

SCIENCE

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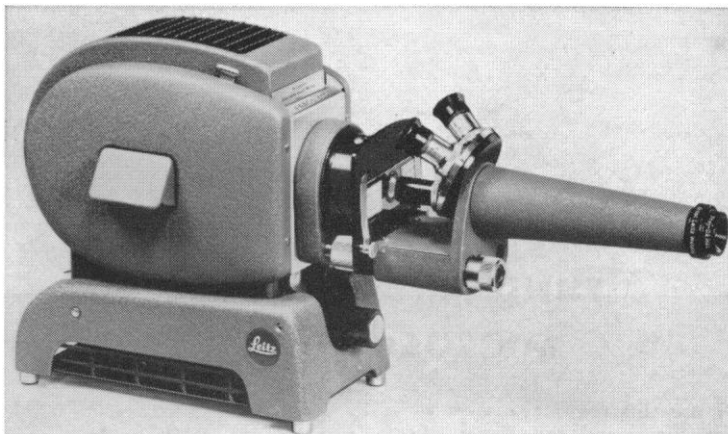
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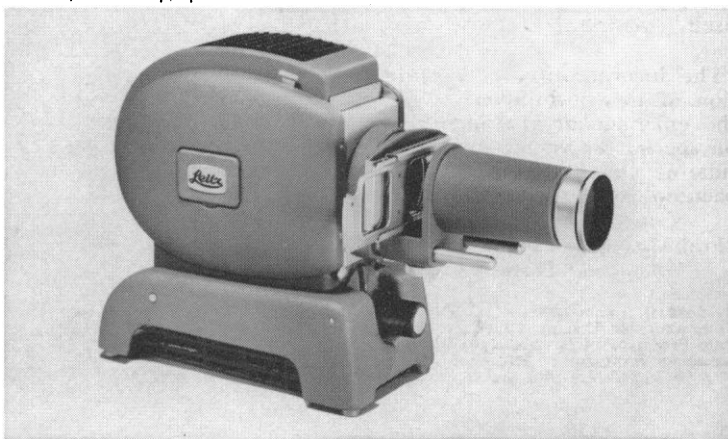
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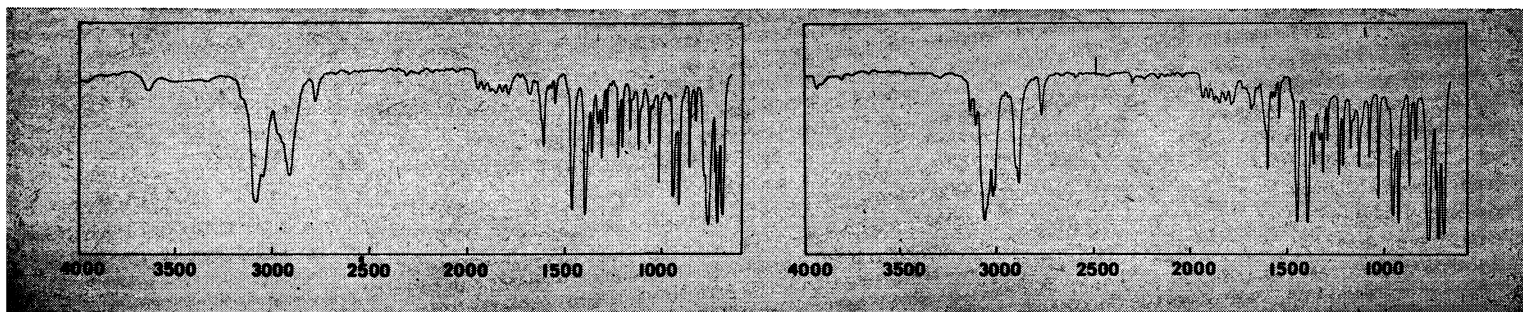
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Linear wavenumber spectrum of the same sample, same cell thickness, run on a new Perkin-Elmer Model 221-G prism/grating spectrophotometer. Note improvement in resolution over that obtained in other run.

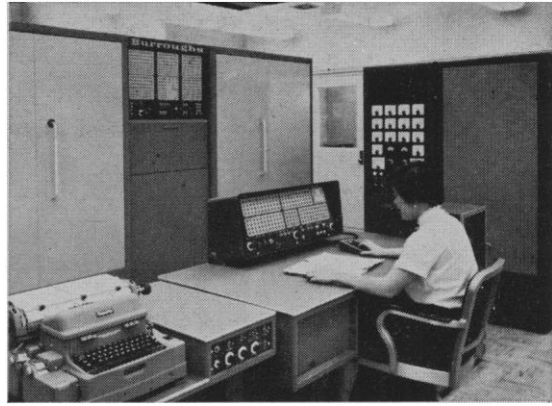
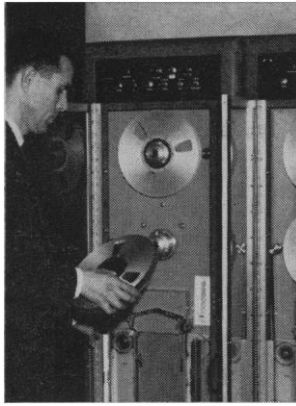
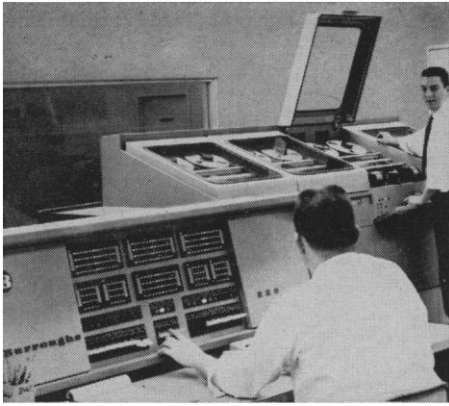


Editorial	Popularization of Science	1491
Articles	Earthquake Mechanisms: <i>P. Byerly</i>	1493
	Seismograms give clues to possible mechanisms that convert potential into kinetic energy at the source.	
	Population and World Economic Development: <i>J. J. Spengler</i>	1497
	In a finite world, population growth, before it is finally halted, entails diverse costs.	
	Biologic Synthesis of Deoxyribonucleic Acid: <i>A. Kornberg</i>	1503
	An isolated enzyme catalyzes synthesis of this nucleic acid in response to directions from pre-existing DNA.	
Science in the News	Scientists in Government: Growing Concern over Conflicts of Interest; United States and Russia Begin Exchange Visits of Nuclear Scientists	1508
Book Reviews	<i>Evolution after Darwin</i> , reviewed by <i>C. Zirkle</i> ; other reviews	1519
Reports	Use of Chemicals To Control Shellfish Predators: <i>V. L. Loosanoff, C. L. MacKenzie, Jr., L. W. Shearer</i>	1522
	Sulfur Dioxide Sensitized Photochemical Oxidation of Hydrocarbons: <i>H. S. Johnston and K. dev Jain</i>	1523
	Connection between <i>Archaeopteris</i> and <i>Callixylon</i> : <i>C. B. Beck</i>	1524
	Numerical Comparison of Geomorphic Samples: <i>W. F. Tanner</i>	1525
	Role of Olfactory Sense in Pregnancy Block by Strange Males: <i>H. M. Bruce and D. M. V. Parrott</i>	1526
	Selection of Food by Size in the Chimpanzee, and Comparison with Human Judgments: <i>E. W. Menzel, Jr.</i>	1527
	Synchronous Division in <i>Chlamydomonas moewusii</i> : <i>E. Bernstein</i>	1528
	Subfractionation of Human Serum Enzymes: <i>C. A. Dubbs, C. Vivonia, J. M. Hilburn</i> ..	1529
	Distortion of the Pyramid of Numbers in a Grassland Insect Community: <i>F. C. Evans and U. N. Lanham</i>	1531
	Uptake of Glucose from Solution by the Solitary Coral, <i>Fungia</i> : <i>G. C. Stephens</i>	1532
	Applicability of Hodgkin-Huxley Model to Experimental Data from the Giant Axon of Lobster: <i>J. C. Dalton and R. FitzHugh</i>	1533
	Prehistoric Copper Objects from Western Mexico: <i>C. W. Meighan</i>	1534
Departments	Near Eastern Prehistory; Forthcoming Events; New Products	1536
	Letters from <i>R. G. Barker; J. W. Winchester; A. Wittenberg and S. E. Ross;</i> <i>W. Ley and K. E. Boulding; C. C. Lindegren</i>	1560
Cover	Faulting in Nevada in 1954 (Fairview Peak earthquake). [Karl Steinbrugge]	

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Long before the vessel was launched these computer runs predicted changes that were to take place in the heart of the nuclear reactor. With the aid of these data, decisions were made as to the optimum size of the reactor, the lifetime of the fuel elements, amount of fuel needed, approximate costs and myriad other specifications.

Of course, a simulated run could have been made with a desk calculator—but it would have taken one year to complete a single run. The 205 has completed the same job in just a few hours.

This is the latest installment in a success story that started in November, 1955—the installation date of the Burroughs 205 at the Atomic Energy Division. Aside from the N. S. Savannah project, the same computer contributed immeasurably to other reactor designs, and other engineering work involving stress and thermal calculations, plus cost

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A recognized pioneer in the application of electronic data processing equipment, B&W was one of the first companies to develop its own automatic programming system. The effect of this powerful programming aid—called DUMBO—is to extend the capabilities of the 205 to hundreds of engineers without special knowledge of computer characteristics and techniques.

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With valuable 205 experience on design problems of a different nature, B&W's Boiler division (at Barberton, Ohio) has now installed a larger Burroughs 220 computer system to handle its increasing activities. Now in the design stage, with the aid of the 220, is one of the largest steam boilers ever conceived. When finally erected, the new steam boiler will stand as high as a 22-story skyscraper, produce 4,900,000 pounds of steam per hour, and generate sufficient power to light a city of 5,000,000 population.

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B&W, whose product range includes tubular products, refractories, and marine boilers, as well as stationary steam generators, is also spearheading the development and construction of nuclear stationary and marine propulsion power plants. In all these programs, B&W depends upon the most modern analytical processing equipment.

At the company's Research and Development Center based in Alliance, Ohio, a third Burroughs computer has recently gone "on the air." This Burroughs 205 was purchased to process data for a variety of research experiments in the fields of heat transfer, fluid flow, stress analysis, and thermodynamics. Its immediate impact has been to free creative engineering talent from routine calculations and to reapply valuable human resources to the pursuit of new sources of economical energy. This 205 has already developed research data otherwise inaccessible.

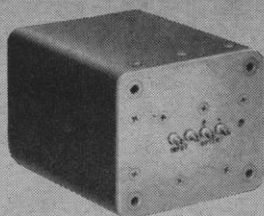
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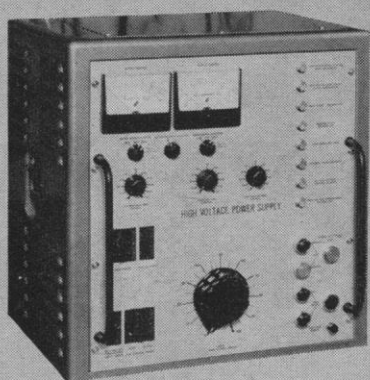
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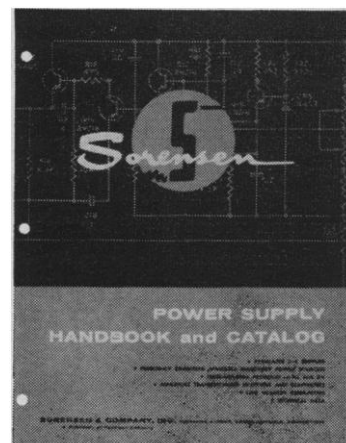
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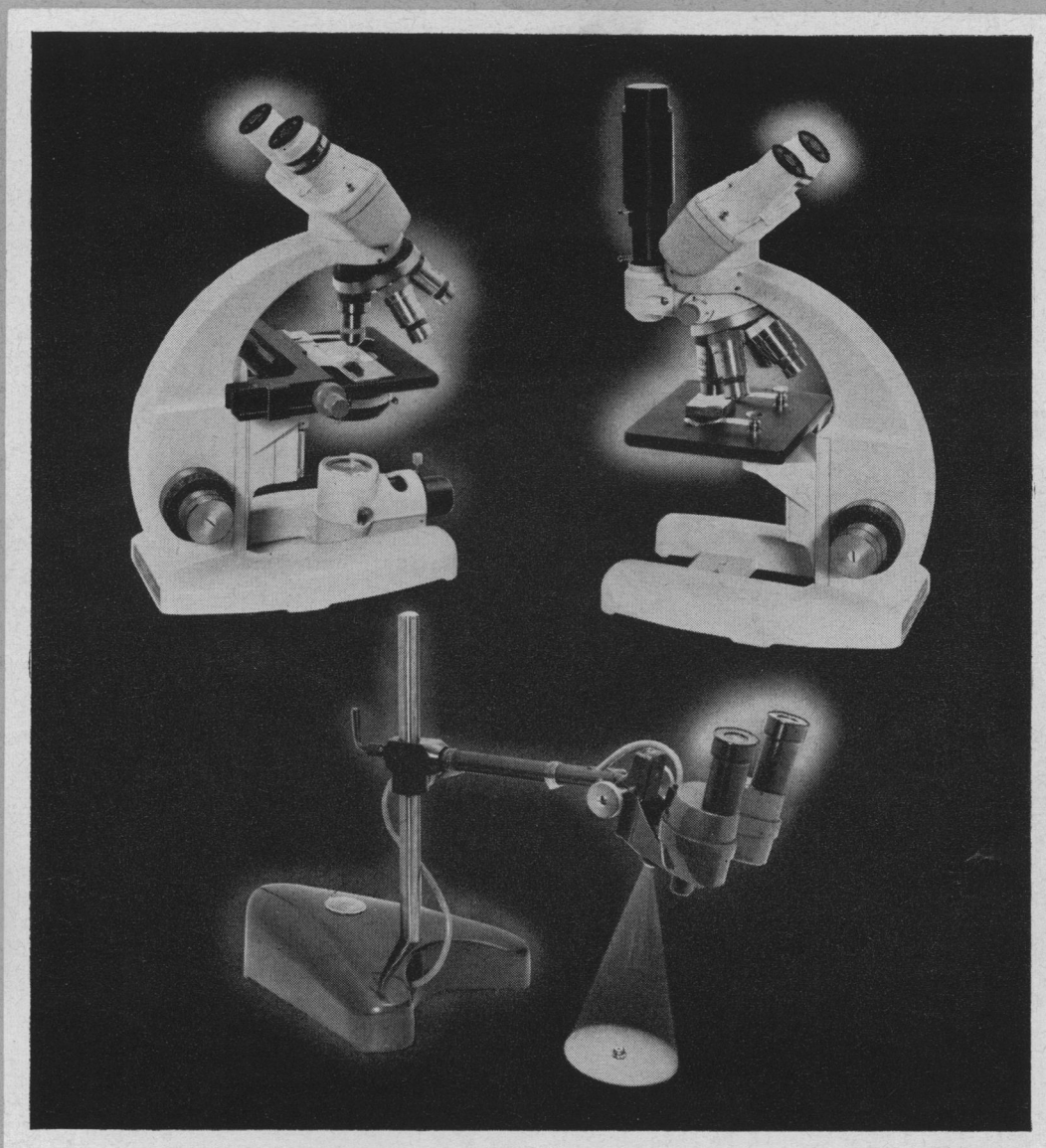


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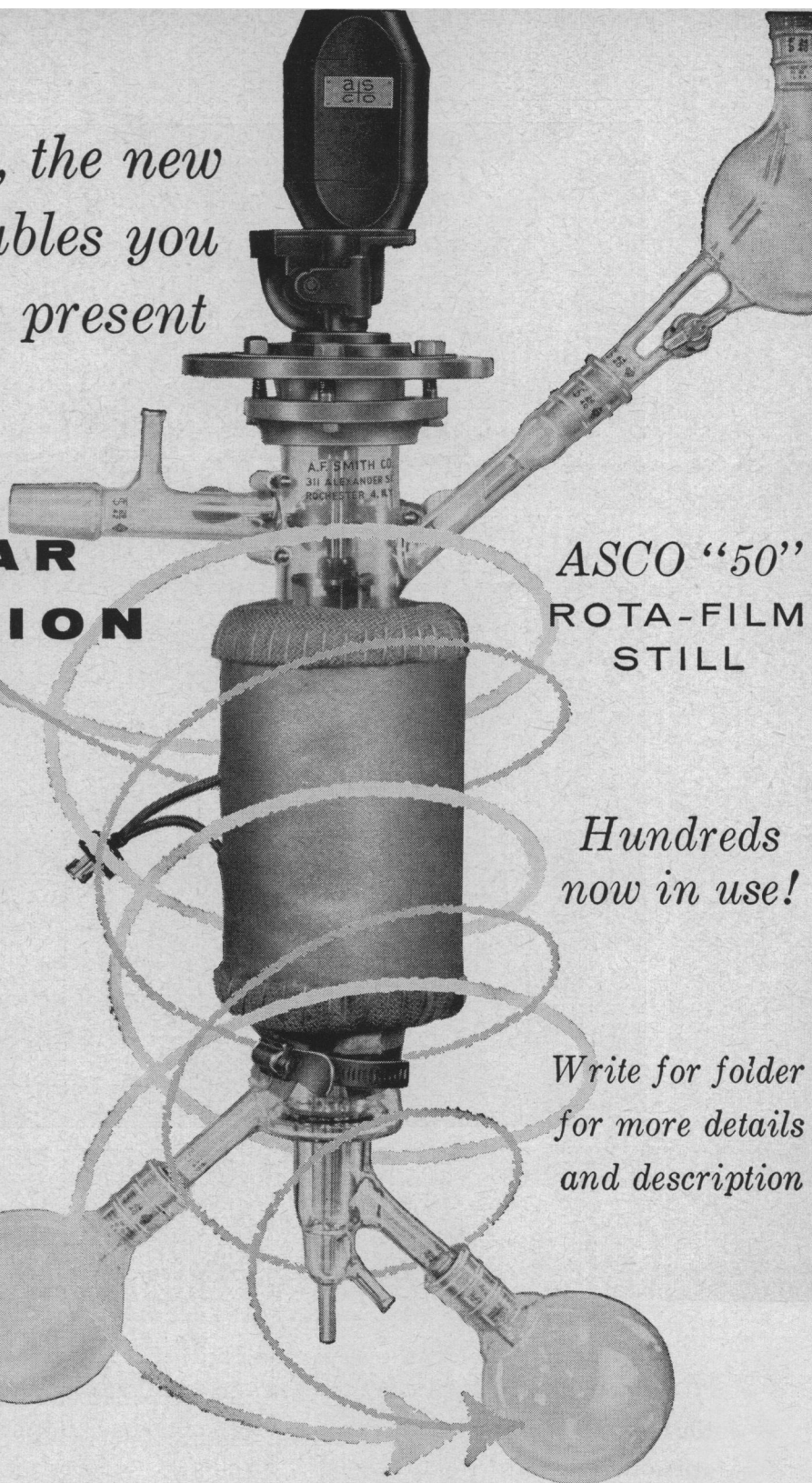
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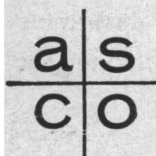
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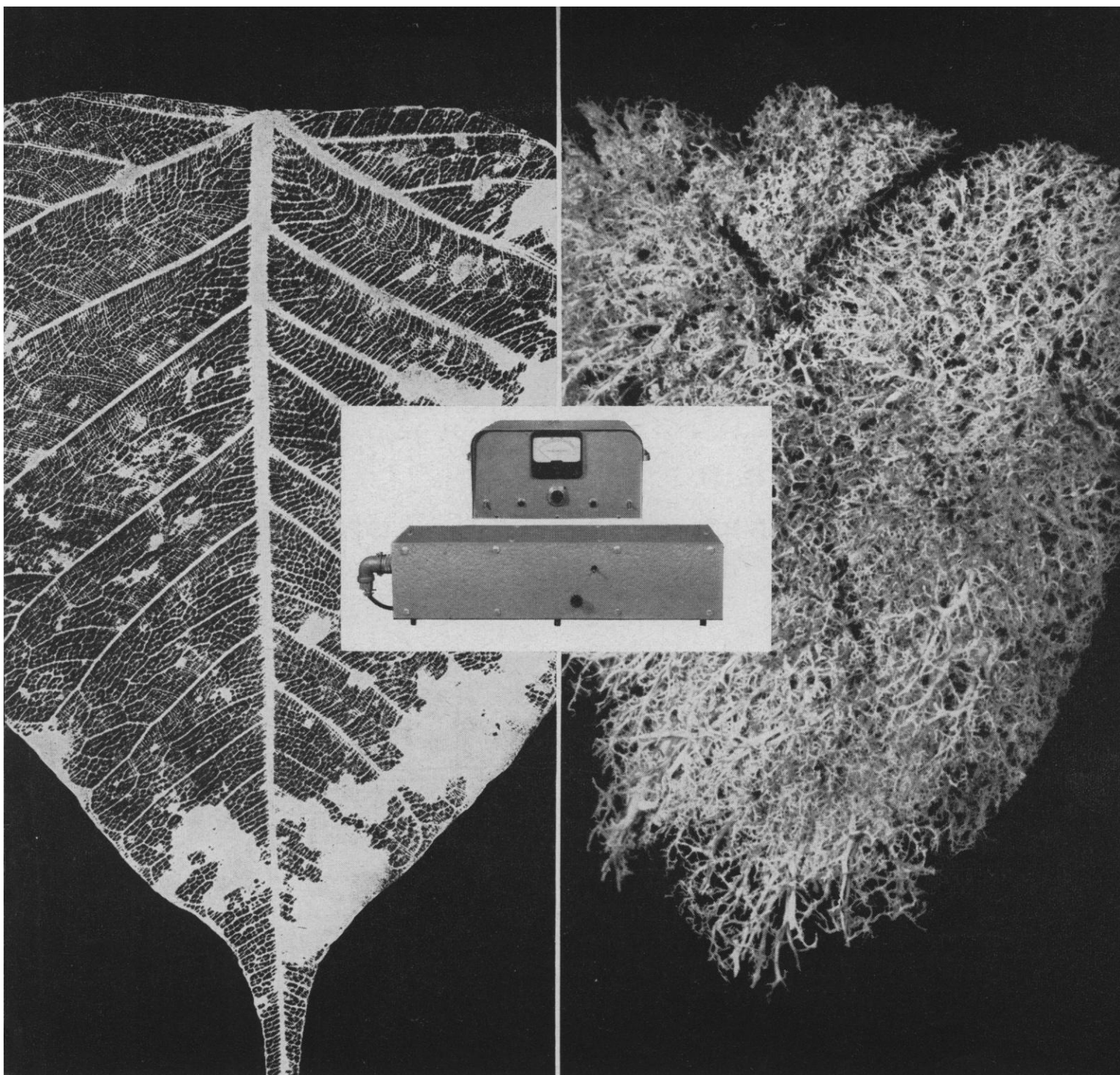
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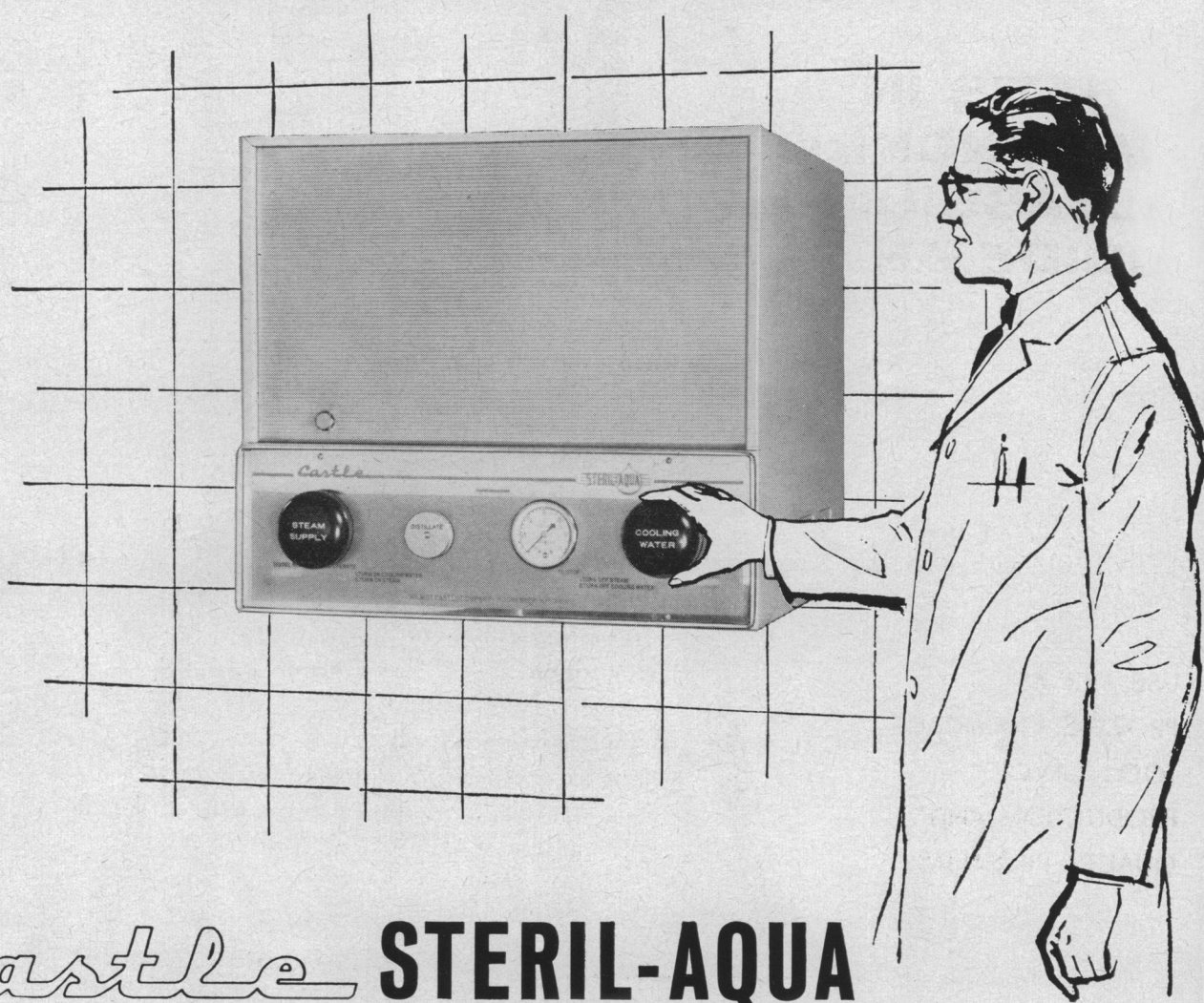
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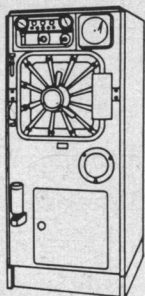
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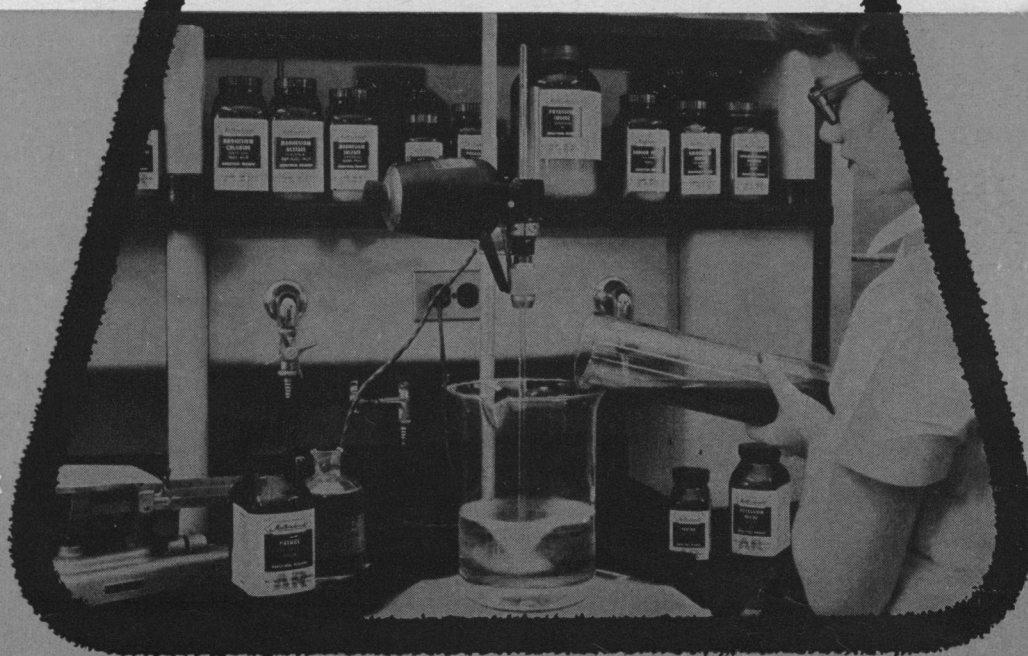
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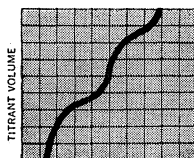
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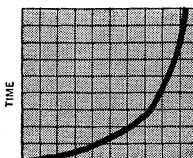
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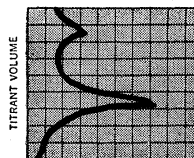
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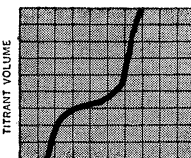
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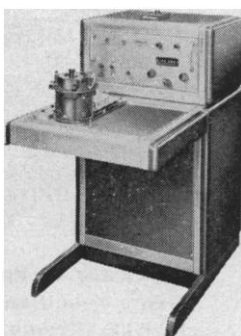


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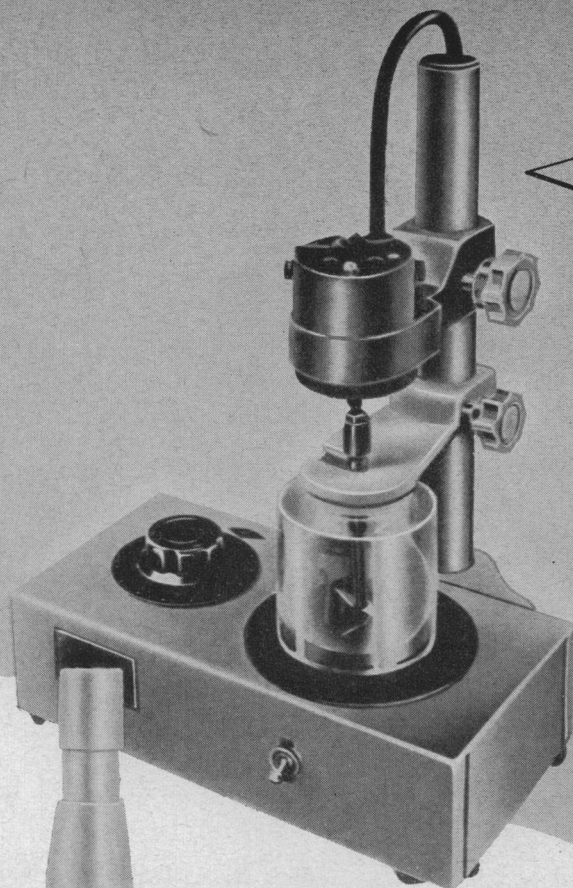
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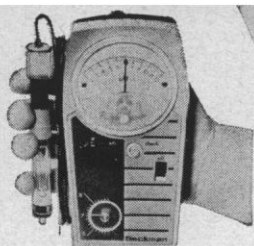
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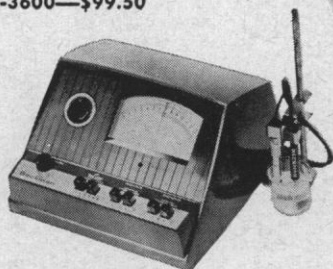
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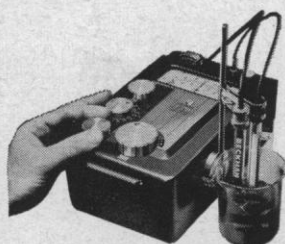
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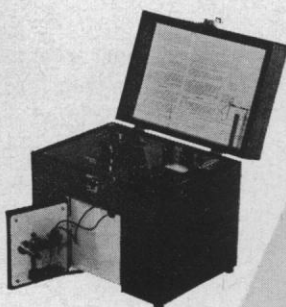
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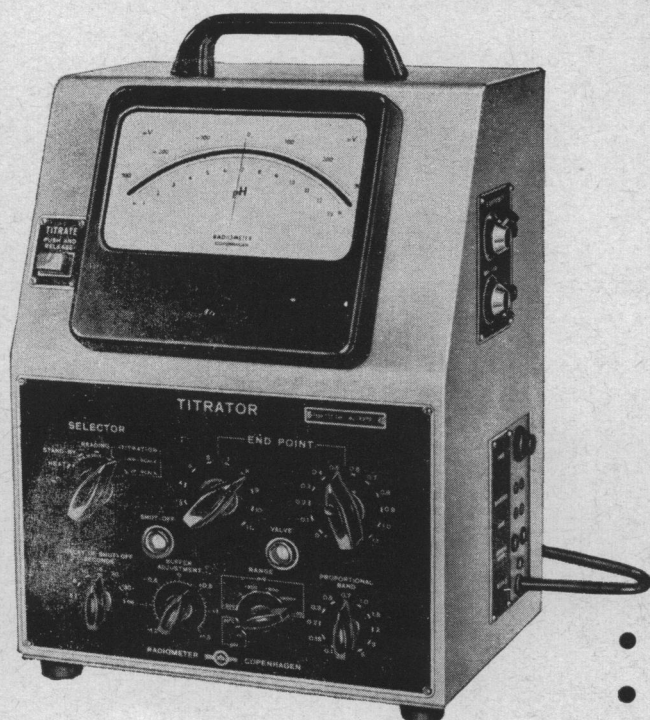
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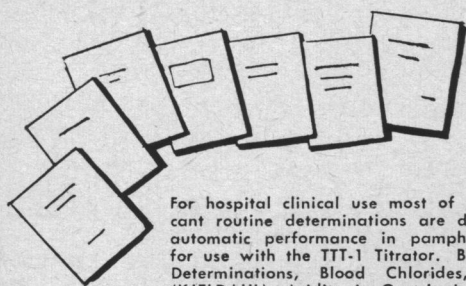
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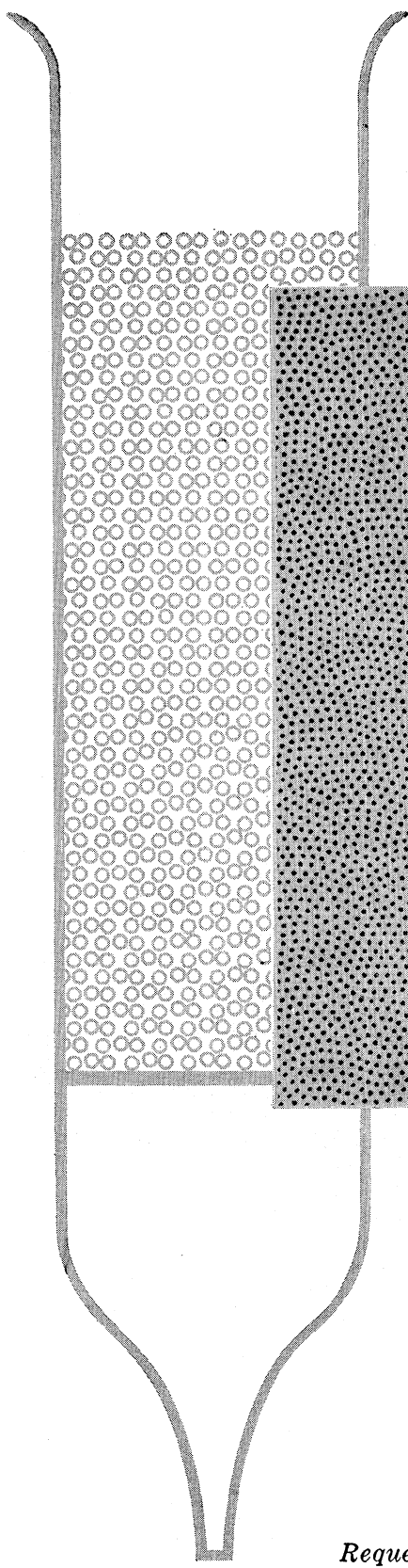
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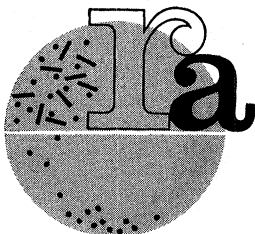
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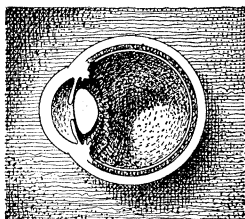


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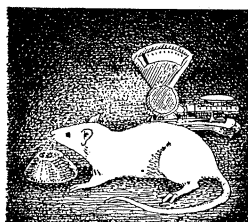
IT HAPPENED THIS MONTH...

a glance at yesterday in relation to today



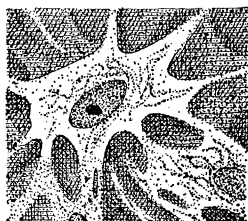
IN MAY—(1878)—W. Kühne, of Heidelberg, discusses the recently discovered photosensitive pigments of the retina. “If one considers the extremely widespread occurrence in the animal kingdom of the black pigment of the eye, and other similarly stable pigments, it is scarcely possible to repress the idea that these, in addition to visual purple, also represent visual excitants. . . . Now as I have convinced myself by prolonged observations, partly on myself, and partly on animals . . . that even after the disappearance of the visual purple acute vision is still perfectly possible, I have come to the hypothesis that the visual purple, which is the most unstable visual excitant known at the present time, serves for the perception of feeble light, while the other pigments whose occurrence has been observed in the eye serve for that of more intense light.”¹

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1. Kühne, W.: Addition to the article “On the stable colours of the retina.” *J. Physiol.* 1:189, 1878-1879. 2. Rose, W. C.; Haines, W. J.; Johnson, J. E., and Warner, D. T.: Further experiments on the role of the amino acids in human nutrition. *J. Biol. Chem.* 148:457 (May) 1943. 3. Healy, G. M.; Fisher, D. C., and Parker, R. C.: Nutrition of animal cells in tissue culture. VIII. Desoxyribonucleic acid phosphorus as a measure of cell multiplication in replicate cultures. *Can. J. Biochem. Physiol.* 32:319 (May) 1954.



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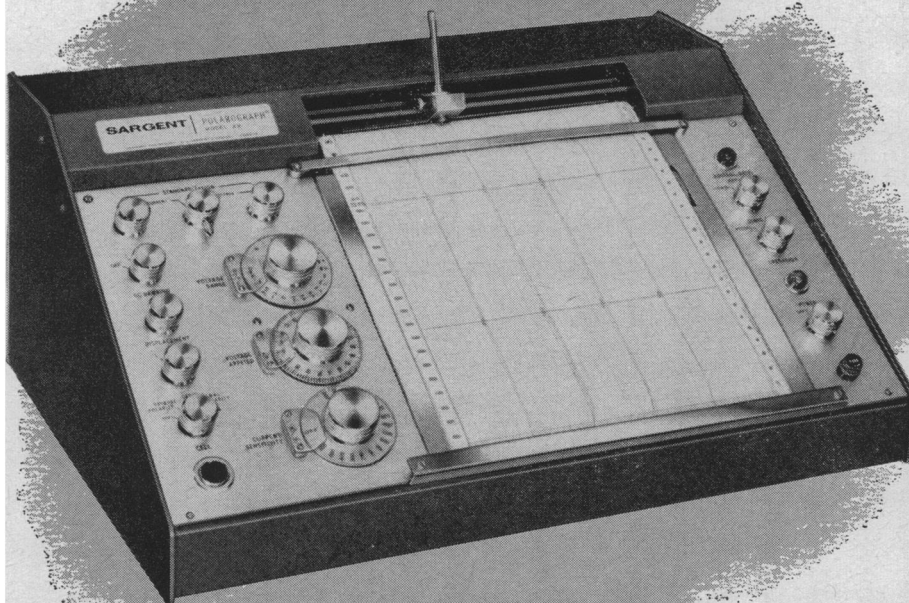
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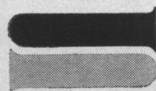
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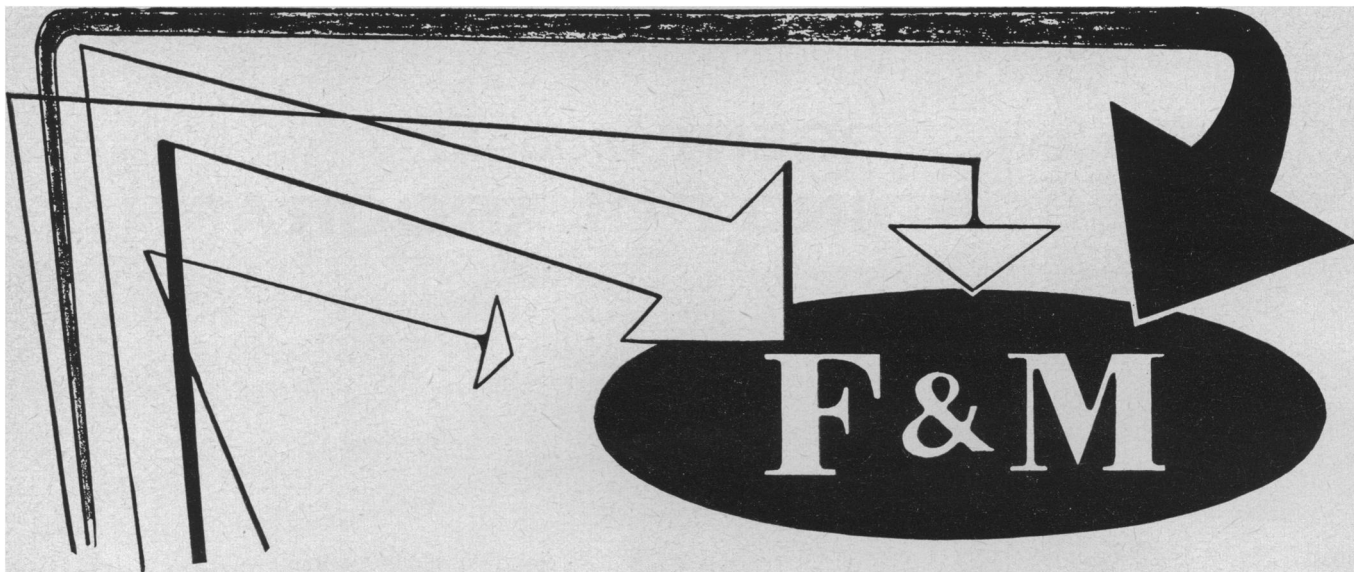
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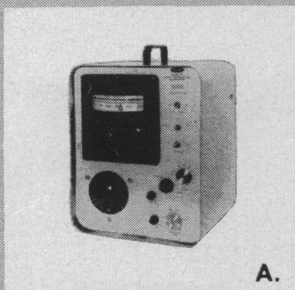
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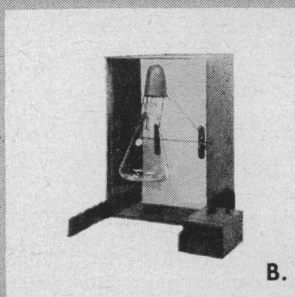
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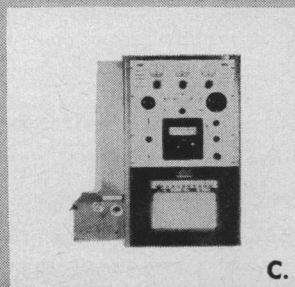
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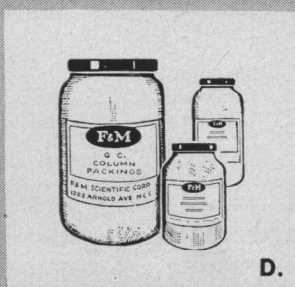


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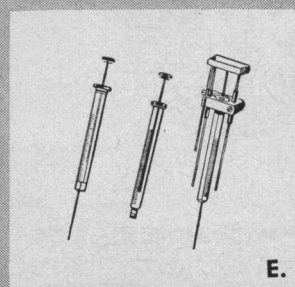
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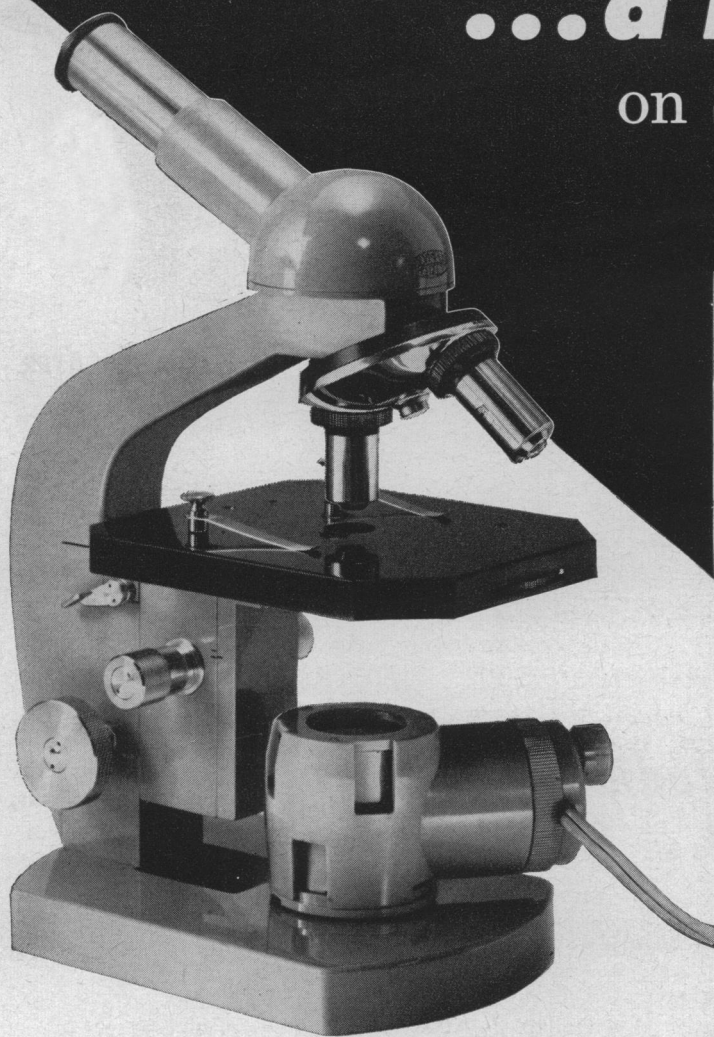
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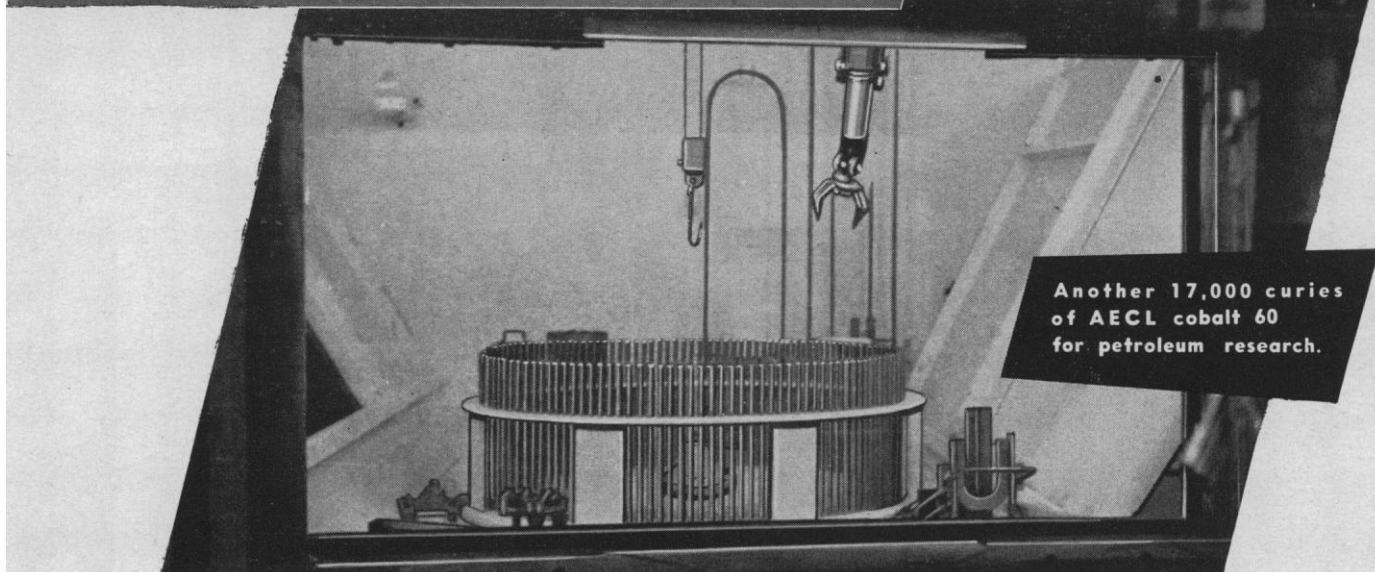
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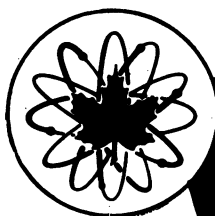
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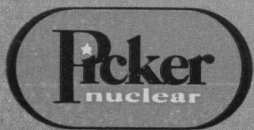
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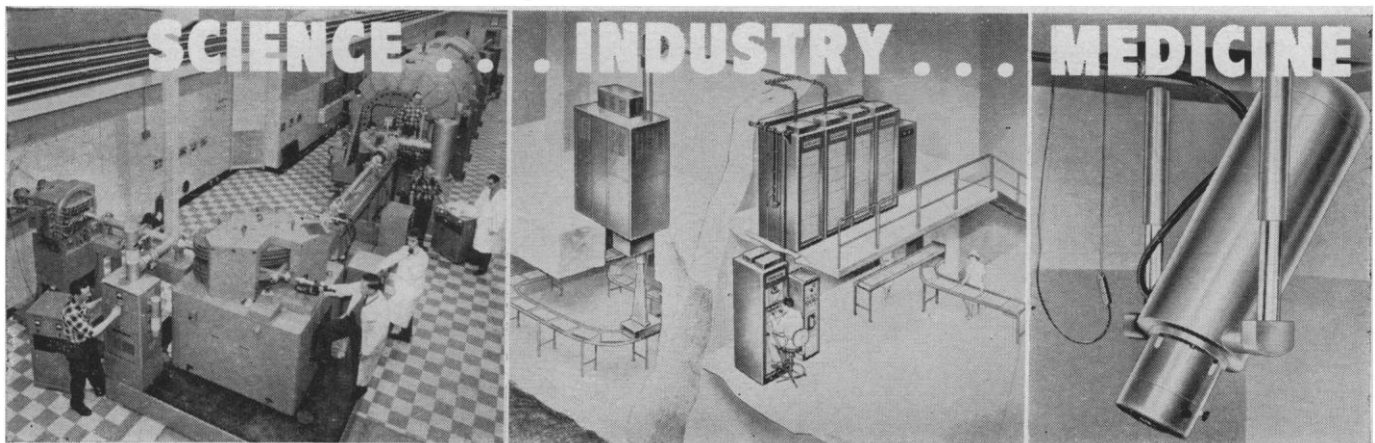
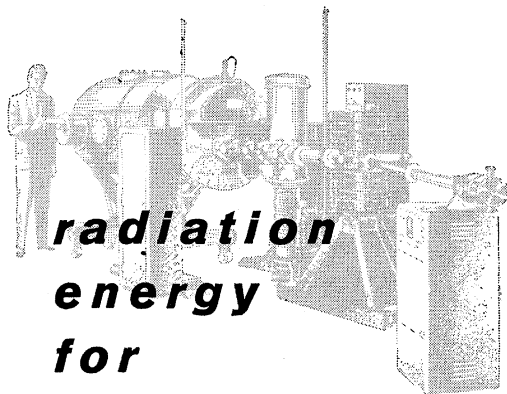
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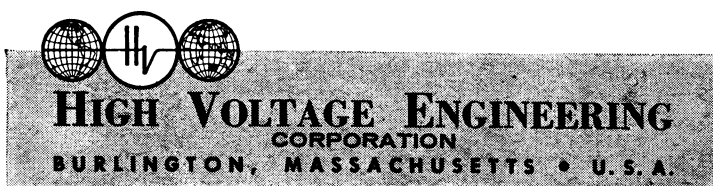
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Popularization of Science

The aims of the popularization of science are numerous and of considerable significance. It continues, corrects and fills the gaps in school education which inevitably lags behind the march of progress; it arouses the desire to take up research and is thus of direct benefit to creative science; it likewise benefits creative science by acquainting the public at large with its power and efficiency, thus providing science with a hearing and with the support of public opinion; it creates a link between specialists in different disciplines, since it is popularization which ensures that the physicist is not altogether unaware of what is happening in biology nor the biologist of what is going on in the realm of physics; it keeps—or could keep—politicians informed—and politicians have an ever greater need to be familiar with scientific developments.

But indeed it is undeniable that these various functions, however important, do not take into account the true and specific function of popularization which is purely and simply to introduce the greatest number of people into the sovereign dignity of knowledge; to ensure that the great mass of people should receive something of that which is the glory of the human mind and not be kept apart from the momentous adventure of our kind; to bring man closer to man by striving to reduce the terrible if invisible gulf of ignorance; to struggle against mental starvation and the resulting under-development by providing every individual with a minimum ration of spiritual calories. . . .

In a word, the ideal of the popularization of science (and here lies its moral value) is to develop and assist a community of thought. It is the reverse of Renan's aristocratic concept whereby an uncultivated multitude should become the ward of a handful of the "informed". . . .

Its mission is still more exacting and we must be that much more demanding with regard to the way in which it is carried out. We are entitled to expect a rigorous impartiality, an unfailing objectivity, an absolute philosophic honesty. There is no question of using the mantle of science to indoctrinate minds or force them to conform to a pattern; there is no question of implanting in them any cramping and constricting dogmas; it is a question of "converting them to unquestionable truths," as the philosopher Guyau so admirably put it, so that, using the basic materials honestly provided, each individual may freely build his own small universe.

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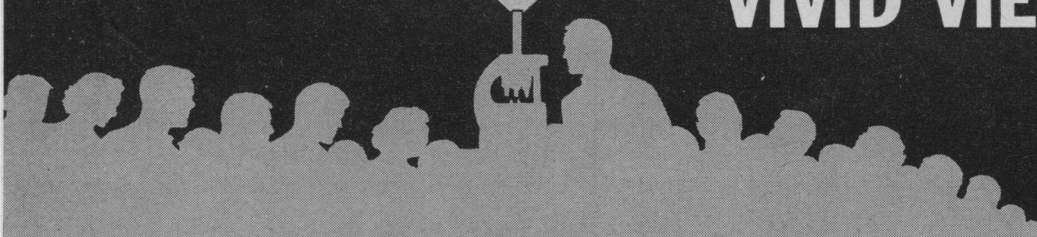
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[Excerpt from M. Rostand's address on the occasion of his accepting the 1959 Kalinga Prize for "outstanding contributions to the dissemination of scientific knowledge to the general public," 21 April 1960]



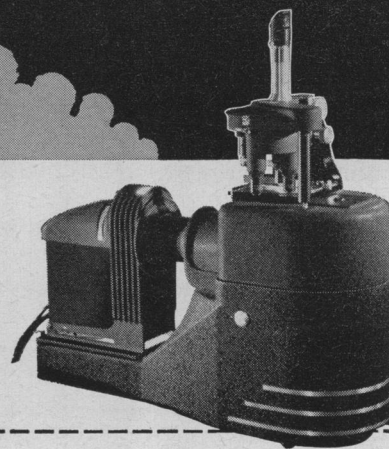
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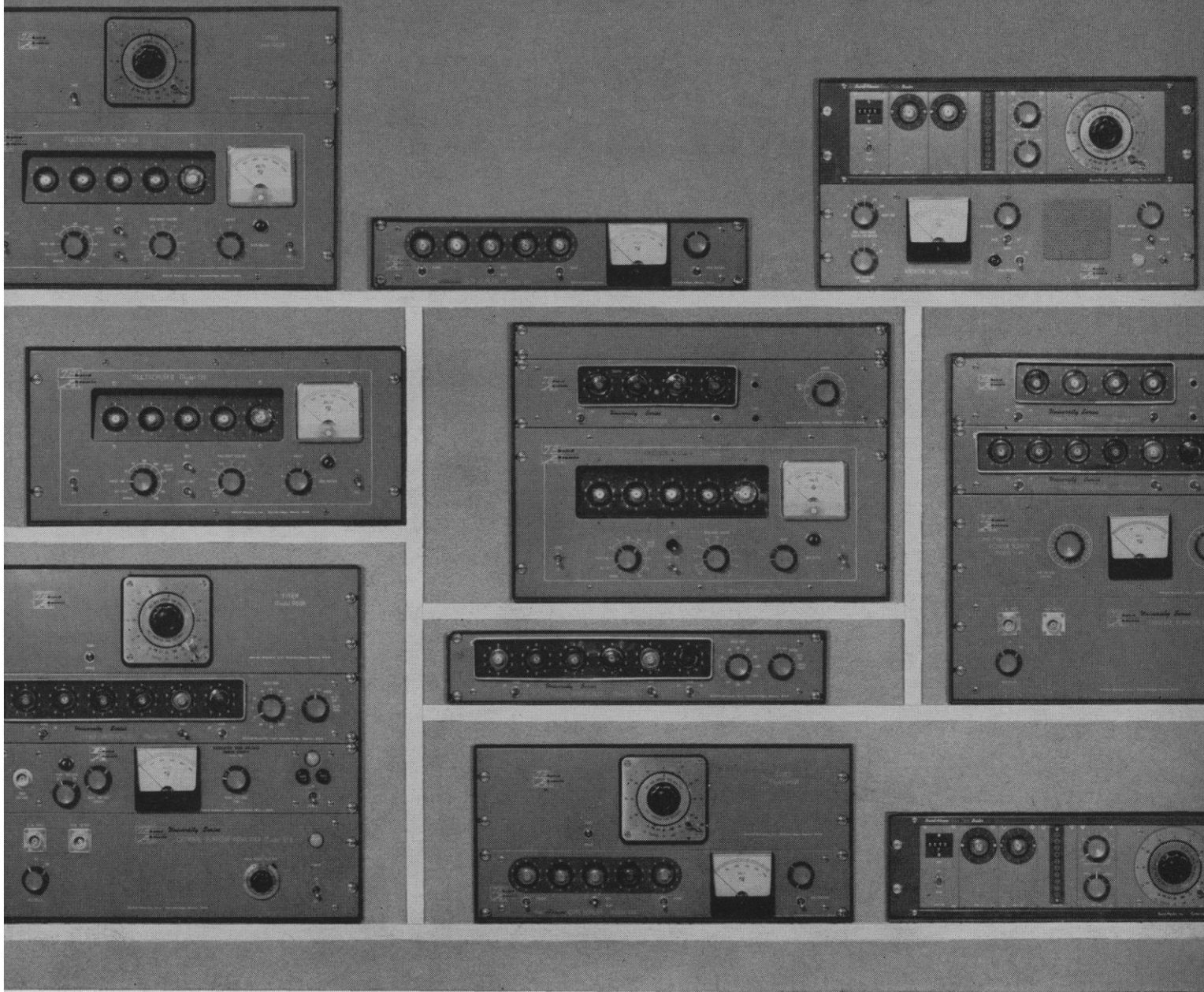
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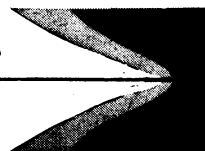


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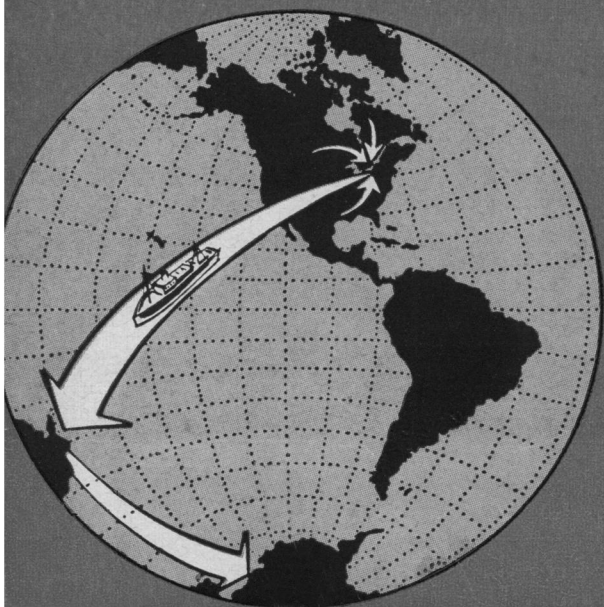


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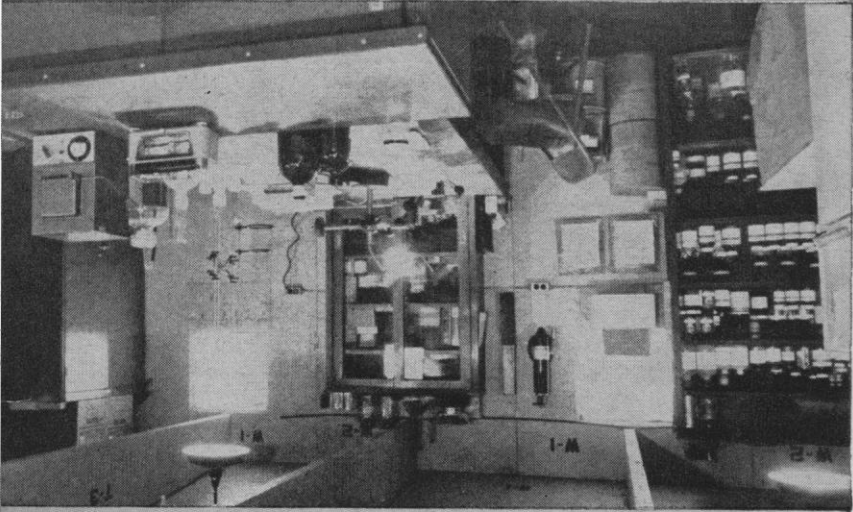
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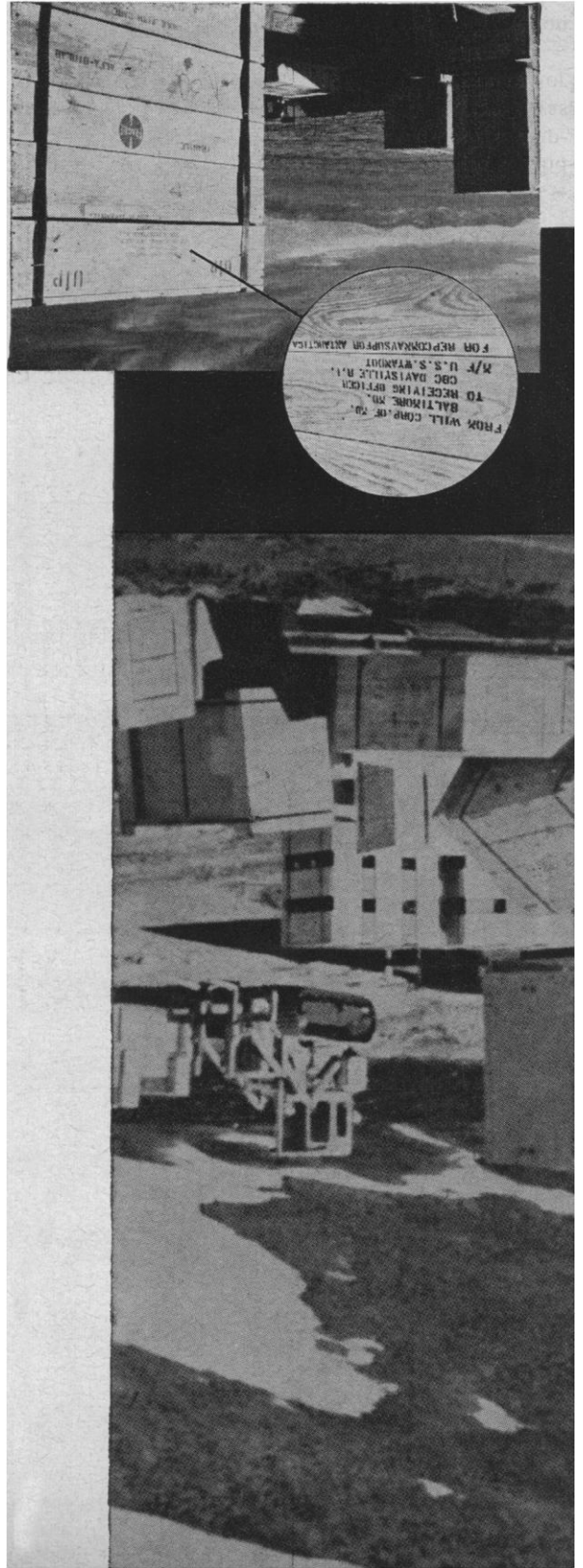


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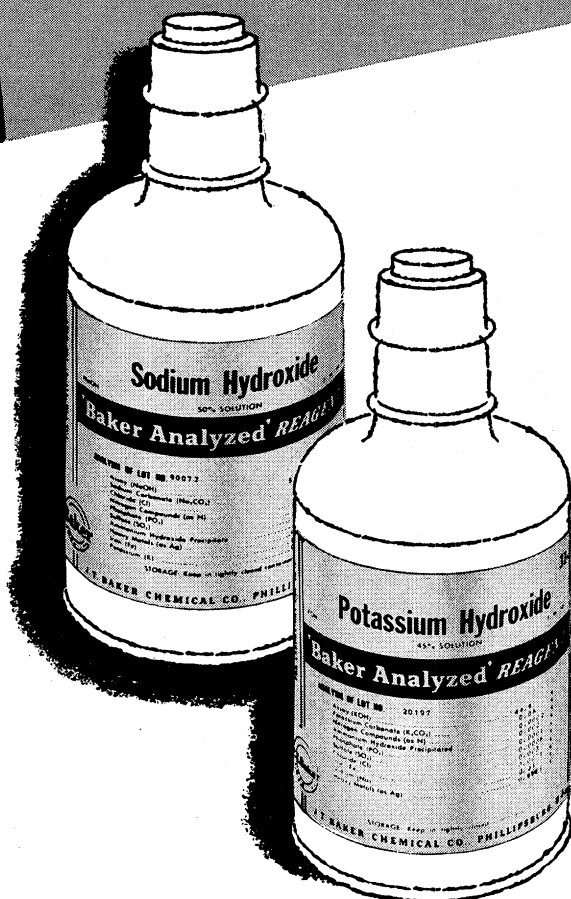
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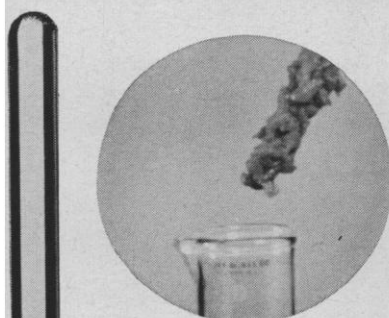
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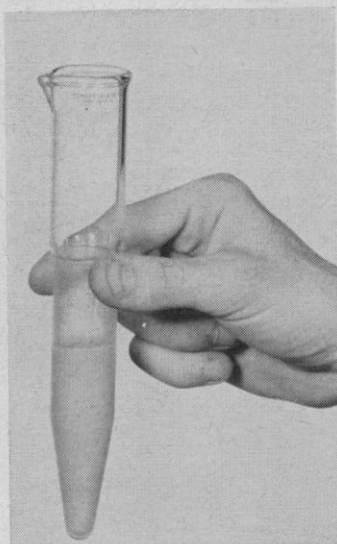
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Meetings

Near Eastern Prehistory

A seminar on "The Early Appearance and Development of Agricultural Communities in Iran and Southwestern Asia" was held in the Institute of Archeology of the University of Tehran, 15–25 February 1960, under the chairmanship of Dean A. A. Siassi, with Robert J. Braidwood and Ezat O. Negahban as co-chairmen. The session was organized to take advantage of the presence, in or near Tehran, of a number of prehistoric archeologists and natural historians, both foreign and Iranian, and to consider new evidence bearing on Near Eastern prehistory (1). Background papers were submitted by Pierre Bessagnet (UNESCO), Linda and Robert J. Braidwood (Chicago), M. L. Dewan (FAO), M. H. Ganji (Tehran), R. Ghirshman (Delegation Archéologique Française en Perse), Bruce Howe (Harvard), Indu Shekhar (Tehran), Ezat O. Negahban (Tehran), H. Pabot (FAO), Charles A. Reed (Illinois), E. H. Rieben (FAO), D. Sheiknia (Tehran), M. L. Smith and L. Aksoy (CENTO Institute of Nuclear Science), L. Van den Berghe (Ghent), P. J. Watson (Chicago), and R. A. Watson (Minnesota).

In the general sessions, beginning with the appearance of Acheulean type hand-axes (in Iran as well as in southwestern Asia generally) about 100,000 years ago, Howe described a trend towards increasing cultural complexity and variety as time went on. Following Acheulean types of tools of wide distribution and uniform type, there came the Mousterian industry, which begins to vary regionally. A date might center around 60,000 years ago. Next came the even greater variance in industries of the Upper Paleolithic blade tool tradition, ending in a flourish of microlithic tools. This stage covered the remainder of the last glacial period, from about 40,000 to 15,000 or even 12,000 years ago. Howe then considered the archeological traces of the very interesting transitional range of the next 2000 years, for which little open sites yield traces of intensified food collection. In a theoretical sense this transitional period must contain the incipient phases of plant and animal domestication. However, the archeological evidence for this period is so slight that its elements of food production cannot yet be defined. Indeed, the artifactual material appears still to be a part of the previous tradition associated with food collectors. It is rather by hindsight from the next stage that we postulate this incipient stage.

In his account of the first bona fide

traces of the village farming communities Braidwood wondered if a reversal of the trend towards regional intensification might not now be observed. In considering archeological evidence for the earliest village farming communities the following factors must be borne in mind.

1) Increased size and depth of accumulation, including house structures, indicating permanence, stability, and at least eventual population increase. Ethnological data suggest that there may be a few exceptions to a general rule that these features imply food production.

2) The so-called "neolithic" traits—ground stone (for example, celts and milling stones), pots, weaving, and so on—probably suggest new species and genera of tools which attend establishment of the village farming community. Certain of these traits now appear to have entered the record at different times, either before or after the achievement of food production; but, Braidwood asked, "Would a constellation of these traits have been possible without (i) an assured and surplus food supply, (ii) circumstances which allowed the rise of specialist craftsmen, (iii) a blurring of Howe's regional specialization as trade, and even an exchange of ideas beginning to be evidenced?"

3) Obvious proof of the village farming community stage depends on the contextually certain traces of the plant and animal domesticates.

4) Slightly weaker evidence of the village farming community stage would be artifacts for which the simplest explanation suggests techniques of food production.

Along with the immediate consequences which these four points suggest, there must have come vast changes in other realms of human culture. Matters of art, religion, politics, law, the moral order are at issue, but we have much more to learn before significant reconstructions of these can be made.

Next Negahban approached the question of whether the formative and earliest stages of the village farming community way of life may be identified on the Anatolian and Iranian plateaus. Strong typological suggestions of this early stage have been gathered from the Iranian plateau, but their serious study is impeded by lack of excavation into deposits of this stage. He next explained the archeological evidence of the well-formed village farming communities known from some eight sites in two subdivisions of cultural development, a northern and a southern one. He then posed certain questions regarding factors in the transition from food collecting to food production. He asked: (i) What was the effect of cli-

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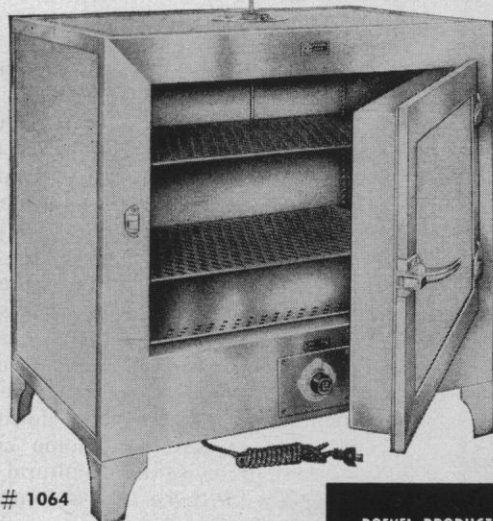
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matic change, if it occurred on the activities of man in developing this new way of life? (ii) What was the effect of a deterioration of plant and animal resources, if it occurred, and did it impel man towards a new type of food quest? Considering these points, one asks: To what degree had man as an increasingly successful food collector become a destroyer of the natural environment?

Shekhar then painted a picture of the brilliant achievement of a later, and urban, civilization in the Indus Valley. Again, lack of information prevents our knowing what were the antecedents of this civilization. The question of the

formation of the Indus Valley civilization is one of the great challenges facing archeology today, and work in India, Pakistan, and Iranian Baluchistan will be required before it is met. The available materials from both northern and southern Baluchistan suggest directions for further research.

Next, as the seminar turned its attention to the paleo-environment, P. J. Watson took up the artifactual and nonartifactual traces of food production in southwestern Asia. This discussion was based upon her ethnological investigations into present-day non-mechanized agricultural procedures as

well as on her knowledge of the archeological record. Such artifacts as digging stick weights, stone sickle blades, grindstones, and wheat and barley were singled out. The point was made that these last two items as domesticates were, in fact, artifacts and no longer nonartifactual material. Combining her impressions of present-day nonmechanized procedures with the implications to be drawn from the artifacts, she arrived at a reconstruction of early food production that shares many elements with today's practices of planting, reaping, threshing, and winnowing. Such items as the animal-drawn plow, the rotary quern, and the metal sickle, are, of course, not present in the earliest stages.

Further exploration of the paleo-environment followed in Reed's consideration of the animals of the pertinent area and time range (2). Provocatively describing man's place in nature from the zoologist's point of view, Reed emphasized the importance of the natural habit of social behavior among those animals which became domesticated. The cat appears to be a single exception. Reed defined domestic animals as those whose reproduction man controls. It follows that they also are artifacts. Since the social behavior of the potential domesticates must be assumed to be some millions of years old, it is striking that, with this preadaptation, domestication was so long delayed. Reed favored the uplands about the Fertile Crescent as the locale for early domestication and, on the archeological record to date, showed that the dog and the goat were present in domesticated form at both Jarmo in Iraq and Jericho in Palestine at a date which he took to be about 8500 years ago. On present evidence, Reed rejected both the notion of climatic change and changes in human physical type as determinative factors in animal domestication. He saw the achievement of a necessary but unspecified level of cultural evolution as the requisite for domestication, thereby throwing the problem back upon the archeologists. He also concluded that animals were domesticated after permanent human settlements were achieved and that plant domestication may well have preceded animal domestication.

Next followed a joint consideration of the physical factors in the paleo-environment by R. A. Watson, Dewan, and Ganji. Watson supposed that archeologists expect aid of geologists in geochronological dating and in the reconstruction of past climate and physical environments. Before adequate geological aid can be given, he averred, two things would be needed. Much further study and description of the general geomorphological features of southwestern Asia will be necessary. This will also involve reassessment of the

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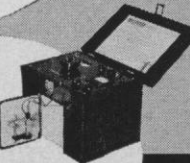
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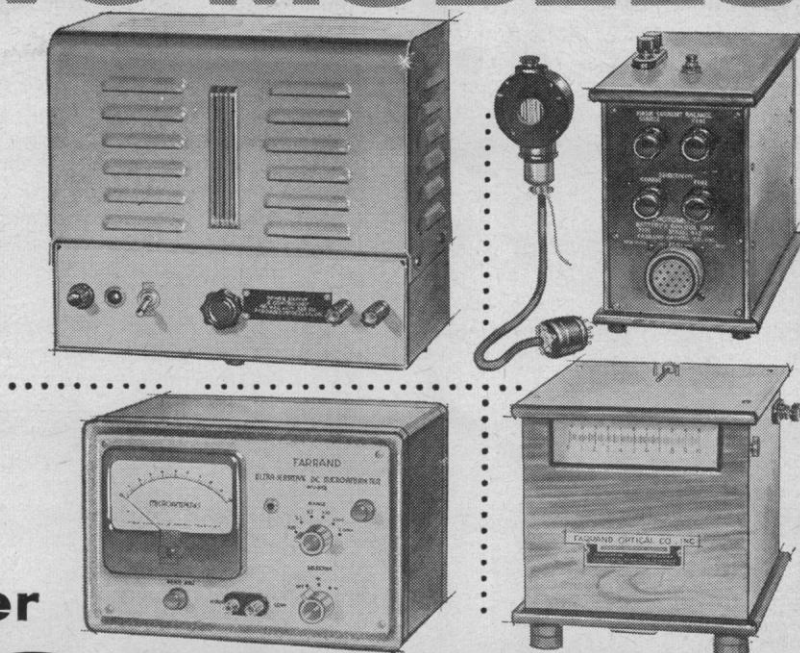
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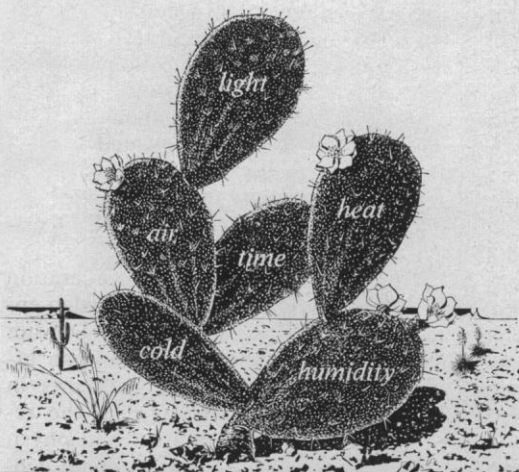
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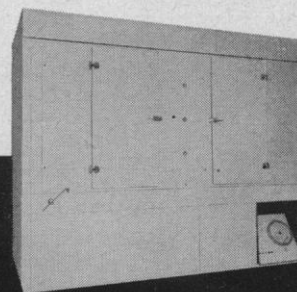
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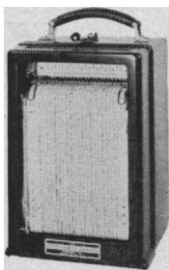
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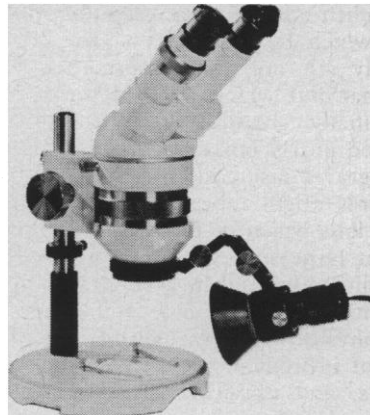
older, simplistic generalizations on such features as end-Pleistocene lakes, sand dunes, fluvial and marine terraces, and glacial and periglacial phenomena.

Dewan emphasized that, of the whole range of soils to be found in southwestern Asia, those most pertinent to early agriculture would be the alluvial soils and the brown soils. He described their characteristics, properties, and distribution. These data he covered in much more detail in his very useful background paper.

In elaborating on his own useful background paper, Ganji also emphasized the limitations of present climatic data in arriving at a detailed picture of present climate for southwestern Asia. Thus, the projecting of climate into the past is that much more difficult. However, it is clear that gross climatic change within the last 10,000 to 15,000 years is not evidenced, although frequent minor cyclic variations can be traced. Ganji urged attention to the paleobotany of grains as a clue to understanding past climates. He summarized his observations on Iran in two detailed maps, one of rainfall and one of his adaptation of the Koeppen system for delineating the climate as applied to Iran.

Although diffident about discussing paleobotanical matters, Pabot made stimulating contributions to the central question of the seminar. He suggested that the wild wheats may have a distribution slightly further to the southeast of the Kermanshah area than those shown on Helbaek's map of 1959 (3). He also stated that he had never observed wild wheat throughout the country of the Syrian saddle except below the latitude of the Beirut-Damascus road. Southern Turkey is not under consideration here. He further stated that he would not expect the plant communities of the lush East Mediterranean strip or those of the Caspian or Black Sea littorals to have included the wild wheats, although he added that, in his opinion, the presently suggested prototypes of wheat are not yet proved to have been the ancestors of the domesticates. Pabot was firmly convinced that the present natural habitat of the wild wheats lies above approximately 1000 meters. He also made stimulating comments about how the wild grains may have been taken into domestication and first utilized. He remarked that the wheats under primitive conditions may have been rather rare grains and are adapted to areas of disturbed soil conditions. Furthermore, the reaping process could have involved plucking plants out by the roots. Interestingly, Pabot concurred with the notions of Reed and of the archeologists that the transition to cereal domestication may have taken about 2000 years.

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Sheikhnia then emphasized the importance of the forest trees and of fruit trees and viticulture in the development of the village farming community way of life.

Rieben posed a very interesting problem which he realized was not immediately relevant to the purpose of the seminar but which is, nevertheless, of potentially great importance. He described nearly horizontal layers of mud and gravel just east of Tehran. These features might represent either an extinct lake beach or the trace of a more recent large artificial canal.

Smith discussed in general terms the potential contribution to archeology of the physical sciences, considering matters of identification, utilization of materials, and physical chronologies. He clearly described the radioactive carbon method of age determination, noting the degree of physical and statistical error which is necessary in expressing the age determination. Even more important is the possibility of contamination of samples *in situ* which might result in larger degrees of error than those expressed by the statistical formula. The still remote possibilities for dating baked-in-place pottery by means of the earth's magnetism were discussed. The possibilities for identification of materials by neutron activation and beta-ray back scatter were also considered.

Bessagnet introduced the subject of the pertinence of social-anthropological studies to archeological interpretation, noting the cautions necessary in extrapolating backwards from present-day tribal behavior to a reconstruction of past social organization.

In originally proposing the seminar the co-chairmen had hoped that it might clarify understanding of how and under what circumstances man, for the first time in his history, achieved food production and settled community life in southwestern Asia. One of the most important challenges in any scientific research is that of finding how to pose the questions properly for further research, and it was the firm conviction of the organizers of this seminar that the questions had become more clear. The proceedings of the seminar will be published by the Institute of Archeology of the University of Tehran.

ROBERT J. BRAIDWOOD

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Chicago, Illinois

BRUCE HOWE

Harvard University,
Cambridge, Massachusetts

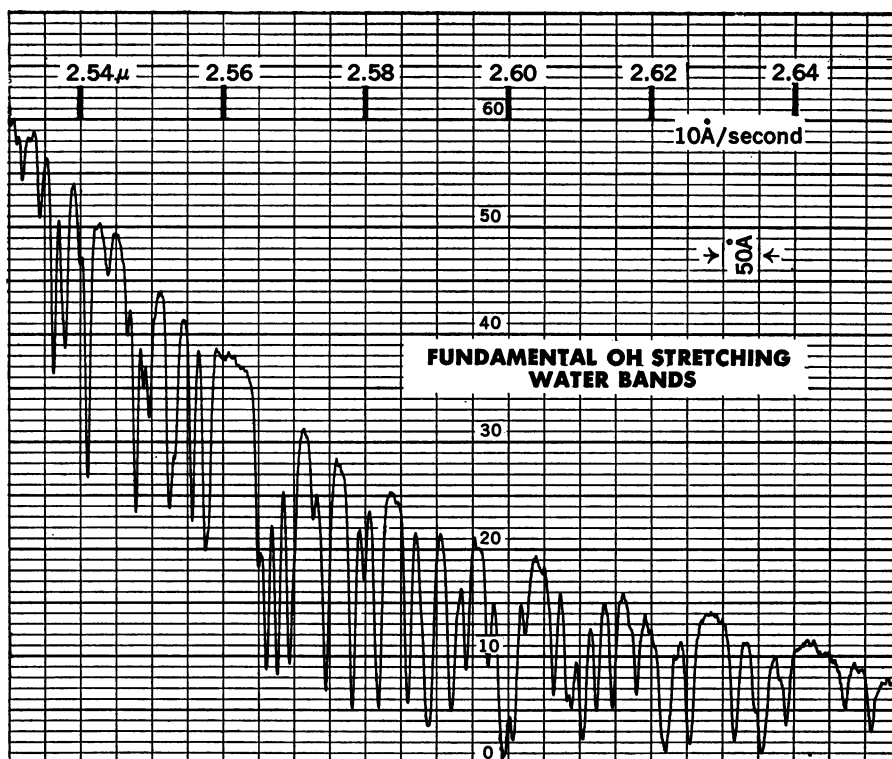
EZAT O. NEGAHBAN

University of Tehran, Tehran, Iran

References

1. R. J. Braidwood, *Science* 127, 1419 (1958).
2. C. A. Reed, *ibid.* 130, 1629 (1959).
3. H. Helback, *ibid.* 130, 365 (1959).

20 MAY 1960

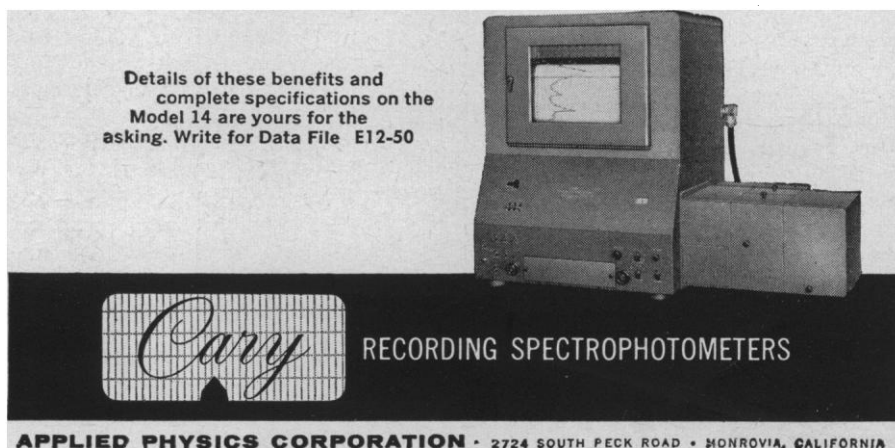


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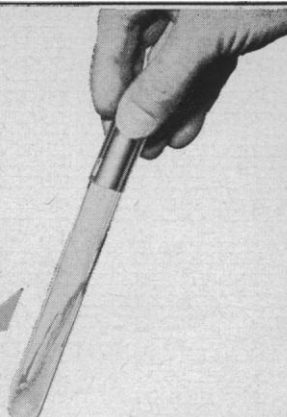
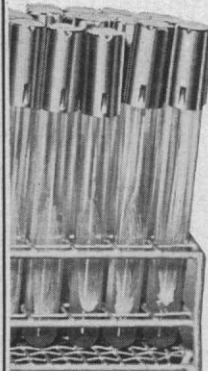
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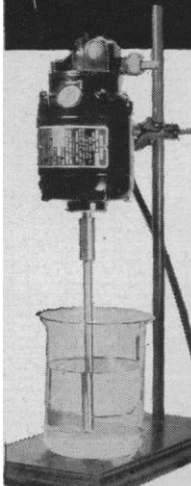
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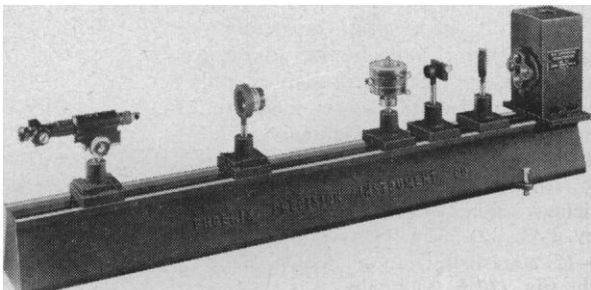
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Forthcoming Events

June

8-10. Canadian Federation of Biological Societies (Canadian Physiological Soc., Pharmacological Soc. of Canada, Canadian Assoc. of Anatomists, Canadian Biochemical Soc.), 3rd annual, Winnipeg, Manitoba. (E. H. Bensley, Montreal General Hospital, 1650 Cedar Ave., Montreal 25, P.Q.)

8-11. National Soc. of Professional Engineers, annual, Boston, Mass. (P. H. Robbins, NSPE, 2029 K St., NW, Washington 6)

8-12. American College of Chest Physicians, Miami Beach, Fla. (M. Kornfeld, 112 E. Chestnut St., Chicago 11, Ill.)

9-10. American Geriatrics Soc., Miami Beach, Fla. (R. J. Kraemer, 2907 Post Rd., Warwick, R.I.)

9-10. Canadian Inst. of Food Technology, 3rd annual conf., Winnipeg, Manitoba. (W. J. Eva, Box 846, Winnipeg, Manitoba)

9-10. Society of Women Engineers, 10th annual conv., Seattle, Wash. (Mrs. J. A. Troxell, 3613 E. 43 St., Seattle 5)

9-11. Acoustical Soc. of America, Providence, R.I. (W. Waterfall, ASA, 335 E. 45 St., New York 17)

9-11. Endocrine Soc., Miami Beach, Fla. (H. H. Turner, 1200 N. Walker, Oklahoma City 3, Okla.)

9-11. National Speleological Soc., annual, Carlsbad, N.M. (G. W. Moore, U.S. Geological Survey, Menlo Park, Calif.)

9-12. American Medical Women's Assoc., Miami Beach, Fla. (Mrs. L. T. Majally, 1790 Broadway, New York 19)

9-12. American Rheumatism Assoc., annual, Hollywood-by-the-Sea, Fla. (F. E. Demartini, Presbyterian Hospital, 622 W. 168 St., New York 32)

9-12. American Therapeutic Soc., Miami Beach, Fla. (O. B. Hunter, Jr., 915 19 St., NW, Washington 6)

10-12. American College of Angiology, Miami Beach, Fla. (A. Halpern, 11 Hampton Court, Great Neck, N.Y.)

10-12. American Electroencephalographic Soc., Boston, Mass. (G. A. Ulett, 1420 Gratten St., St. Louis 4, Mo.)

10-12. Society for Biological Psychiatry, Miami Beach, Fla. (G. N. Thompson, 2010 Wilshire Blvd., Los Angeles 57, Calif.)

11. American Acad. of Tuberculosis Physicians, Miami Beach, Fla. (G. P. Bailey, P.O. Box 7011, Denver 6, Colo.)

11-12. American Diabetes Assoc., Miami Beach, Fla. (J. R. Connelly, 1 E. 45 St., New York 17)

11-16. American Soc. of X-ray Technicians, Cincinnati, Ohio. (G. J. Eilert, 16 Fourteenth St., Fond du Lac, Wis.)

12. Society for Vascular Surgery, Miami Beach, Fla. (G. H. Yeager, 314 Medical Arts Bldg., Baltimore 1, Md.)

12-15. American Nuclear Soc., 6th annual, Chicago, Ill. (O. Du Temple, ANS, c/o John Crerar Library, 86 E. Randolph St., Chicago 1)

12-15. American Soc. of Agricultural Engineers, Columbus, Ohio. (J. L. Butt, P.O. Box 229, St. Joseph, Mich.)

12-16. Cancer Research, 4th Canadian conf., Honey Harbour Ontario, Canada. (R. L. Noble, Collip Research Laboratory, Univ. of Western Ontario, London, Ontario, Canada)

12-17. Association for Research in Ophthalmology, Miami Beach, Fla. (L. V. Johnson, 10515 Carnegie Ave., Cleveland, Ohio)

13-14. Technical Writing Improvement Soc., 5th Southern Calif. Industrial Writing Inst., Los Angeles, Calif. (J. L. Kent, TWIS, P.O. Box 5453, Pasadena, Calif.)

13-15. American Neurological Assoc., Boston, Mass. (M. D. Yohr, 710 W. 168 St., New York 32)

13-15. American Soc. of Heating, Refrigerating and Air-Conditioning Engineers, 67th annual, Vancouver, B.C. (E. R. Searles, ASHRAE Journal, 234 Fifth Ave., New York 1)

13-15. Chemical Inst. of Canada, 43rd conf., Ottawa, Ontario. (CIC, 48 Rideau St., Ottawa 2, Ontario)

13-15. Herpetologists League, Eugene, Ore. (A. M. Woodbury, 248 University St., Univ. of Utah, Salt Lake City 2)

13-15. International Powder Metallurgy Conf., New York, N.Y. (K. H. Roll, Metal Powder Industries Federation, 60 E. 42 St., New York 17)

13-15. Microscopy, natl. symp., Chicago, Ill. (Walter C. McCrone Associates, 501 E. 32 St., Chicago 16)

13-15. Society for Investigative Dermatology, 21st annual, Miami Beach, Fla. (H. Beerman, SID, 255 S. 17 St., Philadelphia)

13-17. American Medical Assoc., Miami Beach, Fla. (F. J. L. Blasingame, 535 N. Dearborn St., Chicago 10, Ill.)

13-17. Canadian Medical Assoc., 93rd annual, Banff, Alberta. (CMA, 244 George St., Toronto, Canada)

13-17. International Conf. of Physiopathology of Animal Reproduction and Artificial Insemination, Amsterdam, Netherlands. (J. Edward, Milk Marketing Board, Thames, Surrey, England)

13-17. International Cong. of Clinical Pathology, Madrid, Spain. (J. A. Garrido, Sandoval 7, Madrid)

13-17. Molecular Structure and Spectroscopy, symp., Columbus, Ohio. (R. A. Oetjen, Dept. of Physics and Astronomy, Ohio State Univ., Columbus 10)

13-18. AAAS Pacific Div., Eugene, Ore. (R. C. Miller, California Acad. of Sciences, Golden Gate Park, San Francisco 18)

13-2 Sept. Gordon Research Confs., Meriden and New London, N.H. (W. G. Parks, Univ. of Rhode Island, Kingston)

14-16. American Meteorological Soc., Eugene, Ore. (K. C. Spengler, AMS, 45 Beacon St., Boston 8, Mass.)

15-17. American Physical Soc., Montreal, Quebec, Canada. (K. Darrow, APS, Columbia Univ., 116 St. and Broadway, New York, N.Y.)

15-17. Mechanisms of Peroxide Reactions, conf., Providence, R.I. (J. O. Edwards, Metcalf Research Laboratory, Brown Univ., Providence 12)

15-24. International Union for Conservation of Nature and Natural Resources, Warsaw and Cracow, Poland. (H. J. Coolidge, National Research Council, Washington 25, D.C.)

15-25. Large Electric Systems, intern. conf., Paris, France. (British National Committee, Thornecroft Manor, Dorking Rd., Leatherhead, Surrey, England)

15-29. Nuclear Congress and Exhibition on Electronics and Atomic Energy, 7th intern., Rome, Italy. (Secretariat, Rassegna



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16-17. National Colloid Symp., 34th, Bethlehem, Pa. (B. R. Ray, Dept. of Chemistry, Washington State Univ., Pullman)

16-18. American Scientific Glassblowers Soc., 5th annual conf., Pittsburgh, Pa. (W. E. Barr, Gulf Research & Development Co., P.O. Box 2038, Pittsburgh 30)

16-18. Growth; Molecule, Cell, and Organism, intern. symp., Lafayette, Ind. (M. X. Zarrow, Dept. of Biological Sciences, Life Science Bldg., Purdue Univ., Lafayette, Ind.)

17-19. American Soc. of Ichthyologists and Herpetologists, Chicago, Ill. (R. Conant, Philadelphia Zoological Garden, 34 St. and Girard Ave., Philadelphia 4)

19-22. American Inst. of Chemical Engineers, Mexico City, Mexico. (F. J. Van Antwerpen, AICE, 25 W. 45 St., New York 36)

19-22. American Soc. of Mammalogists, annual, Tacoma, Wash. (B. P. Glass, Dept. of Zoology, Oklahoma State Univ., Stillwater)

19-24. American Soc. of Medical Technologists, Atlantic City, N.J. (Miss M. C. Wethington, 4221 Ann St., Saginaw 3, Mich.)

19-25. American Library Assoc., Montreal, Canada. (D. H. Clift, ALA, 50 E. Huron St., Chicago 11, Ill.)

19-25. American Soc. of Civil Engineers, Reno, Nevada. (W. H. Wisely, 33 W. 39 St., New York 18)

20-22. Medicinal Chemistry, 7th natl. symp., Kingston, R. I. (J. J. DeFeo, Dept.

of Pharmacology, Univ. of Rhode Island, Kingston)

20-July 30. Mathematical Statistics and Probability, 4th symp., Berkeley, Calif. (Dept. of Statistics, Statistical Laboratory, Univ. of California, Berkeley 4)

20-22. Society for the Study of Development and Growth, 19th symp., Waltham, Mass. (L. Jaffe, Biology Dept., Brandeis Univ., Waltham 54)

20-23. Society for Applied Spectroscopy, 11th annual symp., Chicago, Ill. (H. Wilson, Continental Can Co., Inc., 7622 So. Racine Ave., Chicago 20)

20-24. American Soc. for Engineering Education, Lafayette, Ind. (W. L. Collins, Univ. of Illinois, Urbana, Ill.)

20-24. International Acad. of Pathology, London, England. (G. J. Cunningham, Royal College of Surgeons of England, London, W.C.2, England)

20-24. National Inventions Exhibition and Creativity Conf. (Cleveland Engineering Soc.), Cleveland, Ohio. (Cleveland Engineering Soc., 3100 Chester Ave., Cleveland 14)

20-26. Congress on Nuclear Energy, Rome, Italy, (Comitato Nazionale per le Ricerche Nucleari, Via Belisario 15, Rome, Italy)

20-1. Air Force Missile Development Center and Univ. of New Mexico, series of seminars, Cloudcroft, N.M. (J. R. Foote, P.O. Box 1053, Holloman AFB, N.M.)

22-24. Standards and Electronic Measurements, conf., Boulder, Colo. (J. F. Brockman, National Bureau of Standards, Boulder)

22-25. Society of Nuclear Medicine, Estes Park, Colo. (T. P. Sears, V.A. Hospital, Denver 20, Colo.)

25-5. First Intern. Cong. on Automatic Control, Moscow, U.S.S.R. (R. Oldenburger, Mechanical Engineering Dept., Purdue Univ., Lafayette, Ind.)

26-1. American Physical Therapy Assoc., Pittsburgh, Pa. (Miss J. Bailey, 157 N. 79 St., Milwaukee 13, Wis.)

26-1. American Soc. for Testing Materials, Atlantic City, N.J. (R. J. Painter, 1916 Race St., Philadelphia 3, Pa.)

26-1. Mass Spectrometry, 8th annual, Atlantic City, N.J. (V. H. Dibeler, National Bureau of Standards, Washington 25)

26-1. National Education Assoc., Los Angeles, Calif. (W. G. Carr, 1201 16 St., NW, Washington 6)

26-2. American Physical Therapy Assoc., Pittsburgh, Pa. (Miss L. Blair, 1790 Broadway, New York 19)

27-29. Military Electronics, 4th natl. conv., Washington, D.C. (C. M. Crenshaw, Dept. of Army, Office of the Chief Signal Officer, R. & D. Division, SIGRD-2, Washington 25)

27-30. Institute of the Aeronautical Sciences, Los Angeles, Calif. (R. R. Dexter, IAS, 2 E. 64 St., New York 21)

27-30. National Assoc. of Power Engineers, annual conv., San Francisco, Calif. (E. J. Schuetz, NAPE, 176 W. Adams St., Chicago 3, Ill.)

27-1. International Assoc. for Bridge and Structural Engineering, 6th cong., Stockholm, Sweden. (P. Lardy, IABSE, Ecole Polytechnique Fédérale, Zurich, Switzerland)

27-1. Reading Conf., 2nd annual, Syracuse, N.Y. (R. A. Kress, Reading Center, Syracuse Univ., Syracuse 10)

28-1. American Home Economics Assoc., Denver, Colo. (Miss M. A. Warren, School of Home Economics, Univ. of Oklahoma, Norman)

29-1. Health Physics Soc., 5th annual, Boston, Mass. (E. E. Anderson, Health Physics Div., Oak Ridge National Laboratory, Oak Ridge, Tenn.)

July

3-5. American Assoc. of Colleges of Pharmacy, Boulder, Colo. (G. L. Webster, College of Pharmacy, Univ. of Illinois, Chicago 12)

4-8. Polarization Phenomena of Nucleons, symp., Basle, Switzerland. (K. P. Meyer, Physikalisches Institut der Universität Basel, Klingelbergstr. 82, Basle, Switzerland)

5-9. Goiter Conf., 4th intern., London, England. (J. C. McClintock, 149½ Washington Ave., Albany 10, N.Y.)

6-15. Entomological Conf., 7th Commonwealth, London, England. (Commonwealth Inst. of Entomology, 56 Queen's Gate, London, S.W.7)

10-14. Pan American Tuberculosis Cong., 12th, Bahia, Brazil. (F. D. Gómez, 26, de Marzo, 1065, Montevideo, Uruguay)

11-15. British Dental Assoc., annual, Edinburgh, Scotland. (Secretary, British Dental Assoc., 13 Hill St., Berkeley Sq., London, W.1, England)

11-15. Royal Medico-Physiological Assoc., annual, London, England. (A. B.

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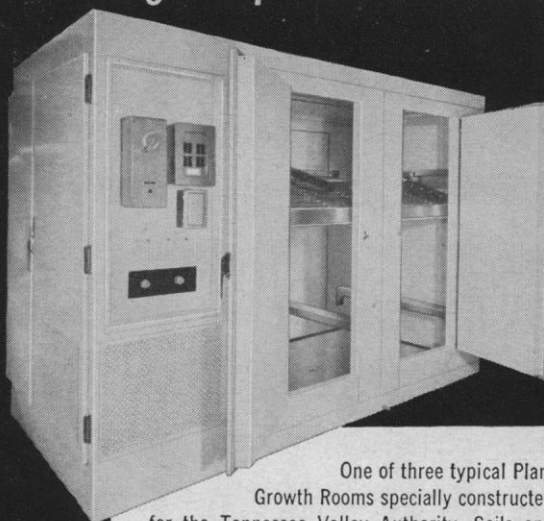
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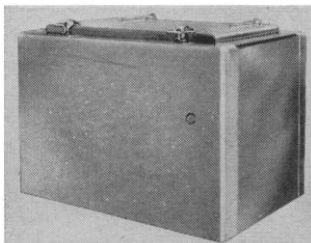


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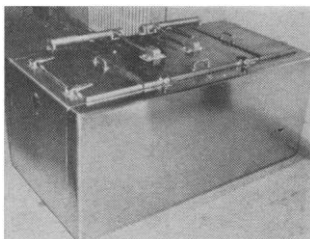
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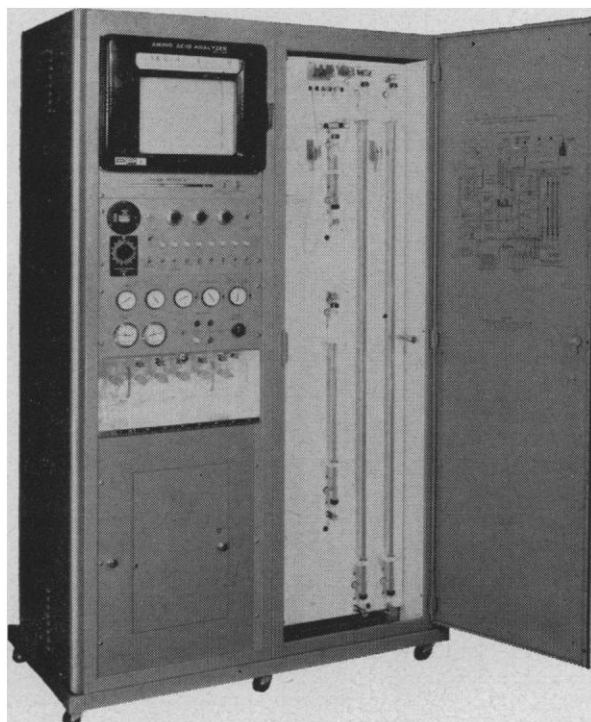
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11-18. Earthquake Engineering, 2nd world conf., Tokyo and Kyoto, Japan. (K. Muto, Organizing Committee, 2nd World Conf. on Earthquake Engineering, Science Council of Japan, Ueno Park, Taito-ku, Tokyo)

11-22. Grassland Cong., 8th intern., Reading, Berks, England. (British Grassland Soc., Grassland Research Inst., Hurley, North Maidenhead, Berks)

15-22. Mycology, 6th Commonwealth conf., London, England. (Commonwealth Mycological Inst., Ferry Lane, Kew, Surrey, England)

18-22. International Conf. on Congenital Malformations, London, England. (S. E. Henwood, Intern. Medical Congress, Ltd., 120 Broadway, New York 5)

18-23. Endocrinology, 1st intern. cong., Copenhagen, Denmark. (G. Pincus, 1st Intern. Cong. of Endocrinology, Worcester Foundation, Shrewsbury, Mass.)

18-25. French Assoc. for the Advancement of Science, 79th cong., Grenoble. (Association Française pour l'Avancement des Sciences, 28 rue Serpente, Paris 6°)

19-22. International Conf. on Scientific Problems of Crop Protection, Budapest, Hungary. (Z. Király, Research Inst. for Plant Protection, Budapest)

21-27. Medical Electronics, 3rd intern. conf., Olympia, London, England. (Secretary, Institution of Electrical Engineers, Savoy Pla., London, W.C.2)

23-28. Otolaryngology, 7th intern. cong., Paris, France. (H. Guillon, 6, avenue MacMahon, Paris, 17°)

24-29. American Assoc. on Mental Deficiency (London Conf. on the Scientific Study of Mental Deficiency), London, England. (H. A. Stevens, P.O. Box 3128, Madison 4, Wis.)

25-29. Occupational Health, 13th intern. cong., New York, N.Y. (I. R. Tabershaw, ICOH, 375 Park Ave., New York)

25-9. International Union of Geodesy and Geophysics, 12th general assembly, Helsinki, Finland. (Organizing Committee, c/o Institut Géodésique, Bulevardi 40, Helsinki)

25-6. International Assoc. of Physical Oceanography, 13th general assembly, Helsinki, Finland. (B. Kullenberg, c/o Oceanografiska Institutet, P.O. Box 1038, Goteborg 4, Sweden)

26-28. Poliomyelitis, 5th intern. conf., Copenhagen, Denmark. (S. E. Henwood, International Poliomyelitis Congress, 120 Broadway, New York 5)

27-12. Mathematical Statistics and Probability, symp., Berkeley, Calif. (A. P. Burroughs, Air Force Office of Scientific Research, Presentations Div., Research Information Office, AFOSR/USAF, Washington 25)

28-29. Computers and Data Processing, 7th annual symp., Estes Park, Colo. (W. H. Eichelberger, Denver Research Inst. Univ. of Denver, Denver 10, Colo.)

31-5. Alcohol and Alcoholism, 26th intern. cong., Stockholm, Sweden. (A. Tongue, Bureau International contre l'Alcoolisme, Case Gare 49, Lausanne, Switzerland)

31-5. Photobiology, 3rd intern. cong., Copenhagen, Denmark. (A. Hollaender, Biology Div., Oak Ridge Natl. Laboratory, Oak Ridge, Tenn.)

New Products

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Neither Science nor the writer assumes responsibility for the accuracy of the information. A coupon for use in making inquiries concerning the items listed is included in the post card insert. Circle the department number of the items in which you are interested on this coupon.

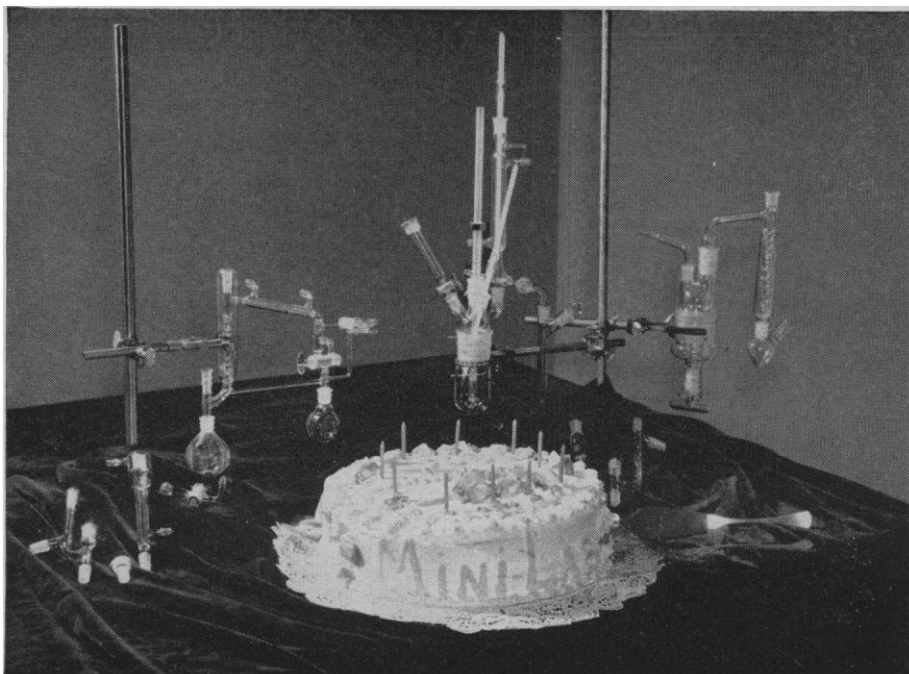
■ **SHOCK TESTING MACHINE** for small electronic, electromechanical, and mechanical components accommodates specimens weighing up to 20 lb. and occupying an 8-in. cube. The machine utilizes the free-fall principle. Half-sine, saw-tooth, and square-wave pulses are produced. Drop heights may be preset for both manual and automatic cycling. When half-sine pulses are used, the specimen table is caught at the peak of rebound. (Barry Controls Inc., Dept. Sci516, 700 Pleasant St., Watertown 72, Mass.)

■ **SOLVENT EVAPORATOR** combines a controlled temperature-vacuum system with rotary vibration. Test tubes or centrifuge tubes from fraction collectors are processed in groups of ten in the apparatus. Typical evaporation rates cited are 0.75 ml/min for water and 7.5 ml/min for acetone in each tube. Vacuum is furnished by a water aspirator and is controlled for each test tube by a separate stopcock. The instrument is 15 in. in diameter and 21 in. high. (Laboratory Glass and Instruments Corp., Dept. Sci517, 514 W. 147 St., New York 31)

■ **PUNCHED-TAPE READER** and companion spooler mechanism is a completely transistorized read-out system with output said to be compatible with most data-processing systems. Reading speeds up to 200 characters per second are possible with the spooler, which accommodates paper or Mylar tape up to 1 in. in width on reels 8 in. in diameter. Without the spooler, reading rates up to 1000 characters per second are possible. (Potter Instrument Co., Inc., Dept. Sci521, Plainview, N.Y.)

■ **PORTABLE RECORDER** is a 6-in. strip-chart potentiometer type with selectable 9- to 120-mv span. Optional features include ball-point pen, 1-mv span preamplifier, and resistance-bulb bridge for temperature measurement. Balance time is 0.8 sec; sensitivity is ± 0.25 percent of full scale. Gear-shift selection of chart speed is provided. (Systron Corp., Dept. Sci522, 950 Galindo St., Concord, Calif.)

■ **FLUORINE ANALYZER** employs nuclear-magnetic-resonance techniques. Fluorine can be detected in liquids down to 3 mg in any sample size from 0.2 to 40 ml. An integrator accessory provides linear response in terms of mass of



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fluorine present. When chemical shift is great enough, each peak in an unknown mixture can be separately integrated. Precision of the analyzer is said to be ± 1 percent of the signal. Sweep amplitude is 0.1 to 20 gauss in a choice of eight settings; sweep time is 0.5 to 4 min. (Schlumberger Well Surveying Corp., Dept. Sci 520, Ridgefield, Conn.)

■ **SILICON CARBIDE HEATING ELEMENTS** for temperatures up to 1575°C are fabricated in one piece with the hot zone in the form of a spiral. Elements are available with over-all lengths up to 63 in. and hot-zone lengths from 7

to 40 in. A double-spiral hot-zone model requires connection at one end only. (Morganite Incorporated, Dept. Sci524, 3302-3320 48th Ave., Long Island City, N.Y.)

■ **COUNT-RATE METER** is a completely transistorized unit with eight scale ranges extending to 600,000 count/min. Three time constants, 1, 5, and 10 sec, can be selected with a front-panel switch. Input is sensitive to a 250-mv negative pulse; output is provided for 0-to-1-ma or 0-to-10-mv recorder. (Interstate Electronics Corp., Dept. Sci525, Anaheim, Calif.)

■ **TARGET SIMULATOR** for radar calibration furnishes delays continuously variable from 100 to 300 μ sec and simulates target velocity to 20,000 ft/sec. Bandwidth is 45 percent of center frequency of up to 40 Mcy/sec. Rise time is 0.1 μ sec or better. Variation is servo controlled. (Andersen Laboratories Inc., Dept. Sci528, 501 New Park Ave., West Hartford 10, Conn.)

■ **CONSTANT RATE BURETTE** consists of a ground-glass solution barrel and plunger driven by a synchronous motor. Neoprene rings held in stainless-steel collars are used for sealing. Drive, transmitted by a lead screw and nylon follower, is self-limiting at both ends. A separate motor provides rapid motion for refilling and for discharging excess titrant and flushing. (E. H. Sargent & Co., Dept. Sci526, 4647 W. Foster Ave., Chicago 60, Ill.)

■ **MICRO SYRINGE BURETTE** is graduated in 0.0001-ml units. Capacity of the syringe is 0.25 ml. A lock nut permits repeated deliveries of identical volumes. Replacement of the hypodermic needle with a special glass tip converts the device into a microburette. The syringe can be emptied completely except for the volume of the 27-gage needle. (California Laboratory Equipment Co., Dept. Sci527, 1717 Fifth St., Berkeley 10, Calif.)

■ **LUBRICANT TESTING MACHINE** can be adapted to testing either dry or liquid lubricants, at ambient or high temperatures, with oscillatory or rotary motion and with a range of velocity and loads. Operation with friction coefficients of 0.5 at full load can be maintained. Instrumentation is mounted in a separate cabinet. (Alpha-Molykote Corp., Dept. Sci529, 65 Harvard Ave., Stamford, Conn.)

■ **THERMISTOR PSYCHROMETER** is a portable instrument that measures moisture content of air by means of wet and dry thermistor beads. The instrument has three scales to cover the temperature range -10° to $+80^{\circ}$ C. Accuracy is said to be ± 0.5 percent of relative humidity. Reading of both wet-bulb and dry-bulb temperatures can be accomplished in 10 sec. A spring coil motor can be supplied in place of the battery-operated motor for hazardous locations. (Atkins Technical, Inc., Dept. Sci531, 1276 W. Third St., Cleveland 13, Ohio)

■ **SIGNAL GENERATOR** furnishes 20 cy/ to 20 kcy/sec sine or square waves for audio, and 20 kcy/ to 12 Mcy/sec sine and 20 kcy/ to 2 Mcy/sec square waves for video signal and video sweep, with the latter at a 60-cy/sec sinusoidal sweep rate. Outputs of a high-fre-



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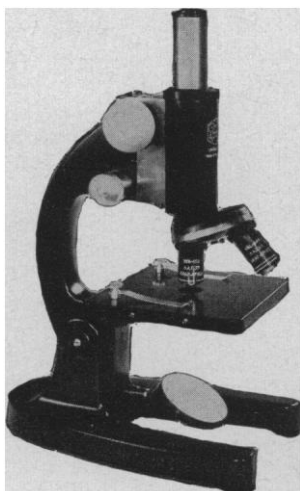


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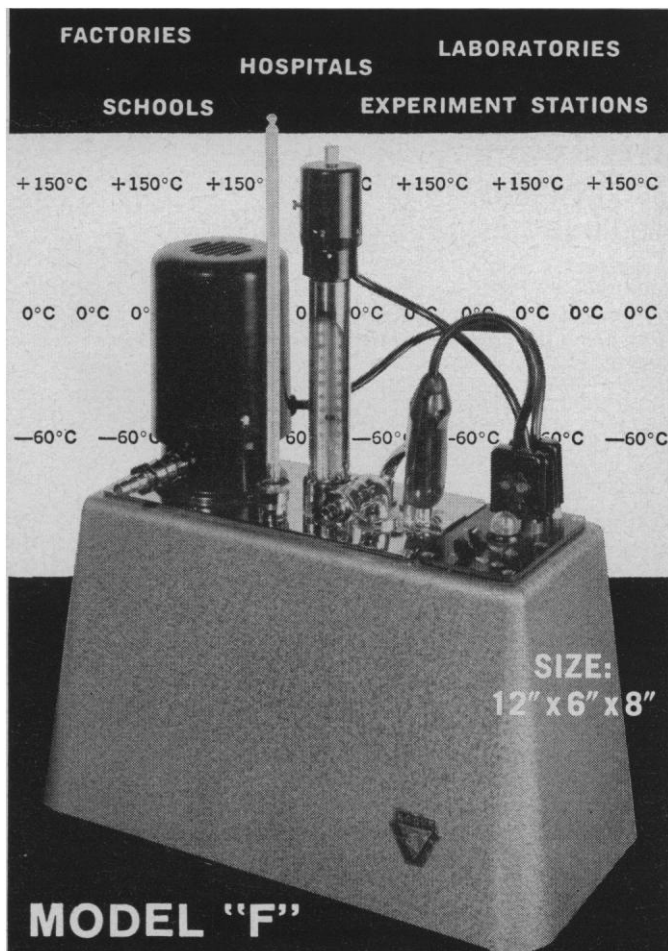
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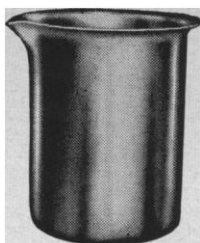
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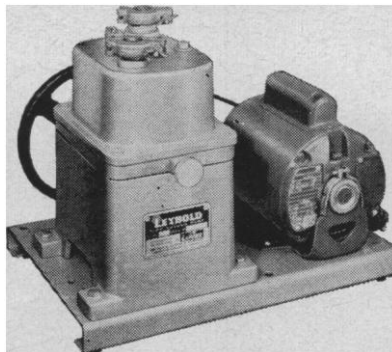
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■ **PLASMA FLAME SPRAY GUN** is said to be capable of applying coatings of any material that can be melted without decomposition. An electric arc and inert gases are used to produce temperatures said to be as high as 30,000°F. Nitrogen with 5 to 10 percent hydrogen is used to form the plasma. Both the gun body and nozzle are water cooled. (Metallizing Engineering Co., Dept. Sci530, 1101 Prospect Ave., Westbury, N.Y.)

■ **PROJECTOR PROGRAMER** is a modified slide projector that handles magazines of 40 slides each. A 12-bit photoelectric pickup device has been installed to read holes punched in the cardboard portion of standard 35-mm slides, permitting selection of 4096 binary codes. The magazine can be advanced or reversed by remote cable or by the output of a switching device controlled by the punched-hole reader. The device can accommodate programs 80 units in length if two magazines are taped together. (Davis Scientific Instruments, Dept. Sci533, 12137 Cantura St., Studio City, Calif.)

■ **PRESSURE SWITCH** combines a Ni-Span-C pressure capsule and a snap-action switch in a housing of less than 1 in.³ volume and with total weight slightly over 1 oz. Pressure setting is adjustable; ranges up to 200 lb/in.² are available. (Bristol Co., Dept. Sci534, Waterbury 20, Conn.)

■ **DIFFERENTIAL D-C AMPLIFIER** is said to provide stability of ± 0.05 percent. The transistorized amplifier operates with input and output isolated from each other and from ground. Common mode rejection is said to be 10^6 to 10^7 . Gain is variable in eight steps from 10 to 500. (Neff Instrument Corp., Dept. Sci540, 2211 E. Foothill Blvd., Pasadena, Calif.)

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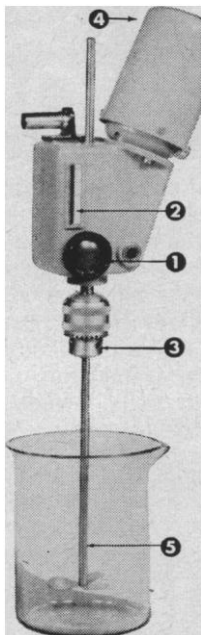
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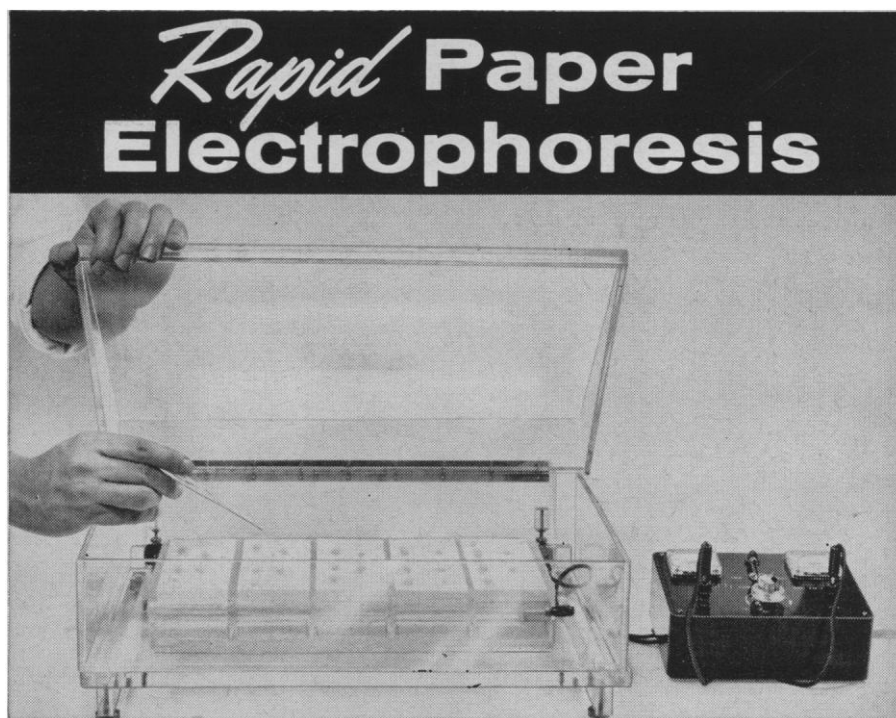
■ **COUNTER** furnishes both digital and analog readout for operating printers and chart recorders. The instrument includes two counting sections. The first, designed for data identification, counts to 10^2 and provides digital output and two analog outputs, 0 to 100 volts and 0 to 10 mv positive. The second section for 10^5 counts, provides digital output and one analog output 0 to 10 mv. A range selector switch permits full-scale range selection for 10^3 , 10^4 , or 10^5 counts. Resolution is 5 μ sec for pulse pairs. (Victoreen Instrument Co., Dept. Sci536, 5806 Hough Ave., Cleveland 3, Ohio.)

■ **TURNABLE CONTROL** for fraction-collection turntables permits them to be operated on either a time or volume basis. The control operates with a contactor actuated by air pressure from a calibrated siphon in which the fraction is being caught. The contactor actuates the turntable to move an empty test tube under the siphon. Siphons in any size from 1 to 100 ml can be used. Operation on a time base is accomplished by allowing the control siphon to fill from a constant-head Mariotte bottle while the fractions are caught directly by the receivers. (Organomation Associates, Dept. Sci537, P.O. Box 5, Shrewsbury, Mass.)

■ **DENSITOMETER** for photographed spectra is designed for comparing unknown spectra with master spectra and for measuring percentage transmission or density of spectrum lines. It accommodates both film and plates. Scanning in forward and reverse directions at four selectable rates is controlled by a foot switch. The instrument resolves lines 10 μ apart and provides horizontal and vertical magnifications of 15. Zero drift is said to be less than ± 0.2 percent, full-scale drift less than ± 0.5 percent, repeatability better than ± 0.5 percent, and scattered light less than 1 percent. Readings are recorded on a 9½-in. wide chart moving at 3 in./min. Reading speed is up to 6 lines per minute. (Applied Research Laboratories, Inc., Dept. Sci538, P.O. Box 1710, Glendale 5, Calif.)

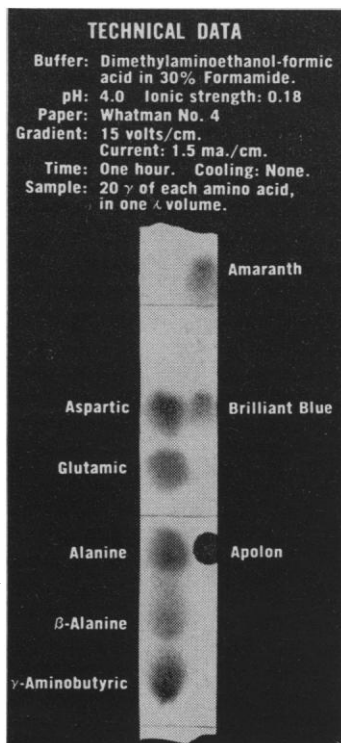
■ **EMERGENCY OXYGEN UNIT** that provides approximately 7 gal of gaseous oxygen measures 11-in. high by 3-in. in diameter and weighs 20 oz. Oxygen can be administered by pressing a button on the top of the container. A disposable face mask is included with the unit. (Linde Co., Dept. Sci544, 420 Lexington Ave., New York 17, N.Y.)

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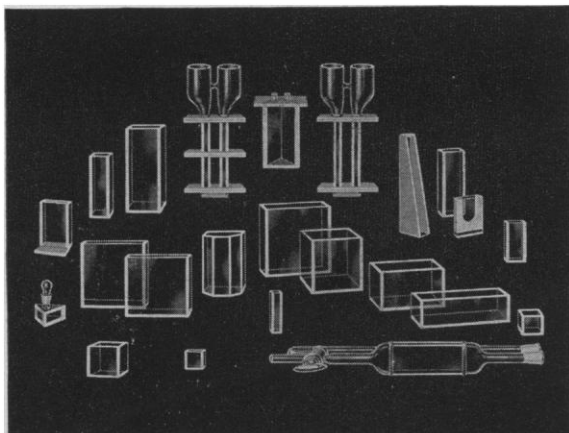
Misco will be happy to send you more information about rapid paper electrophoresis and a reprint of the Werum-Gordon-Thornburg article. Please address Dept. 98.

*Rapid Paper Ionophoresis Using Organic Buffers in Water-Formamide and Water-Urea. L. N. Werum, H. T. Gordon, W. Thornburg. *J. Chromatography* (in press).

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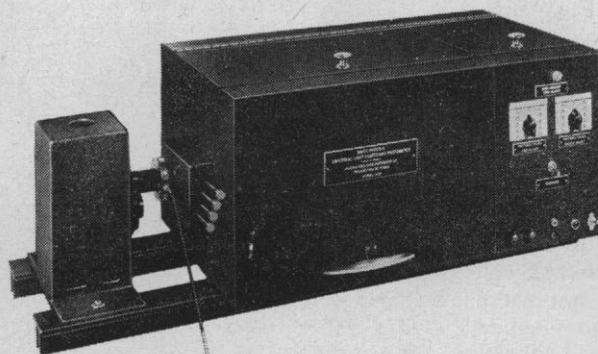


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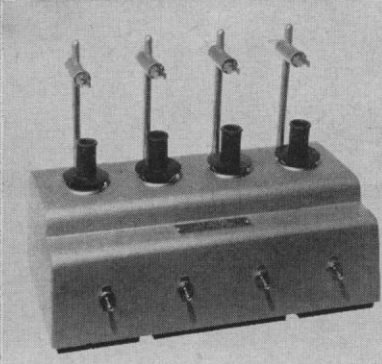
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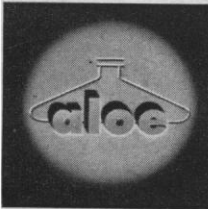
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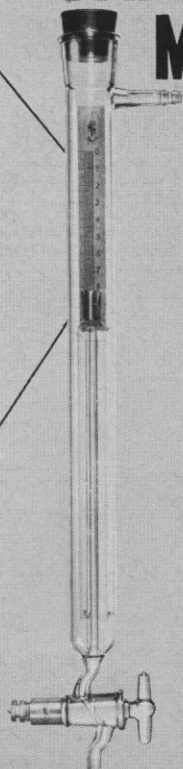
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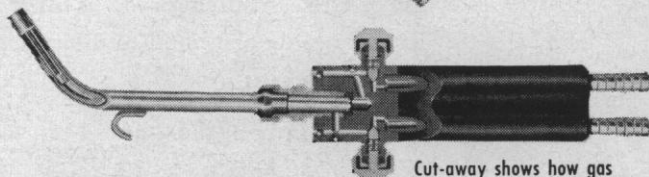
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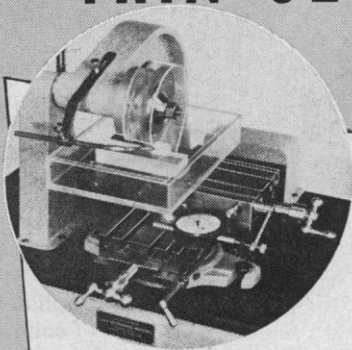
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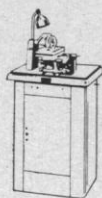
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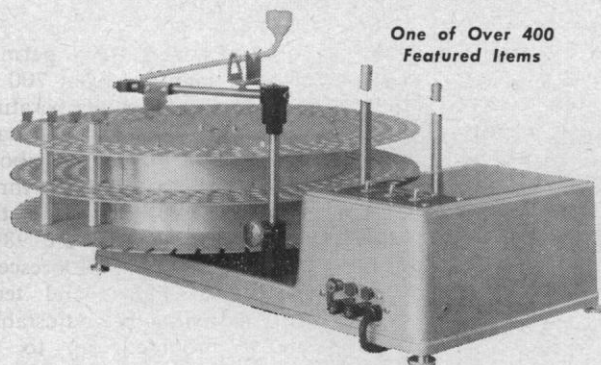
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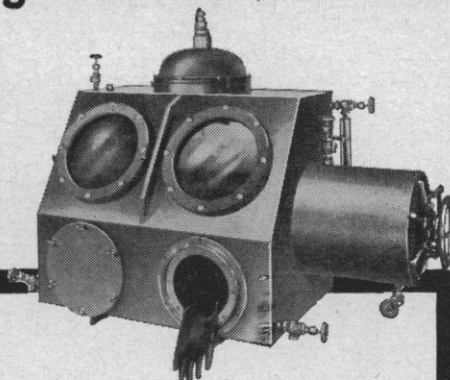
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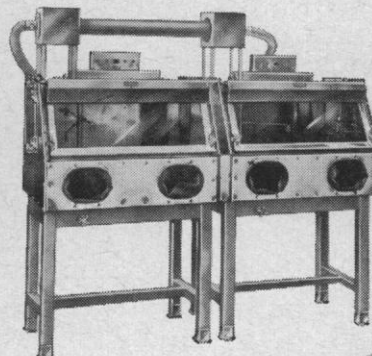
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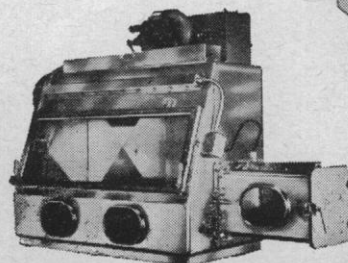
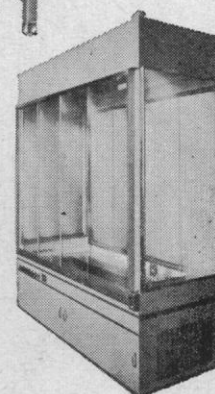


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■ **RELAY** designed for squib-firing applications operates on 28 volts d-c and delivers 50 amp for a period of 50 msec. Pickup time is said to be 4 μ sec and dropout time 20 μ sec with no contact bounce. Open-contact resistance is 5 megohms, and closed-contact resistance is 0.04 ohm. All components are solid-state types with no moving parts. Operating temperature range is -85° to $+257^{\circ}$ F. (Curtiss-Wright Corp., Dept. Sci549, Wood-Ridge, N.J.)

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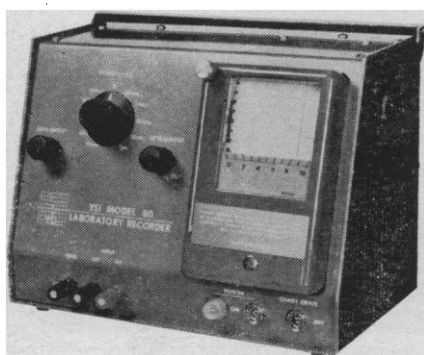
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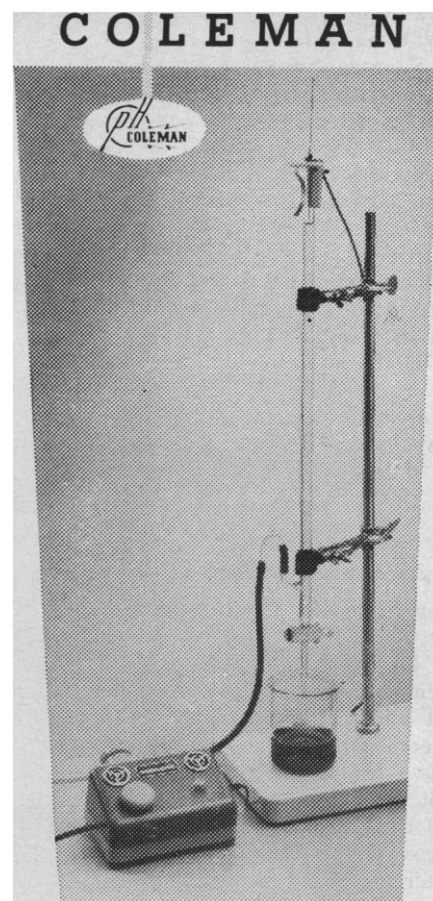
Small High Schools

James B. Conant concludes from his survey of the American public high school system that it is burdened with far too many small schools. He says, "The country over, something like a third of our youth are attending high schools that are too small. As a result, one of the most precious assets of our nation is being squandered—the potential talent of the next generation. It is almost impossible for students graduating from many of the small schools later to become members of learned professions [*The Child, the Parent and the State* (Harvard Univ. Press, Cambridge, Mass., 1959), p. 37]. . . . The elimination of the small high school through district reorganization and consolidation should have top priority" (*ibid.* p. 39). Conant's studies lead him to believe that comprehensive high schools with graduating classes of fewer than 100 students inevitably provide an inferior education.

Conant's analyses and arguments, which are based upon his observations of the curricula, the organization, and the staffing of high schools, seem reasonable. But considering how little we really know of the consequences of various educational practices and arrangements, one wishes for data on how students turn out. Some data on this point have come to hand in a recent issue of *Science*.

Harmon [*Science* 130, 1473 (1959)] in connection with another analysis of public high school graduates, reports data showing that 35 percent of the science doctorates awarded in 1957 and 1958 went to persons who had been educated in small high schools (schools with fewer than 100 graduates each year), and that 6 percent of the degrees were earned by the graduates of very small high schools (schools with fewer than 20 graduates each year). Statistics assembled by the U.S. Office of Education (*Statistics of Public Secondary Day Schools, 1951-52*) show that when most of these 1957-58 science doctors were graduating from high school, about 36 percent of all public high school students attended small schools, as defined above, and 5.5 percent attended very small schools.

Some estimation is necessary here, for Harmon reports class size and the Office of Education reports school size, and the time of graduation from high school of the 1957-58 doctors is not known with precision. The figures given are based upon 1946, the best estimate of the year of graduation for which data are available; the estimates would



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SCIENCE, VOL. 131

not be appreciably changed if data for 1938 were used.

At any rate, it seems clear that the number of science doctorates awarded the graduates of these small schools is in line with the total number of students educated in these schools. How can it be that the small high schools of 1946, that presumably possessed all the curricular, instructional, and material deficiencies said to go with smallness, produced their full quota of scientists in 1957 and 1958?

Is the situation different today?

ROGER G. BARKER

University of Kansas, Midwest
Psychological Field Station, Oskaloosa

Importance of Chinese for Scientific Communication

During recent years the number of scientific journals and the total volume of scientific literature published by the People's Republic of China appear to have increased considerably. Evidence cited by Wilson (1) on the magnitude of the effort in scientific education and research leads one to expect that the increase will continue. According to a sampling of journals received by the Harvard-Yenching Institute, Cambridge, Mass., the vast majority of Chinese scientific publications appear only in the Chinese language and normally are not translated. However, two journals published in Peking, *Scientia Sinica* by the Academia Sinica and *Science Record* by the Science Press, consist of papers in Western languages, principally English. These papers, representing various fields of science, often appear previously in other Chinese-language journals.

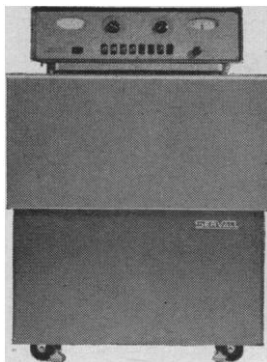
In view of the rapidly increasing importance of Chinese scientific literature it is desirable that some scientifically trained persons now begin learning to read scientific Chinese. Only when knowledge of the language is widespread can Chinese scientific progress be evaluated accurately. The task may soon be too great for exclusive reliance on the few American scientists who speak Chinese as their native tongue.

Most of the difficulties associated with learning to read scientific Chinese are not associated with the language itself and seem to reflect a lack of interest on the part of Western scientists. According to a study that I have made the following problems stand out.

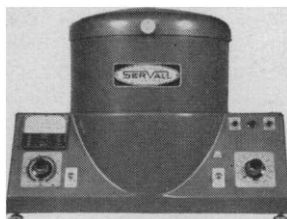
1) Because of present world unrest, publications of the People's Republic of China do not circulate freely in the United States.

2) No textbooks and selected read-

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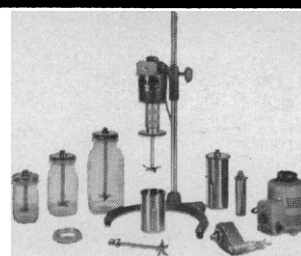


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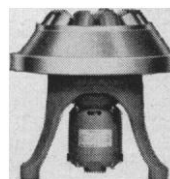
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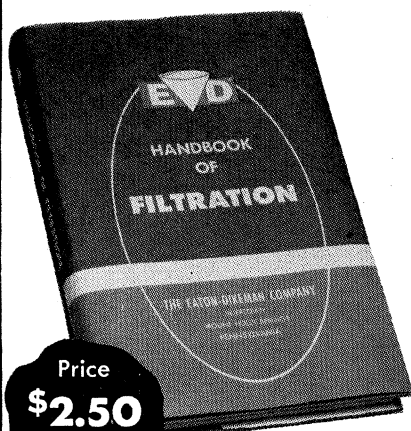
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ing materials specifically prepared as aids in learning to read scientific literature are yet available.

3) There appear to be no technical Chinese-English dictionaries, such as exist for German, French, and Russian. The existing specialized dictionaries of technical terms, intended mainly for those who speak Chinese, are not easily used by the Western student.

4) Class instruction in Chinese for the scientist is not currently offered by universities in the United States (the Massachusetts Institute of Technology is planning a course in scientific Chinese for September 1960).

Learning Chinese is not as insuperable a problem for the Western scientist as many tend to believe. The grammar of the language is simple; words are not inflected as in Western languages, and number, tense, case, and person are all indicated by the context. Furthermore, an active interest in teaching Chinese to Western students in nonscientific fields already exists, and much of this experience would be of value in the teaching of scientific Chinese. An increase in interest and an organized effort on the part of individuals aware of the growing need for scientists with a reading knowledge of scientific Chinese could overcome most of the problems.

JOHN W. WINCHESTER

Department of Geology and
Geophysics, Massachusetts Institute of
Technology, Cambridge

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1. J. T. Wilson, "Red China's hidden capital of science," *Saturday Review of Literature* (8 Nov. 1958); *One Chinese Moon* (Hill and Wang, New York, 1959); "Geophysical institutes of the U.S.S.R. and the People's Republic of China," *Trans. Am. Geophys. Union* 40, 3 (1959).

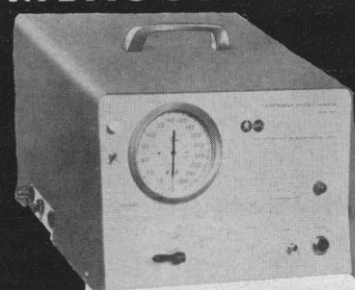
The Scientist and Moral Values

The two letters concerning animal research [*Science* 131, 263 (29 Jan. 1960)] by implication raise issues of fundamental importance to the role of science and to the respect it may claim in the world of tomorrow.

The first is a question one would like to see squarely answered: Are there any moral limits at all to animal experimentation? Or is it the responsible and considered opinion of today's biologists and psychologists that any experiment, no matter how cruel, is permissible as long as it is scientifically worth while?

The second is a scientific problem that has been surprisingly—and significantly—little investigated: that of the psychology of scientists. Who are the people who will choose lines of research leading them to ever more cruel and, to

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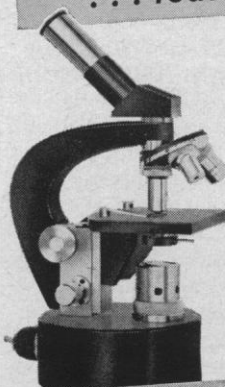
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an outsider, seemingly barbaric experiments? What are their motives and the conscious and subconscious satisfactions they derive from their work? What else would they be capable of doing if given the opportunity?

In the popular view of science, the scientist too often appears as a kind of impersonal superman, investigating with cold detachment, and with concern only for truth. But surely this is preposterous. The scientist as a human being is very much a part of the picture of science, and science cannot be adequately understood without an understanding of the scientist; this line of research has been surprisingly shunned by scientists themselves.

With respect to animal experiments, I venture the hypothesis that, as the intrinsic scientific value of experiments decreases and the cruelty to animals increases, a critical point is reached beyond which the driving force is no longer scientific curiosity but sadism pure and simple. "Research" becomes a legalized outlet for pathological drives. Placing no moral limitations whatsoever upon research is an open invitation for this.

If the scientific community were to condone this, it could only lead to justifiable distrust of scientists in the long run. Indeed, the great claims of science in the last analysis boil down to this: that science is a form of service to mankind. But the very idea of service to mankind is a moral ideal that is intimately linked with the whole of human morality, of which reverence for life is an essential part.

If, under the guise of science, that reverence for life were entirely discarded, the resulting moral debasement of scientists might well raise fears that, given the opportunity, they might turn against man himself in a sort of scientific folly. After all, it has already happened at least once: in Nazi Germany, where scientists performed "scientifically worth while" experiments on human beings they elected to consider "sub-human." In the modern world, scientists should not be the last to learn the lesson that, whenever the ends are thought to justify any means whatsoever, it is the means that will utterly corrupt the ends. Or, to put it in the words of a wise old Frenchman, Montaigne: "*Science sans conscience n'est que ruine de l'âme* (knowledge without conscience is nothing but the ruin of the soul)."

ALEXANDER WITTENBERG

Faculty of Science,
Laval University, Quebec, Canada

A recent exchange of letters on animal research left me puzzled. Can the painful problem of what constitutes proper animal experimentation be solved by the magic of words?

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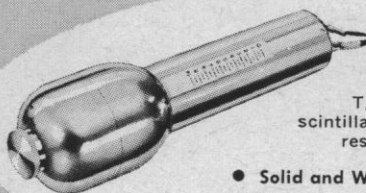


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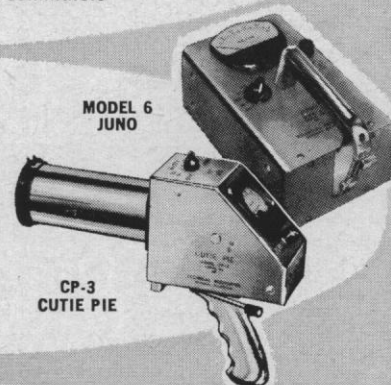
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R. B. Kelman objects on moral grounds to experiments published by V. H. Denenberg and G. G. Karas, in which animals were starved to death to measure their resistance to stress under certain conditions. Denenberg in his reply gives *relevancy*, *sensitivity*, and *precision* as his criteria in selecting a dependent variable. "Any variable which satisfies these demands is scientifically valid and may be used to study subhuman organisms." He points out that in starving animals to death survival time is a relevant dependent variable for measuring resistance to stress;

that it is precise, because the same general findings can be obtained on different occasions; and that it is sensitive, since it uncovered statistically highly significant differences between different groups of animals. He concludes that survival time is a scientifically valid measure of resistance to stress; that it is specific, since "it is based upon the preservation of life"; and he adds that to him his data are most interesting.

Denenberg's criteria for scientific validity are explicit and sufficient. They help one think up other valid experi-

ments to measure resistance to stress, such as immersion into chemically inert hot liquids. Unlike starvation, an all-or-none affair, thermal stress can be varied in degree. Survival time in total body thermal stress (TBTS) probably depends upon the degree of stress and the surface area of the animal, or, perhaps, a surface-volume relationship; one might get a family of curves for animals of different size when plotting survival time as a function of temperature. Simple refinements of these experiments might include a one-lead electrocardiogram, to show the combined effect of nonspecific stress and rising temperature on myocardial conductivity. Or the electrical activity of the brain could be recorded during these conveniently shortened (as compared to starvation) tests for resistance to stress; a simultaneous temperature curve of the cerebrospinal fluid obtained through a needle thermocouple in one of the cerebral ventricles would provide convenient arbitrary landmarks in the gradual transition from being into nonbeing. The brief survival time would lead to a greater number of experiments, improving their reliability and increasing efficiency in utilizing scientific manpower.

Such experiments would fully satisfy the stated requirements for scientific validity, yet one would not wish to maintain that boiling them alive in mineral oil is a proper way of testing resistance to stress in mice, rats, or other "subhuman" mammals. Our criteria let us down, for at least two reasons: they have no circumscribed meaning and they are not pertinent to the issue, which is a moral one. *Relevancy* of survival time in indicating resistance to stress is assured by definition; no matter what we do to shorten the life of our animals, survival time will remain relevant in measuring resistance to what we are doing to them. The same is true of *specificity*. *Sensitivity* and *precision*, as used in this context, can be interpreted rather broadly to fit almost any experiment in biology worth reporting; they do not describe the experiments as much as the frame of mind of the person talking about them. In general, applying such terms to one's own results amounts to little more than saying, "I like what I am doing," in different words. Admitting this in public is proper and may even have didactic value, but it is a pity to conceal an essentially noble message behind inappropriate words.

The problem of what constitutes humane experimentation on animals is painful and difficult, and most of us are reluctant to think it through. Like other moral problems, it probably cannot be solved by rules that are simple, consistent, and always uniquely applicable. Even if rules were set up they



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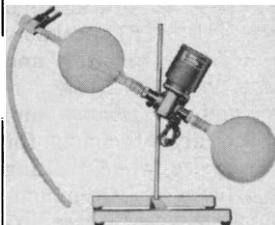


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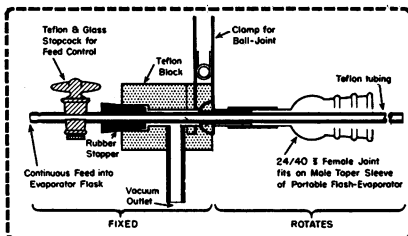


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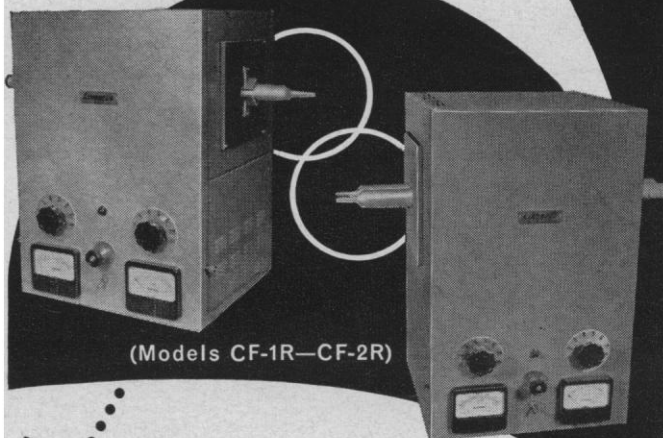


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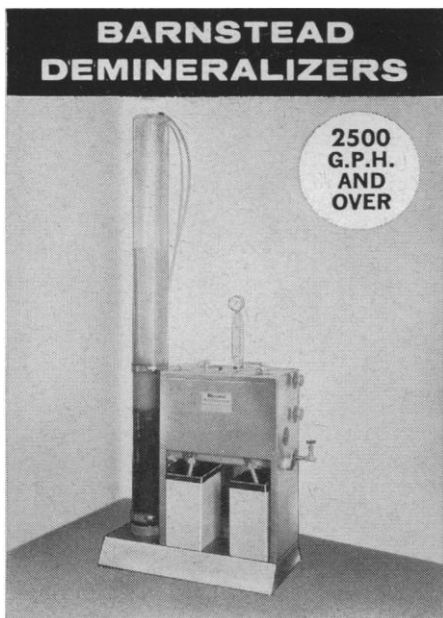
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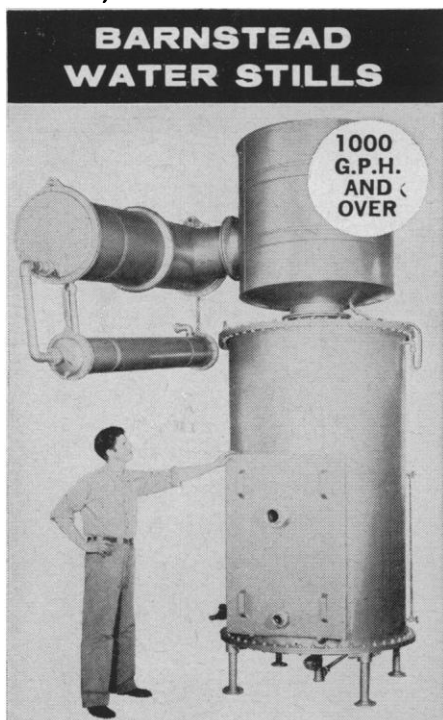
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would have to be interpreted in doubtful cases; ultimately it must be the scientist concerned who decides whether work he is about to undertake is sound intellectually and morally, and we had better select our scientists so that we can entrust them with such decisions. On occasion, a scientist may feel the need to show the rest of us his work as a source of excitement, delight, or inspiration, but the justification of what he is doing—its agreement with a given set of standards, scientific and moral—rests in itself; the record is all that is needed, and nothing else will do. Calling one's results relevant, sensitive, specific, precise, significant, and scientifically valid adds nothing to them.

STEVEN E. ROSS

2210 Jackson Street,
San Francisco, California

More about Nomenclature

I have just read K. E. Boulding's letter in [*Science* 131, 874 (1960)]. I don't think that it will be necessary to waste any space on the proposed astronomical classification since, like his "Bimbambim" it probably won't be used by anybody.

But I do wish to protest three statements: (i) that names like selenium, tellurium, or, for that matter, Rhynchocephalia are "unscientific"; the history of science happens to be a science too; (ii) that it is "fortunate" that most scientists are not acquainted with the "dead" languages from which nomenclature is drawn. I, for one, consider this most unfortunate, provided it were true; (iii) that the letter *x* cannot be used to begin a syllable. Boulding may have heard of St. Xavier at one time. To be more personal about it, my younger daughter is named Xenia, and even in grade school her classmates had no trouble learning the proper pronunciation, Ksay-niya.

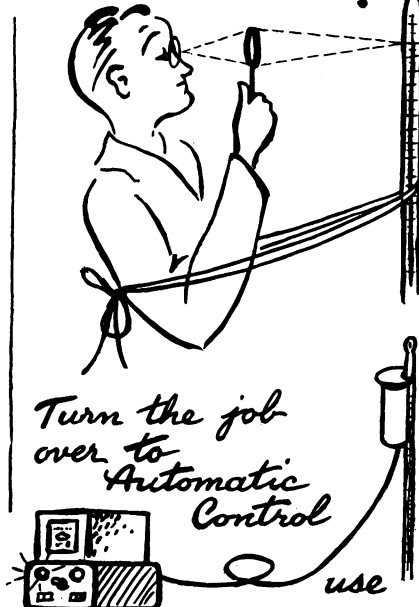
WILLY LEY

37-26 77th Street,
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As an old S-F fan I am flattered by Willy Ley's attention to my excursion into the grain-of-truth-among-chaff business. But the history of science is not science but History, an appalling mishmash of unrepeatable accidents, quite unfit company for the respectable readers of this journal. Selenium has nothing to do with the Greeks, the moon, or the metal, just as (to cover his second point) irony has nothing to do with Fe. And in a world in which so much information has to be carried in such little skulls, there is a real problem of Economy in language.

But I am sorry about *x*. It has always

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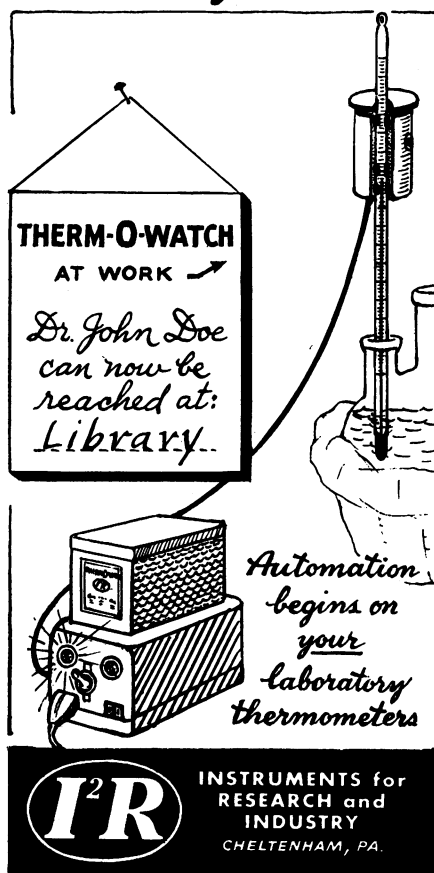


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