SCIENCE

12 February 1960

Vol. 131, No. 3398

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Beckman / Spinco Model 120

AMINO ACID ANALYZER

By providing automatic instrumentation for the Spackman-Stein-Moore technique of amino acid chromatography, the Model 120 Amino Acid Analyzer has proved an invaluable aid to the biochemist.

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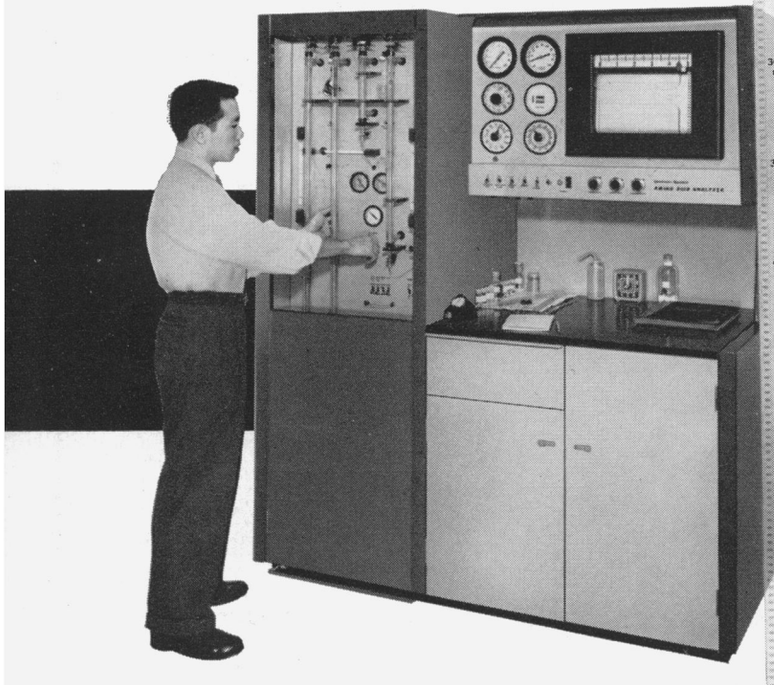

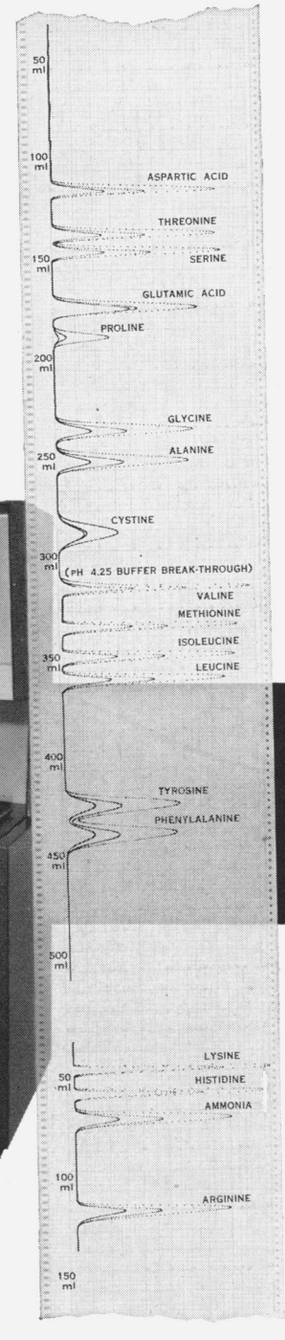

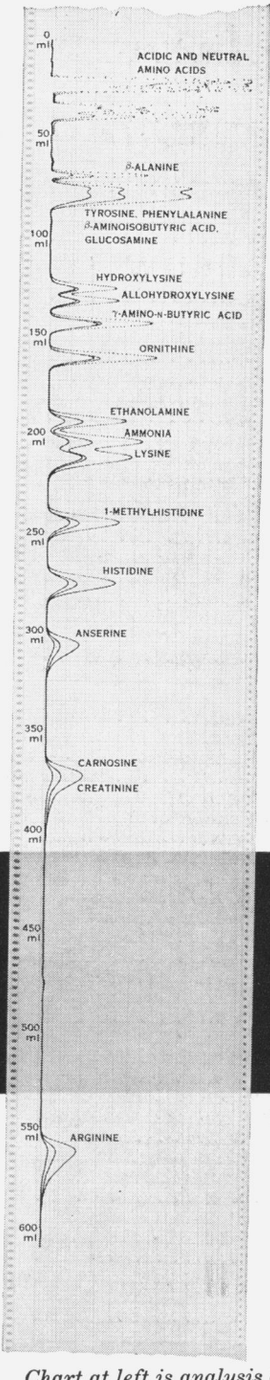

Chart at left is analysis of amino acids found in protein hydrolyzates: top run on 150-cm column at 50°C and pH 3.25 buffer, with changeover to pH 4.25 buffer at 6 hours; lower run on 15-cm column at 50°C and pH 5.28 buffer

Chart at right shows components in physiological fluids: 50-cm column at 30°C and pH 4.26 buffer, with changeover to 50°C at 14 hours.

Results are reproducible to better than 3 percent.

Reference: *D. H. Spackman, W. H. Stein, and S. Moore, "Automatic Recording Apparatus for use in the Chromatography of Amino Acids", Anal. Chem., 30, 1190-1206, 1958.*

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Beckman Instruments, Inc.

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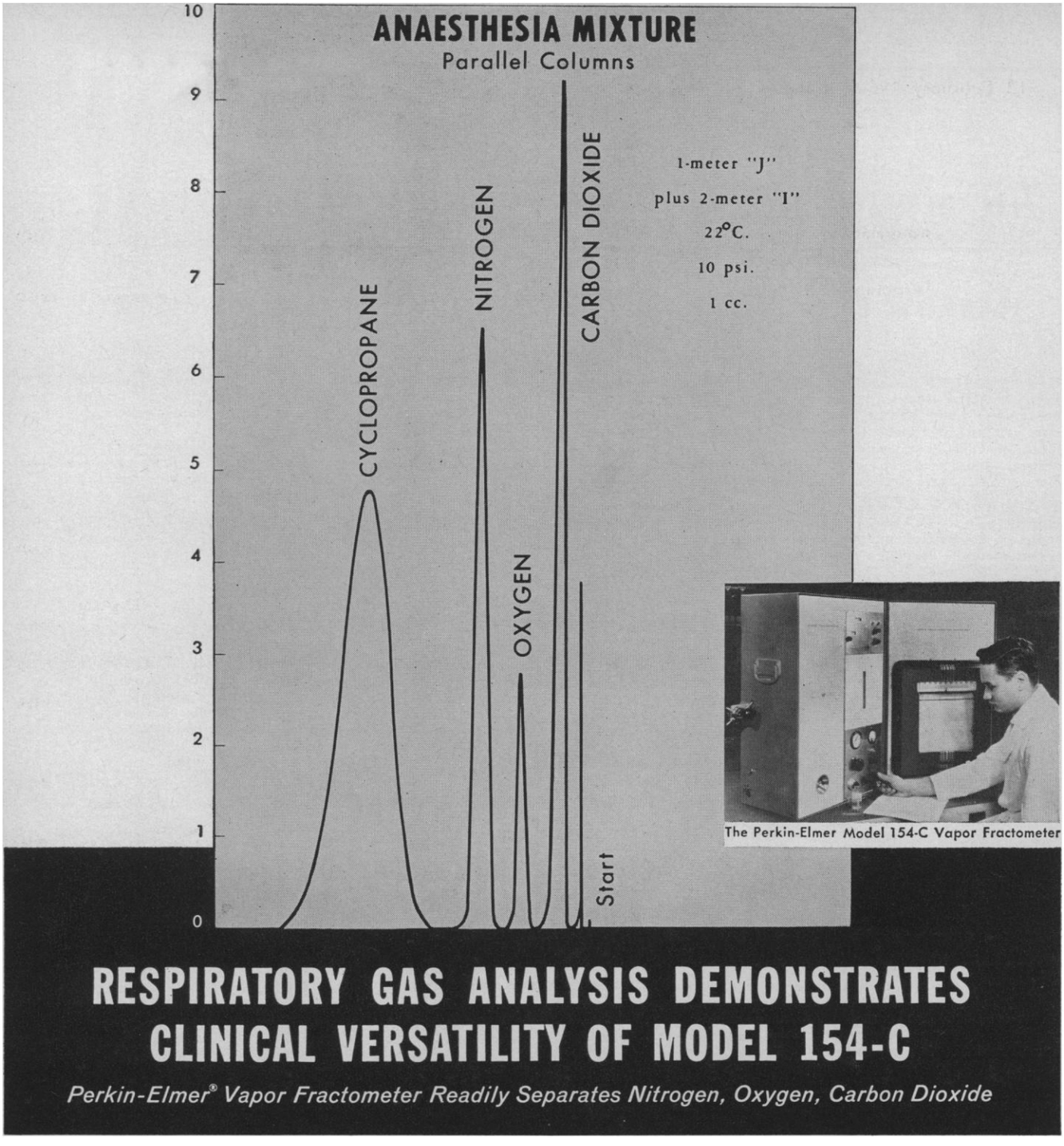

Use of the parallel column technique, developed by Perkin-Elmer, allows gas chromatographic analysis of mixtures containing carbon dioxide, nitrogen and oxygen—in a matter of minutes. Previously, single-column separation of nitrogen and oxygen *irreversibly absorbed* carbon dioxide, making two separate analyses necessary. The fractogram above, from a Perkin-Elmer Model 154-C Vapor Fractometer, shows the useful application of parallel columns to qualitative and quantitative analysis of anesthesia gases.

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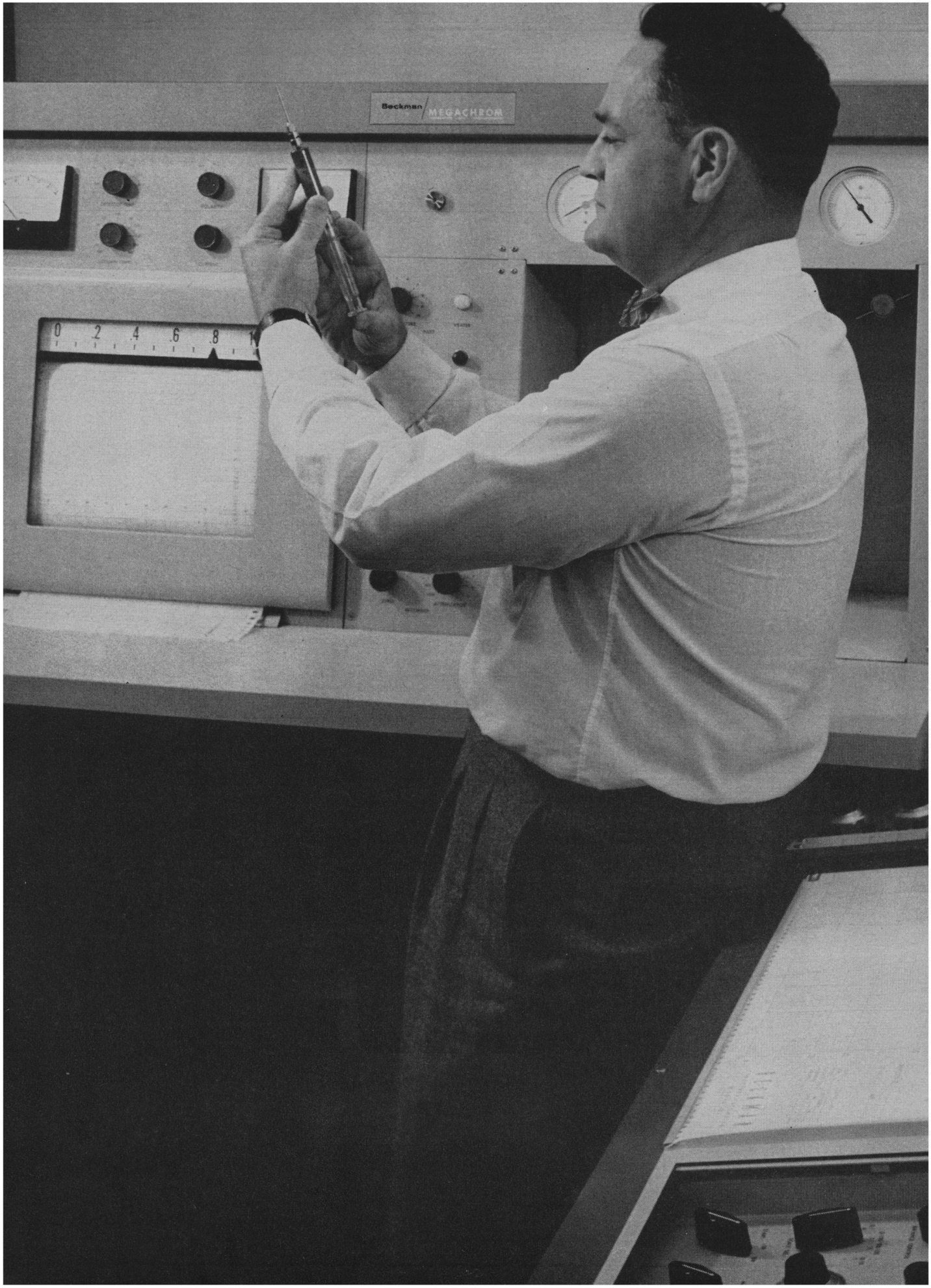
12 February 1960, Volume 131, Number 3398

SCIENCE

Cover

The upper first and second molar teeth of the type specimen of a fossil horse *Asinus pons* Quinn from the early Pleistocene Comosi fauna in the San Rafael Valley, southern Arizona. The specimen, which still retained the milk teeth, was sliced on a rock saw to show the enamel pattern about 30 mm below the crown of the unerupted molars. The crenulations are caused by the intricate folding of the enamel which was inked to bring out detail. The nearly enclosed loop near the margin of each tooth is the protocone, which is one of the diagnostic characters for identifying fossil horses. Each tooth is about 25 mm in anterior-posterior diameter. [Photo by J. F. Lance, Geochronology Laboratories, University of Arizona]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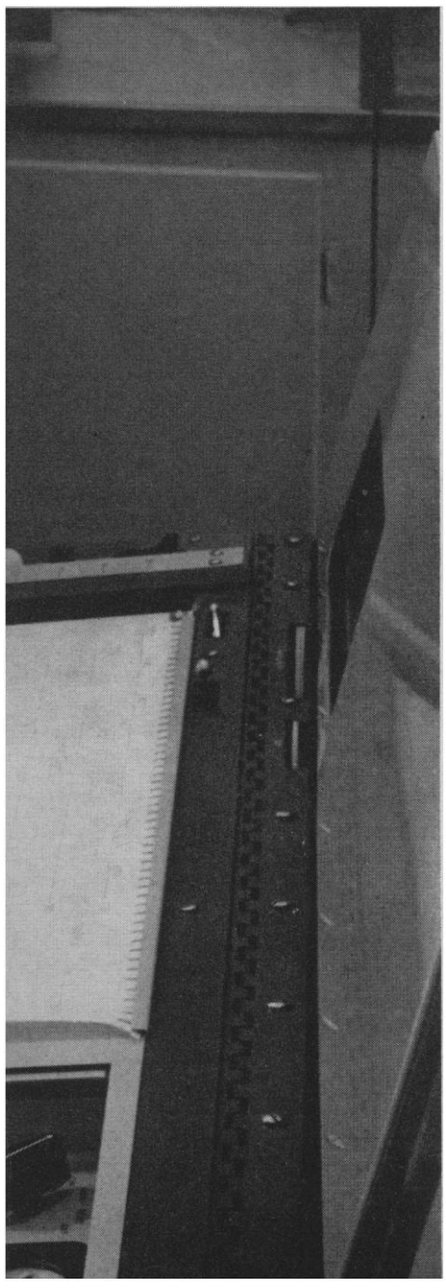
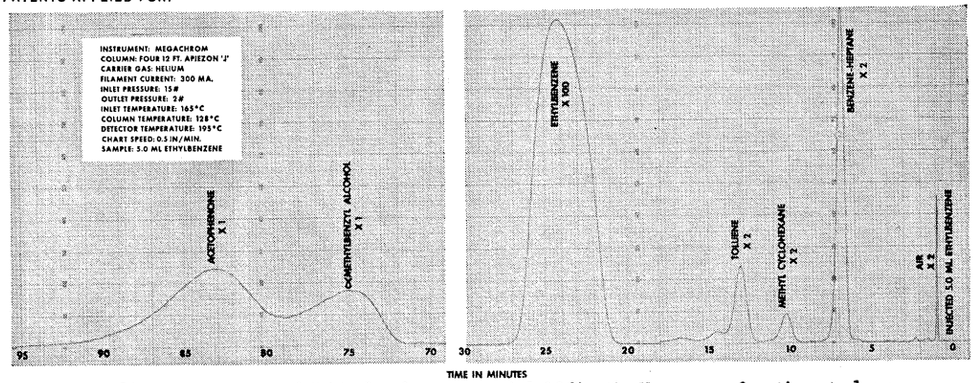
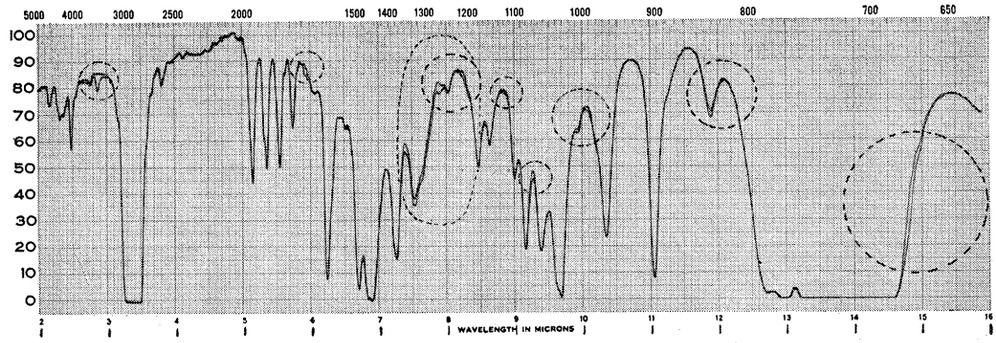
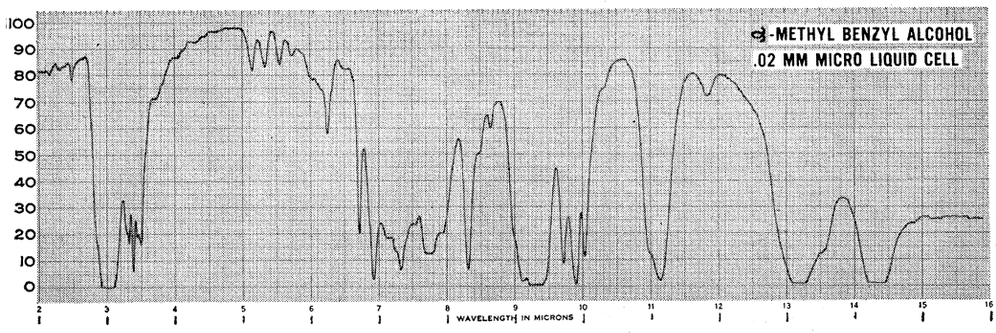




Chromatogram of 5.0 ml. of commercial 99% ethylbenzene fractionated on Megachrom. (Megachrom can handle as much as 20 ml.) Note resolution of contaminants which total only 1% of injected sample.



Infrared spectra of Megachrom-pure ethylbenzene (upper curve) and unpurified commercial ethylbenzene (lower curve). Impurity bands are circled.



Infrared spectrum of 0.1 microliters of ∝-methyl benzyl alcohol, a contaminant collected by Megachrom. With ordinary chromatograph, collection of this quantity of fraction for infrared or other analysis would be tedious or impossible.

Letters

Leonardo da Vinci, Man of Science

The objection of I. Webb Surratt to the inclusion of Leonardo da Vinci among the "Immortals of Science" [*Science* **130**, 1435 (1959)] deserves little support. The choice for the University of Bridgeport was made by nearly 1200 college and university presidents, editors of science periodicals, science editors of the world's great newspapers, and professors of science at scores of universities. In number of votes, Leonardo ranked 13th among the 25 immortals chosen.

In every category of science, from aeronautics and anatomy down to zoology, the first modern presentation is often ascribed to Leonardo. The universality of his genius is construed by Surratt as a weakness in his not having thoroughly worked any single field. His failure to publish kept him from winning earlier recognition, but is this a reason for detracting from his scientific contributions? Sarton, to whom Surratt points as one holding Leonardo in lesser esteem, saw fit to treat Leonardo as one of the great in his *Six Wings of Science in the Renaissance*. In this critical study he states (p. 174), "I shall speak only of two of them, the greatest of all, the Italian Leonardo da Vinci and the Fleming Andreas Vesalius. Leonardo was the real pioneer, for his anatomical investigations were already begun before the end of the fifteenth century, while those of Vesalius culminated in 1543." Sarton, most penetrating of all historians of science, says further (p. 229), "Leonardo was one of the greatest men of science in history, but the world which admired him as an artist did not discover the man of science until many centuries after his death."

Surratt suggests that the selection of Leonardo is "an example of the blind following of tradition." But it is not a matter of tradition; Sarton states (p. 219), "It is pleasant to end with one of the immortals. Leonardo is alive today as he ever was." It shows that modern science is catching up with Leonardo's thoughts, and thus it in part compensates for 400 years of neglect. Leonardo's first published work appeared 132 years after his death. A commentary on Leonardo's work in science was first published by Venturi in 1797, and translations of his more detailed scientific studies were first made by Richter in 1882.

The six magnificent folio volumes published in Oslo in 1911–16 first revealed the full scope of Leonardo's work in anatomy. These volumes were followed by a book by McMurrich, sponsored by the Carnegie Institute of Washington, which shed further light on Leonardo's work in anatomy.

More recently, O'Malley and Saunders published *Leonardo the Anatomist*, a quarto of 506 pages. Is it any wonder that Castiglioni in his *A History of Medicine* was impelled to repeat that Leonardo's was "the grandest effort ever made by any man to explore and interpret the universe"? Duhem, physicist and mathematician, saw fit to devote a three-volume study to Leonardo. Pledge, in his *Science since 1500*, a standard reference book in the history of science, chose Leonardo's self-portrait as the frontispiece. Finally, Massachusetts Institute of Technology engraved the name of Leonardo da Vinci, along with those of Newton, Darwin, Pasteur, and Copernicus, on its entrance towers, as men fit to be honored among the immortals of science.

BERN DIBNER

Wilton, Connecticut

Names for the Sun and Moon

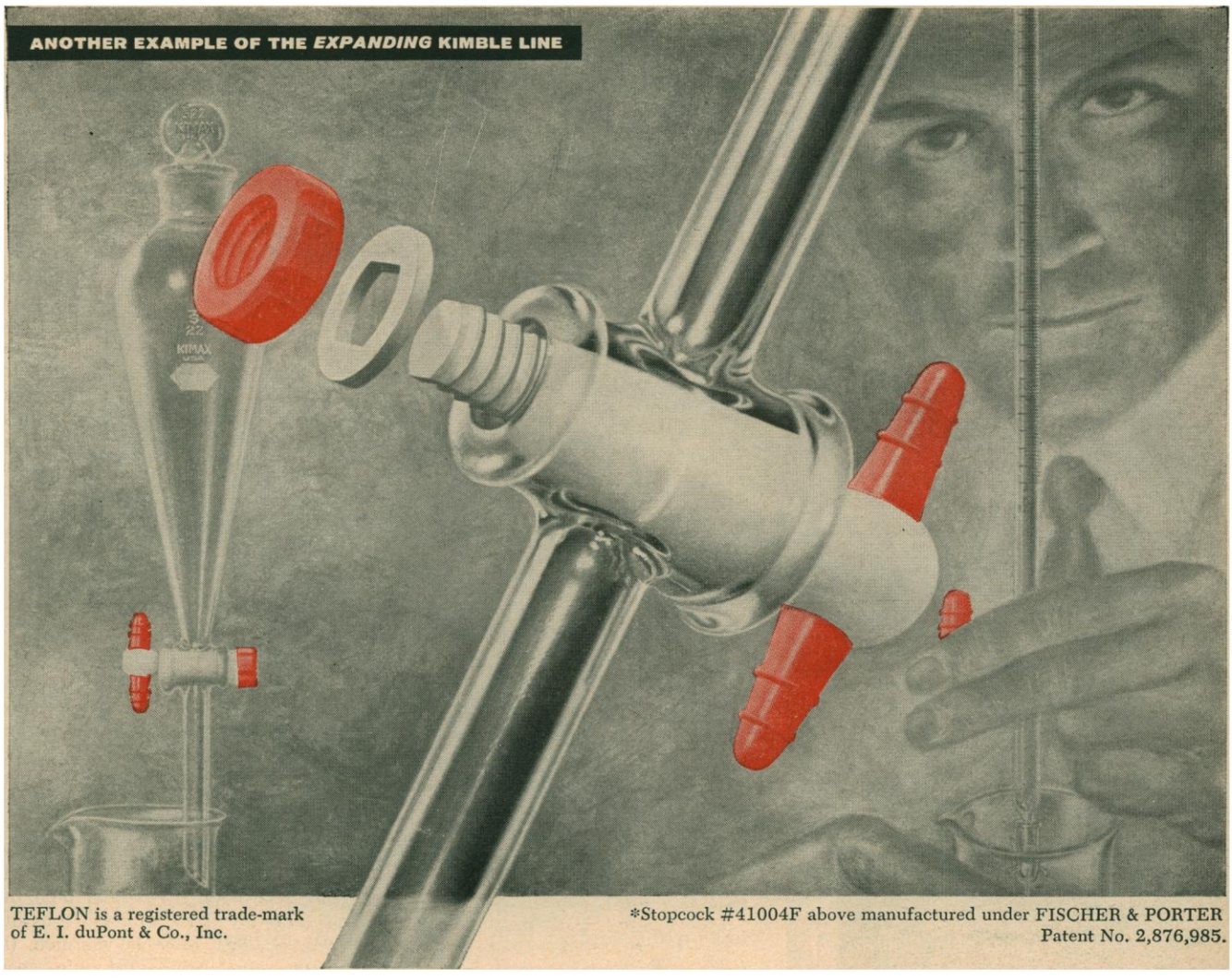
We, the members of the Future Scientists of America Science Club, have discussed naming the earth's sun and moon. We decided to work on this problem for the following reasons. (i) There is no universally established name for our sun. Literature of various kinds informs us that the Greeks, Romans, Egyptians, and others assigned names to the sun. The moon is also unnamed, but it has generally been referred to as our lunar body. This must be clarified. (ii) Heavenly bodies billions of miles away are specifically named, but these two masses in our own system are not. In this space age these bodies should be referred to by name, not as "our sun" or "our moon." Astronomers have named the 12 moons of Jupiter but not the Earth's moon.

We have reached the following conclusions. (i) *Sol* should be used as the name of our sun. This word is from the Latin and will apply very well, for our system is called the solar system. In the future, other systems should be called sun or star systems, not solar systems. (ii) The name of the earth's moon should be *Luna*. To assign any other name would be contrary to the weight of the available reference material.

The members of our science club would like to emphasize the importance of adhering to these established names. People throughout the world would no longer have only a vague notion of the names of the bodies investigated. We would like to see *Sol* and *Luna* used universally.

VINCENT M. MASSARO

Future Scientists of America Science Club, Roy W. Brown Junior High School, Bergenfield, New Jersey



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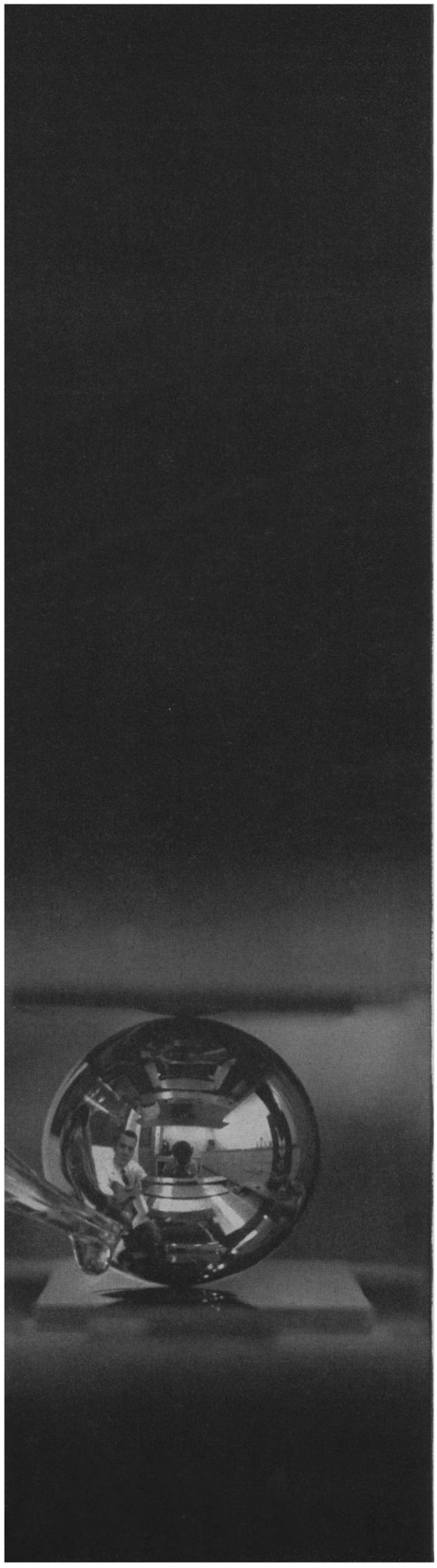


One of a series

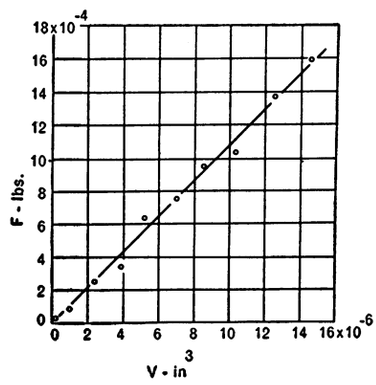
On the riddle of rolling friction

It doesn't take much to roll a hard ball across a hard, smooth, level surface — actually only about 0.00001 times the normal force acting vertically on the ball. But by careful measurement of this tiny rolling force, scientists at the General Motors Research Laboratories are helping to unravel the riddle of rolling friction.

An important relationship recently uncovered in this fundamental study: the rolling force is proportional to the volume of material that is stressed above a certain level. As a result, a GM Research group have not only confirmed the hypothesis of *how* a rolling ball loses energy (Answer: elastic hysteresis) but also have learned *where* this lost energy is dissipated (Answer: in the interior of the material, not on the surface). Mathematical analyses have indicated the exact shape of the elastically stressed volume in which all the significant frictional loss takes place.

The purpose of friction research at the GM Research Laboratories is to learn more about the elastic and inelastic behavior of materials. This knowledge — of academic interest now — will eventually give GM engineers greater control of energy lost through friction. This is but one more example of how General Motors lives up to its promise of "More and better things for more people."

General Motors Research Laboratories
Warren, Michigan



Relationship of rolling force to elastically stressed volume.

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Army Drops the Ball

From earliest times man has sought to escape from the cycle of the fat and the lean years by storing food. Grains are readily stored without special treatment, but leafy vegetables and meats must be preserved from attack by decay organisms. All of the methods in use until recently—drying, salting, pickling, smoking, and canning—change to some degree the appearance, flavor, and texture of the foods.

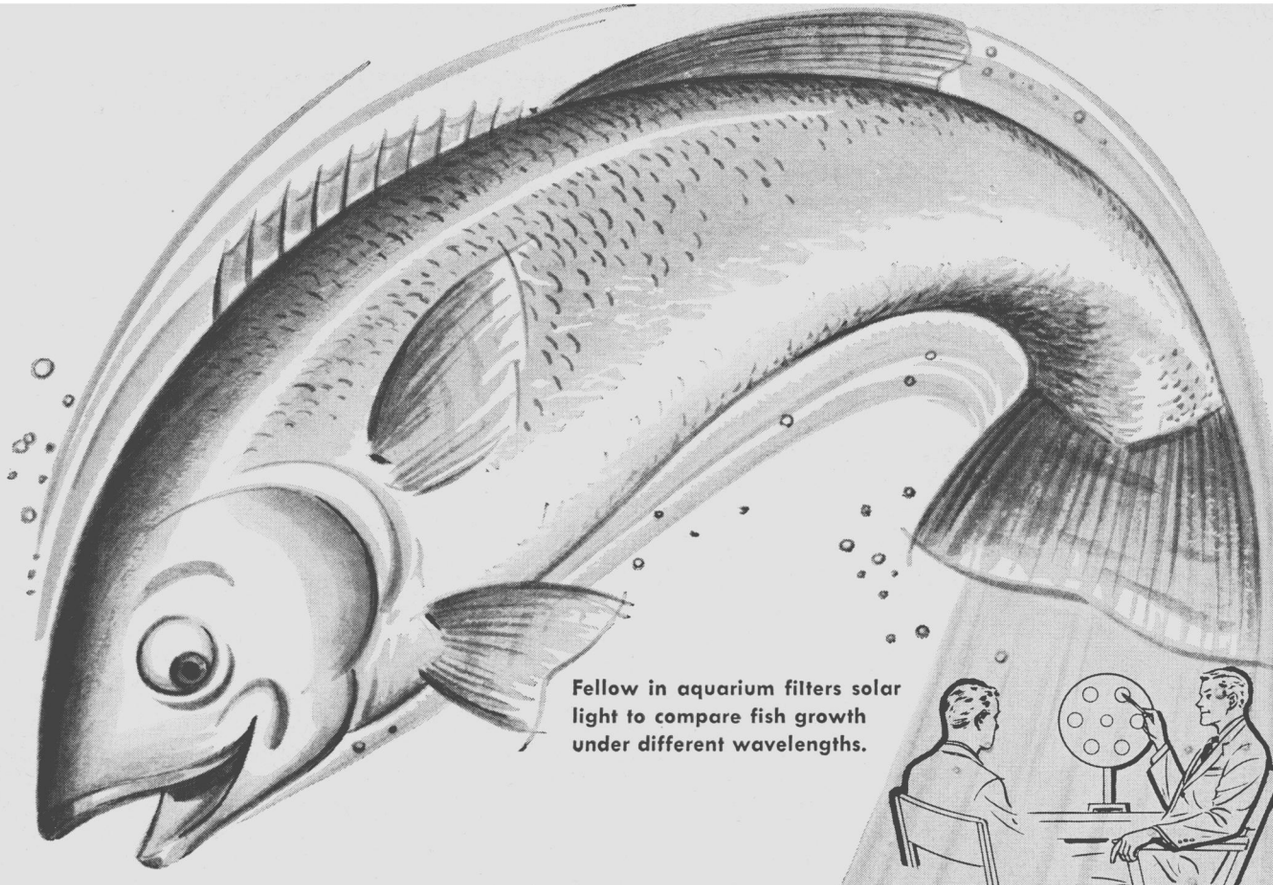
The goal of storing foods in an essentially fresh condition for indefinite periods has only been attained in this generation, through quick-freeze techniques and storage at temperatures sufficiently low to prevent multiplication of decay organisms and inhibit enzyme activity. But this method can only function in societies that can afford the refrigeration equipment and the power supplies to keep it in operation.

More than ten years ago atomic energy seemed to offer an alternative mode of food preservation. In principle, the method is simple and straightforward: irradiation in sufficiently high doses will kill all decay organisms. Thus, if food is properly packaged during irradiation it will be completely sterilized and no decay will occur even without refrigeration. In practice, some difficulties are encountered: some irradiated foods develop unpalatable flavors or undergo changes in appearance; the dosages used for sterilization do not destroy the enzymes in the food, and consequently gradual changes occur at ordinary temperatures. But preservation by irradiation would, if successful, make it possible to store and ship essentially fresh foods without refrigeration, and it was this promise that led the Quartermaster Corps of the Army to start a research program in 1951. By 1954 the results seemed to justify an accelerated attack. The Department of Defense worked out an agreement with the Atomic Energy Commission for all research in food irradiation to be carried out by the Army. The main sources of radiation, then and since, were spent fuel elements from reactors; hence, the sources were variable, and precise conditions of irradiation were not reproducible.

By 1955 enough progress had been made for the Army to lay plans for the construction of an Army Ionizing Radiation Center at Stockton, California. This installation was to provide a cobalt-60 source for gamma rays and a linear accelerator for electrons. It was to be both a research laboratory and a pilot plant capable of sterilizing several tons of food per day. The program has so far cost more than $14 million, of which about $1.7 million was spent for test borings and for design and engineering studies for the proposed $7.5 million radiation center.

On the recommendation of Richard S. Morse, Director of Research and Development, the Army indefinitely suspended the program on 22 October 1959. At hearings held last month by the Joint Congressional Committee on Atomic Energy, Morse testified that the suspension was in order because the Army had no urgent need for irradiated food, irradiation had not been shown to offer substantial economic advantages over methods now in use, and additional research was needed before irradiated food could be proved suitable for long-term human consumption. On all these points except the last there was contrary testimony. Most of those who testified agreed that further research was needed but felt that the outlook was so bright that an intensive effort was justified.

Should this country abandon all effort to perfect so promising a method of food preservation? Perfection of the method, by making high-quality proteins readily available in underdeveloped areas, would be a long step forward in the Atoms-for-Peace program. In our opinion, the Atomic Energy Commission should move to recover the Army fumble.—G.DuS.



Fellow in aquarium filters solar light to compare fish growth under different wavelengths.

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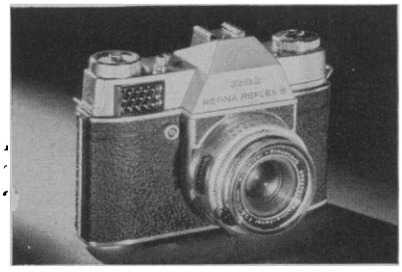


This, in our current and patently prejudiced view, is the best camera that money can buy, $199.50 worth of money, to be specific.

This is the camera we recommend for the scientific worker who does not especially enjoy photography for its own sake but has decided to deprive himself no longer of its benefits to his work.

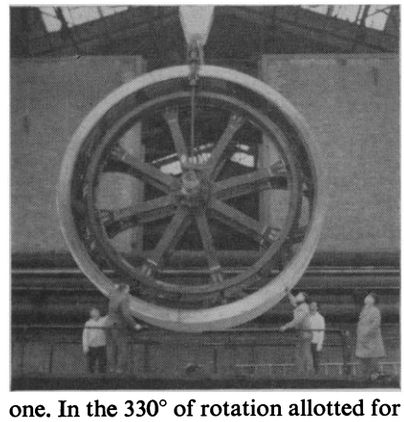
This camera is very handy for recording facts as they occur, under the widest variety of conditions and with the least thought to technicalities, least of all to the tiresome question of parallax. Even at only 5⅞″ film-to-subject distance, made possible by the supplementary lenses for closeups, the exact scene falling on the user's own retina as he presses the button will shortly be a 35mm color slide for projection. He sees the scene through the camera lens itself at its full aperture, with a split-image rangefinder view at the center of the ground glass. He can make pictures as fast as he can flip the lever, real pictures for which opportunity may have come rapidly, not just a succession of wasteful trial shots that grope for some usable combination of camera pointing, focus, and exposure. Judgment and arithmetic in choosing proper exposure are replaced by the act of bringing two pointers into coincidence, one of them being photoelectrically actuated.

This camera, its wide-angle lenses, its telephoto lenses, and its specialized photo aids (such as for adapting to a microscope) all come from Kodak A. G. in Stuttgart, a plant devoted to the Retina system of photography. They make the taking of good photographs easy. Great photographs are another matter. Great photographs convey universal emotion and are works of art. A great and talented artist may not need a *Kodak Retina Reflex S Camera*, but neither does a *Kodak Retina Reflex S Camera* need a great and talented artist.

They are still a little scarce at the camera shops. Please don't be angry if you have to come back a second time.

A kind word for triacetate tape

We make cellulose triacetate base for magnetic tape. We cast it from solution on the nigh miraculously smooth peripheries of 18-foot wheels like this



one. In the 330° of rotation allotted for preliminary evaporation of the solvents before stripping off as sheet, the thickness—along with any thickness errors—shrinks by 4/5. Except for infrequent replating, these prodigious wheels have been rotating with stately unbroken angular momentum night and day, winter and summer, weekends and workdays for a full generation of mortal man.

Not only do our tape-making customers rival each other in excellence of deposition, but our cellulose triacetate has a rival of its own in polyethylene terephthalate, which is known as polyester. Because of the slightly higher price of polyester tape, it has often been assumed on all counts superior. This misconception hurts us.* The price difference at least partially stems from the higher salable yield that the tape manufacturer gets from cellulose triacetate. He has to reject less tape for deformation or "skew" and has the inherent thickness uniformity of the solvent-evaporation method to thank.

Though most of the tape being bought today is our beloved cellulose triacetate, there is a place for polyester. That we admit. It's very good for humidity amplitude and devilishly strong.

Cellulose triacetate, on the other hand, has only 15% ultimate residual elongation, not 45%. It does not go on stretching and stretching when overloaded by apparatus design that leans too heavily on strength of the tape base. In many applications a stretch of large and unknown magnitude could have a sneaky effect on the results.

One other factor puts cellulose triacetate high with the man to whom the word "dropout" is an expression of horror. A dropout is caused by an inhomogeneity. Our cellulose triacetate, by the nature of its manufacture, is not likely to contribute inhomogeneity. Believe us.

Chroma for chromatography

2-Bromo-4′-phenylazoacetophenone, now available as Eastman 7492, forms orange-colored esters with many organic acids, each with its own relative rate of travel over silicic acid, or over paper in that type of chromatography. The esters are all orange-colored, as is the reagent itself. The color makes the bands easy to find and the rate of movement easy to measure. The separated esters can then be hacked out, eluted with acetone, and the melting points of the wee bits of ester measured to clinch the identification.

The list of melting points and relative mobilities of these esters and a procedural abstract that we can send you for the asking come from two papers (*Anal. Chem. 29*, 1162 and *26*, 1228) by some California viticultural and enological chemists. These fellows got into the subject in attempting to measure minuscule amounts of various esters and free acids that distinguish the bouquet of one wine from another's. You might mention this to the *sommelier* at your favorite little restaurant in Paris.

We like this trick of pinning phenylazophenacyl tails on derivatives formed with various classes of compounds so that they can be located in chromatograms. It puts the "chroma" back in chromatography, where it belongs. The new Eastman 7492 joins *p-Phenylazobenzoyl Chloride* (Eastman 5549) for alcohols, *p-Phenylazobenzenesulfonyl Chloride* (Eastman 7487) for colored amides from amines, *p-Phenylazophenyl Isocyanate* (Eastman P7438) for colored urethanes from alcohols, and *4-(p-Phenylazophenyl)semicarbazide* (Eastman 7443) for carbonyl compounds.

Those are Eastman Organic Chemicals. From Distillation Products Industries, Rochester 3, N. Y. (Division of Eastman Kodak Company), where some 3800 of them are on hand.

Price is list and subject to change without notice.

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TRADE MARK

*Another thing that disturbs us is inclusion of cellulose triacetate under the generic term "acetate." Fortunately, cellulose *di*acetate is fast disappearing from the tape market.

has free charges only on the surface and showed that the theory agreed fairly well with experimental results.

D. J. Worsfold and S. Bywater (National Research Council) spoke on properties of poly-α-methylstyrene produced by anionic polymerization. They have made a thorough molecular-weight analysis of poly-α-methylstyrene samples produced with sodium naphthenide as catalyst. One important result is a determination of the intrinsic viscosity-molecular weight relationship for polymer samples of very sharp distribution.

M. Senez and H. Daoust (Montreal), in their paper on heat parameters for polyisobutylene solutions, compared heat parameters determined for the polyisobutylene-chlorobenzene system by calorimetry and by the viscosity method of Fox and Flory. The data fit the Fox and Flory treatment of viscosity data.

W. Heller and M. Nakagaki (Wayne State), in discussing the exact theory of the scanning method for determining particle sizes from light scattering, gave accurate calculations of the angular positions of maxima and minima for nonabsorbing spheres for the large relative refractive index of 1.20. The results for other relative refractive indices can now be calculated fairly readily.

T. Gillespie (Dow Chemical Co.) presented papers on the limited flocculation of a colloidal system by a water-soluble polymer and the rheology of a polystyrene latex thickened with methylcellulose. His results on the flocculation of styrene-butadiene latex by methylcellulose indicate that the stabilization of a hydrophobic colloid by a hydrophilic colloid is due to changes in the balance of the flocculation and deflocculation processes. Methylcellulose thickens a polystyrene latex by causing a reversible partial flocculation.

A. Novak and E. Whalley (National Research Council) presented data on the infrared spectrum of polyformaldehyde and showed that these data could be interpreted on the assumption of a helical model for the polymer.

E. H. Immergut, G. Kollmann, and A. Malatesta (Dunlop Research Centre) reported results on the cationic copolymerization of propylene and isoprene. They prepared soluble copolymers under carefully controlled conditions, using aluminum chloride as catalyst at −78°C (molecular weight range, 4000 to 10,000). Reactivity ratios for propylene and isoprene are approximately 0.23 and 0.5. M. H. Jones, U. Martius, and M. P. Thorne (Ontario Research Foundation) discussed the polymerization of 1-butene by metal alkyl-titanium halide catalysts. They reported the results of chemical and x-ray analyses of the complex catalysts produced by the interaction of aluminum triisobutyl or lithium *n*-butyl with titanium trichloride or tetrachloride. Kinetic results for the polymerization of butene-1 with aluminum triisobutyltitanium trichloride were given; the products were of very high molecular weight (intrinsic viscosity between 5 and 6).

C. H. Bamford, in a paper on termination by primary radicals in vinyl polymerization, said that when the initiator concentration is high, a plot of rate of polymerization of styrene versus monomer concentration is curved. This can be quantitatively accounted for by assuming termination of some growing polymer radicals by primary radicals from the initiator. The velocity constant for primary radical termination is about 60 times that for mutual termination. The interaction of unlike radicals was discussed by C. Sivertz and Y. Ebisuzaki (Western Ontario) in a paper on the measurement of the cross-termination velocity constants for picrylhydrazyl and alkyl radicals. They studied the thermal decomposition of azobisisobutyronitrile at such low concentrations that the combination of free cyano-alkyl radicals competed with the reaction with diphenylpicrylhydrazyl. The relationship between the two velocity constants was derived.

L. E. Coleman and J. F. Bork (Lubrizol Corp.) spoke on the reactivity ratios of N-vinyl oxazolidone and N-vinyl pyrrolidone with vinyl monomers. N-vinyl oxazolidone copolymerizes well with vinyl chloride and vinyl acetate but not with styrene and methyl methacrylate; N-vinyl pyrrolidone is more reactive than N-vinyl oxazolidone. W. E. Walles, W. F. Tousignant, and T. Houtman (Dow Chemical) have studied poly-N-vinyl, 5-methyl, 2-oxazolidone, a new complexing polymer, of molecular weight 150,000. It is soluble in water below 40°C and insoluble at higher temperatures. This behavior is explained in terms of a change from a structure which presents largely hydrophilic groups to the solvent to one which is almost entirely hydrophobic.

R. J. Ceresa and F. H. Cotton (National College of Rubber Technology, London), in presenting a paper on the mechanicochemical modification of high polymers, said that cold mastication of elastomers in the presence of 0.1 percent aluminum isopropoxide eventually leads to gels; under similar conditions a mixture of polyvinyl acetate and polyethylene may give a fair yield of block copolymer.

R. J. Richardson (Atomic Energy of Canada) spoke on radiation grafting of high polymers. Nylon tenting fabric was irradiated with gamma rays in the presence of styrene to give polystyrene

grafts largely on the surface of the nylon, with a resultant improvement in the weathering properties of the fabric. Irradiation of nylon and terylene in the presence of acrylonitrile and vinyl pyrrolidone gave a slight improvement in dyeing response.

J. R. Tichy (Maine Medical Center), in his paper on the polymerization of phosphorous pentachloride and urea, presented analytical data on the products of this complex polymerization. In the last paper presented, R. W. Lenz and W. K. Carrington (Dow Chemical) discussed the preparation of phenylene sulfide polymers by the Macallum polymerization. The reaction of *p*-dichlorbenzene with sulfur and sodium carbonate at 300° to 350°C to give a phenylene sulfide polymer of high molecular weight probably proceeds partly by a direct attack of sulfur diradicals on the dihalide and partly by attack of sodium sulfide formed by reaction of sulfur with sodium carbonate.

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Forthcoming Events

March

13–14. American Otological Soc., Miami Beach, Fla. (L. R. Boies, University Hospital, Minneapolis 14.)

14–16. American Railway Engineering Assoc., annual conv., Chicago, Ill. (N. D. Howard, AREA, 59 E. Van Buren St., Chicago 5.)

14–17. Positive Health of Older People, forum, Miami Beach, Fla. (A. Mallach, National Health Council, 1790 Broadway, New York 19.)

14–18. National Assoc. of Corrosion Engineers, 16th annual, Dallas, Tex. (W. A. Mapler, NACE, 18263 W. McNichols Rd., Detroit 19, Mich.)

15–16. American Broncho-Esophangological Assoc., Miami Beach, Fla. (F. J. Putney, 1712 Locust St., Philadelphia 3.)

15–21. Nondestructive Testing, 3rd intern. conf., Tokyo and Osaka, Japan. (S. Ishizaka, Scientific Attaché, Embassy of Japan, 2514 Massachusetts Ave., NW, Washington 8.)

16–18. Genetics Soc. of Canada, 5th annual, Vancouver, B.C. (Miss K. Cole, Dept. of Biology and Botany, Univ. of British Columbia, Vancouver 8.)

17. Congress for Pharmacists, 2nd annual, Jamaica, N.Y. (Congress for Pharmacists, Public Relations Office, St. John's Univ., Jamaica 32.)

17–19. American Radium Soc., conf., San Juan, Puerto Rico. (ARS, 635 East Union, Pasadena, Calif.)

17–19. Blood Platelets, intern. symp. (by invitation only), Detroit, Mich. (Miss S. A. Johnson, Henry Ford Hospital, Detroit 2.)

17–19. National Federation of Science Abstracting and Indexing Services, annual, Washington, D.C. (R. A. Jensen, 301 E. Capitol St., Washington 3.)

17–20. International Assoc. for Dental Research, Chicago, Ill. (D. Y. Burrill, Northwestern Univ. Dental School, 311 E. Chicago Ave., Chicago 11.)

18–19. American Laryngological Assoc., Miami Beach, Fla. (L. Richards, Massachusetts Institute of Technology, Cambridge.)

20–23. American Assoc. of Dental Schools, Chicago, Ill. (R. Sullen, 840 N. Lake Shore Drive, Chicago 11.)

20–26. American Cong. on Surveying and Mapping, Washington, D.C. (C. E. Palmer, American Soc. of Photogrammetry, 1515 Massachusetts Ave., NW, Washington 5.)

20–26. American Soc. of Photogrammetry, Washington, D.C. (C. E. Palmer, ASP, 1515 Massachusetts Ave., NW, Washington 5.)

21–24. American Acad. of General Practice, 12th annual, Philadelphia, Pa. (AAGP, Volker Blvd. at Brookside, Kansas City 12, Mo.)

21–24. Institute of Radio Engineers, natl. conv., New York, N.Y. (L. G. Cumming, IRE, 1 E. 79 St., New York 21.)

22–24. High-Polymer Physics, 20th, Detroit, Mich. (T. L. Smith, American Physical Soc., Stanford Research Inst., Menlo Park, Calif.)

23–25. National Council on Alcoholism, annual, New York, N.Y. (M. Ross, American Psychiatric Assoc., 1700 18 St., NW, Washington 9.)

23–25. Optical Spectrometric Measure-