead at the thrust of knowledge that has become more and more comprehensive.

As to Commoner's remark that life cannot be reduced to the property of a single substance or of a system less complex than a living cell (and with what courage he pronounces his negative fiat), I repeat my own remark that life depends, *in the last analysis*, on DNA.

To depend "in the last analysis" does not necessarily imply a simple or direct dependence. The dependence is a supercomplex one, in fact, but that in itself does not alter matters.

One can say that American law is based, *in the last analysis*, on the Constitution, but that does not mean that any amount of reading of the Constitution *alone* will explain the nature of the city ordinances of Tulsa, Oklahoma. For that matter, a close reading of the 14th Amendment will not elucidate the social structure of Mississippi. Yet it remains fair to say that the Constitution is the basic law of the land.

And life depends, in the last analysis, on DNA.

If Commoner disapproves of the incoming tide and wishes to amuse himself by standing on the shore and commanding it to stop, he may. He may also quote as many authorities as he likes in order to impress the waves.

But he will get his feet wet just the same.

ISAAC ASIMOV
Boston University School of Medicine, Boston, Massachusetts

Barry Commoner is to be congratulated on his succinct and elegant article on the status of "traditional" and "modern" biology, and on his proposal to restore the science of life. If one assumes general agreement on this goal, the question arises, "How is one to proceed?" I believe that things might be initiated if all modern biologists were asked to take three giant steps backwards and to ask themselves the question: "What is really being studied when we study life?"

Perhaps the chief factor which has placed modern biology in a situation analogous to that in which 19th-century physics found itself in the first part of this century is that modern biologists have failed to realize that the study of life is the study of living organisms and living cells. As Commoner has pointed out, Bohr's theory of complementarity should set the limits as to how far one can go in biology, just as Heisenberg's principle of indeterminacy sets obvious limits in physics. It seems almost axiomatic that putting physicochemical questions to a physical-chemical system results in answers only in terms of the units used, and not in terms of the holistic nature of the organism or intact cell. Furthermore, the fact of epigenesis, and the apparent requirement of DNA for a cellular environment to execute its action, should put into more proper perspective the tingling sensation and fascination which arises at the mention of DNA. The imbalance of interest in DNA certainly stems from such statements as Asimov's that "modern science has all but wiped out the border-line between life and non-life." Such a statement has accuracy only within the framework of what one considers life to be. Replication of molecules is not life.

The regrettable schism between "breakthrough" areas and traditional areas of biology has resulted in a state of affairs that needs obvious correction. Some examples from my personal experience come to mind: (i) ridicule of the direct observational method and a predilection for indirect methods; (ii) introductory courses given over completely to nontraditional biology; (iii) a course in protozoology devoted entirely to a single species; (iv) a professor telling his freshman students that remembering names of species and classification was a discredited method and was not required in his course (he then went on to have them memorize the Krebs cycle, which is really a kind of classification); (v) an internationally known modern biologist, who, having given a seminar on nucleoproteins of frogs, was asked what species of frog was used; his answer, "I don't know, they were bought from some supply house"; (vi) a predoctoral graduate student in biophysics, supported by a large government stipend, declaring that his only wish was to see a protein molecule divide under a microscope (light); (vii) the teaching in many universities that viruses are organisms and bridge the gap between living and nonliving phenomena; (viii) financial support for "breakthrough" areas rather than additive areas of varying magnitude; and (ix) obsession with confidence limits and evaluations. I am certain that any reader can compile an even longer list.

We might learn a lesson from physics, where the mother-child relationship has not been so prodigal. The wave and corpuscular theories of light are still used and found necessary to explain certain phenomena, notwithstanding the quantum theory. I think Commoner has done a great service to all biologists in making a plea for the integrity of traditional and modern disciplines. Furthermore, it is my belief that the bewildered mother would receive again her fast-talking child, and would even take on some of the child's habits, should the road be made open and should agreement be reached as to what each was examining.

H. H. NAJARIAN
University of Texas Medical Branch, Galveston

I believe that most of Asimov's remarks require no comment beyond what has already been said in my original article. However, one of his statements tends to give the reader a misleading idea of the content of my article, which I should like to correct.

With respect to the distinctions between living and other forms of matter, Asimov states: "Scientists who labor to make these artificial partitions between the arbitrary divisions impenetrable and unsurmountable are doing science a great disservice. Nor are they truly serving their own fields by their careful shielding of them from all contact with outside thought."

In the second of the foregoing sentences Asimov has precisely reversed the main point of my article—which is that the real distinction between life and nonlife ought to be recognized *so that physics and chemistry can be more effectively applied to biological problems.* Far from avoiding "contact with outside thought," my article consists of arguments in support of the uniqueness of life which are derived *from* physical and chemical principles.

In the first of the quoted sentences, Asimov has also misinterpreted that part of my article which deals with the significance, for biology, of the principle of complementarity put forward by Bohr. Bohr points out that for reasons which are fundamental to the present structure of quantum physics, a subatomic particle can be described, at any one time, by either its corpuscular or its wave properties, but never by both together. He suggests—and I support this view—that a similar complementarity governs the relationship between two features exhibited by living organisms—the manifest living state and the physicochemical events which go on within it. Asimov is at liberty to regard this proposal as an "artificial partition between the arbitrary divisions" of life and nonlife. But in that case he ought, in the name of logic, to say the same about the distinction between the corpuscular and wave properties of subatomic particles. Yet, much of modern physics has been founded on this distinction.

BARRY COMMONER
Committee on Molecular Biology, Adolphus Busch III Laboratory, Washington University, St. Louis, Missouri

Daedalus and Minos

Dedijer's very interesting article "Why did Daedalus leave?" [*Science* **133**, 2047 (1961)] leaves open a tantalizing question: How about the fate of Minos? In those countries in which the social and political environment is unfavorable to the development of science, does not the return of the Daedali deeply threaten the social system which led to their flight? Would not their return and creation of new traditions necessary to their existence construct a bath to scald Minos to death? And is not Minos, unconsciously perhaps, behaving in his own self-interest in putting last on his priority list "a quantity of problem-solving Daedali?"

LINDSEY R. HARMON
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