SCIENCE

16 August 1963
Vol. 141, No. 3581

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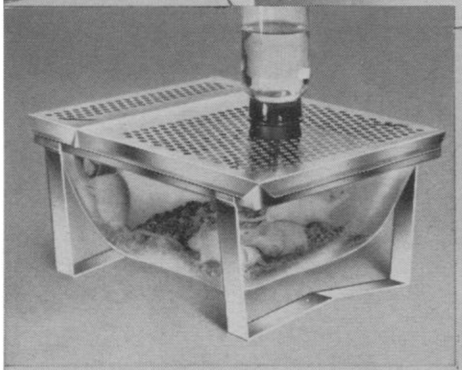

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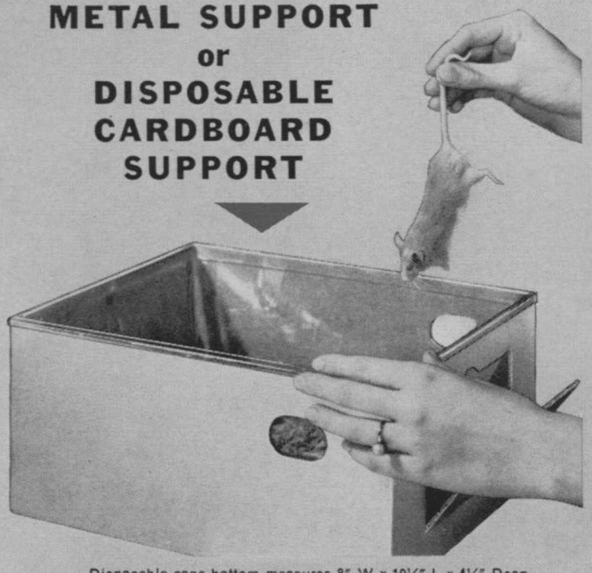

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COVER

Ancient tablet from Nippur in Babylonia. This is the first reasonably well preserved list of Sumerian prescriptions among which are poultices and internal remedies. Ingredients used in the medicines included plants, strong beer, bituminous oil from the river, turtle shell, and water snake. See review of *The Sumerians*, page 623. [University Museum, University of Pennsylvania]

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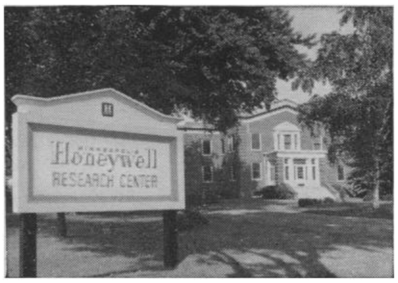


The Measurement of Surface Roughness by Radioactive Adsorbents

Roughness of surfaces affects several parameters including physical movement, magnetic properties and rate of reaction. Radioactive adsorbents now offer a means of accurate repeatable measurement of roughness on a molecular scale.

Scientists have long known that the degree of surface roughness has a profound effect on the physical movement between surfaces, on the physical and chemical properties of materials and on the rate of reaction with a reacting agent. If the degree of roughness could be accurately and quickly measured, the characteristics of the surface could be predicted.

The problem facing the scientist is similar to the topographer measuring a mountain range but the scientist is dealing with a molecular scale in attempting to measure the true profile of a surface.

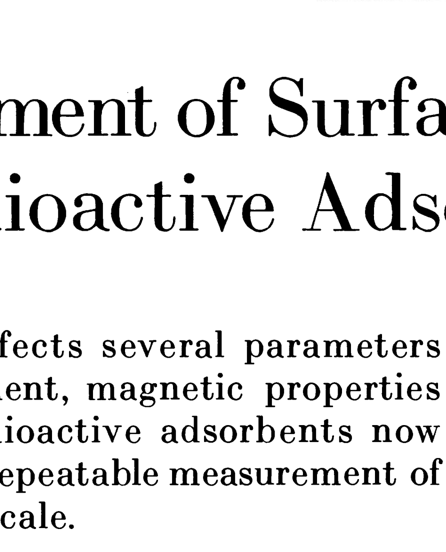
Langmuir, in 1918, discovered that certain gases were adsorbed on a surface in certain cases as a monomolecular layer. In a closed system he would measure the amount of gas adsorbed by the surface. Knowing the area of each gas molecule he could then determine the surface area. The technique was limited in its sensitivity and did not apply to multi-layer adsorption. Langmuir extended his technique to liquids when by dipping a clean glass plate in oleic acid floating on water, he found that the surface was covered with a monomolecular layer of the acid. With diffraction techniques he was able to make a rough measurement of the surface.

Today progress is being made using the new techniques of radioactive tracing.

If a species that would be adsorbed as a monomolecular layer is tagged with a radioactive material of known specific activity (number of counts per unit weight), measurement of the counts on the surface will yield the number of molecules adsorbed. Thus, as with Langmuir's technique, if the area occupied by an adsorbed molecule is known, the total surface area or roughness can be calculated.

Stearic acid was the adsorbent usually used but it would not stick on some surfaces and could not be used on many materials.

FIG. 1



ADSORPTION ISOTHERM OF HMAB ON ALUMINUM AT 25° C.

Honeywell scientists were particularly concerned with measuring the surface roughness of glass and searched for a rapid technique that would work in an aqueous solution. Since detergents are known to coat materials they were considered as a promising group to be tried. They offered wider applications and could be used on plastics, glass and metals. By varying the concentration of detergent it was found that there is a range in water at which the detergent is adsorbed as a monomolecular layer (See Fig. 1.). Hexadecyltrimethylammonium Bromide (HMAB) was chosen and tagged with C^{14}. The radioactivity of the detergent adsorbed on the glass surface was measured and from this the number of molecules on the surface was determined, and thus the area was calculated.

Accurate measurement of surfaces has led to some interesting insights into surface characteristics.

In thin Permalloy films the effect of moderate roughening did not change the coercive force. Upon further roughening, however, there was a sharp rise in coercive force.

When the surface of the substrate was varied by unidirectional scratching a phenomenon known as bi-axial anisotropy (two easy directions of orientation by a magnetic field) was noted for the first time in the material. In addition, aging of the surface was observed as the investigation proceeded.

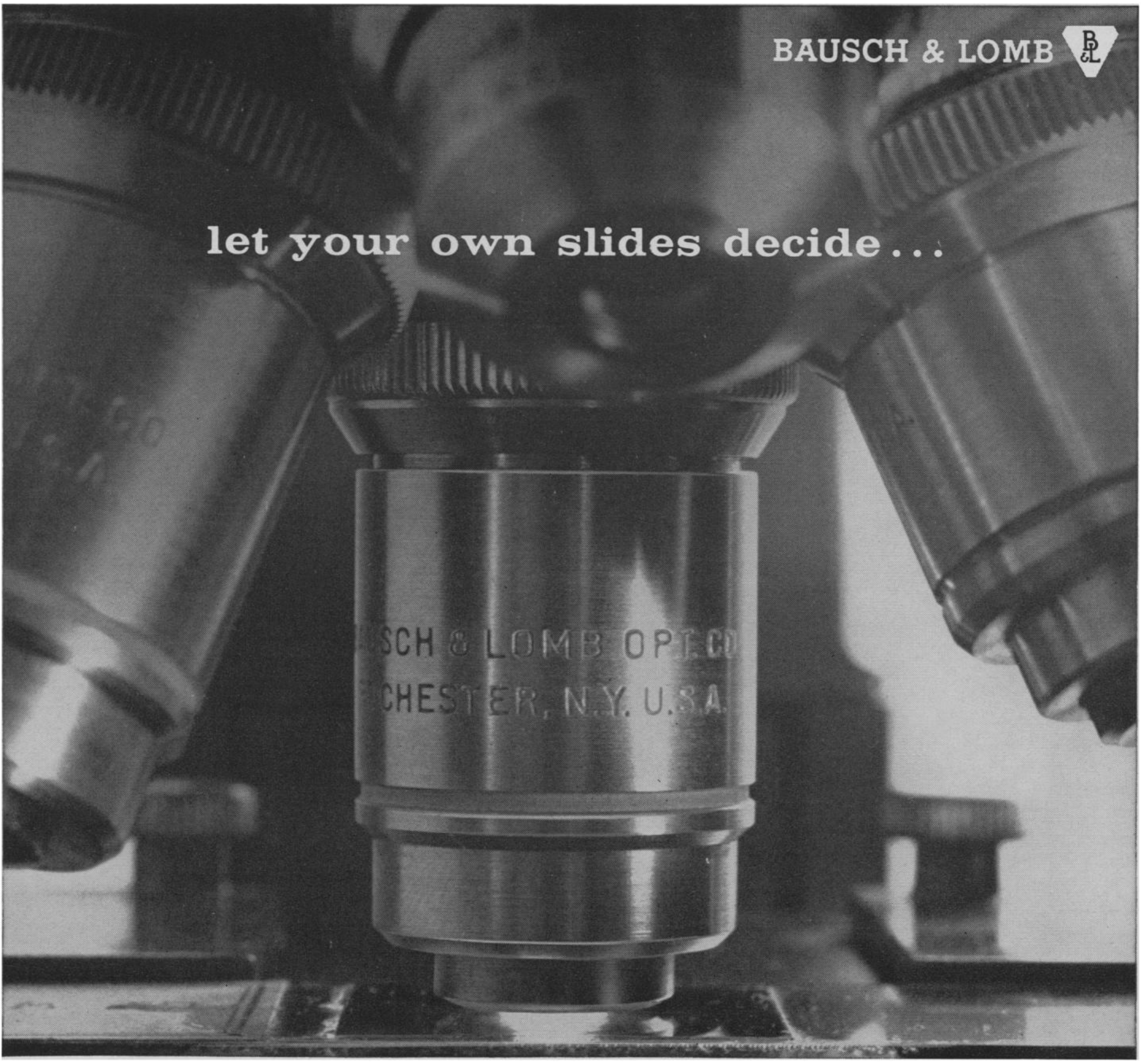
Measurement of the surface area has also permitted Honeywell scientists to determine the effect of varying roughnesses of glass on the speed of movement of mercury — leading to predictable response in faster-acting mercury switches.

Further understanding of the effect of surface roughness is looked for as the surface area measurement techniques are refined.

If you are actively engaged in work in this field and wish to know more about Honeywell's techniques you are invited to correspond with Dr. Joseph Kivel, Honeywell Research Center, Hopkins, Minnesota.

If you are interested in a career at Honeywell's Research Center and hold an advanced degree, you are invited to write Dr. John Dempsey, Director of Research at this same address.

Honeywell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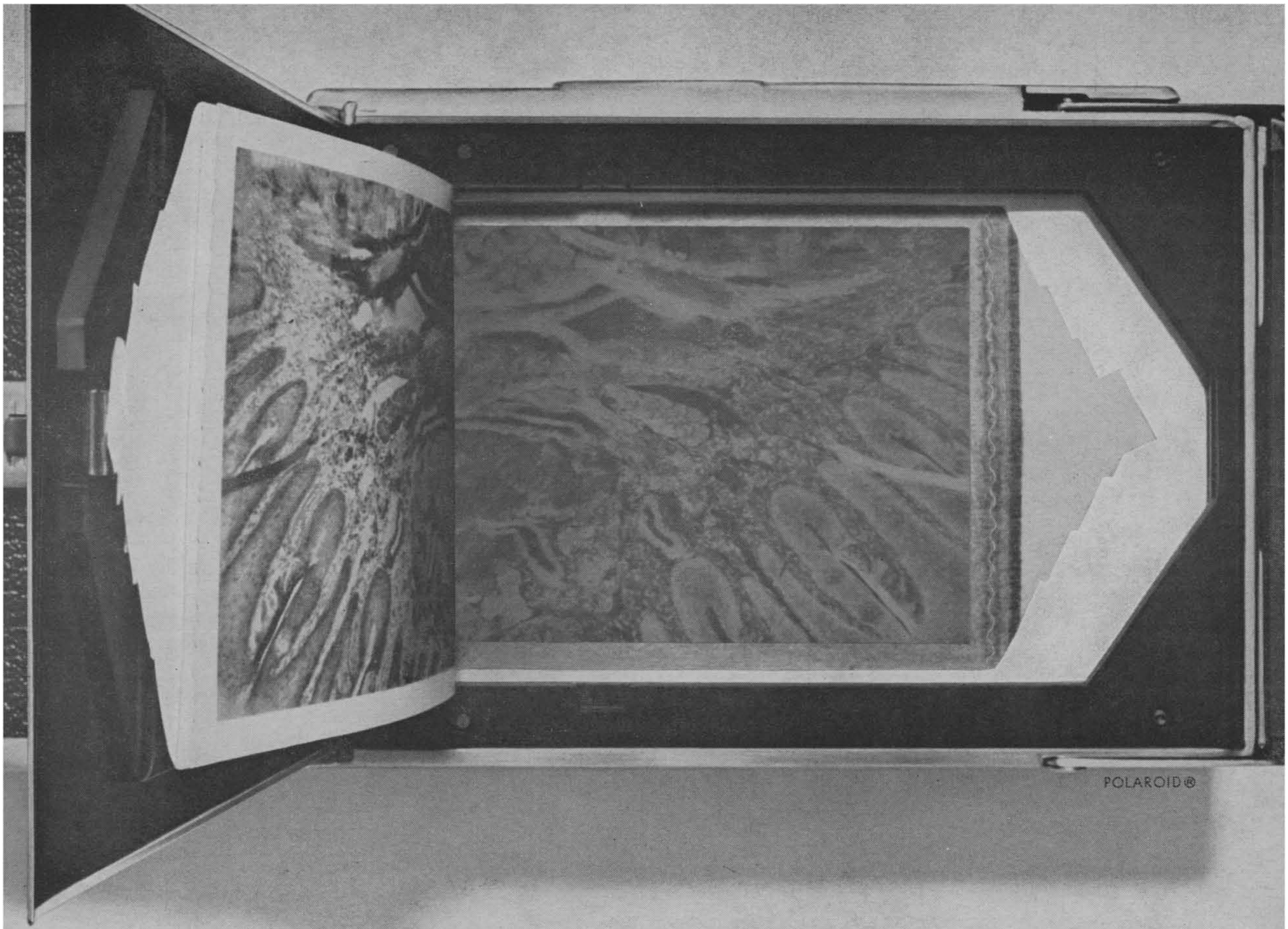

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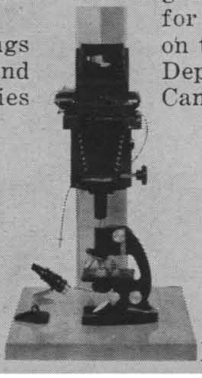

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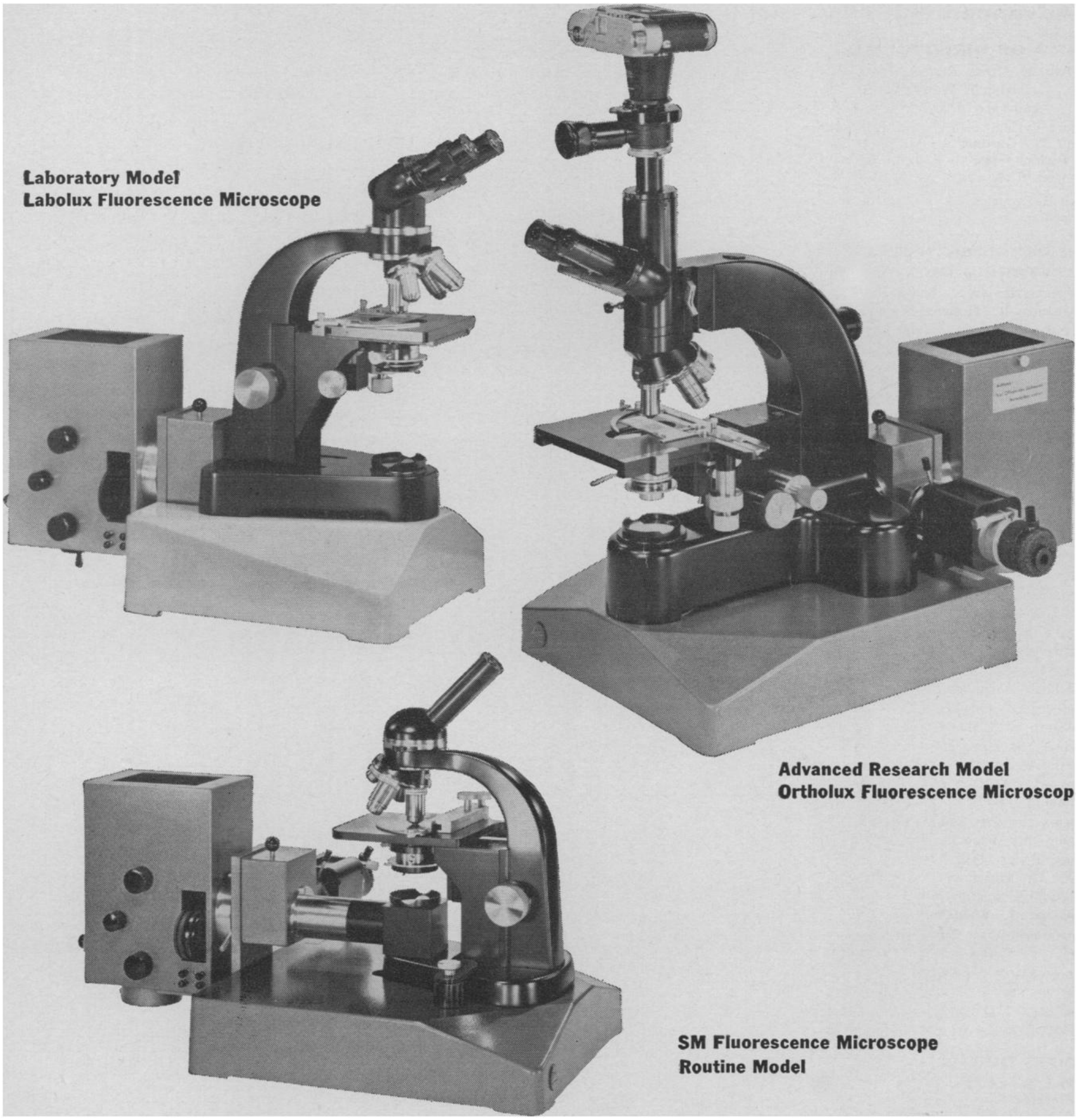

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Revitalizing the Mature Scientist

Those who seek to increase the nation's scientific competence usually concentrate attention on primary and secondary education. They hope that by exposing millions of students to science courses they will persuade many to elect a major in science at college. These efforts are supplemented by science fairs, talent searches, scholarships, and special brochures. Later, in college and graduate school, scholarships and solicitude are lavished on the embryonic scientist. Even in early postdoctoral years abundant fellowships are available. Unfortunately, insufficient attention has been paid to the needs of scientists of proved creativity. Finding better mechanisms for revitalizing mature scientists has been relatively neglected. When efforts are made to identify and encourage the potential scientist, the probability of nurturing a man of future creative capacity may be less than one in a hundred. In dealing with men of proved abilities, the probabilities of obtaining a favorable outcome are much greater. The major challenge is to devise means of extending the period of creativity of the mature scientist.

In the physical sciences and mathematics many workers make their best contributions within a few years after they receive the Ph.D. degree. In biology and the earth sciences this is not so often true, but in fast-moving fields an early peak is likely.

The slow decay which follows this early flowering probably is not due to lessening of potential mental ability. Of the many factors which combine to diminish creativity in the maturing scientist, perhaps the most important are decreased motivation and obsolescence of his personal store of knowledge. The period of peak creativity follows closely a period of intense intellectual growth in college and graduate school. Later, as his activities become devoted to a specific area of research, he is forced to focus sharply. He must be tough-minded in avoiding distractions. In order to maintain maximum self-discipline, it may be necessary for him to regard as trivial, all knowledge which is not immediately applicable to his field of inquiry. In so doing he becomes a victim of his own zeal. This narrowing of interest is useful while an area remains highly fruitful. However, it is inevitable that most of the important problems in any field of research are soon solved, leaving those which are trivial or intractable. When the important problems are solved, a scientist should seek new interests, often removed from his previous experience. He will realize, however, that his store of up-to-date knowledge may be smaller than that of graduate students. Moreover, by this time he may be one of the authorities in his field. If he is in a university he is likely to hold research grants and to be surrounded by students and staff who are dependent on him. In addition, he may have acquired heavy family responsibilities. He is caught in a web of circumstance. The usual outcome is abandonment of the attempt to be creative. This is often marked by readiness to accept additional administrative responsibilities. Many scientists would prefer not to follow this course, but rather to reestablish their creative potential. What they need is an intellectual renaissance. This might take the form of comprehensive refresher courses followed by a dignified apprenticeship.

Industry, government, and the academic world should recognize both the needs and the potential of the mature scientist and establish mechanisms to enable him to do what is necessary to extend his creative life.—P.H.A.

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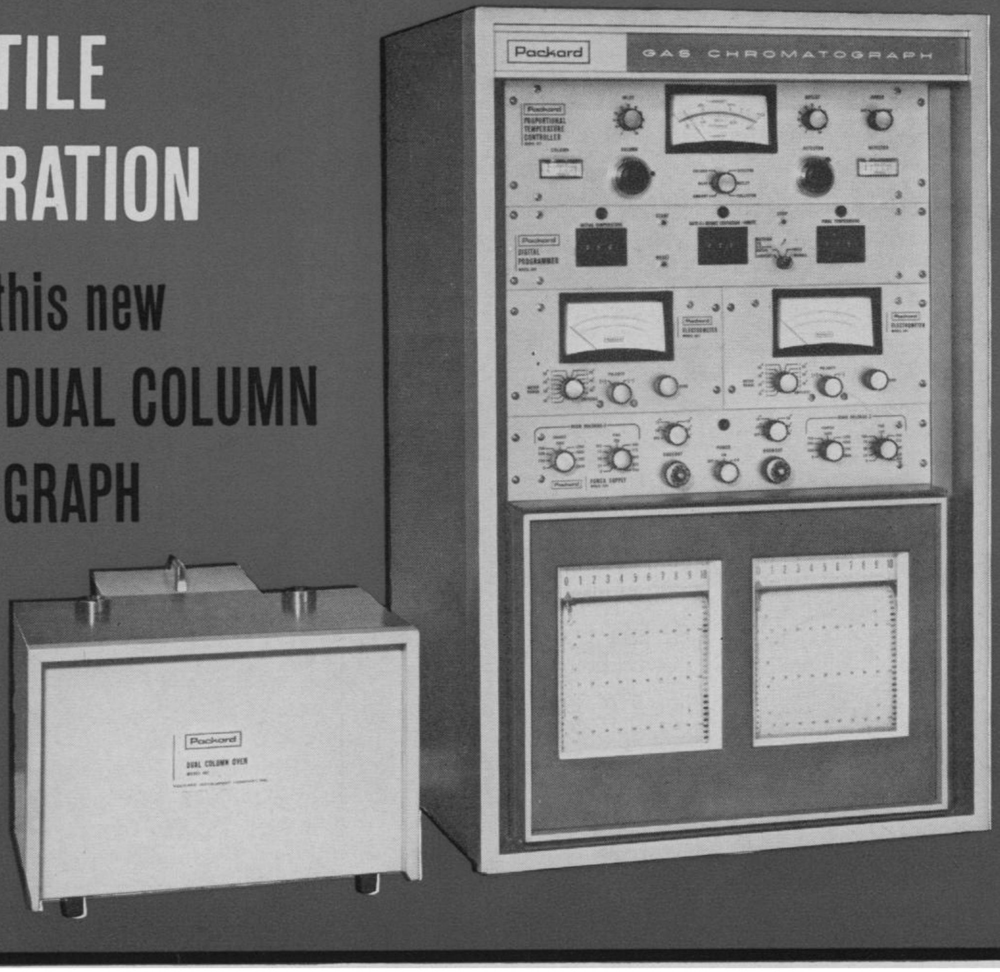

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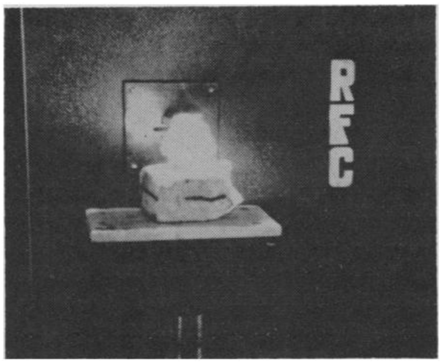

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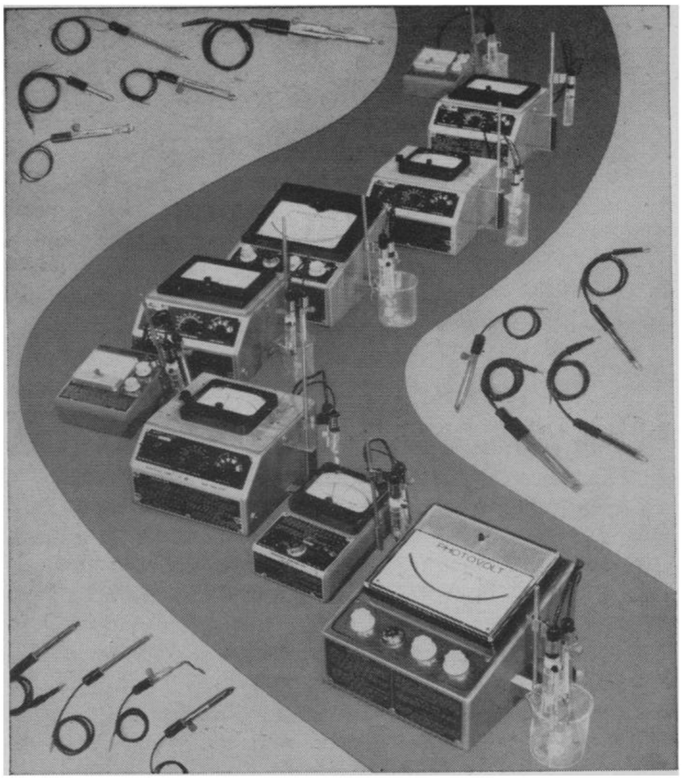

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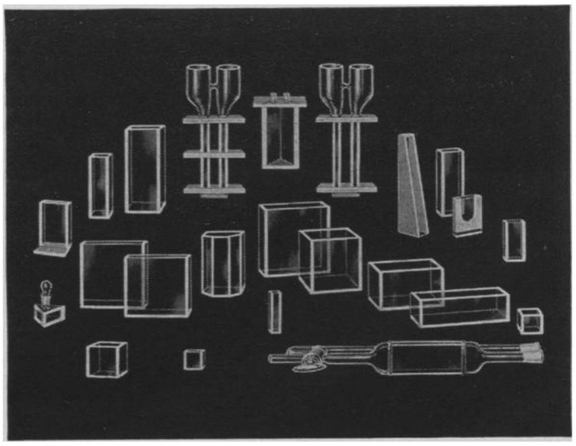

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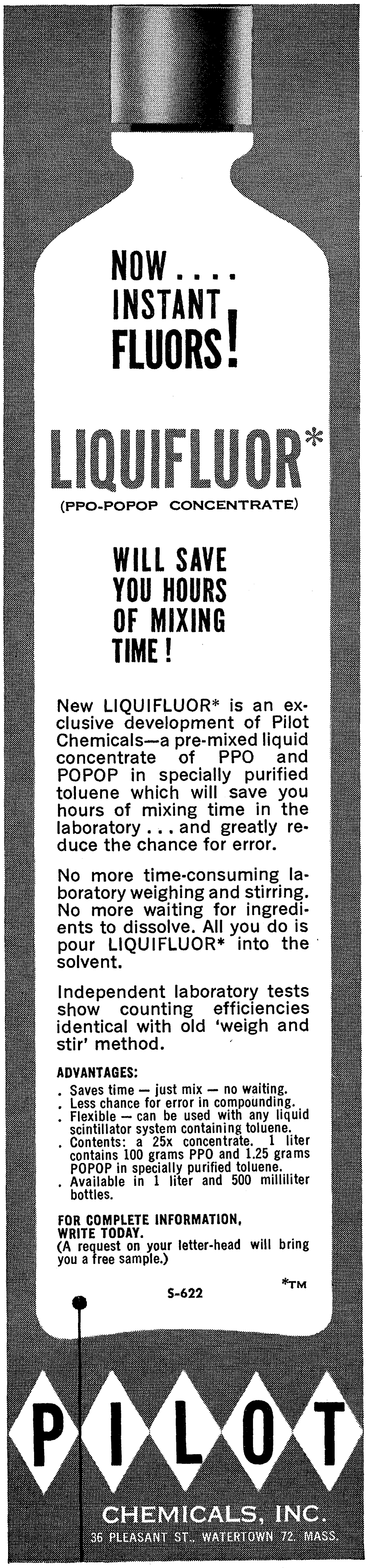
higher thermal stability than does free DNA. Similar results have been observed with the isolated thymus nuclear system as well as with the thymus chromosomal-RNA polymerase system. Methods are available for the preparation of soluble (10,000*g* non-sedimentable) nucleohistones (native or reconstituted from purified histone and DNA); inhibition of RNA synthesis by histone in amounts stoichiometric to the DNA is not due to precipitation of DNA from solution. In the RNA polymerase system of *Micrococcus lysodeikticus*, however, diamines or protamines, at low concentration (and in amounts substantially less than stoichiometric to the DNA present) enhance the activity of RNA polymerase; this occurs only with native DNA as template. The presence of the polycation may cause the removal of RNA from the complex of DNA template and enzyme. The RNA newly synthesized by native chromatin in vitro is informational and supports protein synthesis. The DNA-dependent RNA synthesis in chromatin may be coupled to the RNA-dependent ribosomal protein synthesis. Preliminary information suggests that a specific protein, seed globulin, may have been synthesized by such a coupling system. Interesting observations were reported on the action of histones and of the antibiotic actinomycin D on the activity and morphology of the lampbrush chromosomes of *Triturus*. Actinomycin D, which is highly and structurally specific in its action upon such chromosomes, causes the loops to retract and simultaneously abolishes RNA synthesis. The action of histones mimics that of the antibiotic (*Speakers*: E. Stedman, A. Mirsky, J. Bonner, L. Hnilica, V. Allfrey, S. Weiss, R. C. Huang, and I. Leslie).

The band pattern of the giant chromosomes of fly larvae appears to reflect the genetic structure of the chromosome; a single band comprises a single genetic unit. Swelling associated with RNA synthesis by such a band (the "puffing" phenomenon) is generally regarded as a symptom of gene activity. That specific sequences of band puffing are evoked by application of the moulting hormone, ecdysone (a sterol), to such chromosomes strengthens this view. Puffing, which is inhibited by actinomycin D, is accompanied by a loosening of the chromosome structure and by the appearance of non-histone protein derived from some unknown precursor in the chromo-



some. This precursor is not histone itself, because histone, qualitatively at least exists in the puffing region throughout the duration of the puff. Further suggestions that steroid hormones act by intervention at the level of control of genetic activity are provided by the cases of evocation by estrogens of RNA and protein synthesis in uterine tissue, by testosterone in the prostate gland, and by the flowering hormone, also presumably a sterol, in the bud, which is the subject of floral induction. In the latter case, too, a dramatic reduction of the ratio of histone to DNA accompanies the inductive action of the hormone, suggesting that steroids can in some manner bring about the removal of histone from chromatin. A principal difficulty in the study of the role of histones in morphogenetic events is the quantitative and specific determination of histone. Cytochemistry of histones is still unsatisfactory. Acid fixation removes an unknown amount of histone from the test material. Fast Green, the standard histone stain, stains basic proteins in addition to histones, such as ribosomal structural protein. Better histochemical methods for histones are needed (*Speakers*: U. Clever, H. Swift, J. A. D. Zeevaart, E. Gifford, D. Bloch, W. Vincent, and M. Zalokar).

Histones constitute a principal constituent of the chromosome, and are associated intimately with the chromosomal DNA. In this association the histone renders the DNA inert in RNA-making. The way in which histone carries out its function appears to require understanding of the structure of nucleohistones. If the histones constitute the repressor of genetic activity which participates in and is responsible for the programming of the transcription of genetic information during the course of development, a high degree of specificity would be required of the histone-DNA interaction. In the past, attention has been focused mainly on the ionic nature of this interaction. There are other possible types of interaction of a weaker, but more selective, nature. One could, for example, think of the possibility of specific adapter molecules. Such adapters, if present, might enable histones to form specific complexes with DNA of specific information content (*Speakers*: K. Murray, J. Vinograd, R. L. Sinsheimer, H. S. Swift, I. R. Lehman, and R. Dulbecco).

The conference was held under the auspices of the division of biology, California Institute of Technology, with the joint fiscal support of the National Science Foundation, the Office of Naval Research, and a special gift from H. Kirke Macomber. It was attended by 56 invited participants representing Canada, England, France, Germany, Japan, Scotland, Switzerland, and the United States.

The proceedings of the conference will be published by Holden-Day, Inc., in the later part of 1963.

JAMES BONNER
PAUL O. P. TS'O
California Institute of Technology, Pasadena

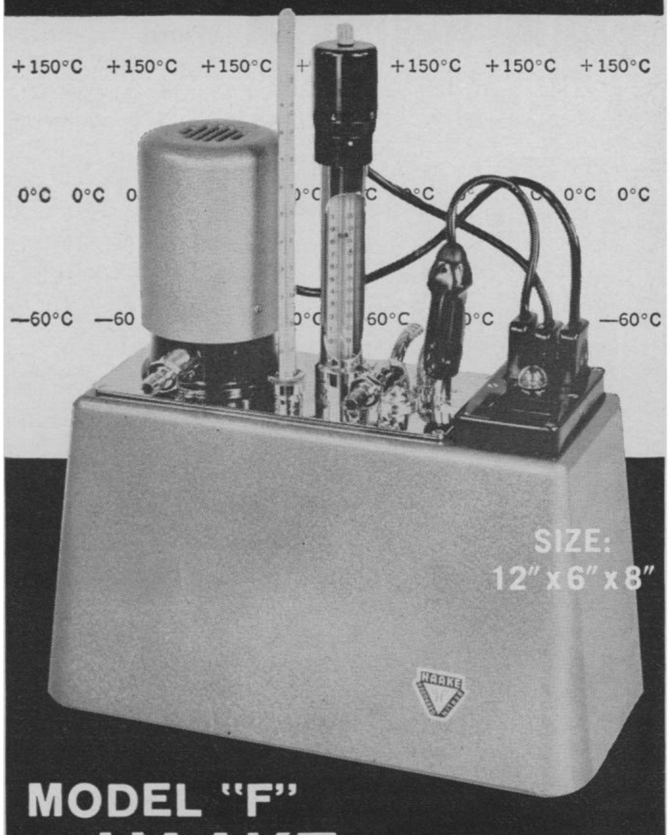
Molecular Structure and Spectroscopy

Molecular forces, interactions, and structure and new spectroscopic techniques were the main topics of interest at the 17th annual symposium on molecular structure and spectroscopy at Ohio State University, 10–14 June.

In a critique on nonbonded forces, E. B. Wilson, Jr. (Harvard), cautioned that most of the present attempts at determining such forces do not lead to an unambiguous interpretation. He presented the results of some microwave studies of the forces involved in barriers hindering internal rotation. One result is that in 1-substituted propylenes, $CH_3C{=}CHX$, the *cis*-form has a much lower barrier than the *trans*-form. This presumably is a result of interaction between the methyl group and the substituent X. The cases where X=F, Cl, CN, and CH_3 have been studied.

Some very interesting work on energy transfer was described by G. W. Robinson (C.I.T.) and his co-workers in several papers dealing with exciton interactions in organic crystals. A direct measurement of triplet exciton interactions and information about the lowest singlet were gained from studies of mixed crystals of benzene and deuterobenzenes. By using isotopic species, preservation of the lattice symmetry and uniform mixing was assured. By varying the amount of deuteration in the isotopic species used, the depth of the exciton trap could be changed in a known manner. It was calculated that approximately 10^{12} nearest-neighbor excitation transfers could occur during the lifetime of the triplet.

W. H. Flygare (Illinois) proposed a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method of studying molecular electric hexadecapoles through the influence of rare gas matrices on the rotational energy levels of trapped molecules. He showed that, for molecules occupying sites of octahedral symmetry, no terms before the hexadecapole in a multipole expansion of the molecular charge distribution can interact with the field of the surrounding lattice. He calculated the effect of this interaction on the rotational energy and showed how it could be used to obtain the hexadecapole.

One of the most interesting molecular structure studies was done by molecular beam methods on alkaline earth dihalides. Wharton, Berg, and Klemperer (Harvard) reported that many of these are not linear, as previously thought. They found that BaF_2, $BaCl_2$, $BaBr_2$, BaI_2, SrF_2, $SrCl_2$, and CaF_2 are deflected by inhomogeneous electric fields and thus have an electric dipole moment which implies a bent structure. On the other hand $CaCl_2$, $CaBr_2$, $SrBr_2$, and SrI_2 appear to be nonpolar and presumably linear.

Two experimental methods of determining molecular structure, spectroscopy and electron diffraction, were discussed by V. W. Laurie (Stanford) and L. S. Bartell (Iowa State), respectively. In both techniques the problem of molecular vibrations is now the limiting factor on accuracy, and methods for partially correcting for this were presented. However, anharmonicity of vibrations is still a major problem.

Applications of masers in the infrared and optical region is of considerable interest at the present time. C. H. Townes (M.I.T.) discussed presently available sources and described experiments designed to improve greatly the Michelson-Morley experiment which tested the existence of the ether. B. P. Stoicheff (National Research Council of Canada) presented some results of using optical masers as sources for Raman spectroscopy and also described some studies on coherent Raman effects. Other speakers (Porto, Cheesman, and DeSiqueria, Bell Telephone) reported on the use of the ruby optical maser as a Raman source.

The Triple Commission for Spectroscopy held a meeting in conjunction with the symposium; its sessions dealt with several problems in astronomy, such as the application of computers to the analysis of some spectra (J. G. Phillips, University of California, Berkeley) and the spectra of atoms and molecules which had been observed in stellar atmospheres (P. C. Keenan, Ohio State).

Abstracts of the papers can be obtained from H. H. Nielsen, Department of Physics, Ohio State University, Columbus.

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Forthcoming Events

September

2–7. Dynamic **Meteorology**, intern. symp., Boulder, Colo. (W. L. Godson, Intern. Assoc. of Meteorology and Atmospheric Physics, 315 Bloor St. West, Toronto, Ont., Canada)

2–7. International **Phycological** Soc., Naples, Italy. (J. Th. Kosher, Rijksherbarmin, Nonnensteeg 1, Leiden, Netherlands)

2–7. **Space** Technology and Science, intern. symp., Tokyo, Japan. (I. Tani, Japanese Rocket Soc., 1-3 Ginza-Nishi, Tokyo)

2–12. **Genetics**, 11th intern. congr., The Hague-Scheveningen, Netherlands. (S. J. Geerts, Genetisch Laboaraorium, Driehuizerweg 200, Nijmegen, Netherlands)

2–13. Epidemiology and Biometeorology of **Fungal Diseases of Plants**, symp. (by invitation only), Pau, France. (R. D. Schein, Dept. of Plant Pathology, 113 Buckhout Laboratory, Pennsylvania State Univ., University Park)

3–6. **Entomology**, Canadian centennial, Ottawa, Ont., Canada. (Executive Committee, K. W. Neatby Bldg., Carling Ave., Ottawa)

3–8. **Anesthetics**, 1st European congr., Vienna, Austria. (K. Steinbereithner, Medizinische Akademie, Alserstrasse 4, Vienna 9)

4–5. **Industrial Design**, 1st intern. technical conf., Leipzig, Germany. (Sekretariat der Tagungskommission, Kammer der Technik, Hauptausschuss, Abt. Technischer Fortschritt, Klara-Zetkin-Str. 115-117, Berlin W.8, Germany)

4–6. Inorganic **Fluorine Chemistry**, symp., Argonne, Ill. (L. Stein, Chemistry Div., Argonne Natl. Laboratory, 9700 S. Cass Ave., Argonne)

4–6. **Proteins** and Their Reactions, symp., Corvallis, Ore. (A. F. Anglemier, Dept. of Food Science and Technology, Oregon State Univ., Corvallis)

4–7. **Biometric Soc.**, Eastern North American region, Cleveland, Ohio. (E. L. LeClerg, Biometrical Services, U.S. Dept. of Agriculture, Plant Industry Station, Beltsville, Md.)

4–7. **Production Engineering** Research, intern. inst., 13th general assembly, Pittsburgh, Pa. (E. Merchant, Cincinnati Milling Machine Co., Cincinnati 9, Ohio)

4–7. **Mössbauer Effect**, 3rd intern. conf., Ithaca, N.Y. (A. J. Bearden, Dept. of Physics, Cornell Univ., Ithaca)

4–7. American **Statistical** Assoc., Cleveland, Ohio. (R. T. Bowman, Office of Statistical Standards, Bureau of the Budget, Executive Office Bldg., Washington 25)