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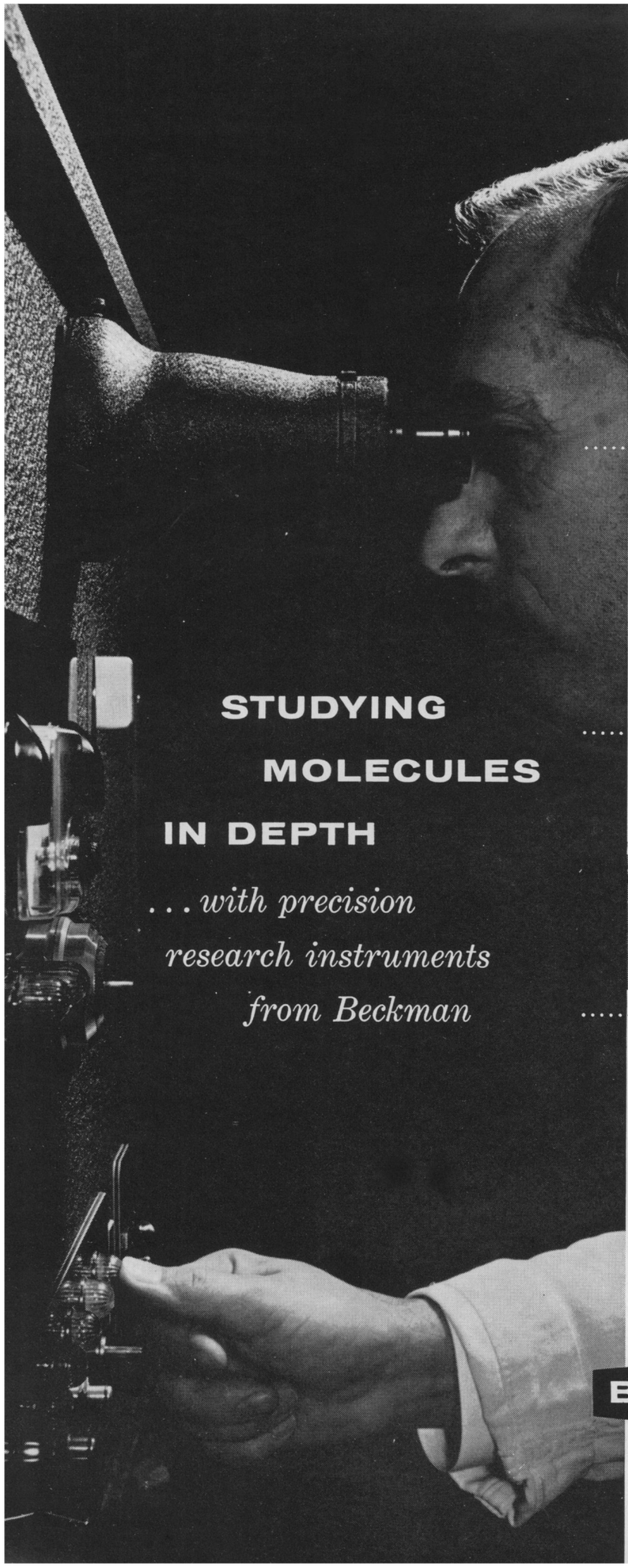

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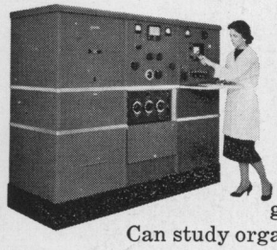

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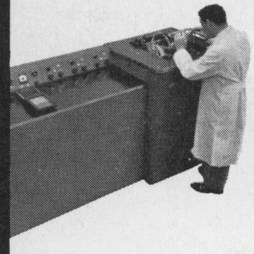

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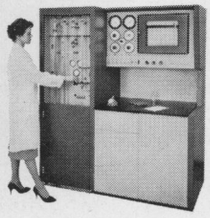

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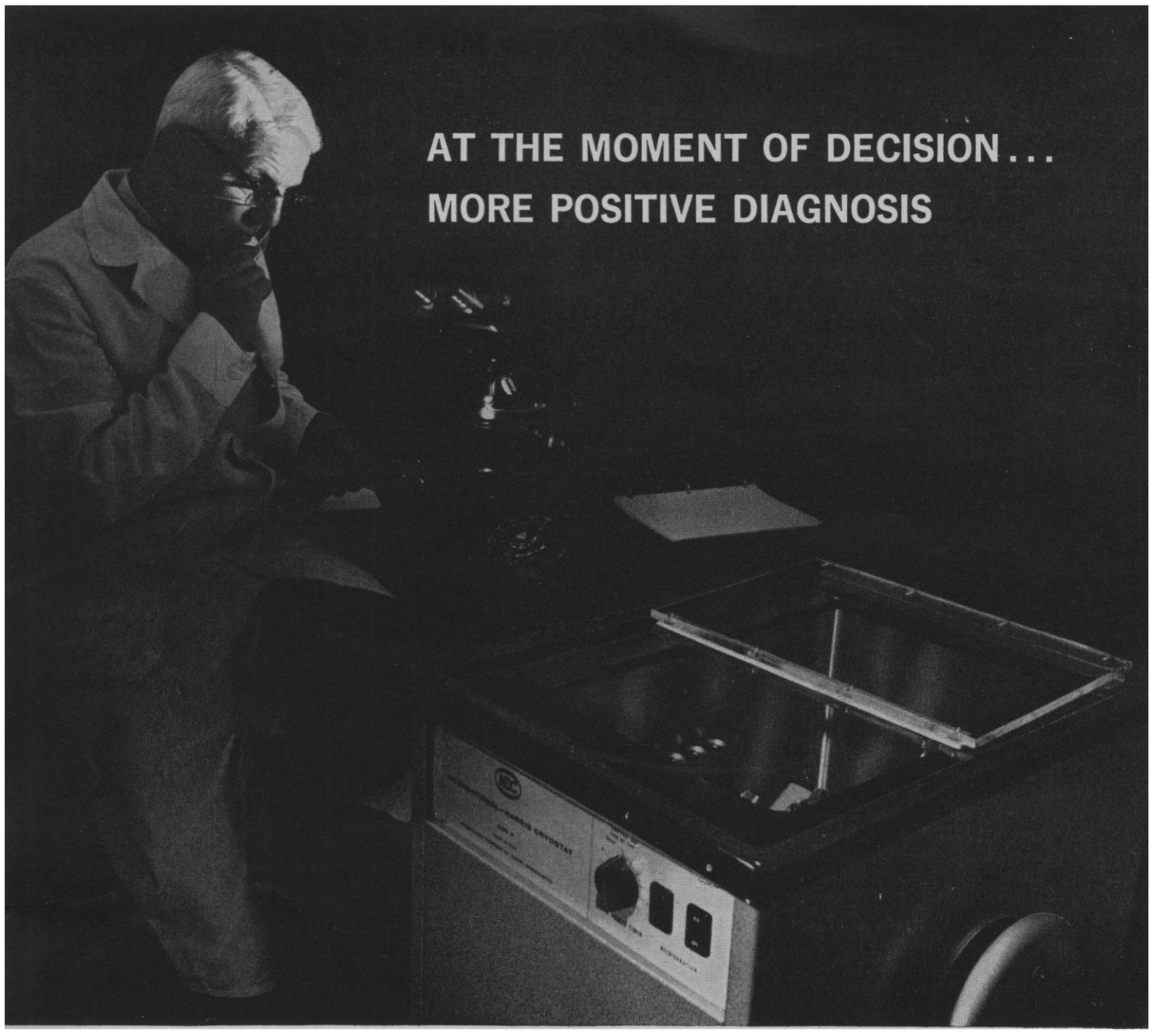
SCIENCE

Cover

Dinosaur tracks in Lower Cretaceous rocks, Bandera County, Texas. The locality, on West Verde Creek on the Davenport Ranch about 9 miles southwest of Bandera, was referred to by R. Bird in an article "We captured a 'live' brontosaur" in the *National Geographic Magazine* [**105**, 707 (May 1954)]. [Courtesy Shell Development Company. Photograph by Lawrence Hinton]



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22 December 1961, Volume 134, Number 3495

SCIENCE

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Costly Cash

Anyone who visits the science departments of a fair sample of our most eminent universities will be impressed by the high quality of the scientists, the diversity of research projects, and the plentiful supply of the complex and expensive instruments essential to modern scientific research. But another impression is equally unavoidable: many first-class men and their instruments for research are housed in hallways partitioned off to serve as makeshift laboratories, in converted basement rooms, or in jerry-built "temporary" buildings put up during the second or even the first world war.

A complete account of the reasons for the disproportion between the support of men and equipment and the provision of adequate housing would require an extensive study of the relation between universities and the federal government and of the policies that govern expenditure of funds for research from public and private sources. In its main outlines, however, the explanation is at hand. During World War II the federal government began to assume major responsibility for the support of research in educational institutions, through the Office of Scientific Research and Development. This support has since been continued by a number of successor agencies. The most general practice is for the agencies to provide support for research projects and training—support that includes funds for technical assistants and for equipment but not for laboratory space. Funds for new buildings for scientific or medical research can be obtained only on a matching basis. And it is here that the account becomes complicated. One reason universities find it so difficult to find matching funds for buildings is, paradoxically, that the grants for project research do not provide enough money to pay the indirect costs.

In a recent study at Harvard, one of 23 now under way with the support of the Carnegie Foundation for the Advancement of Teaching, it was estimated that while spending $11.9 millions of federal funds for project research, the university incurred an obligation for unreimbursed indirect costs of $687,000.

On the basis of a formula worked out by the U.S. Bureau of the Budget, Harvard determined that 28.5 percent of the total costs was an allowable charge for indirect costs on research projects. Some federal agencies paid this amount, but HEW is limited by law to a 15-percent charge for overhead, and the NSF has only recently gone from 15 to 20 percent. Every research grant accepted thus cuts into the general funds that might be used for matching grants or, so far as that goes, for operating university departments outside the sciences.

According to the Harvard study there are additional matters for concern: the concentration of research money in only a few institutions; the threat to the balance between the humanities and the sciences; and the heavy emphasis on research at the expense of teaching.

Piecemeal support by diverse federal agencies means that no agency considers the effects of its operations on higher education as a whole. What is the proper formula for indirect costs? When the Carnegie-supported studies of the relation of the 23 universities to the federal government are completed, government and the universities can better appraise their joint responsibilities for education and research, and for bricks and mortar.—G.DuS.

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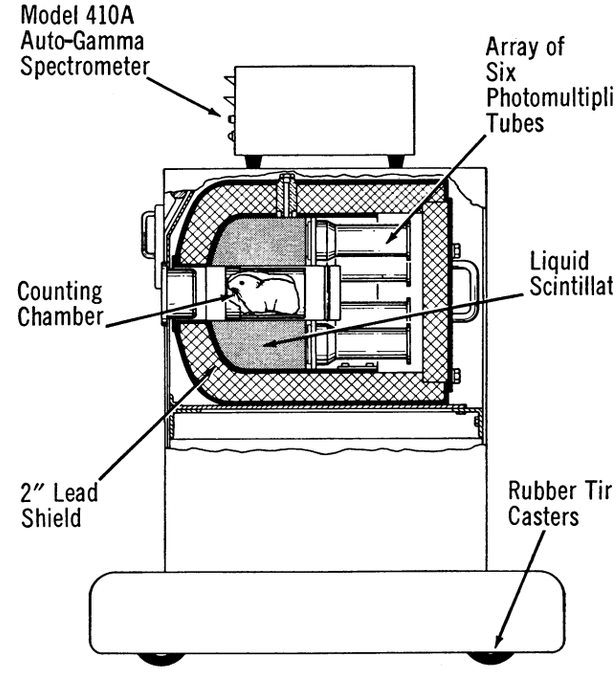

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Meetings

Plant Phenolics

The recent increase of interest in the biology and chemistry of the phenolic constituents of plants becomes immediately apparent on inspection of the table of contents of many of the world's biological and chemical publications. However, workers in the various fields in which there is an interest in the plant phenolics are widely scattered throughout departments of botany, biology, biochemistry, chemistry, microbiology, pharmacy, pharmacology, and forestry, in universities, research institutes, government agencies, and industry. There is consequently almost no common meeting place for people with such interests, with the result that there is little discussion and exchange of information between workers in the different disciplines.

In 1956 the Plant Phenolics Group was founded in England as an informal organization with the aims of promoting "the advancement of the knowledge of phenolic and related constituents of plants in respect of their chemistry, function, biosynthesis, effect on plant and animal physiology and pathology, and the application of such knowledge in agriculture and industry." Since its founding the Plant Phenolics Group has been very successful in achieving these aims, holding two or three meetings per year. The proceedings of many of these meetings have been published.

At the 9th International Botanical Congress in Montreal in 1959, discussions with various biochemists and physiologists interested in plant phenolic substances led to the idea that a sister organization be formed in North America. The largest problem involved in forming such a group on this continent, of course, results from the geographical size of North America, which would prohibit such a group from meeting more often than once a year.

An organizing committee consisting of T. A. Geissman (University of California), V. C. Runeckles (Imperial Tobacco Company of Canada), and G. H. N. Towers (McGill) distributed a letter to interested persons in 1960, the response to which was so enthusiastic as to encourage the committee to make plans for an inaugural meeting. This was held at Colorado State University, Fort Collins, from 31 August to 1 September 1961, and took the form of a symposium on the biochemistry of plant phenolic substances. The meeting was sponsored by the National Science Foundation, under the direction of G. Johnson (Colorado State University) and T. A. Geissman.

Papers were presented as follows: "Recent studies on the structures and bitterness of the flavonoid glycosides of citrus" (R. M. Horowitz, U.S. Department of Agriculture); "Biosynthesis of plant phenols" (S. A. Brown, National Research Council, Saskatoon); "Naturally occurring biflavonyls" (N. Kawano, University of Nagasaki); "Metabolic fate of phenolic substances in animals" (A. N. Booth, U.S. Department of Agriculture); "Role of plant phenolics in disease resistance and immunity" (I. Uritani, Nagoya University); "Melanin and its formation" (G. A. Swan, University of Durham); and "Estrogenic-like substances in plants" (E. M. Bickoff, U.S. Department of Agriculture).

Over 60 delegates attended the symposium, the last session of which was devoted to founding the Plant Phenolics Group of North America. The officers elected were as follows: president, S. H. Wender (University of Oklahoma); vice-president, L. Jurd (U.S. Department of Agriculture); and secretary-treasurer, V. C. Runeckles.

It was agreed at the founding meeting that membership be open to all persons interested in the Group's aims, on application to the secretary, Dr. V. C. Runeckles, P.O. Box 6500, Montreal.

V. C. RUNECKLES
Imperial Tobacco Company of Canada, Montreal

Forthcoming Events

January

2–3. California Assoc. of Chemistry Teachers, San Luis Obispo, Calif. (R. Major, 1736 N. Sierra Bonita Ave., Hollywood 46, Calif.)

8–12. International Heat Transfer Conf., Institution of Mechanical Engineers, London, England. (Secretary, IME, 1 Birdcage Walk, Westminster, London, S.W.1)

8–12. Society of Automotive Engineers, annual, Detroit, Mich. (R. W. Crory, SAE, 485 Lexington Ave., New York 17, N.Y.)

8–13. Central Treaty Organization, Role of Science in Natural Resources, Lahore, Pakistan. (Office of Intern. Conferences, Dept. of State, Washington 25)

9–11. Reliability and Quality Control, 8th natl. symp., Institute of Radio Engineers and American Inst. of Electrical Engineers, Washington, D.C. (Scientific Liaison Office, Natl. Research Council, Sussex Dr., Ottawa, Ont., Canada)

9–12. Radioactive Isotopes in Clinical Medicine and Research, 2nd symp., Bad Gastein, Austria. (R. Höfer, Garnisongasse 13, Vienna IX, Austria)

9–19. Synoptic Meteorology Code Problems, World Meteorological Organization, Toronto, Ont., Canada. (WMO, 41 Avenue Giuseppe Motta, Geneva, Switzerland)

11. Role of Hormones in Protein Synthesis, Assoc. of Vitamin Chemists, Chicago, Ill. (H. S. Perdue, Abbott Laboratories, N. Chicago)

15–17. American Pomological Soc., Toronto, Canada. (G. M. Kessler, Dept. of Horticulture, Michigan State Univ., E. Lansing)

17–19. Instrument Soc. of America, winter conf. and exhibit, St. Louis, Mo. (W. H. Kushnick, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.)

18–31. Tropical Cyclones, inter-regional seminar, World Meteorological Organization, Tokyo, Japan. (WMO, 41 Avenue Giuseppe Motta, Geneva, Switzerland)

22. American Ethnological Soc., New York, N.Y. (N. F. S. Woodbury, Arizona State Museum, Univ. of Arizona, Tucson)

22–24. Institute of the Aerospace Sciences, 30th annual, New York, N.Y. (IAS, 2 E. 64 St., New York 21)

22–26. American Mathematical Soc., annual, Cincinnati, Ohio. (AMS, 190 Hope St., Providence 6, R.I.)

23. Conference on Cardiac and Vascular Surgery, New York Heart Assoc., New York, N.Y. (R. Ober, NYHA, 10 Columbus Circle, New York 19)

23–25. American Soc. of Safety Engineers, Philadelphia, Pa. (A. C. Blackman, 5 N. Wabash Ave., Chicago 2, Ill.)

23–25. Obstetrics and Gynaecology, 2nd Asiatic congr., Calcutta, India. (S. Mitra, 4 Chowringhee Terrace, Calcutta 20)

24–26. Mathematical Assoc. of America, 45th annual, Cincinnati, Ohio. (H. M. Gehman, Univ. of Buffalo, Buffalo, N.Y.)

24–26. Thermophysical Properties, symp., American Soc. of Mechanical Engineers, Princeton, N.J. (E. F. Lype, ASME, c/o Thompson Ramo Wooldridge, 23555 Euclid Ave., Cleveland, Ohio)

24–27. American Physical Soc., annual, New York, N.Y. (K. K. Darrow, 538 W. 120 St., New York 27)

24–27. Federation of American Scientists, Natl. Council, New York, N.Y. (D. M. Singer, FAS, 1700 K St., NW, Washington 6)

25–26. Western Spectroscopy Assoc., 9th annual, Pacific Grove, Calif. (D. G. Rea, WSA, Univ. of California Space Sciences Laboratory, Berkeley 4)

25–27. Western Soc. for Clinical Research, 15th annual, Carmel-by-the-Sea, Calif. (H. R. Warner, WSCR, Latter-day Saints Hospital, Dept. of Physiology, Salt Lake City 3, Utah)

26–29. Man and Civilization: Control of the Mind—II, San Francisco, Calif. (S. M. Farber, Univ. of California San Francisco Medical Center, San Francisco 22)

28–3. American Inst. of Electrical Engineers, New York, N.Y. (R. S. Gardner, AIEE, 33 W. 39 St., New York 18)

28–3. Pan American Assoc. of Ophthalmology, interim congr., Lima, Peru. (J. M. McLean, 525 E. 68 St., New York 21)

29–30. Carbohydrates, Cellulose, and Cellulose Industries, symp., Council of

Scientific and Industrial Research, Ahmedabad, India. (Director, Ahmedabad Textile Industry Research Assoc., Ahmedabad-9)

29–31. American Soc. of Heating, Refrigerating and Air-Conditioning Engineers, St. Louis, Mo. (R. C. Cross, United Engineering Center, 345 E. 47 St., New York, N.Y.)

29–31. Institute of the Aeronautical Sciences, annual, New York, N.Y. (R. R. Dexter, IAS, 2 E. 64 St., New York 21)

29–1. Instrument Soc. of America, conf. and exhibit, Dallas, Texas. (W. H. Kushnick, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.)

30–1. Military Electronics, 4th winter convention, Institute of Radio Engineers, Los Angeles, Calif. (IRE, 1435 LaCienega Blvd, Los Angeles)

30-2. Society of Plastics Engineers, annual technical conf., Pittsburgh, Pa. (T. A. Bissell, SPE, 65 Prospect St., Stamford, Conn.)

31–2. American Geophysical Union, Pacific Southwest regional, Tucson, Ariz. (A. N. Sayre, U.S. Geological Survey, Washington 25)

February

1–2. Industrial Management Engineering Conf., Illinois Inst. of Technology, Chicago. (F. A. Judd, Technology Center, IIT, Chicago 18)

1–3. Congress on Hospital Administration, 5th annual, Chicago, Ill. (American College of Hospital Administrators, 840 N. Lake Shore Dr., Chicago)

4–7. American Inst. of Chemical Engineers, natl., Los Angeles, Calif. (American Petroleum Inst., 1271 Avenue of the Americas, New York 20)

5. World Meteorological Organization, Working Group on Networks of the Commission for Synoptic Meteorology, Geneva, Switzerland. (Secretary, WMO, Geneva)

5–6. Gustav Stern Symp. on Perspectives in Virology—III, New York, N.Y. (M. Pollard, Lobund Inst., Univ. of Notre Dame, Notre Dame, Ind.)

5–7. American Acad. of Allergy, annual, Denver, Colo. (Scientific Liaison Office, Natl. Research Council, Sussex Dr., Ottawa, Ont., Canada)

5–9. Electroforming Applications, symp., American Soc. for Testing and Materials, Dallas, Tex. (ASTM, 1916 Race St., Philadelphia 3, Pa.)

6–7. Vertebrate Pest Control Conf., Sacramento, Calif. (M. W. Cummings, Univ. of California, Davis)

6–8. Society of the Plastics Industry, Reinforced Plastics Div., Chicago, Ill. (Scientific Liaison Office, Natl. Research Council, Sussex Dr., Ottawa, Ont., Canada)

7–9. Military Electronics, Inst. of Radio Engineers, Los Angeles, Calif. (M. E. Brady, Space Technology Laboratories, P.O. Box 95001, Los Angeles)

7–10. American College of Radiology, annual, New York, N.Y. (ACR, 20 N. Wacker Dr., Chicago 6, Ill.)

8. Problems in Food Processing, Assoc. of Vitamin Chemists, Chicago, Ill. (H. S. Perdue, Abbott Laboratories, North Chicago, Ill.)

9–11. National Open Hearth and Blast

Furnace Conf., American Inst. of Mining, Metallurgical, and Petroleum Engineers, Detroit, Mich. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 17)

12–16. Management of Science Information Centers, Inst. on Information Storage and Retrieval, 4th, Washington, D.C. (L. H. Hattery, Center for Technology and Administration, American Univ., 1901 F St., NW, Washington 6)

12–23. Latin American Seminar on Irrigation, 2nd, Panama City, Panama. (J. Melendez, Jefe, Depto. de Ingenieria, Ministerio de Agricultura, Comercio e Industrias, Panama City)

13–14. Sanitary Engineering, 4th conf., Urbana, Ill. (B. B. Ewing, Dept. of Sanitary Engineering, Univ. of Illinois, Urbana)

14–16. Biophysical Soc., 6th annual, Washington, D.C. (D. Cowie, Dept. of Terrestrial Magnetism, Carnegie Institution of Washington, 5241 Broad Branch Rd., NW, Washington 15)

14–16. Solid State Circuits, intern. conf., Philadelphia, Pa. (L. Winner, 152 W. 42 St., New York 36)

14–17. National Soc. of College Teachers of Education, Chicago, Ill. (E. J. Clark, Indiana State College, Terre Haute)

16–18. Medical Congr. in Honor of the Centennial of Bretonneau, Tours, France. (Directeur, École Nationale de Médecine, Tours)

17–24. Pan American Medical Women's Alliance, 8th congr., Manizales, Colombia. (C. Carthers, 1661 Riverside Ave., Suite B, Jacksonville, Fla.)

18–22. American Inst. of Mining, Metallurgical, and Petroleum Engineers, annual, New York, N.Y. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 17)

18–22. Technical Assoc. of the Pulp and Paper Industry, annual, New York, N.Y. (TAPPI, 360 Lexington Ave., New York 17)

19–21. American Educational Research Assoc., Atlantic City, N.J. (G. T. Buswell, 1201 16 St., NW, Washington 6)

19–21. Tracking and Command of Aerospace Vehicles, Inst. of the Aerospace Sciences, San Francisco, Calif. (IAS, 2 E. 64 St., New York 21)

19–22. American Concrete Inst., annual, Denver, Colo. (W. A. Maples, 22400 W. Seven Mile Rd., P.O. Box 4754, Redford Station, Detroit 19, Mich.)

19–22. Industrial Ventilation Conf., E. Lansing, Mich. (Engineering Dept., Michigan State Univ., E. Lansing)

19–23. American Soc. of Civil Engineers, Houston, Tex. (W. H. Wisely, 345 E. 47 St., New York 17)

19–23. Automatic Control in the Iron and Steel Industry, intern., Brussels, Belgium. (Institut Belge de Régulation et d'Automatisme, 98 Chausèe de Charleroi, Brussels 6)

20–21. International Inst. of Sugar Beet Researchers, winter congr., Brussels, Belgium. (O. J. Kint, IISBR, 152 rue Beauduin, Tirlemont, Belgium)

21–25. National Assoc. for Research in Science Teaching, Washington, D.C. (H. Branson, Dept. of Physics, Howard Univ., Washington 1)

22-24. American Acad. of Forensic Sciences, Chicago, Ill. (W. J. R. Camp, Univ. of Illinois, 1853 W. Polk St., Chicago 12)

22–24. Genetics Soc. of Canada, Winnipeg, Man., Canada. (Scientific Liaison Office, Natl., Research Council, Sussex Dr., Ottawa, Ont., Canada)

23–24. American Physical Soc., Austin, Tex. (K. K. Darrow, APS, Columbia Univ., New York 27)

23–24. Canadian Aeronautical Inst., mid-season meeting, Halifax, Nova Scotia. (Scientific Liaison Office, Natl. Research Council, Sussex Dr., Ottawa, Canada)

25–1. Pan American Assoc. of Oto-Thino-Laryngology and Broncho-Esophagology, Caracas, Venezuela. (C. M. Norris, 3401 N. Broad St., Philadelphia 40, Pa.)

26–28. Importance of Electricity in the Control of Aircraft, conf., Inst. of Electrical Engineers–Royal Aeronautical Soc., London, England. (Secretary, IEE, Savoy Place, London, W.C.2)

26–29. Central Treaty Organization, Economic Committee, Washington, D.C. (Office of Intern. Conferences, Dept. of State, Washington 25)

26–2. Current Trends in Nuclear Power, symp., Tucson, Ariz. (L. Weaver, Nuclear Engineering Dept., Univ. of Arizona, Tucson)

27–1. Application of Switching Theory in Space Technology, symp., Palo Alto, Calif. (J. P. Nach, Lockheed Aircraft Corp., Sunnyvale, Calif.)

Letters

(Continued from page 2007)

The implication is ridiculous that the principle of adding extra phases to a material to strengthen it is a logical development of any kind of recent theoretical thinking, let alone a fruit of the state of confusion that has developed from the highly specific models which have been described in metallurgical literature. It seems quite apparent that the work reported by Kingery could have been accomplished by a clear-thinking scientist (which Kingery is, in my opinion) with a classical point of view on strengthening of materials, as opposed to a view of the kind that is arrived at by overdevelopment of oversimplified mechanistic hypotheses. For instance, must we consider dislocation theory the basis for the following statement by Kingery: "As found from long experience with metals, plastics, and ceramics, the kinds of alloys which are most useful under these conditions are those made with stable second-phase additives having useful properties"? The most useful two-phase material discussed by Kingery can be derived and explained on a purely classical basis, with no regard whatsoever for dislocations, whether edge or screw.

It is interesting to attempt to follow Kingery's conclusions about the virtues of adding glass fibers. First of all, it is not clear how fibers will limit the stress induced in ice to a *minimum* value. Second, I fail to see in Kingery's Table 1 the more than tenfold increase in strength from Fiberglas additions that he finds.

In his enumeration of requirements for fibers to be effective in reinforcing materials, Kingery has omitted the third essential feature of the system: good adhesion must be achieved at the fiber-matrix interface. Again, no knowledge of dislocations is required to derive this.

JAMES E. MCNUTT
Wilmington, Delaware

McNutt's opinion that dislocation theory has been of marginal "usefulness" for developing improved alloys is a minority, but not uncommon, opinion among metallurgists. It is probably true that the scientists who have contributed most to dislocation theory have contributed least to alloy development. The argument that technological improvements would have been made with equal facility without a background of understanding based on dislocation

theory is difficult to refute when, in fact, there are few, if any, competent alloy developers unaware of dislocations. At the present time, dislocations *are* a significant part of the "classical point of view on strengthening of materials."

I think there can be no dispute about the utility of dislocation theory for "rationalizing observed strengths." A glance through any contemporary symposium volume on fracture, deformation, or mechanical properties makes it clear that dislocation theory forms the foundation for any science (as opposed to technology) of mechanical behavior of materials.

W. D. KINGERY
Ice Research Laboratory, Massachusetts Institute of Technology, Cambridge

Medical Instrumentation

Duncan A. Holaday is to be commended for his excellent survey "Where does instrumentation enter into medicine?" [*Science* **134**, 1172 (1961)]. He perhaps was more harsh in some of his criticism than someone outside the medical profession could be. However, his solutions to the dilemma—to train physicians in engineering and to bring engineers into hospitals—pose further dilemmas.

Let us consider the first problem: Where does a physician get such training? Only one or two institutions offer a training program honestly aimed at instrumentation. The several biomedical engineering programs offered elsewhere are directed toward developing an engineer with cross-disciplinary training for research—not a man who is a specialist at measurement.

Measurement systems are largely electrical or electronic, so one would expect to find electrical engineers with the necessary training. However, instrumentation is an unwanted by-product in most university electrical-engineering departments. The trend is toward training physicists for applied research, and instrumentation is no longer "respectable."

In any attempt to bring the engineer into the hospital there are two distinct obstacles. First, nonengineering administrators generally have little understanding of what an engineer is, beyond "someone who knows about electronics, radios, and so on." Consequently, in all but a few hospitals the

salaries for electronics personnel are set at the level of the local radio-TV repair man—usually less than a recent engineering graduate receives. If one wishes to attract a man with several years' experience who can bring valuable, up-to-date techniques into the hospital, one must offer a professional salary.

I feel that most engineers interested in a career as a specialist in medical instrumentation will be research-type men who will want to conduct their own research programs in addition to tackling measurement problems for physicians. Consequently, a second big question is raised: Is the engineer to be a professional staff or faculty member or just a technician? Few capable, experienced engineers will accept the latter position.

It is obvious that there are few engineers with the background to make medical judgments; however, a basic problem of instrumentation is that of finding how to obtain significant measurements. We already have too many gadgets produced by well-meaning engineers who don't know the medical problems, or by medical personnel who asked for a device but did not authorize an engineering study of the over-all measurement problem.

No real advances in medical instrumentation will be possible until both physicians and engineers consider each other specialists and are willing to work together on a professional level. It seems apparent that either of Holaday's solutions will require a re-education of both physicians and engineers.

FRED R. SIAS, JR.
Biophysics Department,
Johns Hopkins University,
Baltimore, Maryland

Sias is undoubtedly correct in his conclusion that both physicians and engineers will need training in the other's art before they are able to work together effectively.

Programs to indoctrinate engineers in biomedical areas are beginning to appear. It is true that the emphasis is toward research rather than applied instrumentation, and toward biophysics and bionics (the application of life processes to the solution of engineering problems) rather than medical engineering. Efforts in these areas should, nevertheless, generate mutual respect and, in the course of time, solutions to more immediately practical problems.

Those who have the greatest stake in medical instrumentation might give some thought to helping. Physicians and hospital administrators could profitably make space for engineers to work in their laboratories. Instrument companies would be well advised to remove their development engineers from factory drafting boards, where the engineers continue to make conceptual mistakes in designing instruments for use in patient care, and accept opportunities to place these engineers in hospitals where the latter can witness the causes of earlier failures and participate in field trails of new attempts.

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Selling Methods

Out of profound respect for *Science* and its readers, many of whom are also contributors and advisers to *Encyclopaedia Britannica*, I am compelled to comment on your editorial "The company they keep" [*Science* **134**, 75 (1961)].

The editorial gives the strong—but erroneous—impression that a recent Federal Trade Commission order affecting Encyclopaedia Britannica deals with current selling methods. This is not true.

The original action by the FTC on which the citation was based was taken in May 1958 and involved complaints received by the FTC prior to that time.

Our salesmen have always been instructed, under penalty of immediate discharge, not to use the kind of irregular sales presentation that led to the FTC complaints. As soon as these individual complaints were brought to our attention, we took immediate steps to insure against their recurrence.

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Here is the sequence of Federal Trade Commission documents on which my editorial on the Encyclopaedia Britannica, Inc., was based: (i) a "Complaint," filed 5 May 1958, serving notice to the Britannica company to appear at FTC hearings; (ii) an "Initial Decision," filed 30 August 1960, ordering the company to "cease and desist" from certain sales practices; and (iii) a "Final Order," filed 16 June 1961, ordering the company to "cease and desist" from certain sales practices, following the company's appeal of the initial decision.—J.T.