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.

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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 Inter-

metallic 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.)

10–14. American Soc. of Maxillofacial Surgeons, Chicago, Ill. (O. H. Stuteville, 700 N. Michigan, Chicago 11.)

11–12. Practical Problems of Coordinating and Integrating All Services Related to the Treatment, Training and Management of the Mentally Retarded, conf., Vineland, N.J. (J. D. Eadline, Training School, Vineland, N.J.)

11–13. Instrumentation and Computation in Process Development and Plant Design, symp., London, England. (Institute of Chemical Engineers, 16, Belgrave Sq., London, S.W.1.)

11–13. Microwave Theory and Techniques, natl. symp., Boston, Mass. (H. Pratt, Inst. of Radio Engineers, 1 E. 79 St., New York 21.)

11–13. Power Instrumentation, natl. symp., Kansas City, Mo. (H. H. Johnson, Consolidated Edison Co. of New York, Room 1515-S, 4 Irving Pl., New York 3.)

13–16. Human Biochemical Genetics, Ciba Foundation symp., London England. (G. E. W. Wolstenholme, Ciba Foundation, 41 Portland Pl., London, W.1.)

14–15. Operations Research Soc. of America, Washington, D.C. (H. J. Miser, Rt. 2, Box 211, Vienna, Va.)

14–16. Acoustical Soc. of America, Ottawa, Canada. (W. Waterfall, 335 E. 45 St., New York 17.)

14–17. American Acad. of Dental Medicine, 13th annual, Atlantic City, N.J. (H. A. Lentz, 619 Main Ave., Passaic, N.J.)

14–16. American Assoc. of Physical Anthropologists, Madison, Wis. (E. E. Hunt, Jr., Peabody Museum, Harvard Univ., Cambridge 38, Mass.)

17–20. American Inst. of Chemical Engineers, 40th natl., Kansas City, Mo. (F. J. Van Antwerpen, AICE, 25 W. 45 St., New York 36.)

17–21. American Ceramic Soc., 61st annual, Chicago, Ill. (C. S. Pearce, ACS, 4055 N. High St., Columbus 14, Ohio.)

17–21. Institute of Food Technologists, 19th annual, Philadelphia, Pa. (C. S. Lawrence, IFT, 176 W. Adams St., Chicago 3, Ill.)

17–23. Antibiotics, intern. symp., Prague, Czechoslovakia. (M. Heřmanský, Antibiotics Research Inst., Roztoky near Prague, Czechoslovakia.)

17–23. Mass Spectrometry, 7th, Los Angeles, Calif. (A. G. Sharkey, Jr., U.S. Bureau of Mines, 4800 Forbes Ave., Pittsburgh 13, Pa.)

18–20. Instrumental Methods of Analysis, 5th natl. symp., Houston, Tex. (H. S. Kindler, Director of Technical and Educational Services, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.)

19–23. American Assoc. of Mental Deficiency, Milwaukee, Wis. (N. A. Dayton, Mansfield State Training School & Hospital, Mansfield, Depot, Conn.)

20–22. Education of the Scientist in a Free Society, conf., Milwaukee, Wis. (A. B. Drought, College of Engineering, Marquette Univ., 1515 W. Wisconsin Ave., Milwaukee 3.)

21–23. American Assoc. for the History of Medicine, 32nd annual, Cleveland, Ohio. (Miss E. H. Thomson, Yale Univ. School of Medicine, New Haven, Conn.)

(See issue of 20 March for comprehensive list)

Equipment

The information reported here is obtained from manufacturers and from other sources considered to be reliable, and it reflects the claims of the manufacturer or other source. Neither Science *nor the writer assumes responsibility for the accuracy of the information. A coupon for use in making inquiries concerning the items listed appears on page 918.*

■ TUNING-FORK OSCILLATOR provides any frequency from 400 to 10,000 cy/sec without dividers or multipliers. The transistorized device has a frequency tolerance ± 0.005 percent over the range −55° to +125°C. Output is 5 v r.m.s. across a 10,000-ohm load with essentially sinusoidal waveform. Supply power requirement is 6 or 30 v. Dimensions are 1½ by 1½ by 2¼ in. (Delta-f Inc., Dept. 652)

■ INFRARED ANALYZER is designed to measure water content in liquid or gas process streams. The ratio of transmission at two wavelengths is measured. Interference filters are used to isolate the two wavelengths, and a photoconductor is used to detect infrared radiation. (Analytic Systems Co., Dept. 711)

■ RECORDER provides analog recording with frequency response 0 to 100 cy/sec and 10 channels of event recording. Eight chart speeds are remotely or locally selectable. Sequence response is up to 500 signal changes per second. Operation is on 120-v, 60-cy/sec power. (Brush Instruments, Dept. 712)

■ VOLTAGE REFERENCE has a dual output of ± 50 v in one model and ± 36 v in a second. Total adjustment range is ± 120 mv around the nominal output voltage. Stability is ± 20 parts per million for 8 hr and ± 50 ppm long-term over the load range 0 to 100 ma and input voltage range 105 to 125 v. Temperature response is less than 2 ppm/°C at 25°C. The reference element is a Zener diode. Diode and preamplifier are contained in an isothermal oven. Calibration against an internal reference cell is provided. (Julie Research Laboratories, Inc., Dept. 713)

■ OSCILLOSCOPE with 17-in. screen features 1 percent linearity on both *x*- and *y*-axes. Amplifier sensitivity is 10 mv up to 500 kcy/sec. Magnetic deflection is used. (Eastern Precision Resistor Corp., Dept. 714)

■ VACUUM-TUBE VOLTMETER measures over the frequency range 10 cy to 4 Mcy/sec. Voltages from 0.001 to 300 v are measured in 12 ranges. Accuracy is stated to be ± 2 percent. Indication is r.m.s. value of sine wave. (Republic Electronic Industries Corp., Dept. 716)

■ THROMBELASTOGRAPH makes simultaneous visual and photokymographic observations of three different samples of blood or plasma, giving a permanent record of the coagulation process. The instrument automatically records changes in viscosity and elastic properties of the clot during all phases of the coagulation process. The tracings give a picture of the formation or reduction of fibrin as continuously obtained from a single blood sample. After specimens have been introduced, procedure is completely automatic. (American Hospital Supply Corp., Dept. 721)

■ CURRENT INTEGRATOR is designed for use with high-voltage particle accelerators. Current ranges from 3 na to 1 ma are covered by 12 switch settings. A presetting feature permits the device to provide a warning signal when a specific amount of charge has been collected. An internal current source provides calibration. (Elcor, Inc., Dept. 715)

■ VACUUM SLIDE RULE provides scales for calculations relating pump speed, volume of system, pressure achieved, conductance of tubing, and evacuation time. Tables of unit-conversion factors and barometric-pressure-versus-altitude data are also included. (Central Scientific Co., Dept. 730)

■ GAUSSMETER is a nuclear-magnetic-resonance instrument for measurement of strength and homogeneity of stable or slowly changing magnetic fields. The instrument consists of a probe, an oscillator, and an indicator. A standard probe covers the range 300 to 20,000 gauss. Probes for other ranges are available. The standard probe contains Li^7 and H^1 nuclei in a volume of 0.14 cm^3, so that two distinct frequencies in separate frequency ranges are available. (Harvey-Wells Electronics, Dept. 726)

■ X-Y RECORDER uses two orthogonal mirror galvanometers to attain writing speeds greater than 2500 m/sec and frequency response flat to 100 cy/sec. Traces are recorded on ultraviolet-sensitive charts with recording area 8 by 8 in. The light source is a high-pressure mercury arc. The traces are visible almost immediately; exposure in normal room light completes the developing process. Standard photographic fixing processes may be used to make the record permanent. Inputs for each axis are supplied by interchangeable preamplifiers. Basic sensitivities are 0.625 v/in. and 31.25 mv/in. with d-c coupling preamplifiers. (Sanborn Company, Dept. 719)

JOSHUA STERN
National Bureau of Standards, Washington, D.C.