SCIENCE

25 October 1963

Vol. 142, No. 3591

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SORTED PARTICLES

25 October 1963
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SCIENCE

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COVER

Islands of stones which have been sorted by frost action in the freeze-thaw layer at Thule, Greenland. The diameter of such circles may vary from a few centimeters to many meters for the same depth of the freeze-thaw layer. See page 499.

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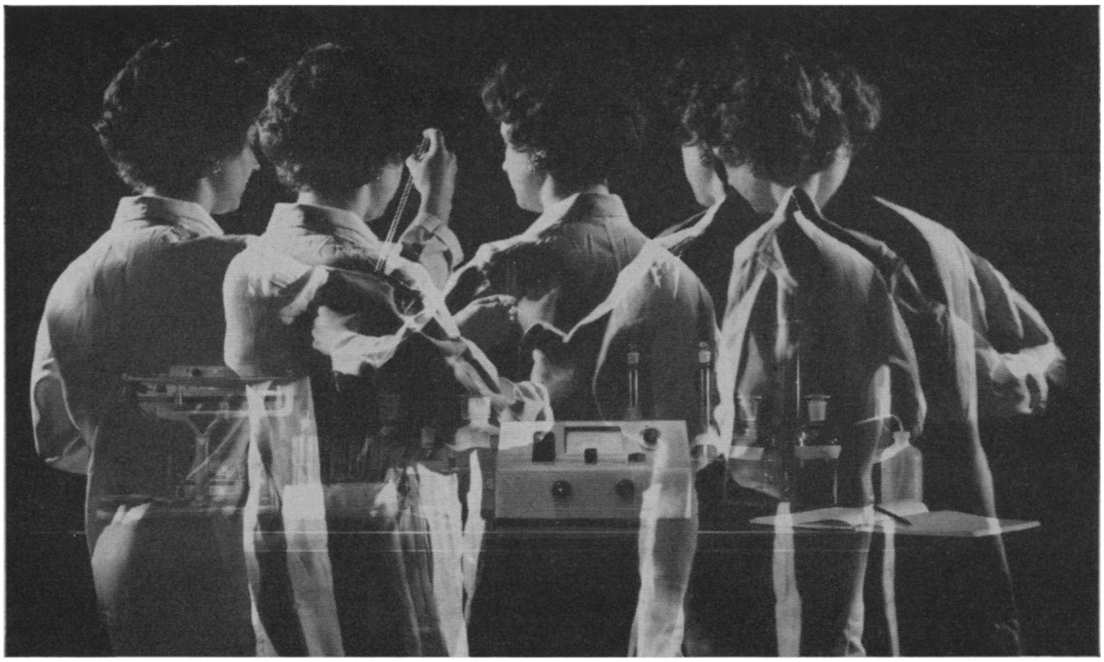

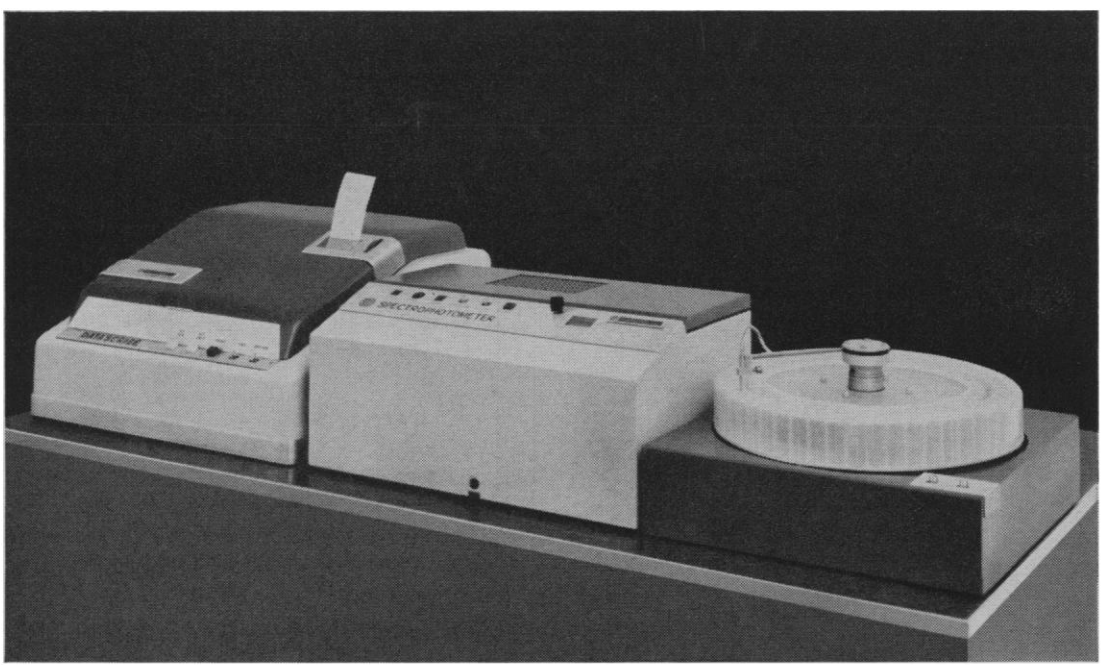
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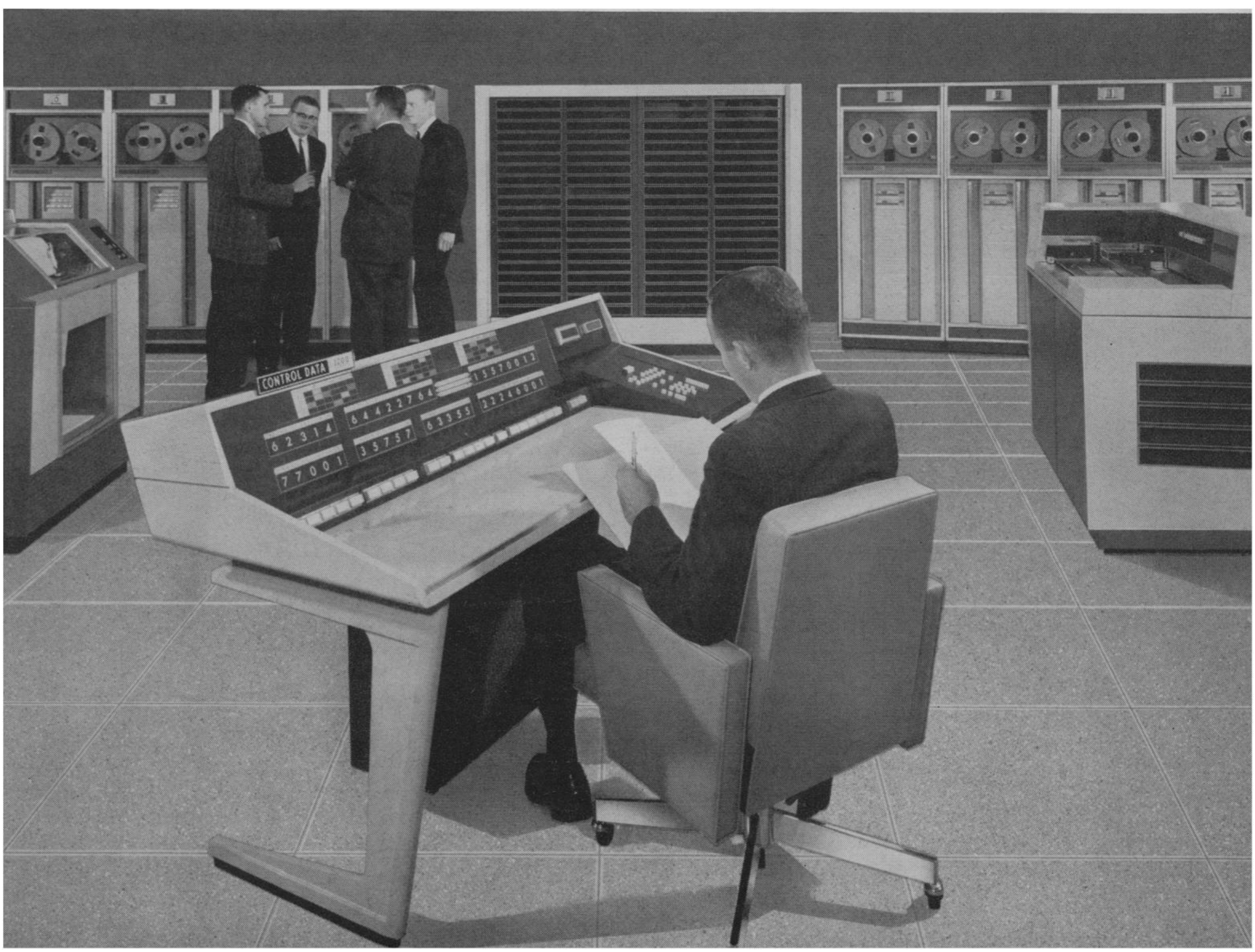

MIDDLE GAME

Without in the least decrying the importance of the opening and the ending, which are vital and integral parts of chess, it's safe to say that the heart and drama of the battle are concentrated in the middle game.

Here is the arena where an opening advantage may be pressed home to victory or where the foundation may be laid for a winning ending. Here is the backdrop of thrust and riposte, sacrificial brilliancy, tactical surprise, masterly combination, attack against the King, grand over-all strategy, all occurring in the wealth and complexity possible only on a board full of pieces.

I. A. Horowitz,
How to Win in the Middle Game of Chess
David McKay Company, Inc.

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At MITRE the work concerns development of command and control systems vital to our country's defense — vital to the "middle game." The strategy is to stay always a move or more ahead of the other side . . . to counter the threat, anticipate the future threats so that a more critical phase can never be reached.

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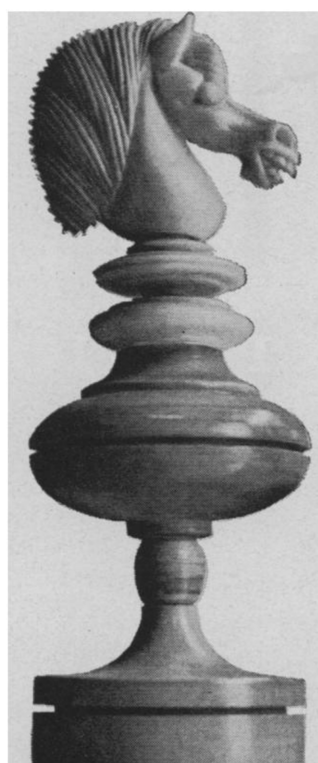

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MITRE needs talented engineers and scientists — preferably with advanced degrees and at least five years' experience in electronics, mathematics or physics. Write, in confidence, to Vice President, Technical Operations, The MITRE Corporation, P.O. Box 208AF, Bedford, Massachusetts. Openings are also available in Washington, D.C. and Colorado Springs, Colorado.

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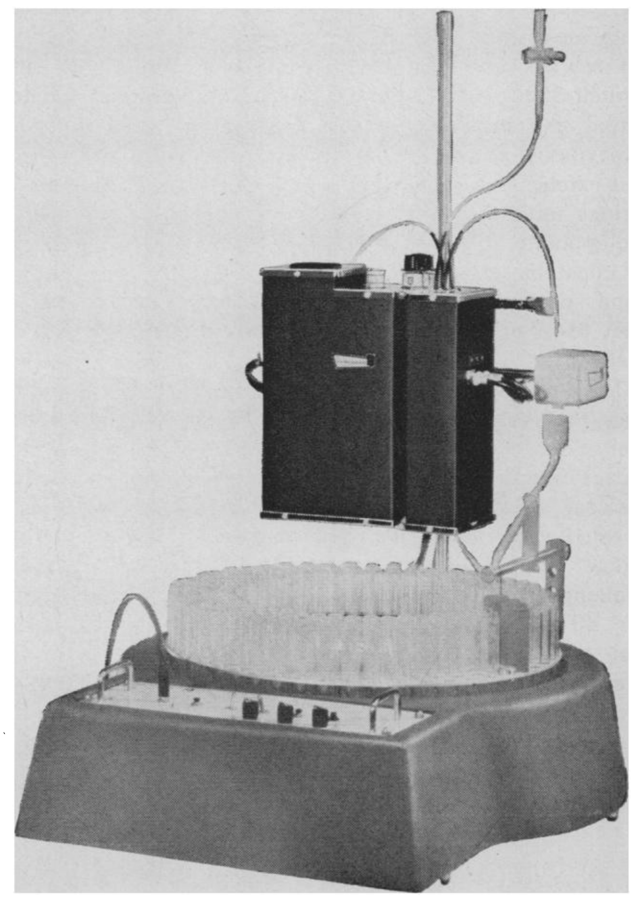
Now Vanguard introduces another innovation in instrumentation, offering the new model 1056-A, the most compact, space-saving, easy-to-operate UV Analyzer available today with variable wave length control. Monochrometer-coupled broad emission UV light source allows selection of any wave length from 200 to over 400 millimicrons with a turn of a dial. Dual-beam operation utilizing sample and reference cuvettes provides continuous base line compensation for gradient elutions and for other applications where the optical density of the eluent may change. The 1056-A operates with minimum supervision and is compatible with all fraction collectors. Automatic chart recorder marking system speeds location and identification of test tubes containing UV absorbing materials. Completely transistorized, for long, maintenance-free operation. Write for complete information.



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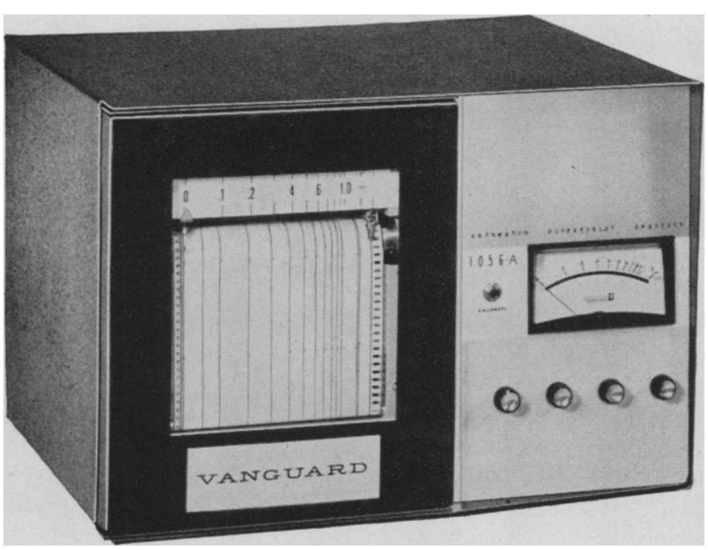

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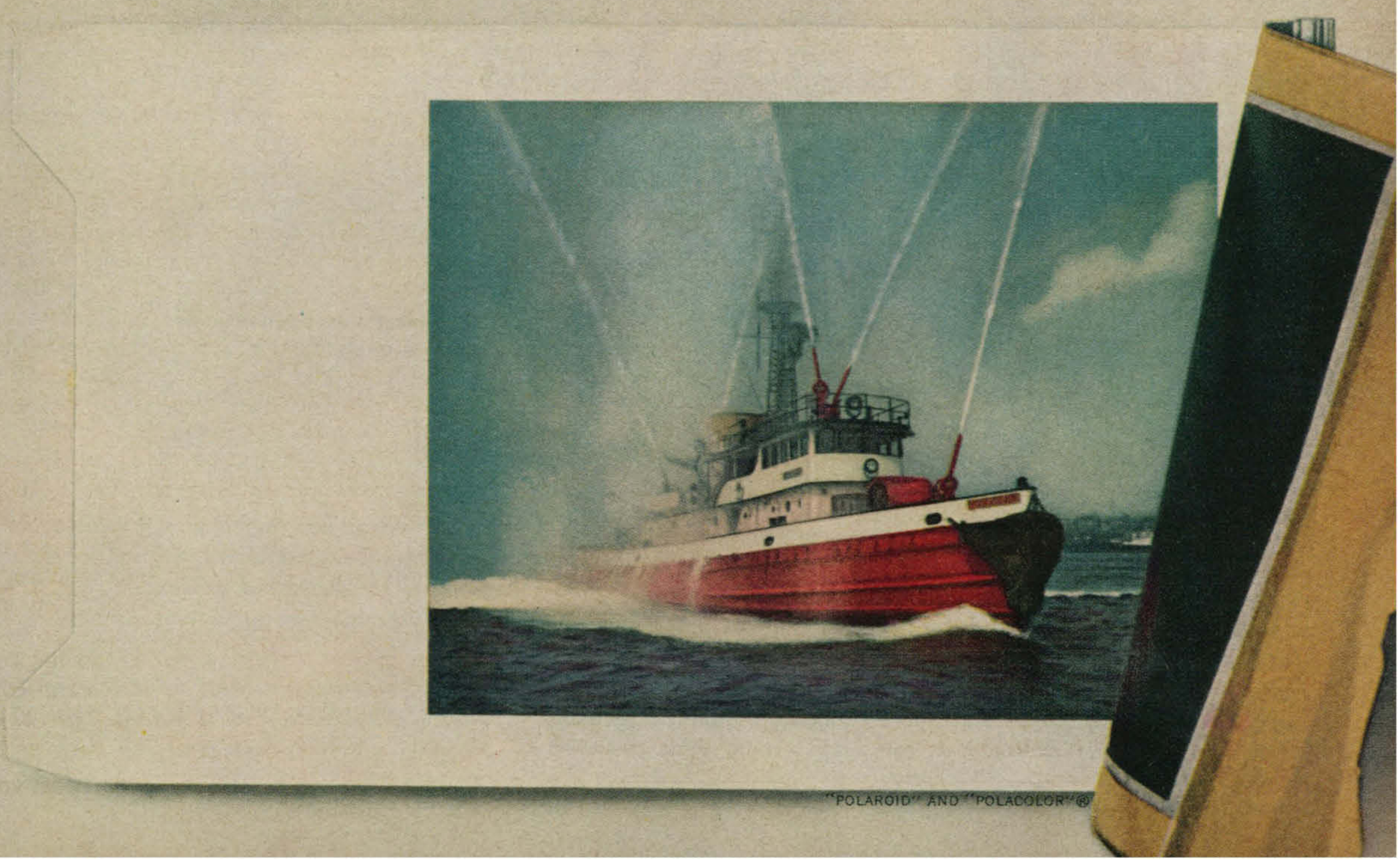

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SCIENCE

Distribution of Research Funds

Congressional discontent with federal support of research arises from a number of causes. One of these is concentration of support at a limited number of universities, ten of which in fiscal 1962 received 38 percent of the total. A compilation of Department of Defense allocations to nonprofit institutions during fiscal 1962 indicates that Massachusetts received $117 million while ten states in the South and West collectively obtained only $560,000. These states have a total population more than twice as great as Massachusetts. The National Institutes of Health and the National Science Foundation have distributed their grants more evenly, but they too have given a large share of their funds to a relatively few institutions. Scientists have always tended to flock to a few major centers. The present mode of allocation of funds makes it even easier for the rich to recruit talent from the poor.

This situation is a natural outgrowth of the philosophic approach which has guided the agencies. The central view has been that the government supplies funds to achieve specific research. Scientists who sit on panels and study sections take into consideration the excellence of the research proposal, the known competence of the principal investigator and his associates, and the reputation of the institution sponsoring the research. These are reasonable criteria if the national interest is best served only by maximum efficiency in research activities. The system leads, however, almost inevitably to concentration of research support in a few institutions. A man of proved research productivity in a small school in the Middle West may submit an excellent proposal, but almost invariably his proposal will receive a rating below that of a comparable application originating at Harvard. The difference is the impact of the known excellence of the institution.

I sat on a study section at the National Institutes of Health from 1956 through 1959. As was the rule, our group rated grants on the basis of a scale from 1 to 5. The quality of applications originating from Harvard varied considerably, yet few if any were turned down, and most received a rating between 1 and 2. Proposals from less well known schools received severe scrutiny, were often rejected, and seldom were given a rating better than 2. Members of the study section were not personally prejudiced in favor of the great institutions and, if anything, would have preferred to encourage research at smaller schools. Yet we could not in good conscience produce a different result.

This lopsided allocation of funds could be corrected in a number of ways. One method would be to change the guidelines, eliminating the excellence of the sponsoring institution as a factor and giving weight to the need to build research in many centers. A second and more desirable method would be to allocate part of the total funds, perhaps 25 percent, directly to institutions on a per capita basis. This would be certain to produce a broad distribution of funds. It would not destroy incentives for excellence. It would have the constructive effect of transferring part of the responsibility and authority for scientific choice back to the universities. The method would have pork-barrel potentials, but this is a small hazard in comparison to the proved inequity of the present approach.

The present allocation of funds for research is not in the long-term national interest. One can only be amazed that congressmen from the underprivileged states have been so remiss in safeguarding the interests of the nation and of their constituents.—P.H.A.

Pulse Summation IN NEW TRI-CARB® SPECTROMETERS

Pulse summation is an exclusive Packard Tri-Carb development for utilizing essentially all of the light energy produced in liquid scintillation solutions, rather than only half of the light as in all older coincidence-type liquid scintillation spectrometers. The benefit to the user is:

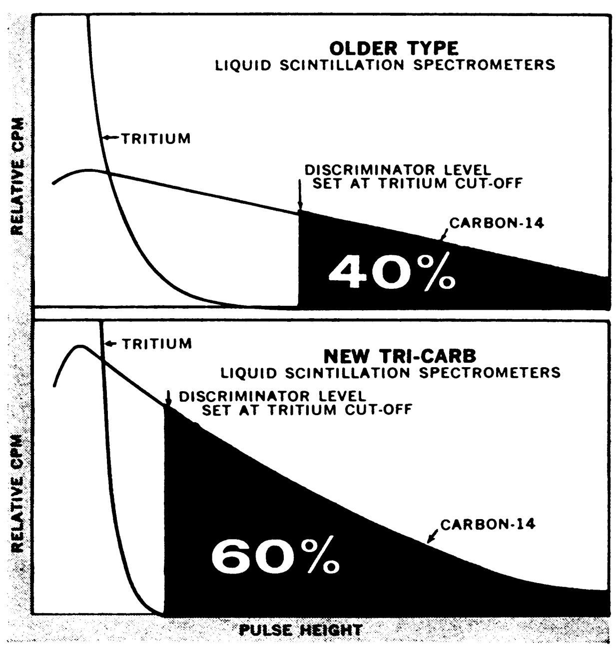
(a) *Higher counting efficiencies, especially for low energy emitters such as tritium*

(b) *Greatly improved isotope separation in double-label counting*

HIGHER COUNTING EFFICIENCIES

Previously, coincidence-type liquid scintillation spectrometers were able to utilize the pulse output from only one of the two photomultiplier tubes—the Analyzer—for pulse height analysis. Pulses from the second photomultiplier tube—the Monitor—served only to provide coincidence signals.

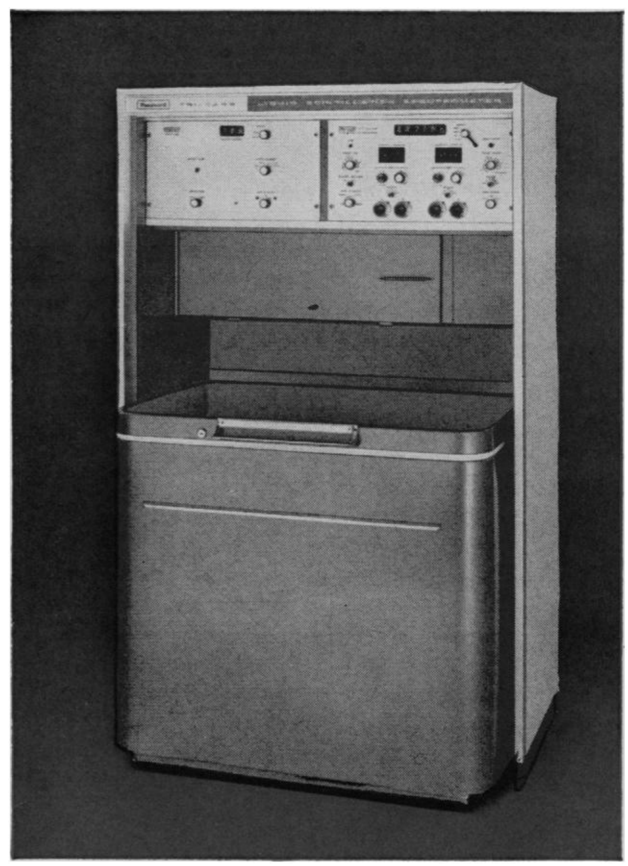
New Tri-Carb Spectrometers incorporate a pair of carefully matched 13-dynode photomultiplier tubes. Pulses from *both* tubes are used to establish coincidence, and simultaneously they are summed prior to pulse height analysis. This results in an improvement in the signal-to-noise ratio by a factor of two, since random noise pulses do not sum and coincident pulses do. Further, the use of 13-dynode photomultiplier tubes obviates the need for preamplifier circuits which inherently tend to slow down the pulse rise time and which contribute to the noise level. This permits much faster coincidence resolving time and relatively lower discriminator settings. The overall benefit is to **provide higher counting efficiencies for low energy isotopes.**



Comparison demonstrating greatly improved isotope separation obtainable with new TRI-CARB Spectrometers by showing percentage of total carbon-14 which appears beyond tritium cut-off. Data is directly comparable in both cases: discriminator levels were set so that only 0.01% tritium remained in the carbon-14.

GREATLY IMPROVED ISOTOPE SEPARATION

A further advantage of pulse summation is the more faithful reproduction of the true spectral shapes of low energy isotopes. The total number of photons emitted for each low energy beta particle is very small. Even with the best light collection and photocathode conversion efficiencies, only one or two photoelectrons are produced in each photomultiplier tube from an average 6 KeV tritium particle. Obviously, with such small numbers, a substantial advantage can be achieved in the statistics of photon collection and photoelectron utilization by doubling the numbers through the full use of *both* photomultiplier tubes for pulse summation and subsequent pulse height analysis. The more precise spectral curves achieved in new Tri-Carb Spectrometers, as a result of better statistics, provide **very greatly improved separation of low energy isotopes such as tritium and carbon-14.**



Pulse summation is just one of many significant new features now available in Packard Tri-Carb Spectrometers. Ask your Packard Sales Engineer for complete details, or write for Bulletin.

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moduline

a new Aerograph series

Hy-Fl_2 • 202 • 1520

How can you design a gas chromatograph and protect heat-sensitive electronic components from the oven heat? One cumbersome method is to build two separate units.

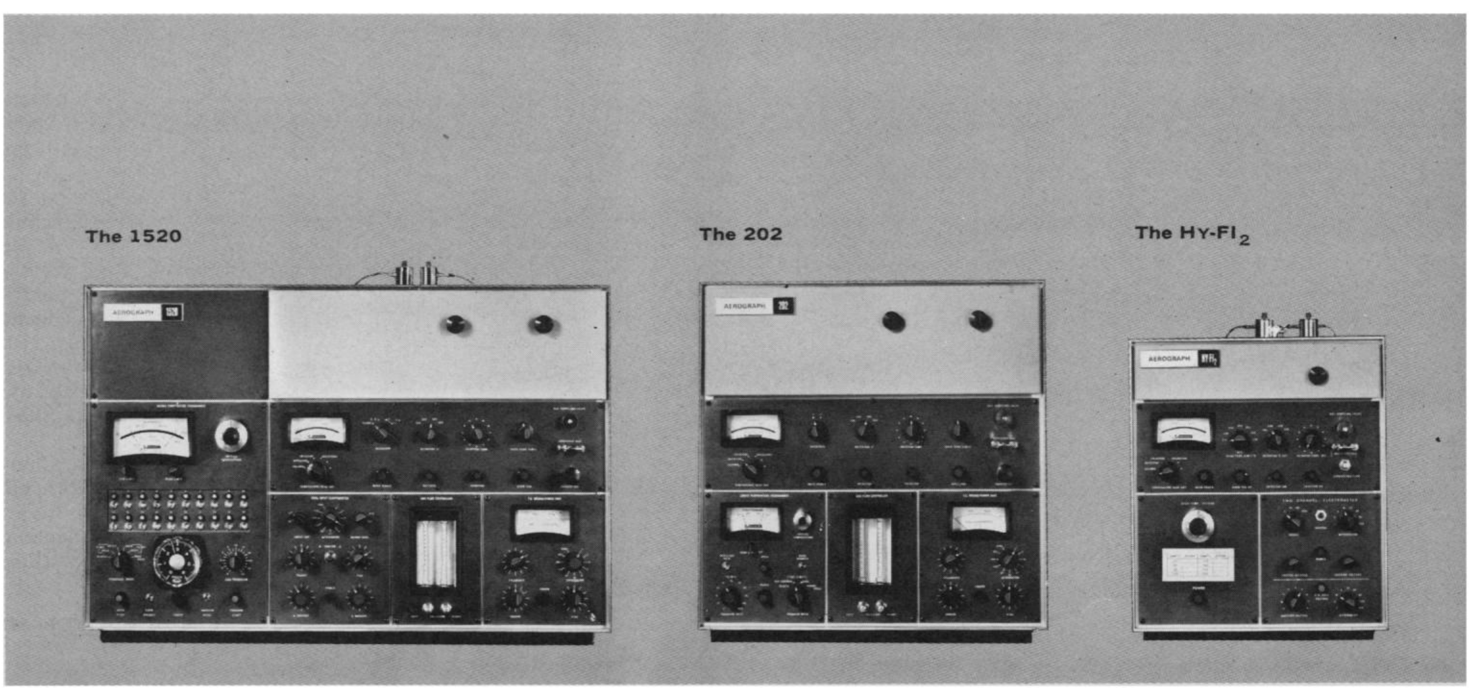
A separate cabinet fan in a single, compact unit is the approach used in the new Aerograph Moduline Series.

Three sparkling models were developed.

THE "Hy-Fl_2" is a single-column instrument which adapts perfectly to: Flame, Electron Capture, Cross Section and Thermal Conductivity detectors. Manual or linear temperature programming modules are optional.

THE "202" is a two-column instrument adaptable to both Dual Flame and Thermal Conductivity detectors. Manual or linear temperature programming modules are optional.

THE "1520" is a deluxe version of the 202 equipped with both Dual Flame and T.C. detectors. It features matrix board temperature programming, automatic cooldown, and automatic reset-to-start temperature.



The 1520 · The 202 · The HY-FI_2

The 202

FEATURES

- Dual-column with either flame or T.C. detectors
- Linear or manual programmer modules
- Automatic oven cool-down (with LP)
- Dual input electrometer or bridge modules
- On-column or flash vaporized injection
- Separately heated detector oven

ORDER:

1. 202—FL/MP—dual flame—manual programmer
2. 202—TC/MP—thermal conductivity—manual programmer
3. 202—FL/LP—dual flame—linear programmer
4. 202—TC/LP—thermal conductivity—linear programmer

THEORY

The concept of two-column gas chromatography was first introduced by Drs. Edward M. Emery and W. E. Koerner, Monsanto Chemical Co., at the 1961 Spring ACS Meeting.

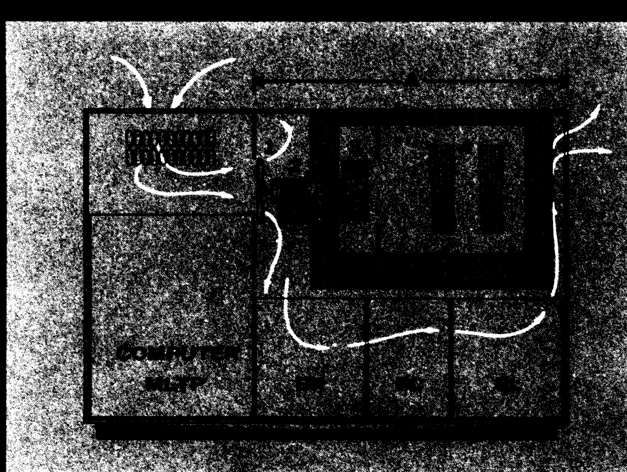
At about this same time we introduced the Aerograph A-350 featuring dual-columns connected to a four-filament T.C. cell and having separate injectors for each column. The basic advantages of the two-column system are:

1. Column bleed compensation is provided by using one column as a blank.
2. Different column packings give the chemist immediate use of two-type columns such as polar and non-polar.

Two new basic dual-column gas chromatographs, 202 and 1520, have been developed. Both instruments have flow controllers, flow meters, and long tapered metering valves for controlling gas flow to each column.

The separate detector oven is carefully regulated at four set temperatures. The all stainless steel column oven, heated by a 800 watt coil, will program at 35°C/min to 400°C and will cool from 400 to 100°C in four minutes.

The Aerograph 202 incorporates either dual flame or dual input detectors. It may be used with the manual temperature programmer or the simple linear tempera-



MODULINE COMPONENTS

1	Fan for cabinet cooling
2	Synchronous motor, rubber-mounted
3	Fan for oven air circulation
4	Dual-column position
MLTP	Matrix linear temperature programmer
BR	Bridge power supply for T.C. detector
FC	Dual flow controllers, flow meters and needle valves
EL	Dual input electrometer

PRACTICE

ture programmer (LP) modules. With the LP, oven cool-down is automatic but door-close is not. A manual switch operates the door at any time.

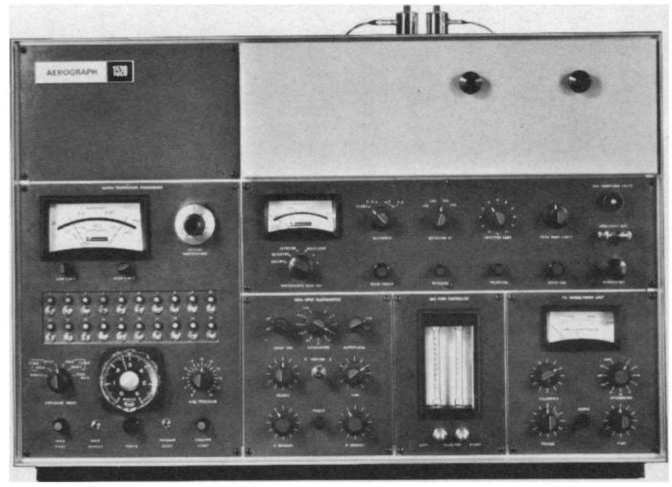
The 1520 is a more deluxe version of the 202. It contains both the dual flame and thermal conductivity detectors. The detector choice is made by re-connecting the downstream ends of the column. The exclusive Aerograph matrix temperature programmer is standard. This deluxe programmer not only gives complete flexibility in pre-setting temperature programming rates but automatically closes the oven door after cool-down and re-establishes the start temperature.

The injectors are independently heated. Temperature readout on an accurate, compensated pyrometer reads column oven, detector oven, injector, collector and auxiliary equipment plug. An automatic upper oven temperature limit control on all Moduline instruments protects columns and equipment from accidental overheating.

At lower right is shown a typical temperature program profile. The program rate may be caused to increase at any time during analysis or may be pre-set before the analysis. The programming rate is established by the resistance value of the matrix plugs . . . the time of change by their position on the matrix board.

At lower left is an interior view of the 1520 showing cabinet air cooling and modules. The 202 is identical to the "A" portion. Modules in this case would be either electrometer or bridge • manual programmer or linear programmer.

The 1520



FEATURES

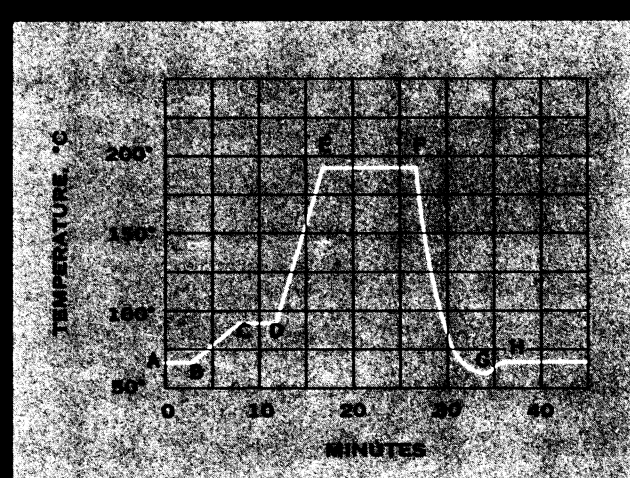
- Dual-column with both flame and T.C. detectors
- Matrix board temperature programmer
- Automatic oven cool-down and re-set to start temperature.
- Both dual input electrometer and bridge modules
- On-column or flash vaporized injection
- Separately heated detector oven

ORDER:

Aerograph 1520—dual column gas chromatograph with both dual flame and T.C. detectors. Flow controllers, electrometer, bridge/power supply and matrix temperature programming modules are standard.

MATRIX TEMPERATURE PROGRAMMER

A	Pre-set temperature—70°C.
A-B	Isothermal operation—@ 70°C for 3 min.
B-C	Linear programming—@ 5°C/min for 5 min.
C-D	Isothermal operation—@ 95°C for 4 min.
D-E	Linear programming—@ 20°C/min for 5 min.
E-F	Isothermal operation—@ 195°C for 10 min.
F-G	Door opens and oven cools down to 60°C in 7 minutes pre-set by timer.
G-H	Door closes and oven heats to pre-set temperature—70°C.



The Hy-Fl$_2$

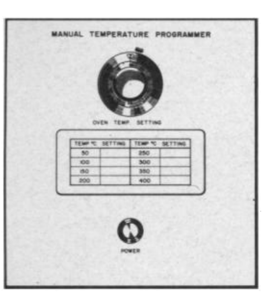
The Hy-Fl$_2$, a big brother to the popular Hy-Fl 600-C, is a single column instrument which adapts perfectly to the three common ionization detectors and to the four-filament Thermal Conductivity detector.

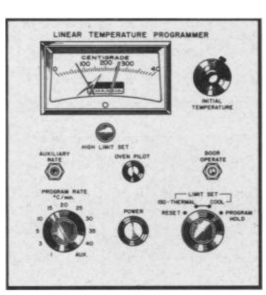
Hy-Fl$_2$ Dual Channel

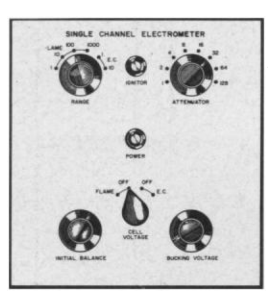
A further interesting option incorporates both flame and electron capture detectors. With this combination the column effluent is divided by a stream splitter to feed both detectors. The signals from both detectors are amplified by a two-channel electrometer which in turn operates a two-pen recorder. A striking trace of peppermint oil was made with this equipment. Many peaks were exhibited by electron capture which were not detected by the flame because of their low concentration. Please write for details.

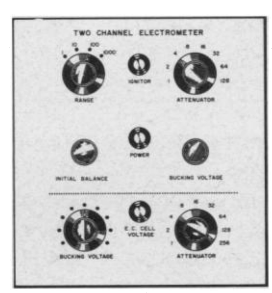
BONUS FEATURES

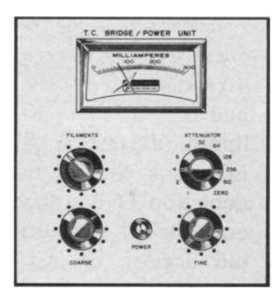
- Separate detector oven, heats to 400°C.
- 2″ injector, stainless, separately heated.
- Variable power and thermocouple plug for auxiliary injection equipment.
- Stainless column oven, heats 40°C/min.
- Sample collection—capillary, with Flame Det.
- Carrier gas flow controller with long, tapered needle valve.











Manual Temperature Programmer — This unique controller supplies constant power to the column oven, by a solid-state electronic, adjustable power controller (APC) and multi-turn pot.

Linear Temperature Programmer—This programmer is completely electronic with no gears, motor or clutch. It programs at 10 precise rates. A matrix plug permits any additional rates.

Single Channel Electrometer — This high impedance electrometer used with single ionization detectors features 100% feedback, decade and binary attenuation and buckout control.

Two Channel Electrometer—This electrometer, with flame and electron capture combination, is actually two electrometers with one common power supply. It features 100% feedback and buckout on each channel.

Bridge-Power Supply — This 12 or 20 volt solid-state bridge and power supply module is used in conjunction with 4-filament T.C. detectors. It is interchangeable in the Hy-Fl$_2$, 202 or 1520.

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gave evidence of long-lived effects presumably due to radioactive debris. The effects were to increase the attenuation on the long great circle path so that for 8 to 12 days the diurnal variation of phase was that to be expected for signals which were received only over the short great circle path.

One surprising feature of the symposium was that several authors utilized observations which were originally made in 1922 as a source of data on the variations of very-low-frequency field strength with respect to distance. Although this should be taken as a compliment to that work, it also points out the necessity for new high quality measurements in this area.

The symposium was sponsored by the Central Radio Propagation Laboratory of the National Bureau of Standards. It is expected that a selection of the presented papers will be published in the Jan.-Feb. 1964 issue of Section D (Radio Propagation) of the *NBS Journal of Research.*

D. D. CROMBIE
Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado

Radioiodine: Its Nature and Effects

Radioiodine-131 is considered one of the most significant fission product elements because of its abundance in early fallout and in the gaseous effluent of certain nuclear industries, its high inventory in irradiated reactor fuels, its chemical, physical, and physiological characteristics, and its widespread use in clinical and therapeutic medicine. All these factors were considered at a symposium held at the Hanford Laboratories, Richland, Washington (17–19 June). In addition to the 75 Hanford scientists about 150 visiting researchers from Belgium, Canada, France, India, Japan, United Arab Republic, the United Kingdom, and West Germany attended.

Historically, the thyroid gland, which concentrates a substantial portion of any administered dose of iodine, was considered a radioresistant structure. Following reports of increased incidence of thyroid tumors in children as a consequence of exposure to x-irradiation early in life, the Federal Radiation Council recommended that a thyroid radiation dose to the general population from I^{131} in excess of 0.5 rem per year should call for some control measures. H. D. Bruner pointed out that the 0.5-rem dose has thus become a limiting case for normal peacetime operation.

The principal emphasis during the symposium was on the sources of radioiodines, their relative concentrations in the air-plant-cow-milk-man (child) cycle, and their possible effects. Principal subject areas were reviewed by leading scientists and each review paper was followed by reports of unpublished work from many laboratories.

In his review on the origin and disposition of radioiodine, J. Z. Holland (USAEC Division of Biology and Medicine) compared the relative biological significance of the several radioisotopes of iodine and concluded that even in cases of heavy environmental contamination with the shorter-lived radioiodines, the delays in the food chain would tend to reduce their relative importance with the result that longer-lived I^{131} is of unique importance. He pointed out that one may expect extreme irregularity in I^{131} distribution following a release incident. This results from the interaction of its relatively high abundance and short half-life with the bouyant rise imparted by the releasing event and the atmospheric eddies and rain clouds that act over periods of a few hours to days. Additional complications are introduced by the behavior of iodine precursors during release and by the chemical behavior of iodine. Iodine reacts with many materials, including many trace substances in the atmosphere, and it is readily oxidized and reduced through a wide range of valence states. The only conclusion which could be drawn at the present time regarding the partitioning of I^{131} between vapor and particulates, soluble and insoluble forms, and among elemental, reduced, and oxidized states is that none is clearly dominant over any great range of conditions.

L. Machta explained that three meteorological mechanisms can probably explain all incidents since September 1961 of higher-than-normal I^{131} levels in the milk surveillance network of the Public Health Service; these mechanisms are: low altitude transport of debris from atmospheric and vented underground tests in Nevada; subsidence within an anticyclone; and rainout of debris moving in the troposphere or even in the lower stratosphere.

The importance of grazing animals was stressed in relation to the biological disposition of radioiodine. The principal route of I^{131} into man appears to be by means of milk from dairy cows which graze in contaminated pastures. In this regard, it was reported by C. P. Straub that in a cooperative endeavor of the U.S. Public Health Service and the St. Louis Health Department, lesser amounts of I^{131} appeared in the milk from cows grazing in well-fertilized pastures. No appreciable contamination of milk with radioiodine was observed when stored hay and grain were fed to dairy cattle. Grazing animals, L. Van Middlesworth concluded, are very good early indicators of radioiodine contamination in the biosphere because they consume large amounts of exposed feed per gram of thyroid. Merrill Eisenbud predicted that for the foreseeable future direct measurements of the radioiodine content of milk would be the indicator of choice when it is necessary to appraise the public health significance of environmental contamination by I^{131}.

In predicting the hazard of I^{131}, it is important to know the concentration ratios along the food cycle from air to milk to man. A number of useful relationships were reported. Under conditions of continuous low-level release: [(picocuries/kg grass)/(picocuries/m^3 air) = 4000 and [(picocuries/ liter milk)/(picocuries/kg grass)] = 0.1. The ratio of peak concentrations after a single contamination event involving I^{131}, taking as unity the thyroid of a human subject (on day 14) who had drunk milk daily, were: cow's total feed on day one, 400; cow's thyroid on day seven, 280; and cow's milk (per liter) on day four, 1.6. Considerable variation occurs, however, in the amount of I^{131} in the milk of different cows and the same cow at different seasons of the year. Milk from a cow labeled with radioiodine or a water solution of I^{131} resulted in comparable uptakes when fed to both man and animals.

R. J. Garner (Harwell) reviewed the effects of radioiodine and stressed the radioresistance of the thyroid gland of domestic animals; doses in excess of 5000 rads to the thyroid are required before any sign of damage may be expected. I. Doniach (London Hospital) reported that various investigators show a similarity in the biological action of x-rays and I^{131} on the thyroid. In the measurement of four different long-term effects, 1000 rads from x-rays has a similar quantitative effect to a calculated mean dose of about 10,000 rads from I^{131}. This is somewhat less than the 20-fold greater effectiveness of x-rays compared with I^{131} which was deduced from early changes with these two forms of exposure in sheep. S. Lindsay concluded that thyrotropic stimulation after subtotal thyroidectomy is a promoting factor in the development of both benign and malignant thyroid neoplasms in the rat and that it may also initiate the development of some malignant neoplasms. In an extension of these findings in animals, E. L. Saenger and co-workers reviewed the available data on the carcinogenic effects of I^{131} compared with x-irradiation in man. These workers concluded that thyroid carcinoma may develop rarely with x-ray doses of 2000 to 6000 r after a latent period of 10-to-35 years and that it is probable that x-ray doses of 100 r or greater to children's thyroids will increase the incidence of carcinoma. Irradiation of the adult thyroid with I^{131} cannot as yet be implicated as a carcinoma-causing mechanism. However, doses of I^{131} in children seem to increase the susceptibility of their thyroids to neoplastic change. According to Saenger and associates, the carcinogenic dose level of I^{131} for a child may not be below 600 rads, considering the differing dose rate between I^{131} and x-rays, fractionation of dose, and irregular distribution.

In a review of the important area of prophylactic and therapeutic measures for radioiodine contamination, F. W. Lengemann pointed out that the best policy is to prevent the entrance of I^{131} into the food chain since this is apparently the major avenue of contamination for those not occupationally exposed. Because milk appears to be the chief vector of I^{131} in the United States and some other countries, he proposed four means of limiting the access to the food chain by means of milk: (i) elimination of milk from the diet, (ii) use of ion-exchange columns to remove radioiodine, (iii) feeding of stored feed to milk-producing animals, and (iv) the substitution of stored milk or milk products for fresh milk. An added consideration was the use of thyroid-blocking agents at a number of places in the feed-milk-man cycle. In this regard, it was suggested that increasing the stable iodine in the feed of a dairy

cow could reduce thyroid uptake by 50 to 80 percent in a person drinking such milk.

A highlight of the symposium was a very stimulating speech in which E. E. Pochin (University College Hospital, in London) posed the question: *What is a permissible dose?* "Perhaps it is more reasonable to look at what is a permissible risk," he said, and went on to cite some interesting comparative levels of risk in established industries today, based on fatal accidents per year or per million people employed. On such a basis, the nuclear industry ranks among the safest. "Although we still have a great deal to learn about quantitation of risks in radiation exposure," Pochin stated, "we have even further to go in attempting to estimate quantitatively the benefits that may be associated with any procedure involving radiation exposure." Pochin went on to say that the attempt to set radiation protection levels on a quantitative basis is a very necessary, but very ambitious undertaking. Many of the difficulties and also criticisms arise simply from the fact that no comparable attempt is being made to deal as quantitatively with many of the other hazards of life or work. This, in fact, may be one of the greatest values of radiation protection work—it may extend the practice of hazard evaluation into other fields and there promote studies of the justification for risks on a factual basis.

Shields Warren was the honorary general chairman of the symposium, and the session chairmen were S. A. Lough and H. D. Bruner (U.S. Atomic Energy Commission), A. H. Wolff (U.S. Public Health Service), B. M. Dobyns (Cleveland Metropolitan General Hospital), E. E. Pochin (University College Hospital Medical School, London), Stuart Lindsay (San Francisco Medical Center at the University of California), and C. L. Comar (Cornell University).

The symposium was under joint sponsorship of the U.S. Atomic Energy Commission and the Hanford Laboratories of General Electric Company; this work was performed under contract No. AT(45-1)-1350 between these two organizations. The proceedings will be published as the December 1963 issue of the *Health Physics Journal*.

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Forthcoming Events

November

1–2. Central Soc. for **Clinical Research**, Chicago, Ill. (J. F. Hammarsten, VA Hospital, 921 E. 23 St., Oklahoma City, Okla.)

2–6. American Soc. of **Anesthesiologists**, Chicago, Ill. (J. W. Andes, 515 Busse Highway, Park Ridge, Ill.)

3–4. Italian Soc. for **Nuclear Biology and Medicine**, 8th congr., Pisa, Italy. (P. Bastai, Clinica Medica, Pisa)

4–6. **Neuro-endocrinology**, seminar, Algiers, Algeria. (J. P. Guitray, Neuro-endocrinology Seminar, Mustaph Maternity Hospital, Algiers, Algeria)

4–7. Inter-governmental Committee for the **World Food** Program, Rome, Italy. (Office of the Director General, Food and Agriculture Organization, Viale delle Terme di Caracalla, Rome)

4–8. **Electronics in Management**, 10th inst., Washington, D.C. (M. M. Wofsey, Center for Technology and Administration, American Univ., 1901 F St., NW, Washington, D.C.)

5–7. **Carbides in Nuclear Energy**, Harwell, England. (L. E. Russell, Metallurgy Div., AERE, Harwell, Didcot, Berks, England)

5–10. Tokyo Intern. **Book Exhibition**, 5th, Tokyo, Japan. (A. P. Wales Organization, 18 Charing Cross Rd., London, W.C.2, England)

5–13. Pan-Pacific **Surgical** Assoc., 9th congr., Honolulu, Hawaii. (F. J. Pinkerton, Pan-Pacific Surgical Assoc., 230 Alexander Young Bldg., Honolulu 13)

5–13. **Tropical Meteorology**, symp., Rotorua, N.Z. (World Meteorological Assoc., 41, avenue Giuseppe Motta, Geneva, Switzerland)

6–7. American **Standards** Assoc., Philadelphia, Pa. (ASA 10 E. 40 St., New York 16)

6–8. **Diffraction**, 21st conf., Pittsburgh, Pa. (W. M. Biagas, Crucible Steel Co. of America, P.O. Box 7257, Pittsburgh 13)

6–8. Mid-Continent Council of **Geological** Soc., biennial meeting, Oklahoma City, Okla. (American Assoc. of Petroleum Geologists, 1444 South Boulder, P.O. Box 979, Tulsa, Okla.)

6–8. American Assoc. of **Petroleum Geologists**, mid-continent regional meeting, Oklahoma City, Okla. (U. R. Laves, 2309 Liberty Bank Bldg., Oklahoma City)

6–9. **Acoustical** Soc. of America, Ann Arbor, Mich. (ASA, 335 E. 45 St., New York 17)

6–9. **Plasma Physics** Div., American Physical Soc., San Diego, Calif. (A. Simon, General Dynamics Corp., P.O. Box 608, San Diego 12)

7–8. **Operations Research** Soc. of America, 24th natl., Seattle, Wash. (ORSA, Mt. Royal and Guilford Ave., Baltimore 2, Md.)

7–8. American Soc. for **Quality Control**, 7th technical conf., St. Paul, Minn. (W. P. Youngclaus, 161 West Wisconsin Ave., Milwaukee 3, Wis.)

7–9. American Soc. of **Cytology**, 11th annual, Columbus, Ohio. (W. R. Lang, 1012 Walnut St., Philadelphia 7, Pa.)

7–9. **Industrial Research** Inst., Hot Springs, Ark. (IRI, 100 Park Ave., New York 17)

8. Advances in **Tracer Methodology,** 8th symp., Chicago, Ill. (P. A. McNulty, New England Nuclear Corp., Boston 18, Mass.)

8–9. American **Psychiatric** Assoc., New York State District, New York, N.Y. (E. Shapiro, 43 Andover Rd., Rockville Center, N.Y.)

8–10. **Nuclear War** Inst., West Baden Springs, Ind. (Communications Dept., West Baden College, West Baden Springs)

8–10. **Tetanus,** intern. conf., Bombay, India. (J. C. Patel, K.E.M. Hospital, Parel, Bombay)

11–12. **Fluid Mechanics,** Soc. for Natural Philosophy, Pittsburgh, Pa. (B. D. Coleman, Mellon Inst., Pittsburgh)

11–15. Yale **Industrial Forestry** Seminar, 21st, Berkeley, Calif. (Z. W. White, Yale School of Forestry, 205 Prospect St., New Haven 11, Conn.)

11–15. **Permafrost;** 1st intern. conf. on problems of the earth's frozen land masses, Lafayette, Ind. (C. T. Grimm, Bldg. Research Advisory Board, NAS–NRC, 2101 Constitution Ave., NW, Washington, D.C.)

11–15. American **Public Health** Assoc., 91st annual, Kansas City, Mo. (APHA, 1790 Broadway, New York, N.Y.)

11–15. Physics and Material Problems of **Reactor Control Rods,** Vienna, Austria. (IAEA, Kärntner Ring 11, Vienna)

11–15. **Reliability Engineering** and Management, inst., Tucson, Ariz. (J. F. McKinley, Div. of Continuing Education, Univ. of Arizona, Tucson)

11–16. **Engineering Materials and Design,** conf. and exhibition, London, England. (Industrial and Trade Fairs, Ltd., Commonwealth House, 1–19 New Oxford St., London, W.C.1)

12–14. Joint **Computer** Conf., Las Vegas, Nev. (P. M. Davies, Abacus, Inc., 1718 21st St., Santa Monica, Calif.)

12–14. Technical Assoc. of the **Pulp and Paper** Industry, 14th testing conf., New Orleans, La. (P. E. Nethercut, 360 Lexington Ave., New York 17)

12–14. **Severe Storms,** 3rd conf., Urbana, Ill. (American Meteorological Soc., 45 Beacon St., Boston 8, Mass.)

12–15. **Magnetism** and Magnetic Materials, 9th conf., Atlantic City, N.J. (W. D. Doyle, Franklin Inst. Laboratories, 221 N. 21 St., Philadelphia 3, Pa.)

13–14. American College of **Preventive Medicine,** Kansas City, Mo. (R. E. Coker, Jr., Univ. of North Carolina, Chapel Hill)

13–15. Eastern **Analytical** symp., 5th, New York, N.Y. (R. F. O'Connell, Sperry Rand Research Center, Sudbury, Mass.)

13–16. American **Medical Women's Assoc.,** San Antonio, Tex. (AMWA, 1790 Broadway, New York 19)

14–15. **Chemical Engineering,** 20th symp., College Park, Md. (ACS, 1155 16th St., NW, Washington, D.C.)

14–21. **Measurement, Control, Regulation and Automation,** 2nd intern. congr., Paris, France. (MESUCORA, 40, rue de Colisée, Paris 8)

15–16. **Cineradiology,** 4th symp., Rochester, N.Y. (S. M. Rogoff, Div. of Diagnostic Radiology, Univ. of Rochester Medical Center, Rochester 20)

15–16. International Soc. of **Dental Surgeons,** Las Vegas, Nev. (E. Altshuler, 6043 Hollywood Blvd., Los Angeles, Calif.)