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Letters

Nuclear Tests

I cannot conceal my disappointment, even shame, on reading the pious platitudes of our Council's Resolution on Control of Nuclear Weapons Tests, printed in the issue of 16 January [*Science* **129**, 137 (1959)]. One might rather have expected such a resolution from an association of scientific civil servants, too terrified of losing their jobs to risk offending Dulles and the Atomic Energy Commission. An embarrassed silence would have been preferable to this type of sickening hypocrisy.

Instead of emitting "profound hope that the Geneva Conference negotiations will prove successful," the Council might well have told the world in a clear, straightforward way (i) whether they consider that nuclear bomb test explosions constitute a probable danger to the future of our species; (ii) whether they favor discontinuance of such explosions (that is, *yes* or *no*); (iii) whether they are alarmed at the present situation in which two armed, cynical, irresponsible, and dishonest giants are daily threatening each other and the rest of the world with total destruction; and (iv) how the international scientific community can bring pressure to bear on Tweedledum and Tweedledee to restore calmness and sanity where it is most needed.

J. Gordin Kaplan
Department of Physiology, Dalhousie University, Halifax, Nova Scotia

Beneficiation of Soils Contaminated by Strontium-90

I have read with surprise and concern W. F. Libby's report [*Science* **128**, 1134 (1958)] on his experiments which were made, as he says, to test two proposals: (i) that the addition of sulfates to contaminated soils might be helpful in making strontium unavailable for plant nutrition, and (ii) that potassium might have a considerable beneficial effect with respect to absorption of radiostrontium.

I will attempt to justify my surprise on purely technical grounds, for what Libby refers to in his report are not experiments but, at best, "high spot tests," which could not, on any grounds, allow one to arrive at valid conclusions.

The soil is such a complex system that it must be fully characterized before one can undertake to do anything with it. To say that the soil used was taken from a garden in Washington, D.C., and that it had an exchange capacity of 32 milliequivalents per 100 g is utterly useless, if this information was intended to help the scientific reader interpret the sig-

nificance of the pot tests. Since we should be interested in facts, I would have preferred to see a minimum of basic information on: (i) the ion components of the exchange capacity, particularly K^+, Ca^{+2}, NH_4^+, and Na^+; (ii) the ease of availability of the "native potassium," both by actual chemical tests and by plant growth tests, and (iii) an analysis of the soluble and insoluble sulfates.

This information would have contributed greatly to understanding the significance of Libby's initial additions of the potassium and strontium salts in amounts of about 1 percent of the total exchange capacity of the soil mass used per pot. The lack of this type of information is perhaps understandable, for it still appears to be the exclusive property of that breed of men known as soil scientists.

The tests themselves were faulty, because their design ignored some basic characteristics of the experimental material and disregarded some elementary principles of experimentation.

The soil cannot be treated as if it were a chemical reagent, for, above all, it is a complex entity with its essential characteristics of variability and a sensitive ability to change with the treatments given, and with environment. To control this inherent variation, an essential part of any experimentation with a soil is replication—not just duplication, as is customarily done in a simple titration, but, say, from three to five repetitions for each treatment. Moreover, these treatments should be laid out in accordance with a design that will strengthen the scientist's chances of beating nature!

Libby's claims, I would assume, must be based on a subconscious acceptance of the findings obtained by Peech, Bradfield, Reitemier and others. His data could not support any of his conclusions.

The use of the ABCD type of tests to arrive at conclusions which have a direct bearing on the health of all mankind should be a question of great concern to all responsible people. I was delighted to read front-page newspaper reports about "Dr. Libby's solution of Sr^{90} fallout by adding to the soil potassium fertilizers," only to find out later, with great disappointment, that the claims were totally unwarranted. But, alas, public opinion has been given one more pill of relief.

L. A. Romo

945 Savitt Place,
Union, New Jersey

The recent report by W. F. Libby demonstrates a surprising lack of information on matters that are relatively well known to biologists. It has been known for at least a quarter of a century that potassium in the soil reduces the uptake of calcium, and, since calcium and strontium are so closely related, it

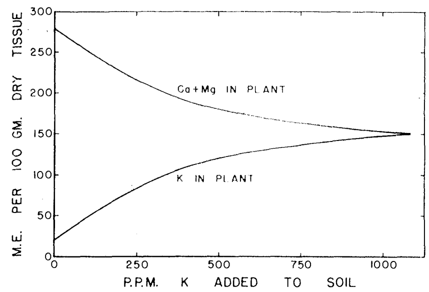

Fig. 1. Ion content of tomato plants as a function of potassium added to soil. [From data of D. R. Hoagland and J. C. Martin, *Soil Sci.* 36, 1 (1933); redrawn by D. R. Hoagland.]

would seem obvious that added potassium would reduce strontium uptake from soil. See Fig. 1, which is slightly modified from one that was published in 1933.

Would it be too much to suggest that the Atomic Energy Commissioners, when confronted with botanical problems, might employ a botanist?

Kenneth V. Thimann
Bruce B. Stowe

Harvard Biological Laboratories,
Cambridge, Massachusetts

I have read with disappointment L. A. Romo's criticism of my article, "Beneficiation of soils contaminated with strontium-90: beneficial effects of potassium." I know well how incomplete the work is, but I hope it has more scientific value than Romo finds in it. Perhaps its best value will be to encourage further research into what is a very important practical problem. The extensive research on radioactive fallout which has been conducted during the past years shows that the type of work I tried to do is urgently needed.

Thimann and Stowe are correct in questioning my knowledge of botany, but I hasten to assure them that the Atomic Energy Commission does employ very capable botanists. It is true, of course, that the effect of potassium on calcium uptake by plants has long been known. The corresponding effect on strontium has not been established so firmly, however, especially for the very low concentrations resulting from radioactive fallout on acid soils.

I hope the work has more merit than the tone of these letters indicates. The problem is a very important one for civilian defense, and it was only after failing to persuade professionals to undertake it that I made this attempt.

I hope Romo and Thimann and Stowe will turn to and do a better job for us all.

W. F. Libby

Atomic Energy Commission,
Washington, D.C.

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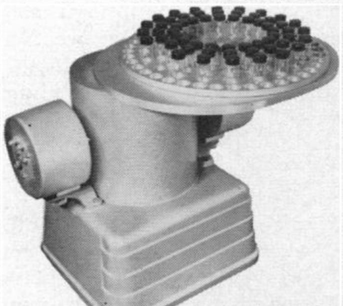

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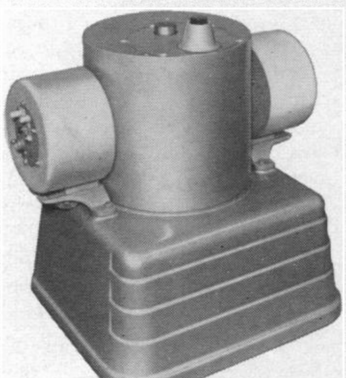

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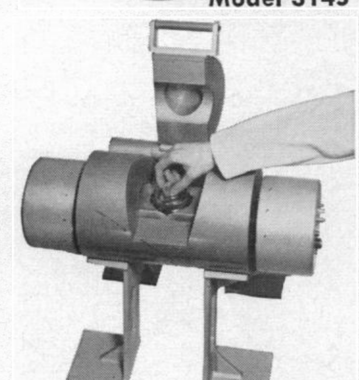

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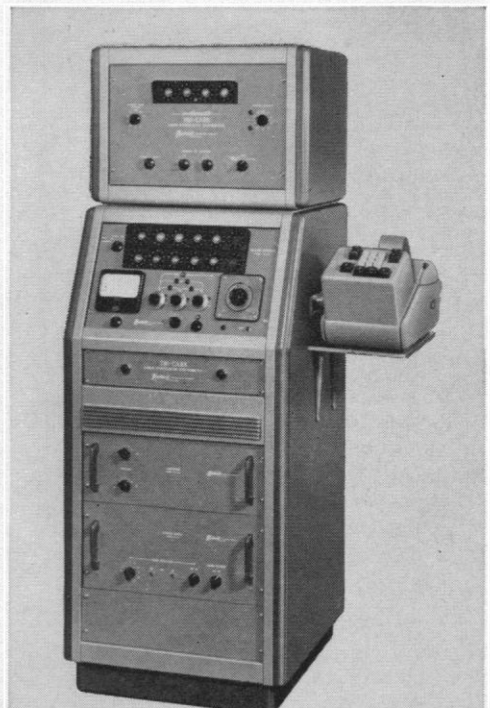

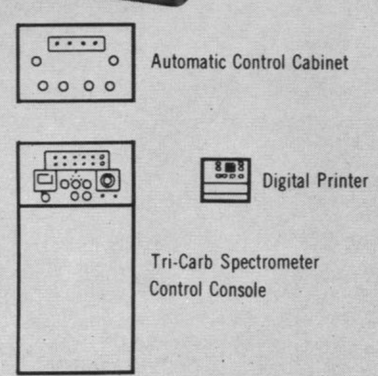

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Meetings

Space Science

Astronomers have for a long time known that interplanetary space is not completely empty and that the skies are not as still and serene as they seem to the poet. It comes as an exciting revelation of the first few satellites and rocket flights that space is filled with dynamic physical and chemical phenomena, some of which had not been accessible to direct observation. Physical phenomena found in space, the principles of rocketry, space biology, and space medicine were discussed in detail at a symposium held in San Antonio, Tex., on 10–12 November 1958. The symposium, the 2nd International Symposium on the Physics and Medicine of the Atmosphere and Space, was sponsored by the School of Aviation Medicine of the U.S. Air Force University. The staff of the Southwest Research Institute was responsible for the arrangements and will also edit the papers, which are to be published in book form. Over 600 scientists and many scientific leaders of government agencies attended the 42 invited presentations.

Otis O. Benson, Jr., introduced the symposium, on the note that physical and biological sciences must work hand in hand in the conquest of space. The discussions may be divided into the following categories: (i) interplanetary physics and chemistry: pressure, temperature, and chemistry of the interplanetary space; electromagnetic and ionization properties of interstellar matter; meteorites and cosmic rays; (ii) factors in space of importance to biology and medicine: gravitational environment, acceleration and weightlessness; biological effects of primary and secondary cosmic rays; time and the relativity theory; (iii) satellite physics and engineering: methods and limitations of chemical and nuclear rocket propulsion; problems in launching, tracking and reentry; manned orbital and lunar vehicles and the "rocket booster glider"; (iv) human factors: the ecology and physiology of sealed cabins; gas exchange, photosynthesis, metabolism, limits of perception, stress and adaptation, psychological problems; human tolerance to acceleration, weightlessness, vibration, temperature, and radiation; (v) problems of escape and rescue in space operations; (vi) solar and planetary environments: physics of the solar, lunar, and planetary surfaces; the possibility of life on planets and survival of living cells under simulated Martian conditions.

An intense new component of cosmic radiation was discovered from data provided by Explorer I by James Van Allen and his group, working at the University of Iowa. This radiation is most intense above the magnetic equator and is much less intense near the poles. The radiation appears to consist of two belts of charged particles, trapped by the magnetic field of the earth, which form a giant magnetic bottle akin to those which are being studied in the laboratory for hydrogen fusion. The charged particles, electrons or protons or both, spiral around the magnetic lines of force and seem to be accelerated to considerable energies. The new component is first found at an altitude of about 600 kilometers, where the particle flux starts to increase by a factor of about two for each 100 kilometers of altitude. Its maximum intensity is reached at about two and one-half earth radii (about 16,000 kilometers), where the dose is as much as 3 to 5 roentgens per hour. At ten earth radii the dose rate drops to 0.2 roentgen per hour.

Several physicists have given theoretical explanations for the radiation belt. According to the model of S. Fred Singer of the University of Maryland, the primary cosmic-ray particles, high-energy protons, helium ions, and light nuclei are responsible for maintaining the radiation level. Near the top of the atmosphere the primaries undergo inelastic collisions. Some of the neutrons are thermalized and escape. Eventually these decay into protons, electrons, and neutrinos. It is assumed that the charged products of neutron decay make up at least part of the radiation belt.

Another explanation is that the particles possibly originate in the sun and travel in ionized magnetic clouds. When these clouds collide with the magnetic field of the earth, exchange of the particles can take place. Crucial to these theories are observations of energy, time, and spatial variation of the rays; additional data are being obtained.

The heavy-ion primaries, which we have known since their discovery by the Minnesota cosmic ray group about 10 years ago, were discussed by Herman J. Schaefer of Pensacola, Fla. The intensity of these particles is low, but they produce very heavy ionization tracks unlike those known to radiobiologists. The heavy-ion primaries are associated with solar events, and it is anticipated that during large solar flares there may be as much as a 1000-fold increase in the low-energy end of the spectrum.

It is fortunate that some knowledge already exists, from work at the 184-inch cyclotron of the Lawrence Radiation Laboratory, about the nature and severity of biological effects of high-energy protons, deuterons, and alpha particles. In addition, there are new heavy-ion linear accelerators both at Berkeley and at Yale University that have accelerated beams of several heavier ions with about 10-Mev energy per nucleon. Some biological studies on unicellular organisms and animal skin have been in progress for a year. Further reports on cosmic ray effects were made by Jakob Eugster of Zurich, who made studies at sea level, high altitudes, and underground, and by J. E. Pickering of Randolph Field, who estimated some "permissible dose levels" for pioneer space fliers. Cosmic rays present definite hazards for the future space flier. However, the radiation belt can be avoided by selecting low or polar orbits, and it is conceivable that it will be possible to shield against it, at the same time cutting out the low-energy heavy primaries.

Fred L. Whipple of Harvard University described our knowledge of meteoritic material in space. The larger fragments originate in meteoritic zones of the solar system and are quite rare; interplanetary dust contains tiny particles originating from comets and ending up on the sun or on the planets. Dust counts from Russian and American satellites indicate that perhaps 3000 tons of dust fall on the earth daily. Falling through the atmosphere, the tiny particles may then act as condensation centers for rain and are thus a factor in meteorology.

John W. Townsend of the U.S. Naval Research Laboratory explained that at very high altitudes the air density is much higher than had been previously expected. A small portion of the solar corona appears to extend down to the earth. Hans Clamann of the School of Aviation Medicine and Marcel Nicolet of the Royal Meteorological Institute of Belgium discussed the chemistry of the upper atmosphere. Under the influence of sunlight the very noxious gas ozone forms. Ozone protects life at the surface of the earth from short-wave ultraviolet rays of the sun, which would otherwise be absorbed by nucleic acids and proteins and could be lethal. At altitudes above 100 kilometers, the air molecules ionize and dissociate. Free electrons and a variety of radical species appear—combinations of atoms N, O, and H. Whether or not thermal equilibrium is established at very low pressures is being questioned. There is an interaction between photochemical reactions and intermolecular action involving diffusion and collisions. At an altitude of 1000 kilometers, half of all molecular species are ions.

Walter Dieminger of the Max Planck Institute of Aeronomy, Göttingen, Germany, discussed the propagation of electromagnetic waves in the upper regions of the atmosphere. If the wavelength is below 5 meters, the atmosphere is quite transparent. Longer wavelengths are reflected and bent by the electron layers. The Russian satellites obtained particularly useful data in this field: the bending of the signals from the sputniks was correlated with electron density.

Thorough and detailed exposition was given to various phases of rocket engineering aimed at putting man into space. There is no doubt that existing rocket-propulsion systems are capable of lifting man into orbit. These were discussed by B. A. Schriever, U.S. Air Force. L. R. Shepherd, chairman of the council of the British Interplanetary Society, claimed that atomic propulsion may extend rocket capability to any place in the solar system. The most promising nuclear systems are reactor-heat exchanger, ion propulsion, and nuclear fusion. Many interesting phases of launching, tracking, cabin design, and reentry were discussed, by Wernher von Braun, Ernst Stuhlinger, Dean Chapman, and Krafft Ehricke, respectively. R. Wellner of the Bell Aircraft Corporation discussed the space plane or "rocket booster glider." A whole morning was devoted to the problem of emergency escape and rescue from a space vehicle, with discussions by P. A. Campbell, R. M. Stanley, Krafft Ehricke, N. V. Pedersen, and A. M. Mayo. Members of the staffs of the School of Aviation Medicine, the Wright Aero Medical Center, and the Lovelace Foundation—namely, R. T. Clark, G. R. Steinkamp, G. R. Hauty, S. J. Gerathewohl, W. R. Love-

lace, II, and J. P. Stapp—reported on parameters of human adaptation and stress, including factors such as anoxia, acceleration, weightlessness, heat, diurnal variation, and psychological stress. These studies, as well as the statement of Scott Crossfield, famous test pilot and design specialist, make it appear that, when the time comes, people will be available who can cope with the stress of orbital flight.

If man is to spend considerable time in interplanetary space or on a planet, he will have to take part of his environment along. He will have to produce on a small scale an ecological cycle comparable to that which now exists between plants, animals, and man on earth. This intricate problem was discussed by Jack Myers of the University of Texas and H. G. Clamann of the School of Aviation Medicine. The final solution should bring much greater insight into the science of bioecology than we now have.

A number of distinguished astronomers discussed the physics of the sun and the environment on the surface of the planets. Walter Orr Roberts of the University of Colorado discussed the role of sunspots and solar flares in terrestrial weather. G. P. Kuiper of the Yerkes and McDonald observatories showed the best photographs of the lunar surface yet made. Gerard de Vaucouleurs of Harvard University cited evidence for "life" on the planet Mars: infrared spectra obtained from scattered infrared rays from light and dark areas of the planet, which resemble spectra obtained from lichens. The problem of extraterrestrial life and of the origin of life is a very fascinating one which interests some of the most outstanding bioscientists. John D. Fulton of the School of Aviation Medicine simulated Martian atmosphere, soil, moisture, and temperature conditions in his laboratory and found three different microorganisms which were still capable of multiplying. Further work, in the presence of solar radiation, is needed. Hubertus Strughold, the first professor of space medicine and the originator of many basic concepts of space biology, discussed the interactions of the gravitational fields of the sun, earth, and moon.

Many basic biological questions remained necessarily unanswered at the conference, among them that of the exact nature of life elsewhere in the solar system. When experiment can answer these questions, then the scope of our knowledge of life processes will be greatly widened. For nature is far more resourceful than we can imagine, and life may originate, exist, or adapt itself to environments in greater richness of forms than we know.

CORNELIUS A. TOBIAS
Donner Laboratory,
University of California, Berkeley

Differentiation

The Roscoe B. Jackson Memorial Laboratory, in celebration of its 30th anniversary, will hold a symposium 15–17 June at Bar Harbor, Me., on "Some Problems of Normal and Abnormal Differentiation and Development." Attendance will be limited to 100. Application should be made *not later than 15 April,* to: Dr. Nathan Kaliss, Symposium Chairman, Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Me.

Laurentian Hormone Conference

The 1959 Laurentian Hormone Conference of the AAAS will be held at Mont Tremblant Lodge, Mont Tremblant, Quebec, between 30 August and 4 September. Investigators interested in attending this conference should make application to the Committee on Arrangements of the Laurentian Hormone Conference, 222 Maple Ave., Shrewsbury, Mass., at an early date and in any event no later than *11 May.*

A conference rate of $13 per day per person is extended to all invited partici-

pants. Since the number of participants is necessarily limited by available accommodations, all applications are screened and invitations to attend are issued by the Committee on Arrangements by 12 June.

Biophysics

Yale University will sponsor a conference on opportunities in biophysics research on 29 June–3 July at the J. W. Gibbs Laboratory under a grant from the National Science Foundation. The conference will be directed by E. C. Pollard, chairman of the biophysics department, with the assistance of Harold J. Morowitz.

During the last 18 months, visiting physicists have repeatedly pointed to the importance of providing research opportunities in physics in the smaller colleges. Physicists situated in these institutions need encouragement and assistance in carrying on small-scale, but significant research. Opportunities for research are often as important as the salaries offered in attracting competent young physicists to the staffs of colleges.

The Yale conference will review opportunities for college physicists in biophysics research. Other universities are considering similar conferences in other areas of physics.

Participants in the conference will receive stipends at the rate of $15 per day and travel allowances at the rate of about 4 cents per mile. Approximately 30 participants can be accommodated. The major criteria for their selection will be interest in conducting some form of research in biophysics, tenure of a teaching position in a small institution where expensive research equipment in physics would be hard to come by, and an advanced degree in physics. Inquiries about the conference should be directed to Professor E. C. Pollard, Department of Biophysics, Yale University, New Haven, Conn.

Wistar Institute Symposium

At the Symposium on the Structure of Science that will be held in Irvine Auditorium at the University of Pennsylvania, 17–18 April, national and international figures in science will suggest some possible directions for future scientific thought and activity. The symposium accompanies the formal opening of new laboratories and a new museum at the Wistar Institute of Anatomy and Biology in Philadelphia.

Senator Lister Hill of Alabama and LeRoy Burney, surgeon general of the U.S. Public Health Service, will join with physicists, philosophers, mathematicians, chemists, biologists, and research institute officials from the United States, Canada, England, and Sweden as speakers at the symposium.

Forthcoming Events

May

3. American Federation for Clinical Research, annual, Atlantic City, N.J. (G. E. Schreiner, Georgetown Univ. Medical Center, Washington 7.)

3. Periapical Lesions-Pacific Coast Oral Pathology Workshop, 1st annual, Los Angeles, Calif. (W. Bullock, Dept. of Pathology, Univ. of Southern California School of Medicine, 1200 N. State St., Los Angeles.)

3–7. American Assoc. of Cereal Chemists, 44th annual, Washington, D.C. (J. W. Pence, AACC, Western Utilization Research Laboratories, Albany, Calif.)

3–7. Electrochemical Soc., Philadelphia, Pa. (Electrochemical Soc., Inc., 216 W. 102 St., New York 25.)

3–7. Electrode Processes, symp., Philadelphia, Pa. (Headquarters, Air Force Office of Scientific Research, Washington 25.)

3–7. Mechanical Properties of Intermetallic Compounds, Philadelphia, Pa. (J. H. Westbrook, General Electric Research Laboratory, P.O. Box 1088, Schenectady, N.Y.)

4. American Soc. for Clinical Investigation, annual, Atlantic City, N.J. (W. W. Stead, J. Hillis Miller Health Center, Gainesville, Fla.)

4–5. Microcirculatory Conf., 7th annual meeting, NIH, Bethesda, Md. (B. W. Zweifach, 550 First Ave., New York 16.)

4–7. American Geophysical Union, annual, Washington, D.C. (W. E. Smith, AGU, 1515 Massachusetts Ave., NW, Washington 5.)

4–7. National Instrumentation Flight Test Symp., 5th, Seattle, Wash. (H. T. Noble, Boeing Airplane Co., Flight Test Station, Wichita 1, Kan.)

4–8. American Soc. of Civil Engineers, Cleveland, Ohio. (W. H. Wisely, 33 West 39th St., New York 18.)

5–6. Association of American Physicians, annual, Atlantic City, N.J. (W. W. Stead, vice president, AFCR, J. Hillis Miller Health Center, Gainesville, Fla.)

5–6. Self-Organizing Systems, conf., Chicago, Ill. (S. Cameron, ICSOS Conference Secretary, Armour Research Foundation, 10 W. 35 St., Chicago 16.)

5–7. International Scientific Radio Union, spring meeting, Washington, D.C. (J. P. Hagen, National Acad. of Sciences, 2101 Constitution Ave., NW, Washington 25.)

5–9. Southwestern and Rocky Mountain Div., AAAS, Laramie, Wyo. (M. G. Anderson, New Mexico College of Agriculture and Mining, State College.)

5–12. Electronic Distance Measuring Equipment, Intern. Assoc. of Geodesy symp., Washington, D.C. (C. A. Whitten, Coast & Geodetic Survey, Washington 25.)

6–8. American Inst. of Chemists, Atlantic City, N.J. (L. Van Doren, American Inst. of Chemists, Inc., 60 E. 42 St., New York 17.)

6–8. American Pediatric Soc., Buck Hill Falls, Pa. (A. C. McGuinness, 2800 Quebec St., Washington 8.)

6–8. Metal-Binding in Medicine, symp., Philadelphia, Pa. (M. J. Seven, Hahnemann Medical College and Hospital of Philadelphia, 230 N. Broad St., Philadelphia 2.)

6–9. National Science Fair, 10th, Hartford Conn. (Science Clubs of America, 1719 N St., NW, Washington 6.)

6–10. Infectious Pathology, intern. cong., Milan, Italy. (A. Janussi, Secretary General, via Boccaccio 25, Milan.)

7–9. Midwestern Psychological Assoc., Chicago, Ill. (I. E. Farber, Dept. of Psychology, Univ. of Michigan, Ann Arbor.)

7–9. World Cong. on Agricultural Research, International Confederation of Agricultural Engineers and Technicians, Rome, Italy. (CITA, Regional Secretariat, 86, via Barberini, Rome.)

8–10. Uranium, 4th annual symp., Moab, Utah. (AIME, 29 W. 39 St., New York 18.)

9–11. International Soc. of Acupuncture, 10th cong., Paris, France. (SIA, 8 avenue Franklin Roosevelt, Paris 8e.)

10–15. Society of American Bacteriologists, St. Louis, Mo. (E. M. Foster, Univ. of Wisconsin, Madison 6.)