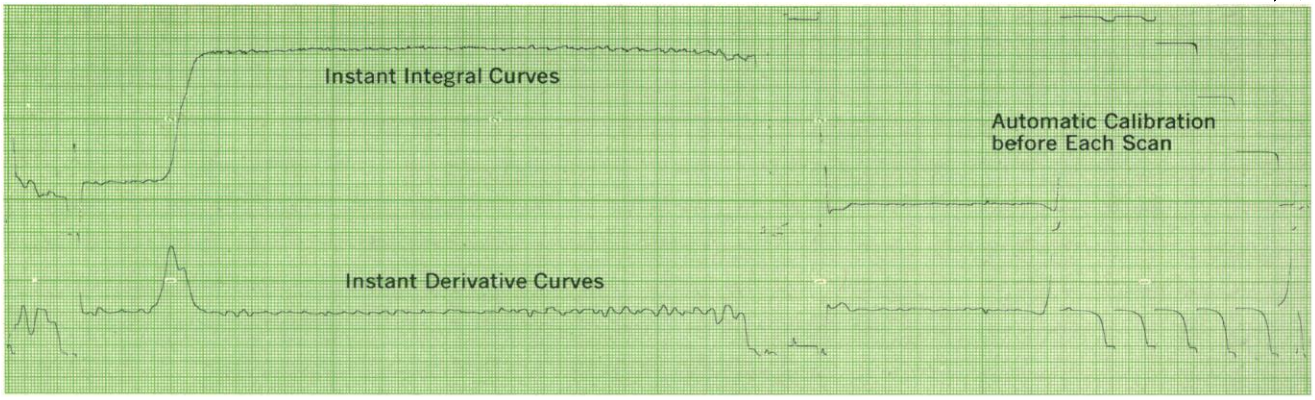
SCIENCE

28 January 1966
Vol. 151, No. 3709

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

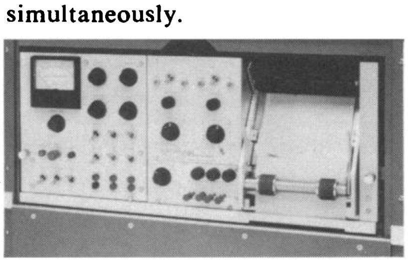
LIGHTNING



Boundary Velocity Experiment, two DNA's, 44,000 rpm, 265 mμ

Direct Scanning...the new era in analytical ultracentrifugation

The Photoelectric Scanner permits investigators, for the first time, to take full advantage of the highly discriminating absorption optical system of the Model E. It provides split-beam photometry—during centrifugation, at wavelengths selectable at will from 440 mμ down to 236 mμ. You can see what is happening in the cell as it happens because you get an immediate written record, and both integral and derivative curves are recorded simultaneously.



Recorder and controls for Photoelectric Scanner

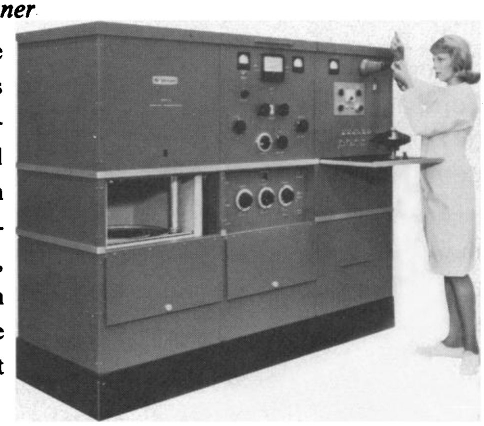
Thus direct scanning frees you from the tedious procedures associated with the camera; provides "direct viewing" of sedimentation processes, electronic precision and discrimination in scanning the cell, and a variety of wavelengths at which to work. The precision and versatility that this new tool brings to biochemical research will inevitably open new areas of study. Already two investigators working with a scanner have been able to distinguish the catalytic and regulatory protein subunits of an enzyme in an association-dissociation study that augurs well for exciting work ahead.

What that work will be, what more will be accomplished in the era of direct scanning, only time and the ingenuity of investigators will tell.

Inherent advantages of the Scanner

- Because the Scanner utilizes the split-beam principle, two samples in a double sector cell can be subjected to identical experimental conditions—an important factor in studying extremely small differences in sedimentation coefficients, for example. Or sample solution and solvent can be used in the double sector cell, with solvent reading automatically subtracted from the sample solution.
- With the Scanner classical sedimentation equilibrium measurements at extremely low concentrations in the UV are significantly easier to make. And they are more accurate because calibration steps are recorded before each scan.
- Having both curves simultaneously is a real advantage. For example: the derivative curve can show the presence of secondary components not readily recognizable from the integral curve; the integral curve can show heterogeneous material not revealed by the derivative curve.

For more information about the Photoelectric Scanner, write to Spinco Division at the address below.



Beckman INSTRUMENTS, INC.
SPINCO DIVISION
PALO ALTO, CALIFORNIA • 94304

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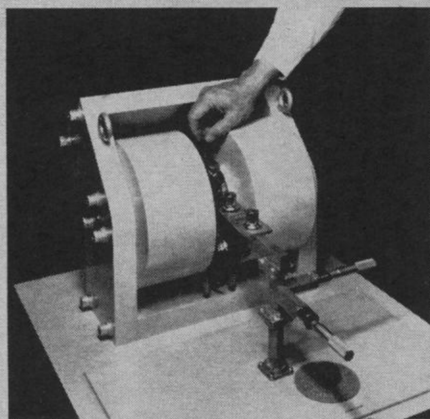
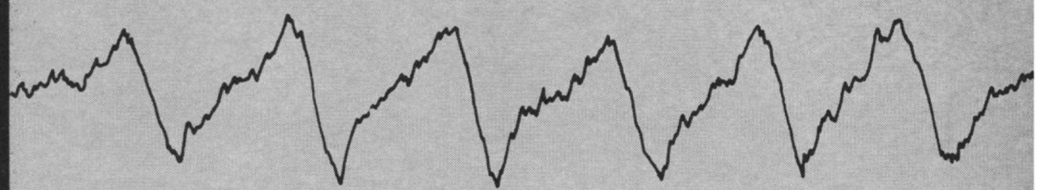
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Intense summer thunderstorms produce brilliant luminous flashes. These flashes, composed of one or more strokes, are usually studied on a time scale measured in *milliseconds*. However, recently the first photographic record of spectral emissions on a microsecond time scale was obtained with a high-speed, slitless spectrograph. See page 451. [Richard E. Orville, University of Arizona]



Closeup of sampling area shows large, accessible sampling system of Model ESR-1. Controls are all convenient to the seated operator.



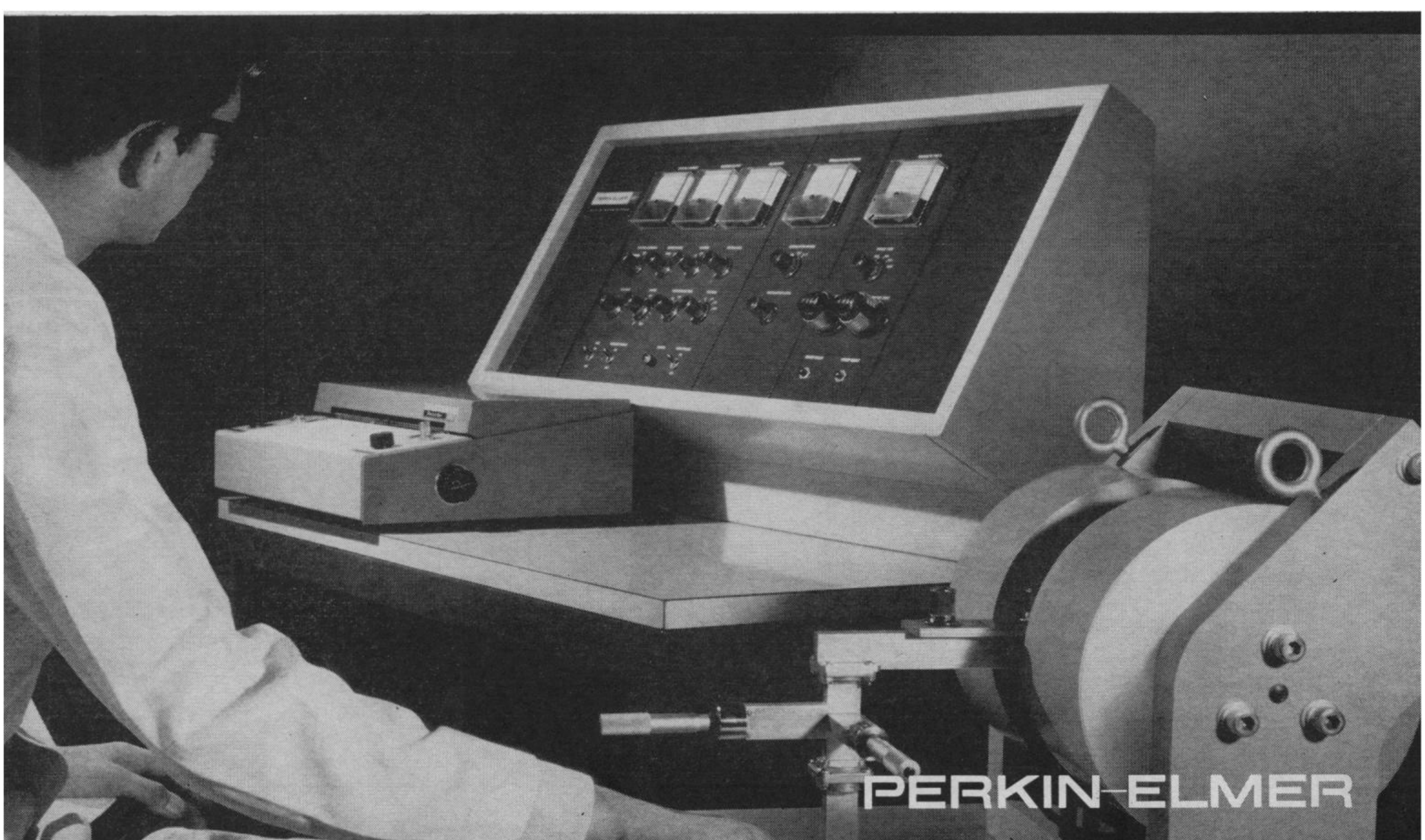
Metals of the transition series (e.g., manganous ions) occur in biological materials such as living bacteria, algae and in complex proteins. To detect these metals in aqueous samples the ESR spectrometer must have high sensitivity. The illustration shows the characteristic ESR signal of manganous ion consisting of six peaks—each separated by approximately 96 gauss. The observed signal-to-noise ratio for 10^{-6} molar concentration is about 10:1. Sample volume was 0.16 ml and the run was made at a time constant of one second and 100 kc field modulation amplitude of 20 gauss. The klystron source operated at 9.0 Gc.

DETERMINE FREE RADICALS IN SURVIVING TISSUE IN THE PRESENCE OF LIQUID WATER WITH THE NEW MODEL ESR-1

Electron Spin Resonance spectroscopy is a technique now being used by biologists, biochemists and organic chemists to gain valuable information—

- about the production of free radicals in biochemical processes in living tissue;
- about the bonding sites of transition series metals in biological compounds;
- about structural changes due to radiation damage to the molecule;
- and about the kinetic behavior of organic free radicals occurring as intermediates in a chemical reaction.

A unique feature of the new Perkin-Elmer Model ESR-1 Electron Spin Resonance Spectrometer is the microwave cavity design, which permits the detection of weak ESR signals in surviving tissue at life temperatures, even in the presence of a large quantity of liquid water. The long cavity design minimizes the effect on the signal of sample location so that sample placement is not critical. The large sample cell can accommodate manageable amounts of living tissue. Cavity Q can be precisely regulated even with the sample in place. The Model ESR-1 detects 5×10^{-9} molar concentrations of free radicals in aqueous solutions at a one-second response time. For more information, write Perkin-Elmer Corporation, Instrument Division, 723, Main Avenue, Norwalk, Connecticut.



Wald's letter makes the valid point that this reform will best be brought about when editors of journals require or strongly recommend the reporting of spectral data in frequency units. In certain fields of science, such a policy could be instituted now without any major difficulty, for the changeover to frequency units is already in progress. A rapid survey of recent literature provides some indications of the extent to which this change has taken place in chemistry. Issues of the American Chemical Society journal *Inorganic Chemistry* for February and December 1965 (chosen arbitrarily) contain 24 articles in which vibrational spectra or data appear; in all but one the data are presented and tabulated in frequency units (cm^{-1}). In the same issues 19 articles contain electronic spectral information; the data appear in frequency units in 12 and in wavelength units in 7. In the recent literature of organic chemistry usage in articles presenting infrared data appears to be about evenly divided between frequency units and wavelengths. In both fields, the use of frequency units has increased markedly during the last five years. However, nearly all data on visible and ultraviolet spectra in organic chemistry journals are still published in wavelength units. That the change to frequency units for electronic spectra is lagging behind that for vibrational spectra reflects the fact that frequency-recording infrared spectrometers are now routinely available, whereas most ultraviolet-visible spectrometers can be obtained only with wavelength recording.

In chemical articles reporting vibrational data in frequency units, wave numbers (cm^{-1}) are universally used, and the same frequency units are also most commonly employed for electronic spectra. Because the change to wave numbers is already well under way for vibrational spectra, and because it would be desirable to have compatible units in all the main spectral regions, wave-number units (possibly in mm^{-1}) seem preferable to Fresnel units for the visible and ultraviolet regions also.

Wald recommends an ascending scale of frequencies from left to right. Nearly all of the tens of thousands of infrared spectra already in the literature appear with frequency decreasing from left to right, and the same direction is usual for electronic spectra when frequency units are employed. It would probably be wise not to try to alter the present convention. An arbitrary change would certainly lead to much confusion and might seriously impede the change to frequency units which is now taking place.

ROBERT WEST
Department of Chemistry,
University of Wisconsin, Madison

. . . In the study of optical properties of insulating solids, the practice of plotting spectra on a frequency scale has been widespread for a number of years. It dates back at least to the early 1930's and the work of Pohl's group on the alkali halides. The frequency unit most often used is the energy unit, electron volt. The numbers are convenient; an *F* center absorbs at 2 to 3 eV, a pure alkali halide at about 5 eV or more. Furthermore, since the fundamental theoretical quantity is the energy (as Wald points out), no further conversion, however trivial, is necessary.

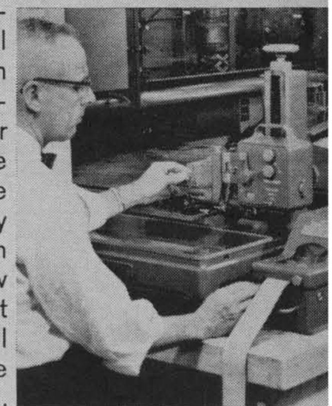
The advantages of using energy (or frequency) rather than wavelength are all that Wald claims. And to the experimentalist who is interested in having his work noticed, there is another point: given two papers containing the same data, in the first case plotted linearly as a function of energy, in the second plotted linearly as a function of wavelength, theorists will study, try to interpret, and refer to the first much sooner than they will the second.

W. BEALL FOWLER
Department of Physics,
University of Illinois, Urbana

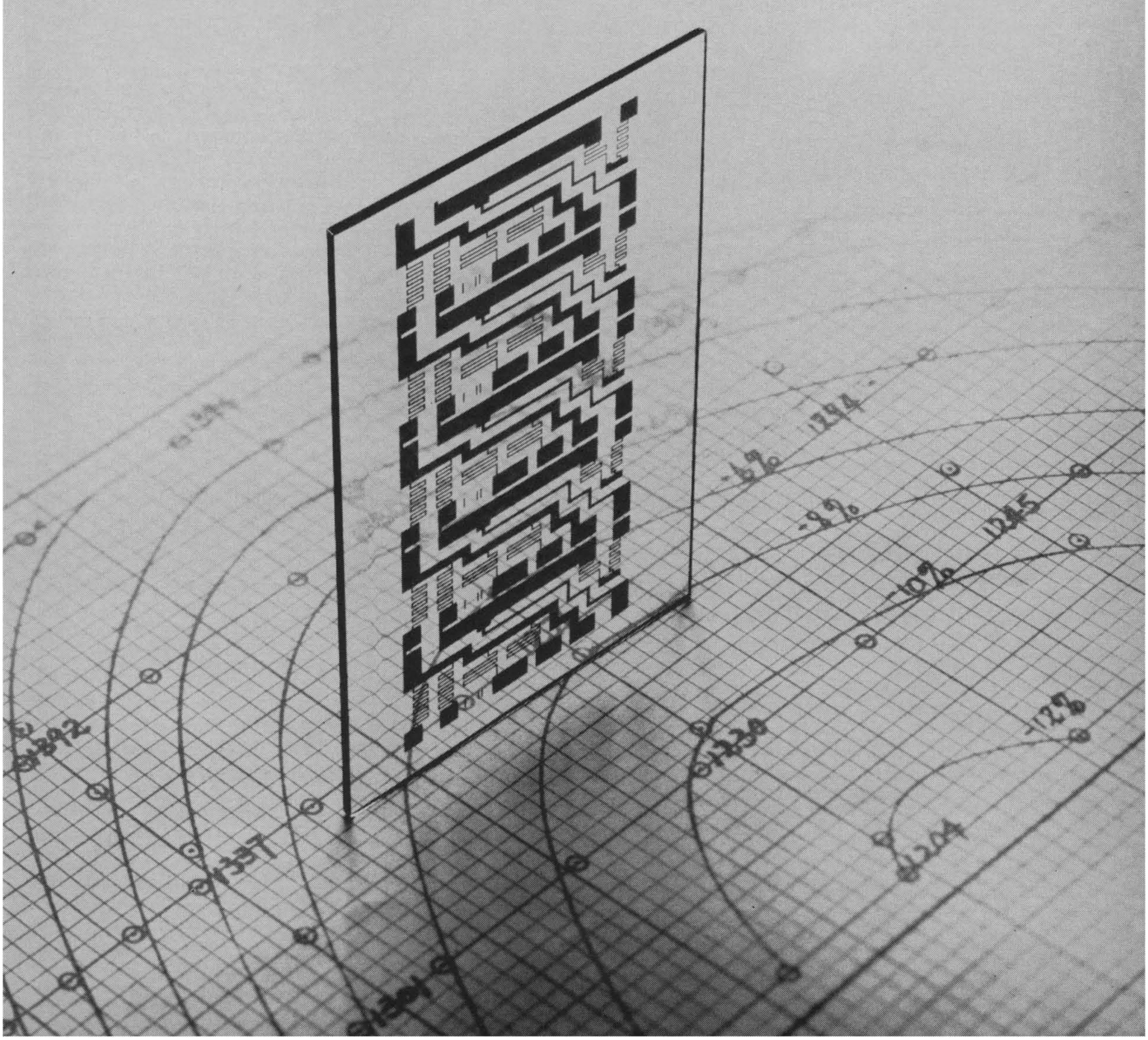
. . . In developing and using spectrophotometers over a period of 25 years, I have found that the ultimate problem is one of accommodating the many different spectral ranges and different magnifications of range that a modern spectrophotometer affords. The ideal answer is a logarithm-of-frequency scale (which, happily, is the same, except for right-left inversion, as a logarithm-of-wavelength scale). Using such a scale an investigator can deal equally well with the range from 2000 to 4000 Å, 3000 to 6000 Å, 4000 to 8000 Å, 8000 to 16,000 Å, and so on. The point is that on a logarithmic scale each of these ranges covers the same width of graph paper and indeed can be drawn on the identical grid (identical format). Or, if desired, a five or ten times greater magnification of abscissa can be employed, in any subportion of the spectrum, again with the same format of

PLOTTING THE UNMEASURABLE

In a tantalum thin film circuit where the film is 400 atom layers thick, a variation in thickness of as little as four atom layers can cause a significant difference in resistance. Since Western Electric is using an increasing number of thin film circuits in the sophisticated communications equipment we are now making for the Bell System, we needed a rapid but reliable method of measuring variations of that order. ☐ Originally Bell Telephone Laboratories engineers worked out a method of using a stylus measuring device to give measurements with a precision of about 15 atom layers. But this was not close enough. So Western Electric engineers went further. ☐ Using the statistical technique known as multiple regression analysis, they developed a computer program that enabled them to derive contour plots of the surface of the film which gave them results almost five times as accurate as their original measurements. This ability to analyze processes far more closely than straightforward measurement would allow is becoming an increasingly important part of Western Electric's job in helping the Bell telephone companies give America the most convenient communications on earth.



Western Electric
MANUFACTURING & SUPPLY UNIT OF THE BELL SYSTEM



graph paper. In acoustics, electronics, chemistry, and other fields, logarithmic scales have proved to be invaluable—the decibel scale, for example, or *p*H. Some years ago I presented many unanswerable arguments for using a logarithmic scale [*J. Opt. Soc. Am.* **32**, 229 (1942)]. With the equipment described in that paper, many millions of spectral curves have been plotted—with logarithm-of-frequency used as abscissa—and have had a variety of applications.

WILLIAM A. SHURCLIFF
Cambridge Electron Accelerator, Harvard University, Cambridge, Massachusetts

Toward Innovation

In his editorial "Barriers to innovation" (15 Oct., p. 295), Wolfle points out that "In new and undeveloped areas such as space exploration, only cost, ingenuity, and technological feasibility place limits on innovation. But innovation in civilian industry encounters a number of other barriers." There is no question that innovation is primarily controlled by political considerations—economic, social, managerial, fiscal, regulatory. Technological knowledge is an impotent force unless political consensus creates a climate conducive to its application. Such consensus requires fresh attitudes by those who control the resources for innovation—government, industry, labor, and the professions. The problem is how best to gain such new attitudes.

I suggest that we would do well to experiment with new institutional relations between these power groups in order to make them aware of the mutuality of enlightened self-interest in innovation. Such awareness can lead to progressive attitudes and to actions that are complementary instead of antagonistic. The School Construction Systems Development project in California (set up by Educational Facilities Laboratories, 477 Madison Avenue, New York 10022) is one example of a successful experiment where new institutional relations helped create an improved climate for innovation—in this case, in building technology. Plans are now being considered by other groups to conduct similar experiments in other parts of the country on other functional needs of society, for example, transportation and education. . . .

My recent experiences in government and in industry make me as hopeful as Wolfle that increasing attention is being paid to the nontechnical barriers to innovation. As yet, however, we are for the most part still talking singly. Let us experiment together.

MICHAEL MICHAELIS
1735 Eye Street, NW, Washington, D.C. 20006

How the Spider Got into the Psalm

In 40 years of Old Testament study I have never come across a spider in the Psalms. Frank Allen (Letters, 29 Oct., p. 554) claims he sees one in Psalm 90:9—

> *Ki kal yomenu panu b'ebrascha,*
> *Kilinu shanenu k'mo hegeh,*

the second line of which he translates, "We spend our years like a spider," adding "—spinning our webs of life."

Beautiful poetic imagery, but not a translation of the Hebrew text.

Psalm 90 was written about 550 to 450 B.C. It was incorporated into the final edition of the Psalter circa 100 B.C. The whole of the Hebrew Bible (Law, Prophets, and Hagiographa) was canonized at Jamnia, Palestine, in 93 Christian Era. Then came the translations: Western Aramaic (Targum), Greek (Septuagint), Latin (Vulgate), Arabic (Saadya Gaon), German (Luther), and English (Coverdale, 1535; King James, 1611; Protestant American Standard Version, 1901; Jewish Publication Society, 1917; New American Catholic Edition, 1952; Protestant Revised Standard, 1952). Not one hints of a spider in Psalm 90.

In the University of Chicago's *An American Translation* (1931), J. M. Powis Smith renders Psalm 90:9—

> For all our years vanish in Thy wrath,
> We come to an end; our years are like a cobweb wiped away.

I find no more textual basis for Smith's cobweb than for Allen's spider. The literal translation, the English for every Hebrew word, is:

> For all our days we have faced Thy wrath,
> We end our years as in a sigh.

The Psalms are Hebrew poems. Biblical Hebrew poetry is characterized by parallelism; the words or clauses of the alpha half of a verse parallel those of the beta half. Thus *yomenu* ("our days") in Psalm 90:9 alpha parallels *shanenu* ("our years") in beta. *Kal . . . panu* ("all . . . we have faced") parallels *kilinu* ("we end") in beta. This leaves us *b'ebrascha* ("thy wrath") demanding a matching term. *K'mo hegeh* ("as in a sigh") is given.

The spider appears but twice in the Hebrew Bible: Job 8:14—"And the web of the spider is his trust," and Isaiah 59:5—"And they shall weave a spider's web." The Hebrew for spider is *akkabis*; for web, *kur*.

How did Smith and his disciple Allen get entangled in spinneret silk? Whence the "cobweb?" They somehow extract it from the phrase *k'mo hegeh* ("as in a sigh"). Some translators render the two words, "as a tale that is told." The noun *hegeh* derives from the verb *hagah*, meaning to point, to pierce, to reason, argue, pronounce, recite, spell, murmur a charm. *Hegeh*, the noun, is found three times in the Old Testament: our Psalm 90:9; Job 37:2—"And the *sound* that goeth out of His mouth"; and Ezekiel 2:10—"And there was written therein lamentations, and *moaning*, and woe." There is neither spider nor web associated with *hegeh* in these verses.

Smith knew post-Biblical Hebrew literature (Talmud and Midrash), wherein the spider symbolizes bad luck. In the Babylonian Talmud, for example, we find, "The evil inclination is at first like the thread of a spider. . . ." The evil inclination is the fuel kindling God's wrath. Thus Smith rounds out the parallelism in concept, forging a gossamer link between *hegeh* and "cobweb." Allen must have reasoned: where there is a web there must be a spider.

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South Orange, New Jersey 07079

Erratum: Wrong Man

In my letter in the issue of 24 December ("Looking ahead," p. 1667), I erroneously made Klement Gottwald, instead of Walter Ulbricht, the protagonist of "a story popular in Germany (East and West) during the 1950's." I am indebted to Károly Balogh for reminding me that Gottwald was Ulbricht's Czech counterpart.

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Chevy Chase, Maryland

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SCIENCE

National Science Policy

Federally supported research activities are being reexamined. The immediate cause is the budgetary squeeze brought on by the war in Vietnam. More fundamental is the fact that a 20-year honeymoon for science is drawing to a close. Although needs for support of basic research are increasing, expanded budgets will be obtained only after convincing justification has been provided. Indications of the present climate can be seen in the executive branch, the press, and Congress. In contrast to other years, President Johnson hardly mentioned science in his State of the Union speech. In an article in the December issue of *Discovery*, John Finney, influential Washington correspondent of the New York *Times*, was critical of science policy making. Two congressional committees have expressed their concern. In hearings held 7, 10, and 11 January, a subcommittee headed by Representative Henry S. Reuss asked: "Are we matching research and development programs with national goals?"

The most significant development affecting science is the content of the report of the Daddario subcommittee (*Science*, 14 January). This document is the result of a searching examination of the National Science Foundation. It is especially critical of the quality of national science policy making. It urges a new role for the National Science Board, and it suggests that NSF should become more interested in applied research.

Two years ago, the Daddario subcommittee sought answers to the following questions:

> (1) What level of Federal support is needed to maintain for the United States a position of leadership through basic research in the advancement of science and technology and their economic, cultural, and military applications? (2) What judgment can be reached on the balance of support now being given by the Federal Government to various fields of scientific endeavor, and on adjustments that should be considered, either within existing levels of overall support or under conditions of increased or decreased overall support?

In one form or another these questions have been posed by Congress since 1950. Originally NSF was expected to provide the answers, but it managed to avoid the problem. Congress did not press the issue, for the funds devoted to science were relatively small, and the honeymoon was on. Apparently despairing of getting a response from NSF, President Kennedy in 1962 assigned the problem to the President's Science Advisory Committee, Office of Science and Technology. When this group was not sufficiently responsive, the Daddario subcommittee put the questions to the National Academy of Sciences (*Science*, 30 April and 14 May 1965). The Academy recommended a 15-percent annual increase for support of basic research and suggested use of NSF as a "balance wheel," but did not provide mechanisms for allocating funds among the various branches of science.

The new Daddario report implicitly is critical of this failure. How can NSF act as a balance wheel if no one knows what constitutes balance? Having failed to obtain what it considered satisfactory guidance from NAS, the Daddario subcommittee has now turned to another source. The NSF Board has been selected as the new fount of wisdom, or, perhaps more accurately, the holder of the buck. The report, however, calls for a diminished role of the Board in the management of NSF.

With its comments and its recommendations of drastic changes the report conveys congressional impatience with key elements of our scientific leadership. As the government agency charged with fostering basic research, NSF has a special responsibility to lead in formulating and illuminating science policy. It must also be a more skillful advocate of the benefits that support of basic research yields the nation.—PHILIP H. ABELSON

23–25. **Biophysical** Soc., 10th annual mtg., Boston, Mass. (J. Baruch, Bolt, Beranek and Newman Inc., 50 Moulton St., Cambridge, Mass. 02138)

24–26. American Acad. of **Forensic Sciences**, Chicago, Ill. (S. R. Gerber, Law-Medicine Center, Western Reserve Univ., Cleveland, Ohio 44106)

24–26. Interdisciplinary Aspects of **Radiative Energy Transfer**, Philadelphia, Pa. (J. J. Welsh, Space Sciences Laboratory, General Electric Co., Box 8555, Valley Forge, Pa.)

25–26. **Thoracic** Soc., spring mtg., London, England. (H. M. Foreman, Sully Hospital, Sully, Glamorganshire, England)

27–3. American Inst. of **Mining, Metallurgical, and Petroleum Engineers**, annual mtg., New York, N.Y. (The Institute, 345 E. 47 St., New York 10017)

27–4. International **Anesthesia Research** Soc., Bal Harbour, Fla. (A. W. Friend, 227 Wade Park Manor, Cleveland, Ohio 44106)

28–4. **Aerial Triangulation**, symp., Urbana, Ill. (M. B. Scher, Intern. Soc. for Photogrammetry, Commission 3, 9701 East Light Dr., Falls Church, Va.)

28–4. American **Crystallographic** Assoc., mtg., Univ. of Texas, Austin. (W. L. Kehl, Gulf Research and Development Co., P.O. Drawer 2038, Pittsburgh, Pa. 15230)

28–4. American Assoc. of **Junior Colleges**, 46th annual conv., St. Louis, Mo. (The Association, 1315 16th St., NW, Washington, D.C. 20036)

March

1–2. **Dairy Engineering**, natl. conf., Michigan State Univ., East Lansing. (C. W. Hall, Agricultural Engineering Dept., Michigan State Univ., East Lansing)

1–3. **Space Maintenance** and Extra-Vehicular Activities, natl. conf., Orlando, Fla. (M. B. Goldman, Mail No. 302, Martin Co., Baltimore, Md. 21203)

1–10. **Industrial Development** in the Arab Countries, regional symp., Kuwait. (Intern. Agency Liaison Branch, Office of the Director General, Food and Agriculture Organization, Via delle terme di Caracalla, Rome, Italy)

2–4. **Air Pollution** Medical Research, AMA conf., Los Angeles, Calif. (Dept. of Environmental Health, American Medical Assoc., 535 N. Dearborn St., Chicago, Ill. 60610)

2–4. **Plasmadynamics**, conf., Monterey, Calif. (American Inst. of Aeronautics and Astronautics, 1290 Sixth Ave., New York 10019)

2–4. **Scintillation and Semiconductor Counters**, 10th symp., Washington, D.C. (W. A. Higinbotham, Brookhaven Natl. Laboratory, Upton, L.I., N.Y.)

3–4. Louisiana Soc. for **Electron Microscopy**, 3rd annual symp., New Orleans. (W. R. Goynes, Southern Regional Research Laboratory, Box 19687, New Orleans)

3–5. Central **Surgical** Assoc., Chicago, Ill. (C. E. Lischer, 457 N. Kingshighway, St. Louis 8, Mo.)

4–5. **Cineradiology**, 5th symp., Rochester, N.Y. (R. Gramiak, Div. of Diagnostic Radiology, Univ. of Rochester Medical Center, Rochester 14620)

4–6. American Assoc of **Pathologists**

and Bacteriologists, 63rd annual mtg., Cleveland, Ohio. (P. Fitzgerald, Downstate Medical Center, 450 Clarkson Ave., Brooklyn 3, N.Y.)

5–7. Society for American **Archaeology**, 31st annual mtg., Univ. of Nevada, Reno. (D. D. Fowler, Dept. of Anthropology, Univ. of Nevada, Reno 89507)

5–10. International Acad. of **Proctology**, 18th annual conv., Miami Beach, Fla. (A. F. Cantor, 147-41 Sanford Ave., Flushing, N.Y. 11355)

6–11. American Soc. of **Photogrammetry**, Washington, D.C. (C. E. Palmer, 5917 Brookview Dr., Brookland Estates, Alexandria, Va.)

7–9. Fundamental **Cancer Research**, 20th annual symp., Univ. of Texas, Houston. (M. Mandel, Dept. of Biology, M. D. Anderson Hospital and Tumor Inst., Univ. of Texas, Houston 77025)

7–9. **Electric Propulsion**, 5th conf., American Inst. of Aeronautics and Astronautics, San Diego, Calif. (A. T. Forrester, Electro-Optical Systems, Inc., 300 N. Halstead St., Pasadena, Calif. 91107)

7–9. **Space**, 3rd congr., Cocoa Beach, Fla. (R. M. Barnes, PAA-Guided Missiles Range Div., Bldg. 423, MU 111, Patrick Air Force Base, Fla.)

7–11. American Soc. for **Metals**, western metal and tool exposition and conf., Los Angeles, Calif. (The Society, Metals Park, Ohio)

7–11. Society of **Plastics Engineers**, 22nd annual technical conf., Montreal, P.Q., Canada. (G. L. Bata, Union Carbide Canada, Ltd., P.O. Box 700, Pointe-aux-Trembles, P.Q.)

7–12. Inter-American **Nuclear Energy** Commission, 6th mtg., Washington, D.C. (J. D. Perkinson, Jr., Pan American Union, Washington 20006)

8–3. World **Meteorological** Organization, commission for synoptic meteorology, 4th session, Wiesbaden, Germany. (WMO, 41, avenue Giuseppe Motta, Geneva, Switzerland)

9–11. **Ethics in Medical Progress**, Ciba Foundation symp., London, England. (Ciba Foundation, 41 Portland Pl., London W.1)

9–13. Teaching Machines and **Programmed Instruction**, intern. symp., Nürtingen, Germany. (Arbeitsgemeinschaft Programmierte Instruktion, Inst. für Kybernetik, Pädagogische Hochschule Berlin, Malteserstr. 74-100, 1 Berlin 46)

10–11. **Heat Transfer** to Non-Newtonian Fluids, 12th annual heat transfer conf., Oklahoma State Univ., Stillwater. (J. D. Parker, Dept. of Mechanical Engineering, Oklahoma State Univ., Stillwater 74075)

11–13. National Council of **Teachers of Mathematics**, San Diego, Calif. (J. D. Gates, 1201 16th St., NW, Washington, D.C. 20036)

11–13. National **Wildlife** Federation, annual mtg., Pittsburgh, Pa. (T. L. Kimball, 1412 16th St., NW, Washington, D.C. 20036)

12–13. **Linguistics**, 11th natl. conf., Linguistic Circle of New York, New York. (L. Pap, State Univ. College, New Paltz 12561)

14–16. Society of **Toxicology**, annual scientific mtg., Williamsburg, Va. (C. S. Weil, Mellon Inst., 4400 Fifth Ave., Pittsburgh, Pa. 15213)

14–16. **Wildlife and Natural Resources,** 31st North American conf., Pittsburgh, Pa. (C. R. Gutermuth, Wildlife Management Inst., Wire Bldg., Washington, D.C. 20005)

14–20. **Obstetrics and Gynecology,** 8th Australian congr., Hobart. (J. F. Correy, 173 Macquaire St., Hobart)

14–6 May. Extraordinary Administrative **Aeronautical Radio** Conf., 2nd session, Geneva, Switzerland. (Intern. Telecommunication Union, Place des Nations, Geneva)

15–16. **Flame Resistant Polymers,** conf., London, England. (Secretary, Plastics Inst., 6 Mandeville Pl., London, W.1)

15–18. **Optical Soc.** of America, spring mtg., Washington, D.C. (M. E. Warga, 1155 16th St., NW, Washington, D.C. 20006)

17–19. **Isobaric Spin in Nuclear Physics,** intern. conf., Florida State Univ., Tallahassee. (D. Robson, Dept. of Physics, Florida State Univ., Tallahassee)

18–19. **Rural Health,** conf., Colorado Springs, Colo. (B. L. Bible, 535 N. Dearborn St., Chicago, Ill. 60610)

18–20. American **Psychosomatic** Soc. annual mtg., Chicago, Ill. (W. A. Greene, The Society, 265 Nassau Rd., Roosevelt, N.Y. 11575)

20–23. **Solar Energy** Soc., 2nd annual mtg., Boston, Mass. (F. Edlin, Arizona State Univ., Tempe 85281)

21–24. **Aerospace Instrumentation,** 4th intern. symp., College of Aeronautics, Cranfield, England. (E. K. Merewether, ISA Aerospace Industry Div., 4515 Canoga Ave., Woodland Hills, Calif.)

21–25. Institute of **Electrical and Electronics Engineers,** intern. conv., New York, N.Y. (IEEE, 345 E. 47 St., New York 10017)

22–23. **Biomagnetics,** 3rd intern. symp., Univ. of Illinois, Chicago. (M. F. Barnothy, Univ. of Illinois, 833 S. Wood St., Chicago)

22–23. Modern Concepts of **Cardiovascular Diseases,** conf. and workshop, Reno, Nev. (G. T. Smith, Laboratory of Patho-Physiology, Univ. of Nevada, Reno 89507)

22–24. Measurement and Applications of **Neutron Cross Sections,** conf., Washington, D.C. (W. W. Havens, Dept. of Physics, Columbia Univ., 538 W. 120 St, New York 10027)

22–31. American **Chemical** Soc., spring mtg., Pittsburgh, Pa. (ACS, 1155 16th St., NW, Washington, D.C.)

23–25. Institute of **Mathematical Statistics,** Purdue Univ., Lafayette, Ind. (G. E. Nicholson, Jr., Univ. of North Carolina, Chapel Hill)

23–25. Modern Methods of **Weather Forecasting and Analysis.** Chicago, Ill. (J. R. Fulks, U.S. Weather Bureau, 5730 S. Woodlawn Ave., Chicago)

24–26. **Biomathematics and Computer Science** in the Life Sciences, symp., Houston, Tex. (Dean, Div. of Continuing Education, Univ. of Texas Graduate School of Biomedical Sciences, Texas Medical Center, Houston 77025)

24–26. Pediatric and Adolescent **Gynecology,** conf., New York Acad. of Sciences, New York. (W. R. Lang, Jefferson Medical College of Philadelphia, 1025 Walnut St., Philadelphia, Pa.)

24–26. **Pollution and Marine Ecology,** conf., Galveston, Tex. (S. M. Ray, Texas A&M Univ. Marine Laboratory, Galveston 77550)

24–27. International Assoc. for **Dental Research,** 44th general mtg., Miami, Fla. (G. H. Rovelstad, U.S. Navy Dental School, Natl. Naval Medical Center, Bethesda, Md. 20014)

25–26. National Assoc. of **Biology Teachers,** western regional conv., Los Angeles, Calif. (The Association, Professional Building, Great Falls, Mont.)

26–2. **Stress Analysis,** 3rd intern. conf., Berlin, Germany. (H. Kotthaus, Verein Deutscher Ingenieure, Prinz-Georg Str. 77/79, 4 Düsseldorf 10)

26–27. Arizona **Chest Disease** Symp., Tucson. (E. A. Oppenheimer, P.O. Box 6067, Tucson 85716)

27–30. American Assoc. of **Dental Schools,** Miami Beach, Fla. (R. Sullens, 840 N. Lake Shore Dr., Chicago, Ill.)

28–30. **Great Lakes Research,** 9th conf., Chicago, Ill. (B. M. McCormac, IIT Research Inst., 10 W. 35 St., Chicago 60616)

28–31. Collegium Intern. **Neuro-Psychopharmacologicum,** 5th biennial mtg., Washington, D.C. (M. K. Taylor, 3636 16th St., NW, Washington 20010)

29–31. **Airborne Infection,** 2nd intern. conf., Illinois Inst. of Technology, Chicago. (E. K. Wolfe, U.S. Army Biological Laboratories, Fort Detrick, Frederick, Md.)

29–31. **Applied Meteorology,** 6th natl. conf., Los Angeles, Calif. (B. N. Charles, Booz-Allen Applied Research, 6151 W. Century Blvd., Los Angeles 90045)

29–31. **Chemical** Soc., anniversary mtgs., Oxford, England. (General Secretary, Burlington House, London W.1)

29–31. **Surface-Active Substances,** intern. conf., Berlin, East Germany. (Inst. für Fettchemie, Deutsche Akademie der Wissenschaften zu Berlin, Rudower Chaussee 5, 1199 Berlin-Adlershof)

29–31. **Symbolic and Algebraic Manipulation,** symp., Assoc. for Computing Machinery, Washington, D.C. (J. E. Sammet, I.B.M. Corp., 545 Technology Sq., Cambridge, Mass. 02139)

29–1. American Assoc. for **Contamination Control,** 5th annual technical mtg., Houston, Tex. (W. T. Maloney, The Association, 6 Beacon St., Boston, Mass. 02108)

29–1. Ultraviolet and X-Ray **Spectroscopy of Laboratory and Astrophysical Plasma,** conf., Abingdon, England. (Inst. of Physics and the Physics Soc., 47 Belgrave Sq., London, S.W.1, England)

30. **Oral Cancer,** 4th symp., St. Francis Hospital, Poughkeepsie, N.Y. (M. A. Engelman, 1 E. Academy St., Wappingers Falls)

30–1. **Magnetohydrodynamics,** 7th symp., Princeton, N.J. (R. G. Jahn, Guggenheim Laboratories, Forrestal Research Center, Princeton, N.J. 08540)

31–2. **Michigan Acad. of Science, Arts, and Letters,** Wayne State Univ., Detroit. (E. A. Wunsch, Dept. of English, Univ. of Michigan, Ann Arbor)

April

1–2. Alabama **Acad. of Science,** Birmingham-Southern College, Birmingham. (W. B. DeVall, Dept. of Forestry, Auburn Univ., Auburn, Ala.)

1–2. Arkansas **Acad. of Science,** Little Rock. (G. E. Templeton, Univ. of Arkansas, Fayetteville)