SCIENCE

23 December 1960

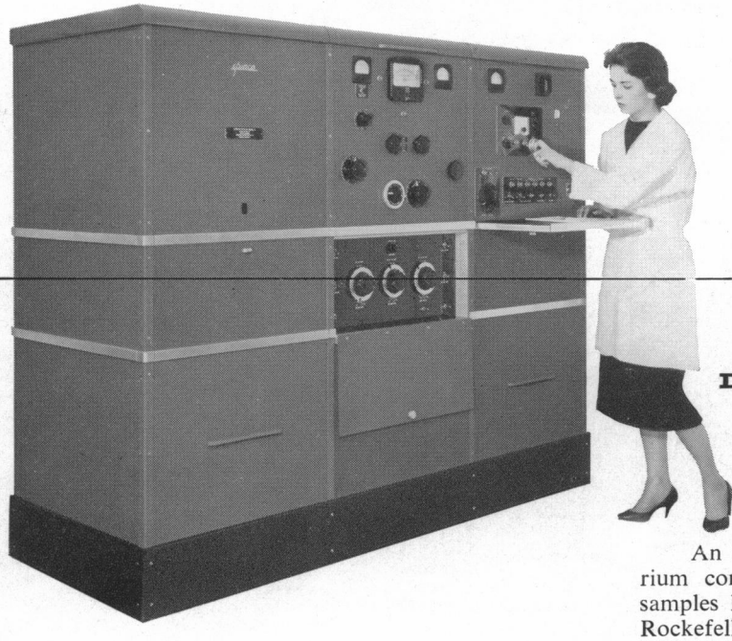
Vol. 132, No. 3443

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

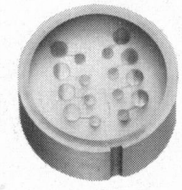
The **Analytical Ultracentrifuge**

. . . now more useful than ever

for studying molecules



Rapid Molecular Weight Determinations of Multiple Samples



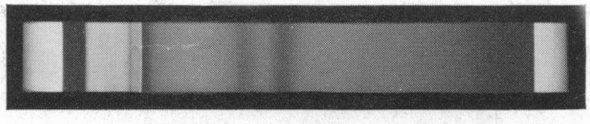
An ingenious ultracentrifuge cell in which equilibrium conditions can be reached rapidly on multiple samples has been described by David Yphantis of the Rockefeller Institute.

The cell features multiple filling reservoirs and measuring chambers which allow a number of sample-solvent pairs to be studied simultaneously. The use of short column heights makes it possible to establish equilibrium conditions quickly. With an 0.8 mm column, equilibrium is attained in 15 minutes for sucrose (M.W.=342), 45 minutes for ribonuclease (M.W.=13,683), and 70 minutes for bovine serum albumin (M.W.=66,000).

The need for only a small volume of sample is another feature of this unusual cell which promises to find wide appplication for rapid measurements of molecular weight.

Density Gradients

Macromolecules of nearly identical density can be separated and measured by the powerful, rapidly developing technique of density gradient ultracentrifugation. A solution such as cesium chloride is centrifuged with the sample and a concentration gradient created in the cell by centrifugal force. The macromolecules of sample seek the level in the cell corresponding to their own density. The resultant discrete bands can be photographed by absorption optics



An example of the extreme power of this method is shown here in the separation of DNA's, one containing N_{14}, the other N_{15}.

A summary of density gradient techniques for both analytical and preparative ultracentrifuges has been published by Spinco and copies are available on request.

Sedimentation of High Polymers

Of special interest to polymer chemists is a comprehensive summary on sedimentation of synthetic and natural polymers by R. L. Baldwin of the University of Wisconsin (now at Stanford) and K. E. Van Holde of the University of Illinois. The authors discuss in detail the kinds of information obtainable by ultracentrifugation, and methods used. An appendix lists polymers run on the Ultracentrifuge, solvents, and literature references.

The work appeared in the first issue of the German journal "Advances in Polymer Science"; reprints (in English) are available from Spinco.

If you are not familiar with the Ultracentrifuge, we will be happy to send you copies of "An Introduction to Ultracentrifuge Techniques" and the latest issue of "Fractions", a periodical sent to owners of Spinco ultracentrifuges, electrophoresis-diffusion instruments and amino acid analyzers. Write Beckman Instruments, Inc., Spinco Div., Stanford Industrial Park, Palo Alto 5, Calif.

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*American Journal of Clinical Pathology Vol. 33. No. 2. February 1960, pp 144-151 "Application of Refrigerated Microtome in Surgical Pathology" by Bernard Klionsky, M.D. and Othello D. Smith, M.D.

The Journal of Histochemistry and Cytochemistry Vol. 8, No. 5. September, 1960, pp 310 "A Frozen Section Freeze Substitutions Technique and an Improved Cryostat" by Jeffrey P. Chang and Samuel H. Hori.

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23 December 1960, Volume 132, Number 3443

SCIENCE

Cover

Salicylic acid crystal (about × 725). [L. C. Massopust, Marquette University School of Medicine]

Letters

Vivisection Bill

I have seen the letter from Bradley T. Scheer of Eugene, Ore., [*Science* **132**, 851 (23 Sept. 1960)] dealing with S. 3570, a bill providing for federal regulation of animal experimentation. I am much distressed over what I think to be oversights in his reading of the bill. It will be found, if one looks at the wording carefully, that S. 3570 permits the use of live vertebrate animals "only" for medical and military research. No experimentation for the pursuit of knowledge per se is provided for, and no authorization is given for use of animals even in agricultural, veterinary, or animal husbandry work. Use of live vertebrate animals in teaching is authorized only for student surgeons, and then only if the animals are not allowed to survive the surgery—an absurd and crippling restriction. Scheer's statement that he "cannot find in this bill the evils" that others see is especially surprising because it would prohibit him from using live vertebrate animals unless he connects his work with medical or military objectives.

Scheer stated: "the bill gives no police powers to HEW or anyone else. . . ." Perhaps Scheer did not read section 4I which states, "Authorized representatives of the Secretary . . . shall be authorized to destroy or require the destruction of animals in accordance with rules, regulations, or instructions issued by the Secretary." What is this, if it is not police power?

The worst part of the bill, from my point of view, is that it would put in the hands of the Secretary of Health, Education, and Welfare complete power over the character of animal experimentation that could be performed in the United States under federal subsidy which now means most of such work. We are presumably (and hopefully) a country ruled by laws and not men. Dictators (even benevolent ones) are anathema to us. It is perhaps true, as Scheer says, that the Secretary of HEW is unlikely to put the most rigid interpretations possible upon his authority if S. 3570 became law, but why should the United States take the risk of some Secretary impeding scientific research by doing so?

On the other hand, I do wish to say that I think I can understand why so many well-meaning people are favorably inclined to the ostensibly mild, but actually very drastic, provisions in S. 3570. Such bills appeal to everyone's humane instincts and we, as biological scientists, should be careful to distinguish between the good motives and the lack of knowledge or poor judgment of the people who would like to satisfy their urge to promote gentleness in the use of experimental animals. Their lack of knowledge about the real situation may excuse many of them for their failure to recognize the great damage that would be done by the type of regulation they propose. Especially, they fail to see that, aside from providing more money for the construction and operation of facilities for the care of experimental animals, there is really no way in which federal intervention would actually increase the comfort of animals employed for legitimate purposes in scientific investigation and teaching.

MAURICE B. VISSCHER
Department of Physiology, Medical School, University of Minnesota, Minneapolis

In your editorial of 1 July 1960 you gave your reasons for opposing a bill (S. 3570), which, if enacted by the Senate and House of Representatives, would control vivisection in the U.S.A. In support of your opposition you made some quotations from a book written by myself. I recognize that you did so in good faith; but, to prevent misunderstanding, I want it to be known by your readers that I have studied this bill and hope that it will be enacted, for it has my full approval. I am a licensed vivisector under the laws of my own country.

JOHN R. BAKER
Department of Zoology and Comparative Anatomy, University Museum, Oxford, England

Conversion Factors

With reference to the letter from H. R. Dursch and the other letters published [*Science* **132**, 848 (23 Sept. 1960)] in reply to my letter [*Science* **132**, 256 (22 July 1960)], I am grateful to the various correspondents who called attention to my outdated tables of conversion factors. The observant Dursch, by the way, noted the revision of the nautical mile on 1 July 1954 but overlooked the revision of the length of the yard on 1 July 1959, a revision which increases the ratio nautical mile/statute mile from 1.150777 to 1.150779. (Incidentally, while replacing *his* outdated conversion tables, Dursch might also oil up his desk calculator and discover that the ratio 6076.1033/5280 does not equal 1,1507575).

Perhaps the various comments on my letter serve very well to emphasize the point I endeavored to make. Congratulations especially to William Allen who, having noted the recent revisions

(*Continued on page 1898*)

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The Disparagement of Statistical Evidence

No one would claim that the theory of probability and that great body of statistical theory and practice which is based upon stochastic concepts are easy subjects, either technically or philosophically. The mathematical requirements are considerable, and the reasoning is often subtle.

But the basic procedures by which one treats the necessarily discordant results of any experiment or set of observations, and by which one calculates the degree of confidence justified by the combined result —these procedures are by now well developed, widely accepted, and competently known by any person with the requisite training.

Since the techniques of statistics are complicated, powerful, and not understood by the general public, there is always the chance of misuse. We remember with a shudder the clumsy enthusiasm with which correlation coefficients were seized upon, years ago, by many who wished to create an illusion of scholarly and scientific competence. And even today almost every big national magazine casts about to find a "statistical index" which "proves" that it has the most to offer to advertisers. It is not surprising that a clever and amusing book has been written under the title *How To Lie with Statistics*.

It must also be agreed that the statistical evidence which results from carefully designed experiments provides a much more solid foundation for inference than does statistical evidence which is, so to speak, merely "gathered."

All this is understandable. But it is shocking to note that various groups, in order to shake public confidence in statements which they find uncomfortable, are taking the position that it is silly to be impressed by evidence that is "only statistical."

For some time the outstanding offenders have been persons associated with the tobacco industry, who have claimed that the evidence for the relation between cigarette smoking and lung cancer is *only statistical*, as though that indicated a fancy and unreal sort of argument, which certainly would not affect down-to-earth persons.

But others are now taking similar attitudes towards statistical procedures. In a current news article I read that "the research directors of the Republican and Democratic campaigns say that . . . we find the statistics and then discount them."

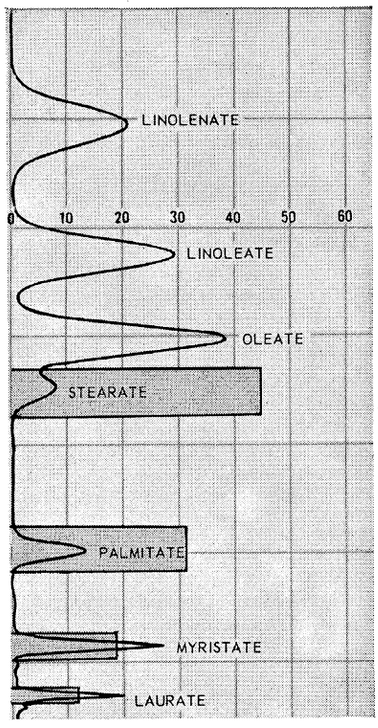
It is, of course, possible that the polls in question were not competently planned, conducted, or interpreted. But it is essentially anti-intellectual to indicate a blanket condemnation of statistical evidence.

Science recognizes the basic and the pervasive role played by probability and statistics. It is through a probabilistic procedure that every indvidual obtains the set of genes which to so great an extent determines what he is. The processes of communication, we have learned in recent years, are essentially statistical in nature. And on the broadest possible scale, our knowledge of the world about us is, in the present view, strictly and inevitably statistical in character.

For the individual behavior of every elementary particle in our universe is governed by laws which can only be expressed in probability terms. Everyday gross phenomena are normally predictable simply because of the vast numbers of individual events involved, the statistics thus becoming "regular" and dependable, just as is the experience of an exceedingly large life insurance company.

The automatic discarding of evidence because it is statistical is unscientific and wholly unwarranted. Statistical evidence is, in essentially all nontrivial cases, the only sort of evidence we can possibly have.—WARREN WEAVER, *Alfred P. Sloan Foundation, New York*

A NEW APPROACH TO PRECISE MEASUREMENT OF RADIOACTIVITY IN GAS CHROMATOGRAPHY



Typical gas chromatogram trace showing mass peaks of fatty acid methyl esters. Superimposed on the mass trace, the bar graph indicates no radioactivity in any of the unsaturates.

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Letters

(Continued from page 1858)

in the English system of units, elegantly and systematically developed the logical conclusion: the potential confusion inherent in the English system of units can be avoided by use of the metric system. (My sharp-eyed critics all noted, implicitly or explicitly, that the various definitions and revisions of the English units are always made in terms of the metric system.) As a postscript to Allen's letter, I wish to quote a relevant resolution from the recent 12th general assembly of the International Union of Geodesy and Geophysics (Helsinki, August 1960):

"The IUGG, considering international procedure concerning the use of metric units in scientific reports, strongly recommends that this practice be adopted in all papers submitted to IAGA. Thus heights of rockets and satellites should be given in kilometers instead of miles and altitudes of balloons and aircraft in meters or kilometers instead of feet."

As for Newell's ribbing on the subject of conversions, hidden in his first paragraph is some useful advice for those news media which are not concerned with accuracy and which want to "have what they say remembered." (I supposed that *Science* was concerned to have its articles be first correct and, if possible, remembered.) It is, of course, a psychological accident in the case in question that the number 9988, which cannot be justified on any technical grounds, appears acceptable, accurate and mnemonic, whereas the number 10,009, which is reasonably justifiable, appears to be either an error or a joke, and virtually demands rounding downward to 10,000. But once such a rounding has been effected, especially if it is then converted to 5 tons, the reader has lost all contact which the apparent degree of accuracy expressed in the original data. In fact, the question then arises, English or metric tons?

In general, I would recommend quoting at least the original data. If *Science* editors believe that a significant portion of *Science* readers do not comprehend the metric system, I would recommend, in this specific instance, a rendition such as: "4540 kg (approx. 10,000 lb)."

Now the witty Newell has also scored a more prevalent problem in conversions: the apparent increase in accuracy through use of conversion factors with *more* significant figures than the original data. But a word of caution to us would-be pedants: Newell happily increased four-place accuracy (4540 kg) to 13-place accuracy through use of a conversion factor with ten or more places (0.4535924277 . . . kg/lb), but unhappily he overlooked the revision (1 July 1959) of this factor. New value: 1 lb = 0.45359237 kg. One pound avoirdupois, that is.

PEMBROKE J. HART
IGY World Data Center A,
National Academy of Sciences–
National Research Council,
Washington, D.C.

On Ignoring Ancient Asia

Is there not some imprecision in the first two sentences of Hutchison's article [*Science* **132**, 643 (9 Sept. 1960)]? Hutchison says: "The main interest of the ancients in the absorption of sound was an indirect one. It concerned the fabrication of bells, which, until about the 8th century, were made of beaten iron sheets riveted together." By *ancients* he certainly does not intend to include the Chinese bell founders, who, long before the 8th century A.D., cast their bells.

That the background to the vast bulk of what constitutes our "science" today lay in Europe is traditional; is it wise to continue to ignore ancient Asia? Must we continue the error of the past in regarding Europe and Asia as two separated continents?

CHARLES O. HOUSTON, JR.
Division of Industrial Cooperation,
Smithsonian Institution,
Washington, D.C.

Meetings

Esperantists

The 45th annual international congress of Esperantists was held in Brussels, Belgium, from 30 July to 6 August, 1960, under the "alta protektado" of His Majesty Baudouin, King of the Belgians. In attendance were 1930 persons from many parts of the world, representing 42 nations. At the opening session a letter of greeting from King Baudouin was read; an address was given by M. Van Acker, former Prime Minister of Belgium; and short speeches were made by official representatives of several countries and by representatives of certain agencies of some others, including the U.S., whose Voice of America uses Esperanto as well as various national languages.

A number of organizations which use Esperanto or are promoting its use for their special purposes held meetings in connection with the general congress. Among them was the Internacia Scienca Asocio Esperantista, which has been in existence more than half a century and publishes an organ of its own, as well as contributing directly, through articles by individual members, to scientific and technical journals which use mainly the national languages. All the sessions of these diverse organizations, as well as the sessions and social functions of the general congress, were carried on smoothly and expeditiously in Esperanto, without translation.

Whereas the 1959 congress (held in Warsaw) emphasized the "Zamenhof year," in commemoration of the centenary of the Polish-born author of Esperanto, whose name appears on UNESCO's list of persons whose birthdays the member nations are requested to honor, the 1960 congress urged that special effort be made during the coming year to increase the teaching of Esperanto as a school subject. It was noted, among other things, that nearly 4000 pupils are taught Esperanto in 127 schools of various grades in Yugoslavia, no doubt owing in part to the efforts of Esperantists during their "summer pedagogical week."

The congress in Brussels was preceded by the usual institute, the so-called Somera (summer) University, during which experts on various subjects lecture in Esperanto. Maximum attendance at the lectures was reported as about 700. Among the subjects treated were the following: Problems of international law relating to space travel; juristic problems relating to atomic energy; the spawning of eels and the relation of European and American eels; Belgian literature from the French point of view; English education as viewed by other countries; toponomy (the study of place names); and historical data on commercial relations between the Canary Islands and Flanders.

An invitation for the 46th congress to convene in Harrogate, England, in 1961 was presented and accepted. As for the 1965 congress, for which an invitation from Japan had been announced at the Warsaw congress, it was stated that the invitation would probably be formally repeated later, with full details, after the forthcoming meeting of the national congress of Japanese Esperantists.

IVY KELLERMAN REED
315 Westbourne Street,
La Jolla, California

Forthcoming Events

January

8–12. Thermoelectric Energy Conversion, symp., Dallas, Tex. (P. H. Klein, General Electric Co., Electronics Lab., Bldg. 3, Room 221, Syracuse, N.Y.)

8–13. American Acad. of Orthopedic Surgeons, Miami Beach, Fla. (J. K. Hart, 116 South Michigan Ave., Chicago 3, Ill.)

8–14. Bahamas Conf. on Hypertension, Nassau. (I. M. Wechsler, P.O. Box 1454, Nasssau)

8–14. International Conf. of Social Work, 10th, Rome. (Miss R. M. William, ICSW, 345 E. 46 St., Room 1012, New York 17)

8–15. Latin American Convention of

Astronomy, 2nd, Lima, Peru. [A. C. Parro, Enrique Palacios 187 (359), Chorrillos (Lima), Peru]

9–11. Reliability and Quality Control, 7th natl. symp., Philadelphia, Pa. (R. L. Schwerin, ACF Electronics Div., ACF Industries, Inc., 11 Park Place, Paramus, N.J.)

9–12. White House Conf. on Aging, Washington, D.C. (Special Staff on Aging, Office of the Undersecretary, Dept. of Health, Education and Welfare, Washington 25)

9–13. Society of Automotive Engineers, annual, Detroit, Mich. (SAE, 485 Lexington Ave., New York 17)

10–11. Conference on Physics of Polymers, Bristol, England. (Organizing Secretary, Physical Soc., 1 Lowther Gardens, London, S.W.7)

16–18. American Astronautical Soc., annual, Dallas, Tex. (F. F. Martin, AAS, 304 S. Woodstock Dr., Haddonfield, N.J.)

16–19. Instrument Soc. of America, winter instrument-automation conf., St. Louis, Mo. (W. H. Kushnick, 313 Sixth Ave., Pittsburgh 22, Pa.)

22–28. Bahamas Serendipity Conf., 3rd, Nassau. (I. M. Wechsler, P.O. Box 1454, Nassau)

23–25. Institute of the Aeronautical Sciences, 29th annual, New York, N.Y. (Meetings Dept., IAS, 2 E. 64 St., New York 21)

23–26. American Meteorological Soc., 41st annual, New York, N.Y. (K. C. Spengler, AMS, 45 Beacon St., Boston 8, Mass.)

24–27. American Mathematical Soc., 67th annual, Washington, D.C. (J. W. Green, Univ. of California, Los Angeles)

24–27. Society for Industrial and Applied Mathematics, Washington, D.C. (G. Kaskey, Remington Rand Univac, 1900 W. Allegheny Ave., Philadelphia, Pa.)

24–27. Society of Plastics Engineers, 17th annual conf., Washington, D.C. (T. A. Bissell, SPE, 65 Prospect St., Stamford, Conn.)

25–27. Mathematical Assoc. of America, annual, Washington, D.C. (H. L. Alder, Dept. of Mathematics, Univ. of California, Davis)

26–27. Western Spectroscopy Conf., 8th annual, Pacific Grove, Calif. (R. C. Hawes, Applied Physics Corp., 2724 S. Peck Rd., Monrovia, Calif.)

27–28. Royal College of Physicians and Surgeons, annual, Ottawa, Ontario, Canada. (T. J. Giles, 150 Metcalfe St., Ottawa)

28–30. Control of the Mind, symp., San Francisco, Calif. (Dept. of Continuing Education in Medicine, Univ. of California Medical Center, San Francisco 22)

28–31. Infertility, sectional meeting, Intern. Fertility Assoc., Acapulco, Mexico. (M. L. Brodny, 4646 Marine Dr., Chicago 40, Ill.)

29–3. American Inst. of Electrical Engineers, winter meeting, New York, N.Y. (E. C. Day, AIEE, Technical Operations Dept., 33 W. 39 St., New York 18)

30–3. Clinical Cong. of Abdominal Surgeons, Miami Beach, Fla. (B. F. Alfano, 663 Main St., Melrose 76, Mass.)

30–4. American Library Assoc., mid-winter meeting. (Mrs. F. L. Spain, New York Public Library, 20 W. 53 St., New York, N.Y.)

31–4. American Assoc. of Physic Teachers, New York, N.Y. (F. Verbrugge, 135 Main Engineering, Univ. of Minnesota, Minneapolis)

31–4. American Physical Soc., annual, New York, N.Y. (K. Darrow, APS, Columbia Univ., 116th St. and Broadway, New York)

February

1–3. Solid Propellant Rocket Conf., American Rocket Soc., Salt Lake City, Utah. (R. D. Geckler, Aerojet-General Corp., P.O. Box 1947, Sacramento, Calif.)

1–3. Winter Military Electronics Conv., 2nd, Inst. of Radio Engineers, Los Angeles, Calif. (A. N. Curtiss, IRE Business Office, 1435 S. La Cienega Blvd., Los Angeles 35)

1–4. American Physical Soc., annual, New York, N.Y. (K. K. Darrow, APS, 538 W. 120 St., New York 27)

2–4. Congress on Administration, 4th annual, Chicago, Ill. (R. E. Brown, American College of Hospital Administrators, 840 N. Lake Shore Dr., Chicago 11)

6–8. American Acad. of Allergy, 17th annual, Washington, D.C. (J. O. Kelly, 756 North Milwaukee St., Milwaukee 2, Wis.)

6–8. Geodesy in the Space Age, symp., Ohio State Univ., Columbus. (W. A. Heiskanen, Ohio State Univ., 1314 Kinnear Road, Columbus 12)

9–15. Second Allergy Conf., Nassau, Bahamas. (I. M. Wechsler, P.O. Box 1454, Nassau)

13–16. American Soc. of Heating, Refrigerating and Air-Conditioning Engineers, Chicago, Ill. (R. C. Cross, 234 Fifth Ave., New York 1)

14–15. Conference on Microdosimetry, 2nd, Rochester, N.Y. (N. Kreidl, Bausch & Lomb Optical Co., Inc., Rochester 2)

15–17. International Solid-State Circuits Conf., Philadelphia, Pa. (J. J. Suran, Bldg. 3, Room 115, General Electric Co., Electronics Park, Syracuse, N.Y.)

16–18. Biophysical Soc., annual, St. Louis, Mo. (W. Sleator, Dept. of Physiology, Washington Univ., St. Louis 10)

22–25. American Educational Research Assoc., annual, Chicago, Ill. (G. T. Buswell, 1201 16th St., NW, Washington 6)

23-25. American Orthopsychiatric Assoc., annual, New York, N.Y. (Miss M. F. Langer, 1790 Broadway, New York 19)

23-25. Fifteenth Annual Symp. on Fundamental Cancer Research, Houston, Tex. (Publications Dept., Univ. of Texas M.D. Anderson Hospital and Tumor Inst., Texas Medical Center, Houston 25)

26–1. American Inst. of Chemical Engineers, natl., New Orleans, La. (F. J. Van Antwerpen, AICHE, 25 W. 45 St., New York 36)

26–2. American Inst. of Mining, Metallurgical, and Petroleum Engineers, annual, St. Louis, Mo. (AIME, 29 W. 39 St., New York 18)

27–3. Conference on Analytical Chemistry and Applied Spectroscopy, 12th, Pittsburgh, Pa. (L. P. Melnich, U.S. Steel Corp., Monroeville, Pa.)

(See 16 December issue for comprehensive list)