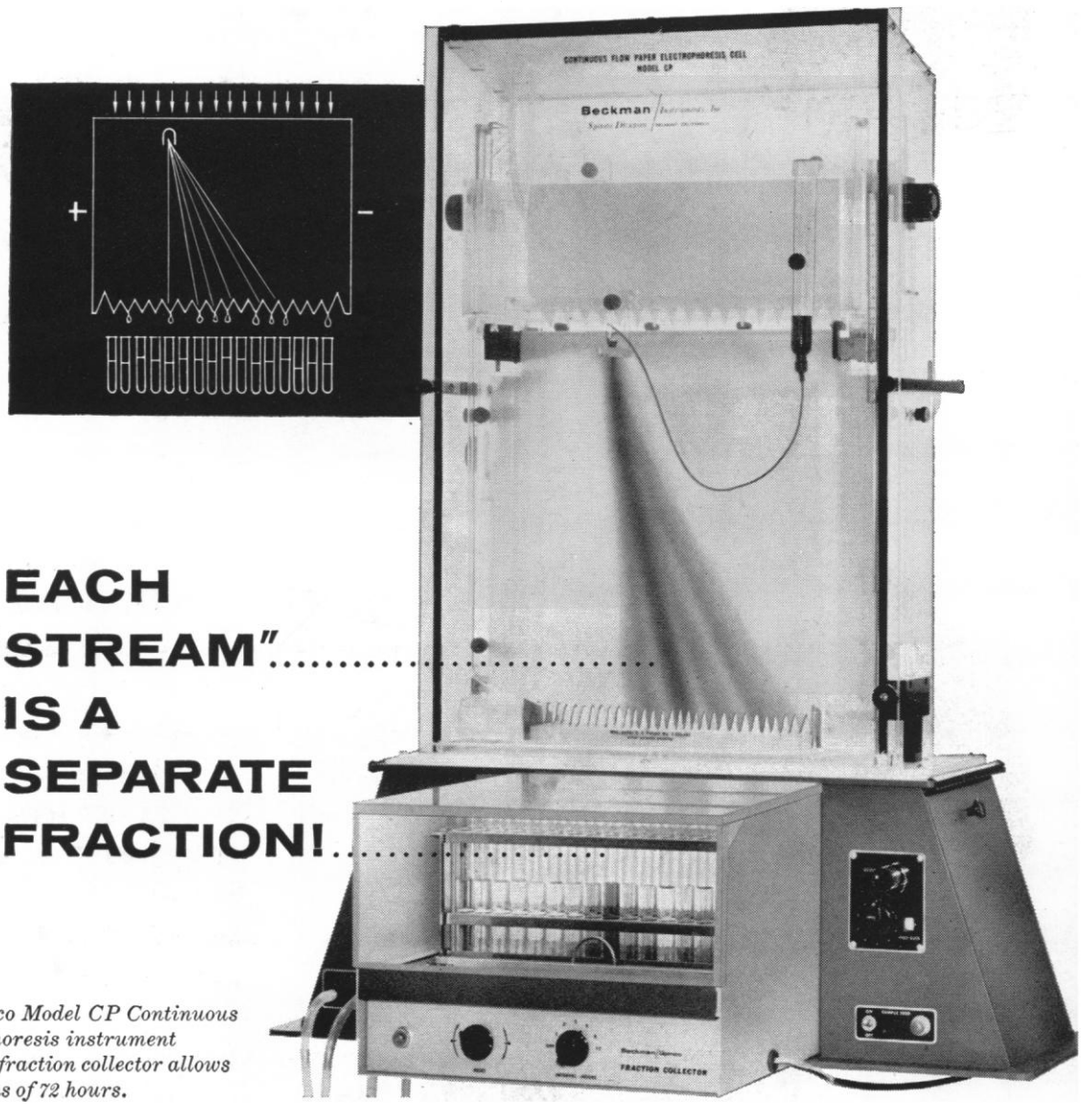
SCIENCE

22 January 1960
Vol. 131, No. 3395

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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☐ Please send me applications bulletin 6055 giving typical operating conditions and literature references.

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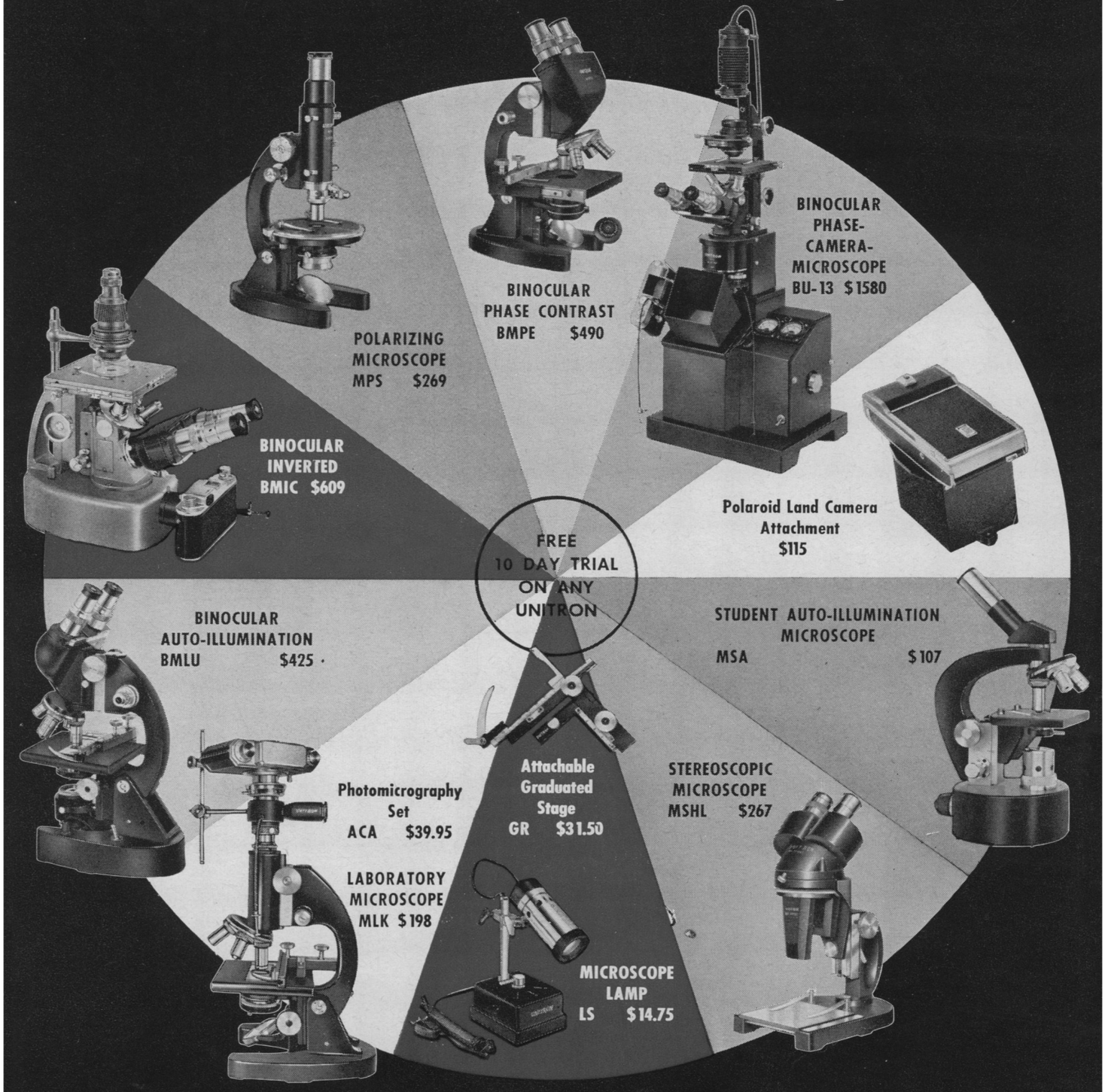

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22 January 1960, Volume 131, Number 3395

SCIENCE

Cover A Navajo weaver spins wool for a rug by a method employed for many centuries. Rug weaving continues to be important in the economy of the Manyfarms-Rough Rock area. See page 197. [Milton Snow, Bureau of Indian Affairs, Window Rock, Ariz.]

Photo courtesy Textile Research Center, School of Textiles, North Carolina State College, Raleigh, N.C.

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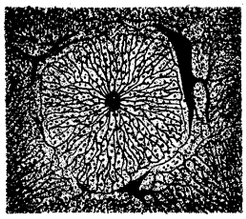
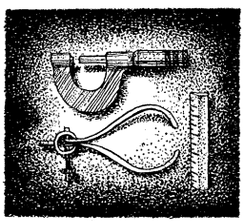
IT HAPPENED THIS MONTH...

a glance at yesterday in relation to today



IN JANUARY—(1930)—proof is offered of a glucose-lactic acid cycle involving liver and muscle. Glucose and lactate determinations were done on blood drawn from the femoral artery, femoral vein, hepatic artery, and portal vein of dogs at rest and during moderate exercise. The data suggest that lactate released into the blood stream by muscle is removed by the liver and converted to glucose. The glucose returns to the blood stream where it is again taken up by skeletal muscle.

Today we know that the ramifications of this cycle include many hexoses, hexose phosphates, and triose phosphates and related compounds. Most of these metabolic intermediates are available from Schwarz BioResearch. We also offer C^{14}-labeled glucose, mannose, ribose, ribose phosphate and yeast polysaccharides.



IN JANUARY—(1933)—Science reports the determination of the size limits of the gene, announced to the A.A.A.S. by Gowen and Gay of the Rockefeller Institute. Dividing the amount of chromatin (in Drosophila chromosomes) by the number of genes (as determined by the mutation rate) they calculate the maximum gene size as 10^{-18} cubic centimeters.

Current biochemical genetics is vitally concerned with nucleic acids and nucleoproteins. Schwarz BioResearch offers a full line of nucleic acid compounds: DNA, RNA, nucleate salts, nucleotides, nucleosides, purines and pyrimidines, pentoses and pentose phosphates. Many of these have been radiolabeled.

IN JANUARY—(1959)—Lockart and Eagle[3] point out that "nonessential" amino acids are indispensable for the growth of certain human tissue cells *in vitro*. A medium containing only the "essential" amino acids was inadequate to support growth of monolayer cultures of HeLa, HeLa-S_3, conjunctiva or KB cells derived from suspension cultures. The nutritional deficiency could be overcome by adding seven amino acids, including serine, ordinarily not nutritionally essential. In most of the experiments, serine alone was sufficient.

If you are also working with amino acids, you may be interested in the Schwarz Kit of 18 optically standardized natural amino acids. You are assured of reliability and convenience when using this Kit for primary standards in chromatography, microbiological assay and other precise research or instructional purposes. Also available are bulk quantities of optically standardized amino acids for nutritional studies and for use in production. We also supply 16 amino acids labeled with C^{14}, 15 labeled with N^{15}, and S^{35}-labeled L-cystine, L-methionine and glutathione. Write for our most recent catalog and price list.

1. Himwich, H. E., Koskoff, Y. D. and Nahum, L. H.: Studies in carbohydrate metabolism I. A glucose-lactic acid cycle involving muscle and liver. J. Biol. Chem. *85*:571 (Jan.) 1930. 2. Science News: Science *77*:8 (Jan. 6) 1933. 3. Lockart, R. Z., and Eagle, H.: Requirements for growth of single human cells. Science *129*:252 (Jan. 30) 1959.

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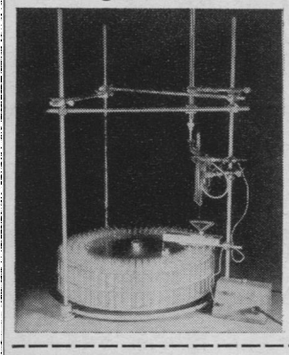
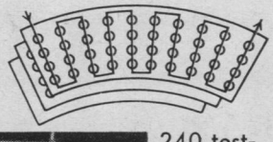


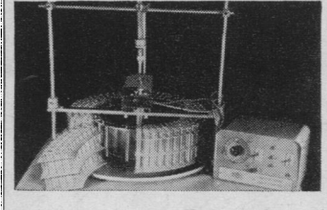
240 test-tubes, 18 x 150 mm.

Four rows of 60 each.

Turntable, 24″ diameter.

SECTIONAL . . . for processing during fraction collecting.



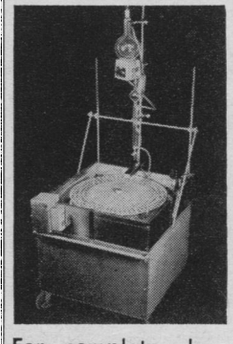


240 test-tubes, 18 x 150 mm.

40 test-tubes in each of six sections.

Turntable, 24″ diameter.

REFRIGERATED . . . the mobile cold-room, refrigerated from column to collecting tubes.



On casters.

Glassware and turntable temperature-controlled.

Fraction collectors removable for all-purpose cold-room work.

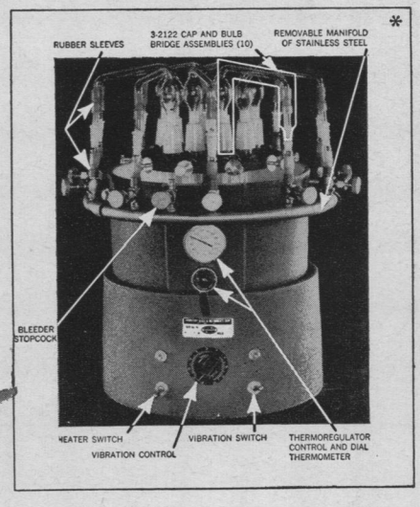
For complete description of all Fraction Collector models, write for Bulletin 3-4000

EVAPORATE MULTIPLE FRACTION CUTS DIRECTLY FROM TEST TUBES IN 10-20 MINUTES!

New!

Rotary Evapo-Mix

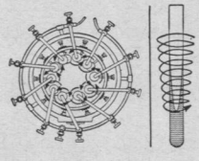
For the rapid and simultaneous evaporation under controlled temperature and vacuum of samples collected from a chromatographic column, centrifuge tubes, or by solvent extraction.



*

FEATURES

- Controlled circular vibration creates deep swirling to prevent "bumping" during heating under vacuum.



vortex created by eccentric motion of unit

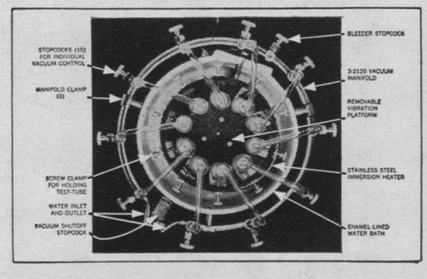
Arrows indicate eccentric motion of unit

- Internal variable voltage transformer controls vibration rate.
- Simultaneously evaporates 10 test tubes or centrifuge tubes, 16-25 mm diameter.
- Connects to efficient water aspirator as vacuum source.
- Automatic thermoregulator controls temperature of water bath.
- Price complete **$436.00**

With the Rotary Evapo-Mix it is possible to achieve in a single test tube evaporation rates of water of 1.0 ml/min; ethonal, 4.2 ml/min; methonal, 4.5 ml/min; ethyl acetate, 7.2 ml/min; and for acetone 10.0 ml/min; with all 10 test tubes attached, evaporation rate decreases approximately 25%.

* Vacuum Manifold only, made of pyrex-brand glass also available.

Request Bulletin 3-2100 for complete details.



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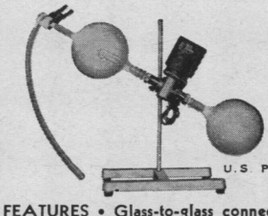
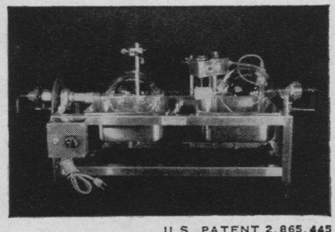
For the evaporation of aqueous solutions, high boiling point solvents, strong acids, alkalis and radiactive materials without contaminating back-drip.

PORTABLE MODEL



U.S. PATENT 2,865,445

FEATURES • Glass-to-glass connections throughout the evaporating system prevent any possibility of contamination. Distillation occurs only within glass. • Balanced design permits smooth rotation without drag and larger output without loss of material. • High torque, totally enclosed motor. • Build it up with accessories for large scale work and temperature control. • Grows with your requirements. • Unit can be easily taken apart for cleaning. • Prices start from $129.35. Basic unit not illustrated.



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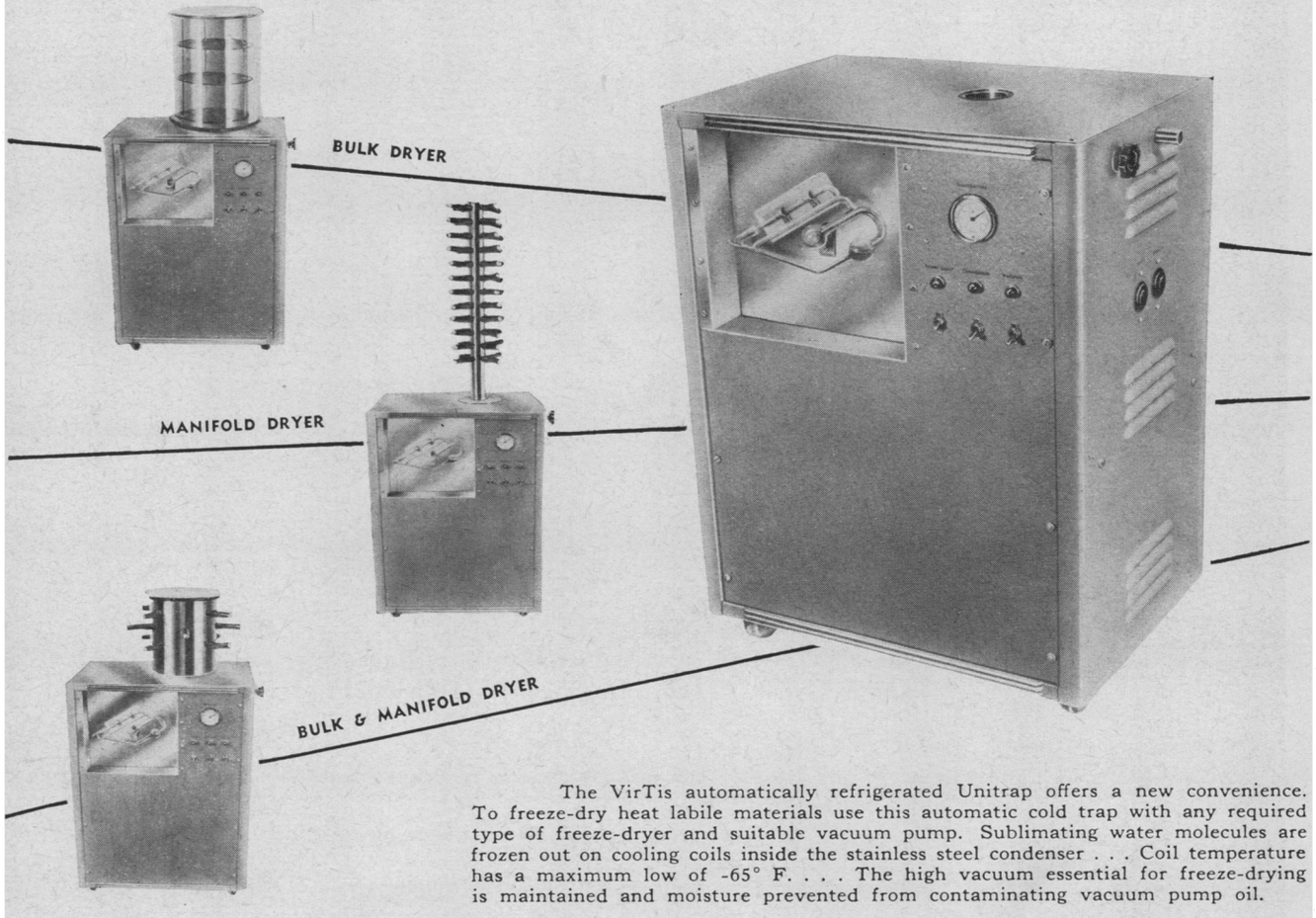

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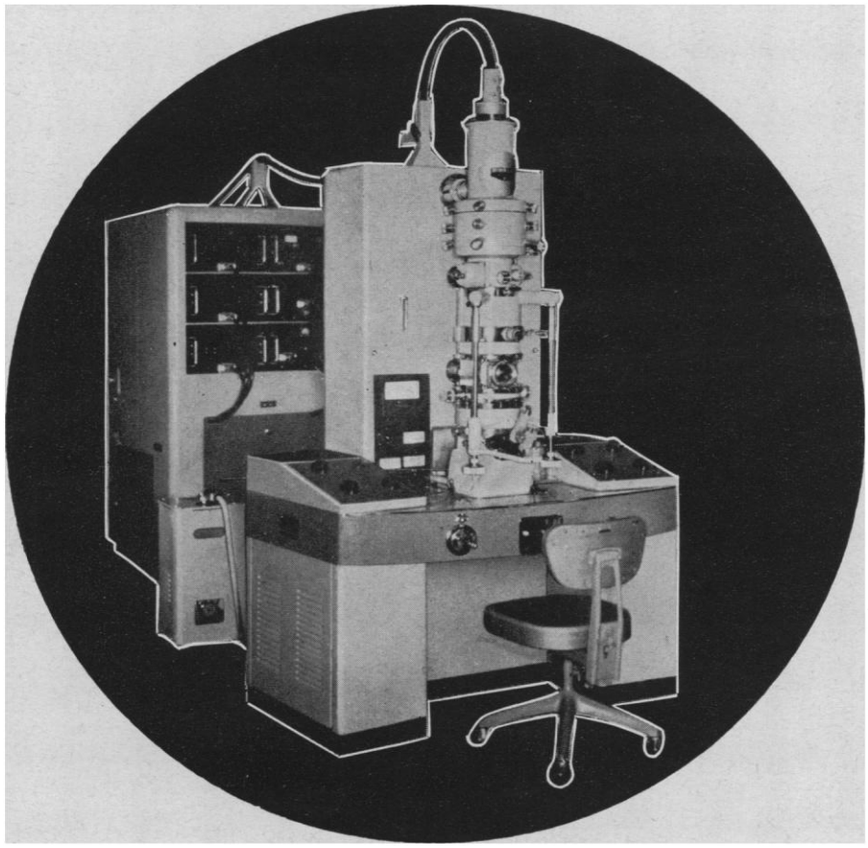

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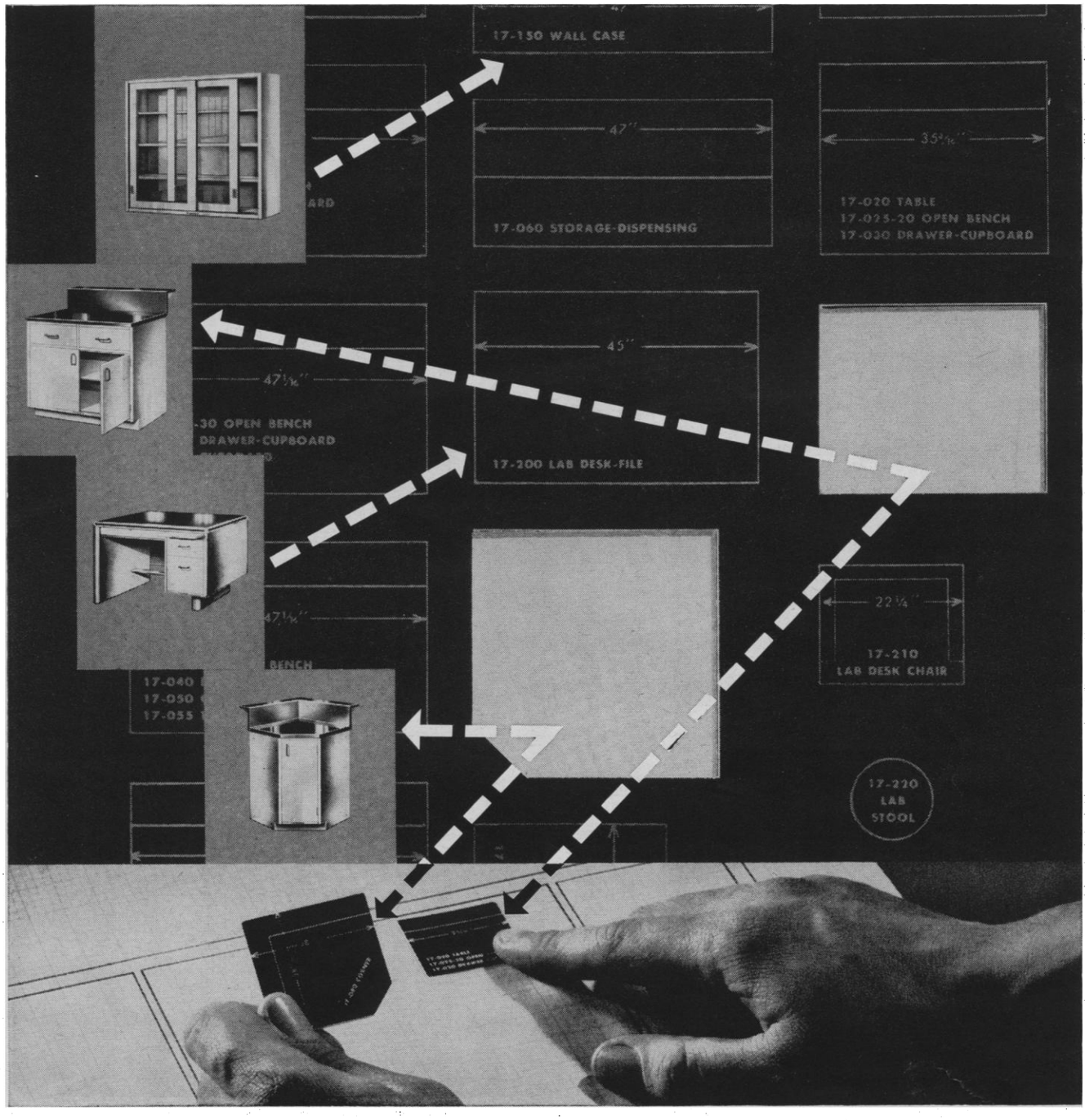
Tokyo Japan



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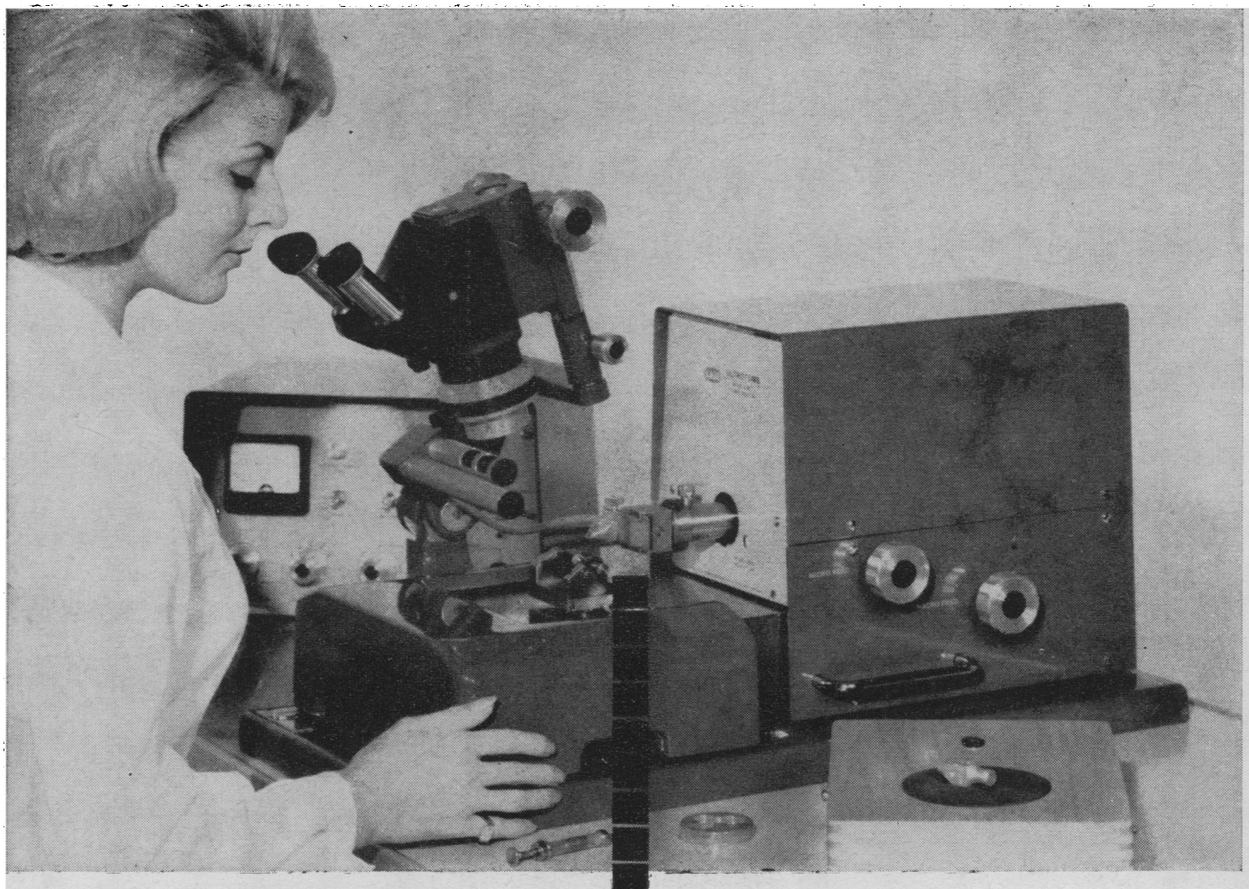

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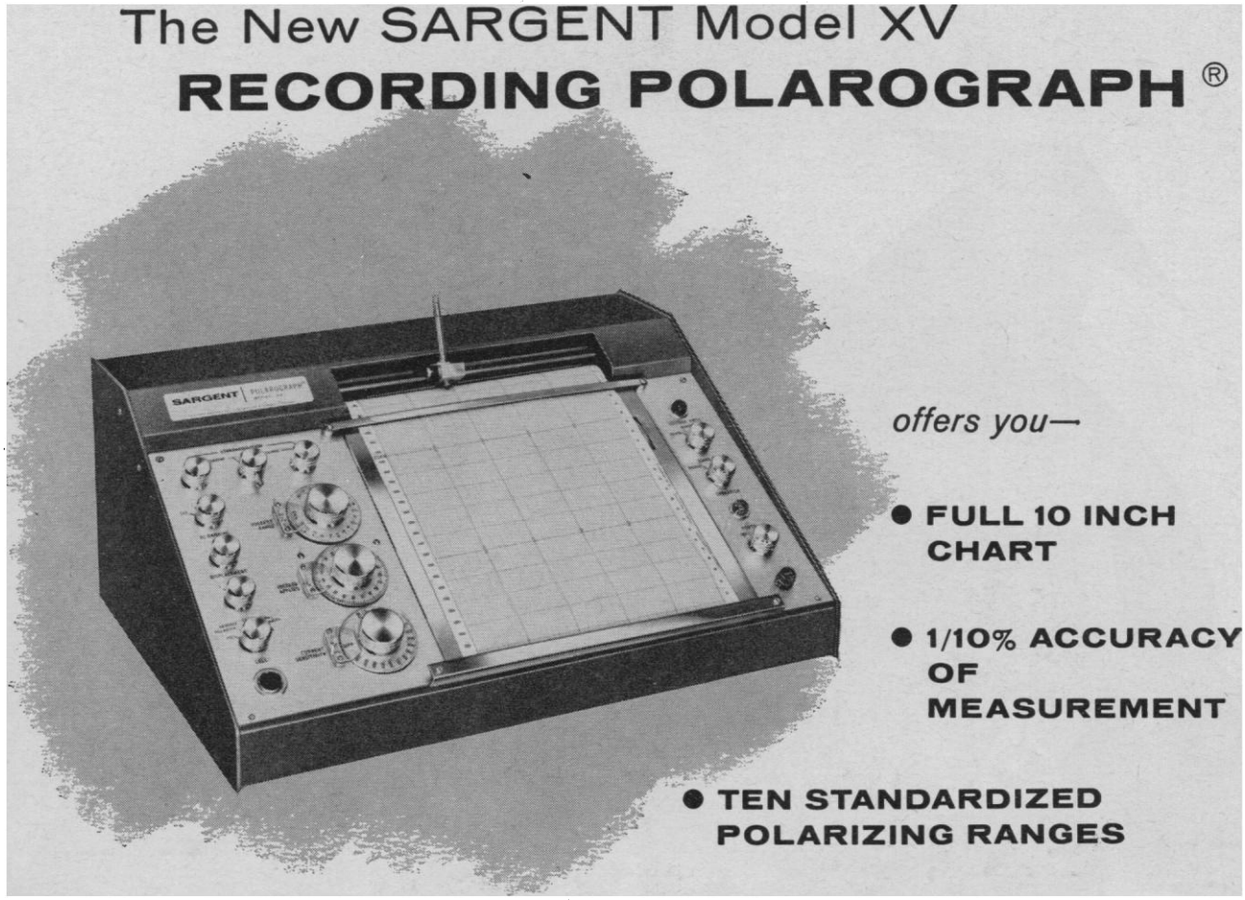

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It offers you optimum specifications based on over twenty years of leadership in design, manufacture and service in this specialized field of analysis.

The polarographic method is capable of reproducibility to 1/10% and analytical accuracy to ½%. To make use of this facility, the instrument must be accurate to 1/10% and chart space must be provided for recording large steps to achieve measuring precision. We strongly advise against the purchase of any polarographic instrument using miniature (5 inch) charts and low gain balancing systems in the 1% order of precision.

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Current Ranges:	19, from .003 to 1.0 μA/mm.
Current Sensitivity:	standard specifications, 10^{-4}μA/mm.
Polarizing Ranges, volts:	0 to −1; −1 to −2; −2 to −3; −3 to −4; +.5 to −5; 0 to −2; −2 to −4; +1 to −1; 0 to −3; +1.5 to −1.5.
Balancing Speed:	standard, 10 seconds; 1 second or 4 seconds optional.
Bridge Drive:	synchronous, continuous repeating, reversible; rotation time, 10 minutes.
Chart Scale:	current axis, 250 mm; voltage axis, 10 inches equals one bridge revolution.
Current Accuracy:	1/10%
Voltage Accuracy:	¼%
Chart Drive:	synchronous, 1 inch per minute standard; other speeds optional.
Writing Plate:	10½ x 12½ inches; angle of slope, 30°.
Standardization:	manual against internal cadmium sulfate standard cell for both current and voltage.
Damping:	RC, four stage.
Pen:	ball point; Leroy type optional.
Suppression:	zero displacement control, mercury cell powered, 6 times chart width, upscale or downscale.
Potentiometric Range:	2.5 millivolts, usable as general potentiometric recorder.
Finish:	case, enameled steel; panels, anodized aluminum; writing plate, polished stainless steel; knobs and dials, chromium plated and buffed.
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22 January 1960, Volume 131, Number 3395

SCIENCE

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Metric versus English Units

The metric system has some undoubted advantages over the English system of weights and measurement. Generation after generation of school children would find it easier to learn and easier to use. Scientists prefer it; among the small number of self-selected respondents to an American Geophysical Union questionnaire, 90 percent consider a change to metric units desirable, and 68 percent believe the change inevitable. They may be right, but conversion would pose a complex problem of balancing some attractive gains against some serious disturbances and losses. How much time saved in learning and using the simpler system is worth how much cost in plant conversion, dual inventories, and difficulties of abandoning a system deeply entrenched in milk bottles, machine tools, land titles, textbooks, boxcars, store scales, and in replacement parts for countless items built to English unit specifications?

Several recent attempts to balance the gains against the losses have resulted in different conclusions. Some countries have converted to the metric system. A New Zealand parliamentary committee has recommended decimal coinage and urged that if that recommendation is adopted it be followed by a study of decimalization of all weights and measures. A committee of the British Association for the Advancement of Science has studied the matter for over two years without deciding what to recommend. A committee of the American Geophysical Union recommends compulsory adoption of the metric system by the end of a transition period of 33 years, one generation. The AAAS Committee on Metric Usage has recorded its opposition to compulsory conversion. These different groups have obviously given different weights to the arguments pro and con.

Some aspects of conversion would be comparatively simple. Quart bottles could be retired in favor of liter bottles, and householders could learn with relative ease to buy meat and potatoes—and to watch their own weight—in kilograms instead of pounds. Similarly, some industries could switch fairly readily, as a good proportion of the chemical and pharmaceutical industries have demonstrated.

In other fields conversion would be difficult. Until the furnace and the plumbing system wear out, householders will need nuts, bolts, pipe fittings, and repair parts measured in English units. Manufacturers of machine tools, printing presses, and other durable equipment would have to provide dual inventories, or, if they did not, would antagonize customers and invite competitors to step into the market they had abandoned.

Following close on the heels of the basic question of balancing the gains against the costs are other questions. Should the U.S., the U.K., and the British Commonwealth act in unison, or reach their own decisions independently? If a change is made, should it be mandatory, and if it is not mandatory will it ever be made? Should the rest of the nation subsidize those segments of industry that will incur the heaviest transitional costs? Is there coming to be sufficiently good agreement on other units, for example, an inch of exactly 2.54 cm, that the advantages of the metric system are no longer as great as they once were? Does the widespread interest in science make the present a particularly good time to start? Advocates on both sides of the basic issue may soon have an opportunity to advance their arguments, for Congress may this year call for a thorough study of the problems and the advantages of adopting the metric system.—D.W.

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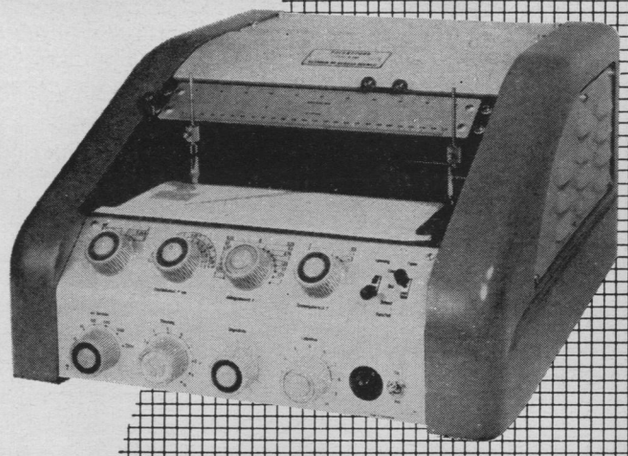

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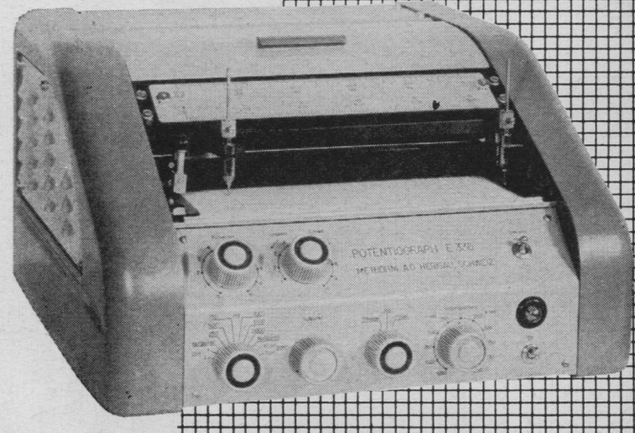

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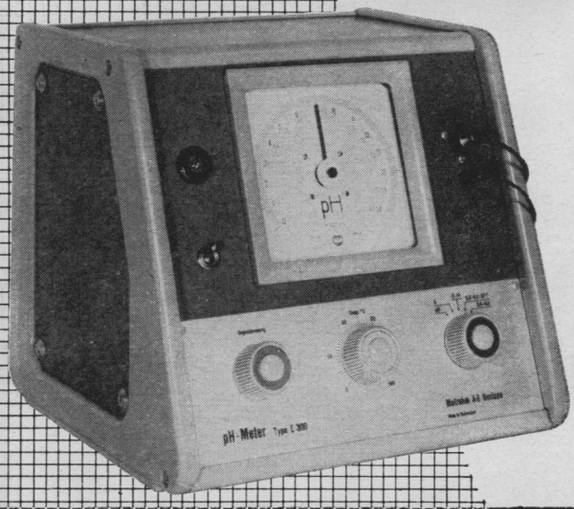

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PHILADELPHIA CLEVELAND HOUSTON MIAMI

Letters

Assessment of Fallout Hazards

J. Gordin Kaplan's very readable letter [*Science* **130**, 728 (1959)] raises some interesting points concerning possible effects of fallout Sr^{90}. Kaplan mentions our studies on high-radium water and bone tumors in the Midwest. There is a preliminary report on this by one of us [L. D. Marinelli, *Am. J. Roentgenol.* **80**, 729 (1958)]. It is now established that some hundreds of thousands of persons have subsisted on water exceeding the maximum permissible Ra^{226} level for large populations, and several thousand, on water with a Ra^{226} content above five times that level.

No areas of significantly increased prevalence of bone tumors related to this exposure have as yet been observed, or can be detected in vital statistics as reported over the past 15 years. Final results of our bone-tumor survey cannot, however, be reported for some time, since it requires careful checking of all cases to rule out such major artifacts as diagnostic errors and areas of occupational and medical overexposure which may affect determination of the true incidence of this rare disease.

We would like to call attention to what is apparently a serious error of fact. Kaplan has suggested "studying" data from Russian reports cited by Engström *et al.* [*Bone and Radiostrontium* (Wiley, New York, 1957), p. 133] which indicate that dogs injected with 0.0001 μc of Sr^{90} per gram developed osteosarcoma 3 years later. We have indeed made a study of this remarkable citation, and it appears that it embodies an error: the dosage given is too low by a factor of about 1000. Our own experience would indicate that this degree of tumor response is characteristic of dosages of about 0.1 μc of Sr^{90} per gram. This is corroborated by published Russian reports [*Summaries of Papers presented at the Conference on Remote Consequences of Injuries Caused by the Action of Ionizing Radiation* (State Medical Literature Press, Moscow, 1956)] and by more recent Russian reviews of the subject [N. A. Kraevsky, *Blastomogenic Effects of* Sr^{90} (Ministry of Health of the U.S.S.R., Moscow, 1958)]. In our own laboratory, injection of 0.01 μc of Sr^{90} per gram in three dogs has induced no tumors, nor in fact has it induced any visible changes in bone structure after 12 years.

The most likely source of this error is the paper of E. V. Erieskova (in the *Summaries* cited above), which describes bone sarcoma in dogs receiving radiothorium (Th^{228}) in dosages of 0.0001 μc/g. This agrees with data obtained by the University of Utah Atomic Energy Project. Radiothorium may be expected, on a basis of microcuries injected per gram, to be between 60 and 600 times as toxic as Sr^{90}. The former figure takes into account only total energy release within the bone; the latter includes consideration of the relative biological effectiveness of alpha particles and the fact that deposition is concentrated in areas of active cellular growth. Another possible source of error might lie in the fact that a translator not versed in the subject could confuse millicurie (мкюри) with microcurie (мккюри). In any case the citation seems to be apocryphal and erroneous.

While a number of other points might be made, one other seems particularly worthy of being brought to Kaplan's attention. The data cited, which indicate that concentrations in "hot spots" in bone and concentrations in other or average areas differ by a factor of 40, are derived from observations where there has been a single injection of isotope. This factor naturally disappears (or nearly disappears) where exposure occurs throughout a major proportion of the individual's life-time, including infancy, since Sr^{90} is laid down along with normally deposited calcium, in more or less proportional amounts. In this case, hot spots are not observed.

AUSTIN M. BRUES
HARRY AUERBACH
L. D. MARINELLI
Argonne National Laboratory, Lemont, Illinois

J. Gordin Kaplan deplores the assessment of fallout danger issued by the General Advisory Committee of the Atomic Energy Commission. He urges the committee to consult a biologist, but his letter contains evidence of such serious deficiencies in his understanding of radioactivity that it does not encourage one to place confidence in the advice of the biologist. For example, he argues that radiation reaching the body from outside is largely irrelevant to the subject of potential dangers from fallout, and he uses the childish analogy of comparing throwing rubber balls at a person to a person's swallowing a ball.

He seems unaware of the fact that cosmic rays penetrate the body and leave a trail of ions all along the path they traverse, and that they penetrate many times more tissue than the weak beta particles from Sr^{90}. Consequently the cosmic-ray background is exceedingly pertinent to an assessment of the dangers from radioactivity, and the fact that the inhabitants of Denver do not show a higher incidence of leukemia and other cancers than the inhabitants of New York, although the Denverites are exposed to 60 percent more cosmic

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radiation, is strong evidence supporting the argument that a linear proportionality does not exist between biologic injury and radioactivity in the range of natural intensities.

Kaplan also seems to be ignorant of the importance of K^{40}, which is naturally radioactive, emits a more energetic beta particle than Sr^{90}, and is present in the body in such quantities that the average adult body experiences about 200,000 K^{40} disintegrations per minute. It is responsible for about one-third of the total background radiation taken into consideration by the General Advisory Committee.

Kaplan further makes the mistake of equating 1000 r at microscopic hot spots with 1000 r of total-body radiation. This kind of large error in quantitative reasoning is not uncommon among biologists. Many students of aquatic ecology, for example, count the numbers of organisms per liter of water without estimating their body mass. Thus, they attach the same importance to a *Chlorella* cell, with a volume of 50 μ^3, that they attach to a *Ceratium* cell, with a volume of 100,000 μ^3.

Finally, Kaplan selects a single experiment, which purports to demonstrate that 1 μc of Sr^{90} caused bone cancers in dogs, and places so much confidence in it that he says this concentration is "known to cause cancer in dogs." He ignores the principle that experiments should be reproducible—that until several laboratories have verified these results we cannot say that 1 μc of Sr^{90} is "known to cause cancer in dogs."

Until we biologists display more wisdom in our interpretation of the hazards of radioactivity than is displayed in Kaplan's letter, we can hardly urge the General Advisory Committee to seek our advice.

JACOB VERDUIN
Biology Department, Bowling Green State University, Bowling Green, Ohio

The first of the three points made by Brues, Auerbach, and Marinelli in their interesting comment concerns their studies on the relation between Ra^{226} in the water supply and in bone of human beings on the one hand and induction of bone cancer on the other. The statement of the General Advisory Committee of the Atomic Energy Commission about which I recommended caution was that "the amount of strontium-90 which has been found in food and water is less of a hazard than the amount of radium normally present in public drinking water supply in certain places in the United States."

Now, there is evidence that Sr^{90} in the food of human beings quickly approaches equilibrium with that in human bone (*1*). The increase in Sr^{90} concentration in human bone seems roughly to parallel that in the diet: from midyear 1955 to midyear 1957, the mean concentration of Sr^{90} in the diet (North America and Western Europe) has risen 1.8 times, and that in human bone has risen about 1.6 times during the same period (*2*). Kulp *et al.* have shown that it is possible to predict with considerable accuracy the skeletal levels of Sr^{90} from dietary concentrations (*2*, Fig 2). With respect to radium, the sparse data presently available do not seem to permit one to conclude that the situation is the same. Data cited by Marinelli (*3*, Fig. 1) show that the range of variation for the Ra^{226} skeletal burden in man is roughly 20 times less than the corresponding variation in the Ra^{226} concentration in drinking water. Indeed, within the range of 0.01 to 0.1 $\mu\mu$c of Ra^{226} per liter of drinking water there seemed to be no corresponding significant variation whatever in skeletal burden for this isotope. Further, Marinelli cites data showing that the mean skeletal burdens of Ra^{226} in the Illinois communities of Joliet, Aurora, and Elmhurst are about 15 times the mean skeletal burden in Chicago, but that the water supplies of the first three communities have about 150 times the concentration of Ra^{226} that the water supply of Chicago has.

Hence, I repeat that "we had better treat . . . with suspicion" all statements citing high radium and thorium levels in the human diet as reassuring evidence of the harmlessness of radiostrontium.

My letter concluded with an argument concerning the possible hazards from the Sr^{90} levels in human bone likely to result from nuclear-test explosions already completed. This argument included reference to Russian experiments on induction of osteosarcomata in dogs by low levels of Sr^{90}, which had been cited by Engström *et al.* (*4*). I am very grateful to Brues, Auerbach, and Marinelli for pointing out that the citation was erroneous; let me add, by the way, that I am considerably relieved, as well. I stated that I was putting forward the argument "in order to solicit a refutation"; this Brues and his colleagues have provided, and I should like therefore to withdraw the argument.

With respect to their final point, one should point out that the absence of "hot spots" in what Björnerstedt and Engström (*5*) call chronic conditions of Sr^{90} poisoning does not necessarily imply that this substance has a completely homogenous distribution in bone. Under these conditions, the Swed-

ish authors point out that "the Sr^{90} concentration may be expected to vary from the average by a factor of about 2 for the 15 year period and by successively larger factors for longer periods." As for the present situation, they state that "today the Sr^{90} contamination of the geosphere and the biosphere is steadily increasing. This corresponds to a situation with aspects that lie somewhere between those of acute and chronic Sr^{90} poisoning conditions. Children in the 0- to 5-year age group are examples of individuals with chronic poisoning conditions. Adults above 20 years of age are more likely to be examples of acute poisoning."

Detailed consideration of Verduin's letter is supererogatory, as it seems largely irrevelant to my own. However, his errors must not be allowed to pass unchallenged. In the recent summary analysis of hearings, the Joint Committee on Atomic Energy stated: "As in 1957, testimony at the 1959 hearings indicated that strontium-90 and cesium-137 are still considered to present the greatest hazard in worldwide fallout . . . But short-lived isotopes, such as Sr^{89}, I^{131}, Ba^{140}, Zr^{95}, and others, were described by several witnesses as worthy of more consideration or as being even potentially as hazardous as Sr^{90} and Cs^{137}" (*6*). My letter stated that "the principal dangers . . . to the human race from fallout stem from the decay of the radioactive fallout material after it has been taken into the body and incorporated within certain cells and tissues." This statement is correct; it is nonsense to bring up cosmic rays and naturally occurring K^{40} in this connection, as they obviously have nothing to do with the matter.

We might have been spared the little lecture on "aquatic ecology" had I stated that the 1000 rads was the approximate dose received by the lungs of the Joachimsthal miners (*7*), not by their whole bodies. I regret this careless error.

I think Verduin is quite wrong in saying that "the fact that the inhabitants of Denver do not show a higher incidence of leukemia . . . is strong evidence supporting the argument that a linear proportionality does not exist between biological injury and radioactivity in the range of natural intensities." This fatigued red herring, which Linus Pauling calls "the Denver argument" (*8*), ought finally to have been exorcized (if that is what one does to red herrings) by the report of Buck, "Population size required for investigating threshold dose in radiation-induced leukemia" (*9*). Buck states: "At an altitude of 6000 feet, the annual excess of cosmic radiation over that received at sea level is approximately 23 mr, or 1.5 r by age 65. I attempted to examine leukemia death rates by altitude in the United States, only to realize that it was

extremely unlikely that the effect of such a small dose, even if it existed, could be demonstrated as statistically significant with the sizes of populations available."

Finally, I must disagree with Verduin's quaint notion that any of my own supposed or, alas, real deficiencies of knowledge make it unwise or unnecessary for the General Advisory Committee to rely on the advice of biologists in preparing a statement about biology. An individual, such as Verduin or I or anyone else, should and must speak out freely at the command of his conscience, even at the risk of making a fool of himself. I stated, and I repeat, that it is presumptuous of an official committee, whose membership comprises not one biologist, to issue what purports to be a definitive statement on a crucial biological matter. This would be so even if the statement did not include the misleading material to which I have drawn attention.

Following my own advice, I conclude by repeating my urgent conviction that nuclear bomb tests must not be resumed.

J. GORDIN KAPLAN
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User's Need of Scientific Information

What is the use of devising highly expensive machinery for searching information, and spending a great amount of money on its development, if we have no clear picture of what the users require? Who ought to benefit from greater availability of information if not the user? For whom is literature produced if not for those who read and use it?

The Royal Society Conference in London in 1948, and still more strongly the International Conference on Scientific Information in Washington in 1958, clearly showed that the user must be made the central focus of all research in improvement of scientific information methods.

Apparently the user wants only those items that are of interest to him at that moment. That means selection—elimination of superfluous texts (for in-

stance, through abstracts); readable texts (preferably not reduced on microfilm); and easy access to the world's literature.

I do not claim to solve the problem in this letter but I want to draw attention to the undiscovered possibilities in the present set-up of abstracting services and automatic searching systems.

It is quite wasteful, both of intellectual manpower and money, to continue as we are now going. Far better service could be produced by more limited means. The greatest trouble seems to lie in the very strength and vested interests of the existing abstracting services. There is, however, no urgent need to put these aside; on the contrary, through close cooperation of these interests, duplication of efforts might be avoided.

It would be worth while to consider the establishment, in place of the many hundreds of abstracting services in all disciplines that now exist, of a limited number of such services—one or two for each branch of science. These should not duplicate each other. These services—with an excellent staff of abstractors, obtained through combining the existing services—would adequately cover the field. These major abstracting centers would be provided with the best machinery available for searching the literature. Moreover, these centers would cooperate with a few regional centers for translation of abstracts into particular languages.

The user would then place subscriptions for abstracts in the subjects in which he has a particular interest. The abstracting services would use an internationally accepted classification system, so that orders might be placed without language difficulty. Such an abstracting service, for instance, would be able to supply abstracts covering certain subjects in a certain country during a certain period; or it would meet broader requests, even requests for complete coverage of scientific literature.

In those cases where the demand for abstracts on a given subject is regular, information could be obtained more quickly through specialized national centers which would receive copies of the material abstracted at the international centers.

For efficient operation, the abstracting services should rely on national depository centers of primary publications. These centers need not necessarily be national libraries or the like, as these do not exist in all countries, but could be set up for each discipline in cooperation with the international abstracting services. Wherever possible, however, central national services should be created, if they do not yet exist, in order to eliminate the possibility of duplication of work and, what is worse, loss of primary material.

A selection of the more important materials for abstracting would be made by the national centers. The remainder might be recorded in bibliographical lists only.

I have not mentioned, so far, the production of original literature. It would be very difficult to eliminate publication in journals, conference reports, and so on. If, however, everything produced is deposited nationally, there would be no danger of loss (unclassified military reports and the like are not discussed here). The abstracting services would publish classified lists of everything produced, whereas the contribution itself need not be produced in print but could be deposited only in manuscript form. Any request for a full paper—which a user would select from the abstracts or lists—could be met by supplying a photocopy or film of the manuscript—or, if published, of the periodical article.

As a first step towards the realization of this program, a conference of the editors-in-chief of some 25 of the bigger abstracting services should be convened to study the possibility of reducing the number of services by pooling manpower and money. Then the program of national services for primary publication should be studied.

Mention should be made here of the work of the International Council of Scientific Unions Abstracting Board, under the direction of Professor Boutry.

In this organization the question of publication of scientific abstracts is under constant discussion.

The International Federation for Documentation could play an important role as a central guiding and information office on abstracting services and translation centers.

W. VAN DER BRUGGHEN
International Federation for Documentation, The Hague, Netherlands

Perceptual Constancy

The very interesting findings by Leibowitz and Hartman on developmental changes in the magnitude of the moon illusion [*Science* **130**, 569 (4 Sept. 1959)] remain ambiguous in one respect. The data of Fig. 1 indicate that the illusion—that is, the disparity between the perceived sizes of the horizontal and overhead disks—diminishes with increasing age. The authors attribute this lessening of the illusion to an increase in the phenomenal size of the overhead disk; in other words, the perceived size of the overhead disk more nearly approaches its objective size—that is, constancy. One could, however, just as easily attribute the shrinkage of the illusion to a *decrease* in the apparent size of the horizontal disk, which would mean that with increasing maturity perception becomes less constant, that one perceives the moon at the horizon more nearly in terms of retinal size. It is not safe to say that the authors' interpretation is the logical one in the light of known principles of perceptual development, for, as C. E. Osgood [*Methods and Theory in Experimental Psychology* (Oxford, New York, 1953), pp. 227-280] points out, the evidence on developmental changes in constancy is at best inconclusive and at worst downright confusing.

One possible way of removing the ambiguity is to test the authors' conclusions in a size-distance constancy experiment for objects in both the overhead and horizontal positions. Such an experiment might show (i) that constancy increases with age for objects at the zenith; (ii) that constancy decreases with age for objects at the horizon; or (iii), that both (i) and (ii) occur. I would be willing to bet on (iii). Or the authors might want to try out the related hypothesis that individuals who habitually operate in three-dimensional space —construction workers, circus aerialists, aviators—are less subject to the moon illusion than the rest of us horizontal-oriented mortals.

JOSEPH CHURCH
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Church's argument is logical if one assumes that the present state of research on developmental changes in perceptual constancy is indeed inconclusive. In Osgood's discussion, the confusion results from considering size and brightness constancy together. Since it has been demonstrated that the different constancies are most probably mediated by different mechanisms [H. Leibowitz, P. Chinetti, and J. Sidowski, *Science* **123**, 688 (1956)], it seems advisable to evaluate size constancy separately. In this context, the studies cited by Osgood as well as the more recent experiments referred to in our original note indicate that size constancy does improve with age, especially for distant objects. On the basis of this evidence, we were led to suggest the hypothesis proposed in the original note rather than the alternative possibility that was suggested by Church.

Church has also suggested that individuals who habitually make discriminations with respect to objects outside of the horizontal plane may demonstrate a decreased moon-illusion effect. We have made no systematic observations on this point, but it is relevant to mention that two of the 19 adult subjects demonstrated no illusion effect whatsoever. Upon further questioning, it was revealed that one of them had worked as a forest ranger while the other is an amateur pilot. Further experimentation is certainly indicated, but the available data are in agreement with part of Church's hypothesis.

H. LEIBOWITZ
THOMAS HARTMAN
Department of Psychology, University of Wisconsin, Madison

Ethology and Psychology

The title of the Sixth International Ethological Conference, recently held at Cambridge University, again focuses attention on the problem of what to call the rapidly developing science of animal behavior. The term *ethology* has been defined by Tinbergen [in B. Schaffner, Ed., *Group Processes* (Macy Foundation, New York, 1955)] as "the biological study of behavior." Since psychology in its modern sense is often defined as "the science of human and animal behavior," it is obvious that these two terms overlap and may be almost identical.

This presents the possibility of a jurisdictional dispute as well as an unreal dichotomy of subject matter, and one wonders why a new term should be needed. The answer lies both in the history and in the professional organization of science. Psychology has concerned itself primarily with human be-

havior and only secondarily with the behavior of the rest of the animal kingdom. On the other hand, a zoologist who concerns himself with animal behavior does not like to call himself a psychologist, nor does the term *animal behaviorist* fit with the usual nomenclature of subdivisions of biological science. There is no term equivalent to "behaviorology"; this is one case where the Greeks did not have a word for it.

Both *ethology* and *psychology* are unfortunate terms because of their derivation. *Ethology* originally meant the science of character, whereas *psychology* meant the science of the mind. Thus, both are based on primitive scientific concepts which no longer have much use and do not describe modern science. In addition, *ethology* is very similar to *ethnology*, a term long used in a purely human context to describe studies of race. According to J. R. Charles, it is linguistically permissible to pronounce *ethology* with a long *e*, and this should be done in order to make a greater phonetic distinction between it and *ethnology*.

There are two conventional ways of subdividing the study of biology. One of these is on the basis of taxonomic groups—that is, ornithology, entomology, bryology, and so on. The other, a more basic one, is based on phenomena observed on different levels of organization, with ecology at the topmost level and genetics at the lowest, and with developmental biology (or, as it used to be called, embryology) cutting across all levels. The phenomenon of behavior, defined as activity of an entire organism, occupies a central position on the organismic level. Its study involves factors operating at all levels of organization, and this provides a natural way of unifying zoological science. The scientist who studies behavior is likely to be by training a geneticist, a physiologist, an ecologist, or a sociologist as well as a psychologist, and he cannot work effectively without some appreciation of factors affecting behavior on other levels. This interdisciplinary nature of the study of behavior has been often recognized in terminology by combining the names of different fields of science—for example, *psychobiology, sociobiology, psychogenetics, physiological psychology, social psychology*, and so on. Most of these terms still describe a field of interest rather than a profession, although they may eventually develop into the latter.

No one can dictate what the eventual usage will become. However, certain principles should be kept in mind. One is that we should define whatever names we give to the science of animal behavior in the broadest possible way, recognizing that this science deals with general phenomena affected by many different sorts of factors and cutting across the conventional boundaries of professional training. Thus, *ethology* should be defined as the study of behavior of all animals, including man, thereby being a term equivalent to *psychology* rather than excluding it. It would be unfortunate for the development of the science if it were confined to the study of instinct and thereby became merely one of the already numerous minor schools of psychology.

It is also possible that workers in the field of animal behavior will find that their concepts have gone beyond the original narrow definition of their science, just as did the embryologists, who found that development did not cease with embryonic life but proceeded into old age and death. By analogy, the science of animal behavior might become known as "behavioral biology."

More important than terminology, however, is the existence of important behavioral phenomena and concepts explaining them which tend to eliminate the somewhat artificial divisions of zoological science which have hitherto been used in the organization of professional training.

J. P. SCOTT
Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine

Meetings

The British Association

The annual meeting of the British Association for the Advancement of Science, with a registration of about 3000 persons, was held this year in the city of York, where the association held its first meeting 128 years ago. At that earlier meeting most of the visiting scientists arrived by stagecoach or on horseback. In the succeeding years the association has held four other annual meetings in York. The objectives of this annual meeting of the British Association are to provide a platform for leading scientists to present current reviews of their areas of specialization, to provide for discussion by workers of problems which cut across scientific divisions, and to provide to nonspecialists and the lay public discussion of scientific advances in a comprehensible form.

Special features of the program included a young people's program, with lectures on atomic energy, giant computing machines, man and insects, and dinosaurs and Darwinism. Given programs, involving 40 separate technical films, constituted the scientific film program. These selected films included contributions from ten foreign countries as well as many from Great Britain. Three new general lectures, known as the Lister, Darwin, and Kelvin lectures, were presented. The Lister lecture was an applied-psychology discussion by D. E. Broadbent, "Time to React"; the Darwin lecture was a botanical discussion by R. G. West, "The Ice Age"; and the Kelvin lecture was a microbiology discussion by S. Brenner, "Building Viruses."

Each of the 14 sections held a series of technical sessions, and numerous excursions were planned for afternoons and for the week-end, which occurred in the middle of the meeting. This is held by custom from Wednesday to Wednesday—a tradition established in the early days so that those traveling by stagecoach would not have to travel on Sunday.

Special entertainment included a garden party given by the city of York, receptions and luncheons for foreign guests, a symphony concert by the Northern BBC orchestra, and a formal banquet in the Muchan Adventurers Hall. The president of the association, Sir James Gray, gave his presidential address, "The Proper Study of Mankind is Man," at the opening session on 2 September. This address and the addresses of the section presidents will appear in the current number of the association's publication, *Advancement of Science.*

The Council of the Association has

adopted a number of changes in general organization structure, including membership, meeting, and publication activities, so the current year should provide some interesting developments. The new president for the coming year is to be Sir George Thomson of Cambridge University, who will give his formal presidential address at the Cardiff meeting in 1960. A number of foreign guests attended and these were recognized by the association and by the city of York. The American Association for the Advancement of Science was represented by Wallace R. Brode, retiring president and chairman of the board of directors.

WALLACE R. BRODE
Department of State, Washington, D.C.

Forthcoming Events

February

18–20. National Soc. of Professional Engineers, winter, Wichita, Kan. (P. H. Robbins, NSPE, 309 Bancroft Bldg., Univ. of Nebraska, Lincoln.)

21–24. American Inst. of Chemical Engineers, Atlanta, Ga. (F. J. Van Antwerpen, AICE, 25 W. 45 St., New York 36.)

22–25. Technical Assoc. of the Pulp and Paper Industry, annual, New York, N.Y. (J. Winchester, TAPPI, 155 E. 44 St., New York 17.)

22–4. Scientific Management, 12th intern. cong., Sydney and Melbourne, Australia. (C. M. Gray, Federal Council of the Australian Inst. of Management, Western House, 83 William St., Melbourne, C.1, Victoria, Australia.)

24–26. Biophysical Soc., 4th annual, Philadelphia, Pa. (O. H. Schmitt, Biophysical Soc., Chairman, Program Committee, Univ. of Minnesota, Minneapolis.)

25–27. American Orthopsychiatric Assoc., Chicago, Ill. (Miss M. F. Langer, 1790 Broadway, New York 19.)

25–27. Cell Physiology of Neoplasia (14th annual symp. on fundamental cancer research), Houston, Tex. (Editorial Office, Univ. of Texas M. D. Anderson Hospital, Texas Medical Center, Houston 25.)

26. Highway Geology, 11th annual symp., Tallahassee, Fla. (W. F. Tanner, Geology Dept., Florida State Univ., Tallahassee.)

28–5. American College of Allergists, Miami Beach, Fla. (E. Bauers, 2160 Rand Tower, Minneapolis 2, Minn.)

29–3. American College of Surgeons, Boston, Mass. (H. P. Saunders, 40 E. Erie St., Chicago, Ill.)

29–4. Pittsburgh Conf. on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Pa. (L. P. Melnich, U.S. Steel Corp., Monroeville, Pa.)

March

3–5. American Acad. of Forensic Sciences, Chicago, Ill. (W. J. R. Camp, AAFS, 1853 W. Polk St., Chicago 12.)

4–6. National Wildlife Federation, Dallas, Tex. (C. H. Callison, 232 Carroll St., NW, Washington 12.)

6–13. American Otorhinologic Soc. for Plastic Surgery, Miami Beach, Fla. (J. G. Gilbert, 75 Barberry Lane, Roslyn Heights, N.Y.)

7–9. Wildlife Management Inst., Dallas, Tex. (C. R. Gutermuth, 709 Wire Bldg., Washington 5.)

7–11. American Soc. of Civil Engineers, New Orleans, La. (E. S. Kirkpatrick, ASCE, 33 W. 39 St., New York 18.)

10. Recent Developments in Poultry Nutrition (Assoc. of Vitamin Chemists), Chicago, Ill. (J. T. Sime, Director of Research, Evaporated Milk Assoc., 228 N. La Salle St., Chicago 1.)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

23–25. Optical Spectrometric Measurements of High Temperatures, symp., Chicago, Ill. (F. Brech, Laboratories for Applied Science, Univ. of Chicago, 6220 S. Drexel Ave., Chicago 37.)

24–25. Human Factors in Electronics, 1st annual symp. (IRE), New York, N.Y. (J. E. Karlin, Bell Telephone Laboratories, Murray Hill, N.J.)

24–26. American Assoc. for the History of Medicine, Charleston, S.C. (J. B. Blake, c/o Smithsonian Institution, Washington 25.)

24–26. Aviation Education, 4th natl. conf., Denver, Colo. (W. Kinkley, Superintendent of Schools, Aurora, Colo.)

26–27. American Psychosomatic Soc., 17th annual, Montreal, Canada. (E. D. Wittkower, APS, 265 Nassau Rd., Roosevelt, N.Y.)

28–31. Exploitation of Natural Animal Populations, symp., Durham, England. (E. D. Le Cren, British Ecological Soc., The Ferry House, Ambleside, Westmorland, England.)

29–31. American Power Conf., 22nd annual, Chicago, Ill. (R. A. Budenholzer, Mechanical Engineering Dept., Illinois Inst. of Technology, 3300 Federal St., Chicago 16.)

29–2. National Science Teachers Assoc., 8th annual conv., Kansas City, Mo. (Miss M. R. Broom, NSTA, National Education Assoc., 1201 16 St., NW, Washington 4.)

30–31. Adrenergic Mechanisms, Ciba Foundation symp. (by invitation only), London, England. (G. E. W. Wolstenholme, Ciba Foundation, 41 Portland Pl., London, W.1, England.)

31–1. Continuous Culture of Microorganisms, symp., London, England. (R. Elsworth, c/o Ministry of Supply, Microbiological Research Establishment, Porton, Salisbury, Wilts., England.)

31–2. American Gastroenterological Assoc., New Orleans, La. (W. Volwiler, Dept. of Medicine, Univ. of Washington, Seattle.)

April

1–3. American Soc. of Internal Medicine, San Francisco, Calif. (R. L. Richards, 350 Post St., San Francisco 8.)

1–3. American Soc. for the Study of Sterility, Cincinnati, Ohio. (H. H. Thomas, 920 S. 19 St., Birmingham 5, Ala.)

1–4. Bahamas Medical Conf., Nassau. (B. L. Frank, P.O. Box 4037, Fort Lauderdale, Fla.)

2. Paleontological Research Institution, Ithaca, N.Y. (Miss R. S. Harris, 126 Kelvin Pl., Ithaca.)

2–6. American College of Obstetrics and Gynecologists, Cincinnati, Ohio. (D. F. Richardson, 79 W. Monroe St., Chicago 3, Ill.)

3–6. American Surgical Assoc., White Sulphur Springs, W. Va. (W. A. Altemeier, Cincinnati General Hospital, Cincinnati, Ohio.)

3–7. International Anesthesia Research Soc., Washington, D.C. (A. W. Friend, E. 107 St. and Park Lane, Cleveland 6, Ohio.)

3–8. Nuclear Cong., New York, N.Y. (P. Lange, Engineers Joint Council, 29 W. 39 St., New York.)

4–6. American Inst. of Electrical Engineers, Houston, Tex. (N. S. Hibsham, AIEE, 145 N. High St., Columbus 15, Ohio.)

4–6. American Inst. of Mining, Metallurgical and Petroleum Engineers (43rd Natl. Open Hearth Steel Conf. and Blast Furnace, Coke Oven and Raw Materials Conf.), Chicago, Ill. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 18.)

4–6. American Oil Chemists' Soc., Dal-

las, Tex. (Mrs. L. R. Hawkins, AOCS, 35 E. Wacker Drive, Chicago 1, Ill.)

4–7. Atomic Exposition, New York, N.Y. (Atomic Exposition, 117 S. 17 St., Philadelphia, Pa.)

4–8. American Soc. of Mechanical Engineers, New York, N.Y. (D. B. MacDougall, ASME, 29 W. 39 St., New York.)

4–9. American College of Physicians, San Francisco, Calif. (E. R. Loveland, 4200 Pine St., Philadelphia 4.)

5–7. Instrument Soc. of America (Natl. Chemical and Petroleum Symp.), Rochester, N.Y. (H. S. Kindler, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.)

5–7. Naval Structural Mechanics, 2nd symp., Providence, R.I. (E. H. Lee, Brown Univ., Providence.)

5–14. American Chemical Soc., natl., Cleveland, Ohio. (A. T. Winstead, ACS, 1155 16 St., NW, Washington 6.)

6–8. Biochemistry and Pharmacology of Compounds Derived from Marine Organisms, symp., New York, N.Y. (R. F. Nigrelli, Dept. of Marine Biochemistry and Ecology, New York Aquarium, Seaside Park, Eighth St. and Surf Ave., Brooklyn 24, N.Y.)

6–8. Hyper-Environments—Space Frontier (Inst. of Environmental Scientists), Los Angeles, Calif. (M. S. Christensen, IES, 6251 Marita St., Long Beach 15, Calif.)

6–8. Radiofrequency Spectroscopy Group, Nottingham, England. (J. E. Ingram, RSG, c/o Dept. of Electronics, Telecommunications and Radio Engineering, Univ. of Southampton, England.)

6–9. Mineral Processing, intern. cong., London, England. (B. W. Kerrigan, Institution of Mining and Metallurgy, 44 Portland Pl., London, W.1, England.)

7–8. Cathode Protection, European symp., Frankfurt am Main, Germany. (Secrétariat du Symposium, Deutsche Gesellschaft fur Metallkunde, Alteburgerstrasse 402, Koln-Marienburg, Germany.)

7–9. American Assoc. of Railway Surgeons, Chicago, Ill. (C. C. Guy, 5800 Stoney Island Ave., Chicago 37.)

7–9. Association of Surgeons of Great Britain and Ireland, Birmingham, England. (F. A. R. Stammers, 47 Lincolns Inn Fields, London, W.C.2, England.)

7–9. Optical Soc. of America, Washington, D.C. (K. S. Gibson, OSA, Natl. Bureau of Standards, Washington 25.)

8–9. American Assoc. of University Professors, Detroit, Mich. (P. R. David, Univ. of Oklahoma, Norman.)

8–9. Southern Soc. for Philosophy and Psychology, Biloxi, Miss. (E. Henderson, Florida State Univ., Tallahassee.)

8–11. American Dermatological Assoc., Boca Raton, Fla. (W. M. Sams, 308 Ingraham Bldg., Miami 32, Fla.)

9–10. Histochemical Soc., 11th annual, New York, N.Y. (H. W. Deane, Albert Einstein College of Medicine, Bronx 61, N.Y.)

11–13. American College of Surgeons, Minneapolis, Minn. (H. P. Saunders, 40 E. Erie St., Chicago 11, Ill.)

11–14. American College Personnel Assoc., Philadelphia, Pa. (M. D. Hardee, Florida State Univ., Tallahassee.)

11–15. American Assoc. of Immunologists, Chicago, Ill. (C. Howe, Columbia Univ., College of Physicians and Surgeons, New York 22.)

11–15. American Inst. of Nutrition, Chicago, Ill. (G. M. Briggs, Div. of General Medical Sciences, National Institutes of Health, Bethesda, Md.)

11–15. American Physiological Soc., Chicago, Ill. (R. G. Daggs, 9650 Wisconsin Ave., NW, Washington 14.)

11–15. American Soc. for Experimental Pathology, Chicago, Ill. (F. J. A. McManus, Univ. of Alabama Medical Center, Birmingham.)

11–15. American Soc. for Pharmacology and Experimental Therapeutics, Chicago, Ill. (K. H. Beyer, Merck Sharp & Dohme Research Laboratories, West Point, Pa.)

11–15. Federation of American Socs. for Experimental Biology, Chicago, Ill. (M. O. Lee, 9650 Wisconsin Ave., NW, Washington 14.)

11–16. American Assoc. of Anatomists, New York, N.Y. (L. B. Flexner, Dept. of Anatomy, School of Medicine, Univ. of Pennsylvania, Philadelphia 4.)

11–16. American Soc. of Biological Chemists, Chicago, Ill. (F. W. Putnam, Dept. of Biochemistry, Univ. of Florida, Gainesville.)

11–16. Anatomical Congress, 7th intern., New York, N.Y. (D. W. Fawcett, Dept. of Anatomy, Harvard Medical School, Boston 15, Mass.)

11–16. Congress of Anatomy, 7th intern., New York, N.Y. (J. C. Hinsey, New York Hospital, Cornell Medical Center, 525 E. 68 St., New York 21.)

11–16. International Anatomical Cong.,