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THE SPACE ENVIRONMENT

(Addendum No. 1)

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THE SPACE ENVIRONMENT

(Addendum No. 1)

21976

This Addendum represents an effort to list and briefly summarize publications of any major advances made in our state of knowledge about the interplanetary environment during the 18 months since the publication of JPL Technical Release No. 34-229, "The Space Environment".

I. ENERGETIC CHARGED PARTICLES

A. The first positive observations of electrons in the cosmic radiation were published in 1961.

Earl, James A., "Cloud-chamber Observations of Primary Cosmic-ray Electrons," Physical Review Letters, 6: 125-128, 1961.

Meyer, Peter, and Rochus Vogt , "Electrons in the Primary Cosmic Radiation," Physical Review Letters, 6: 193-196, 1961.

B. Ground-based, balloon, and rocket observations of the long-term or solar-cycle variations of the primary cosmic radiation have been continued.

Neher, H. V., and H. R. Anderson, "Cosmic Rays at Balloon Altitudes and the Solar Cycle," Journal of Geophysical Research, 67: 1309-1315, 1962.

McDonald, F. B., and W. R. Webber, "Cerenkov Scintillation Counter Measurements of the Light, Medium, and Heavy Nuclei in the Primary Cosmic Radiation from Sunspot Minimum to Sunspot Maximum," Journal of Geophysical Research, 67: 2119-2132, 1962.

C. Solar Cosmic Rays

1. The total number of solar cosmic ray events which generated a sufficient flux of particles with sufficient energy to produce observable effects at moderate latitudes on the surface of the Earth has risen to at least 12 with the addition of the events of August 1956, July 1959, May 1960, September 1960, November 1960, July 1961, and September 1961. Some of these events were complex ones in that more than one flare and cosmic-ray increase occurred. A great number of papers have been published on these newer events. In the references listed, an attempt was made to correlate all the ground-level observations so as to discover information on the solar cosmic-ray energy spectrum and anisotropies in space as functions of time.

   McCracken, K. G., "The Cosmic-Ray Flare Effect, 1. Some New Methods of Analysis," Journal of Geophysical Research, 67: 423-434, 1962.

   McCracken, K. G., "The Cosmic-Ray Flare Effect, 2. The Flare Effects of May 4, November 12, and November 15, 1960," Journal of Geophysical Research, 67: 435-446, 1962.

   Bailey, D. K., "Time Variations of the Energy Spectrum of Solar Cosmic Rays in Relation to the Radiation Hazard in Space," Journal of Geophysical Research, 67: 391-396, 1962.

2. Another publication tabulates and summarizes the properties of 43 polar-cap-absorption events.

   Warwick, C. S., and M. W. Haurwitz, "A Study of Solar Activity Associated with Polar-Cap Absorption," Journal of Geophysical Research, 67: 1317-1332, 1962.

3. Experiments on rockets fired from high latitudes have determined the spectrum of very low-energy (down to 200 kev) solar protons.

   Ogilvie, K. W., D. A. Bryant, and L. R. Davis, "Rocket Observations of Solar Protons During the November 1960 Events; 1," Journal of Geophysical Research, 67: 929-937, 1962.

   Davis, L. R., and K. W. Ogilvie, "Rocket Observations of Solar Protons during the November 1960 Events; 2," Journal of Geophysical Research, 67: 1711-1716, 1962.

4. Nuclear emulsions flown in balloons and rockets have allowed some determination of the mass spectrum of solar cosmic rays.

   Fichtel, C. E., and D. E. Guss, "Heavy Nuclei in Solar Cosmic Rays," Physical Review Letters, 6: 495-497, 1961.

   Biswas, S., P. S. Freier, and W. Stein, "Solar Protons and α Particles from the September 3, 1960, Flares," Journal of Geophysical Research, 67: 13-24, 1962.

   Ney, E. P., and W. A. Stein, "Solar Propons, Alpha Particles, and Heavy Nuclei in November 1960," Journal of Geophysical Research, 67: 2087-2105, 1962.

D. Solar Plasma

1. An upper limit to the interplanetary electron density at 1 AU of 125 cm^{-3} has been obtained from observations of the spectrum of the zodiacal light. On one occasion, following a period of solar activity, the interplanetary electron density may have risen to 300 cm^{-3}.

   Blackwell, D. E. and M. F. Ingham, "Observations of the Zodiacal Light from a Very High Altitude Station; II. Electron Densities in Interplanetary Space, and III. The Disturbed Zodiacal Light and Corpuscular Radiation," Monthly Notices of the Royal Astronomical Society, 122: 129-155, 1961.

2. Lunik II observed a solar wind of protons with energy > 15 ev with strength = 2×10^8 $cm^{-2}sec^{-1}$. During a magnetic storm, the Russian Venus rocket observed a positive ion flux with energy > 25 ev of 10^9 $cm^{-2}sec^{-1}$.

   Gringauz, K. I., V. V. Bezrukikh, V. D. Ozerov, and R. E. Rybchinskii, "The Study of Interplanetary Ionized Gas, High-Energy Electrons and Corpuscular Radiation of the Sun, Employing Three-Electrode Charged Particle Traps on the Second Soviet Space Rocket," Planetary and Space Science, 9: 103-107, 1962.

   Gringauz, K. I., "Investigation of Interplanetary Plasma and Planetary Ionospheres by Means of Charged Particle Traps on Space Rockets," quoted in Current Review of the Soviet Technical Press, November 3, 1961.

3. The Earth-satellite Explorer X observed a plasma flow which could be interpreted as a solar wind. There is some question, however, as to whether Explorer X ever got completely free of the disturbing influence of the Earth, its magnetosphere, and perhaps a resultant standing shock, or bow, wave.

   Bonetti, A., H. S. Bridge, A. J. Lazarus, E. F. Lyon, B. Rossi, and F. Scherb, "Explorer X Plasma Measurements," paper presented at Third International Space Science Symposium, Washington, D. C., May 7, 1962.

   Rossi, B., "Interplanetary Plasma," paper presented at Third International Space Science Symposium, Washington, D. C., May 7, 1962.

II. INTERPLANETARY MAGNETIC FIELD

A. More details of the Pioneer V observations during periods of magnetic activity have been published:

Coleman, P. J., Jr., C. P. Sonett, and L. Davis, Jr., "On the Interplanetary Magnetic Storm: Pioneer V," Journal of Geophysical Research, 66: 2043-2046, 1961.

Greenstadt, E. W., "Magnetic Storms in Interplanetary Space as Observed by Pioneer V," Nature, 191: 329, 1961.

B. Magnetic field data were obtained by Explorer X, but the interpretation of these data are complicated by the proximity of the Earth's magnetosphere.

Heppner, J. P., N. F. Ness, T. L. Skillman, and C. S. Scearce, "Explorer X Magnetic-Field Measurements," IGY Bulletin, No. 55, January 1962.

Heppner, J. P., paper presented at joint APS-AGU Symposium on Recent Results in Space Physics, Washington, D. C., April 26, 1962.

C. Several new models of the general form of the interplanetary magnetic field have been deduced from solar cosmic-ray data.

McCracken, K. G., "The Cosmic-Ray Flare Effect. 3. Deductions regarding the Interplanetary Magnetic Field," Journal of Geophysical Research, 67: 447-458, 1962.

Warwick, C. S., "Propagation of Solar Particles and the Interplanetary Magnetic Field," Journal of Geophysical Research, 67: 1333-1346, 1962.

Obayashi, T., "Propagation of Solar Corpuscles and Interplanetary Magnetic Fields," Journal of Geophysical Research, 67: 1717-1729, 1962.

III. ELECTROMAGNETIC RADIATION

A. The Earth-satellite Explorer XI contributed new data on cosmic gamma rays.

Kraushaar, W. L., and G. W. Clark, "Search for Primary Cosmic Gamma Rays with the Satellite Explorer XI," Physical Review Letters, 8: 106-109, 1962.

B. There are some new data on x-rays emitted during solar flares.

Winckler, J. R., T. C. May, and A. J. Masley, "Observation of a Solar Bremsstrahlung Bust at 1926 UT, August 11, 1960," Journal of Geophysical Research, 66: 316-320, 1961.

Vette, J. I., and F. G. Casal, "High-Energy X-Rays during Solar Flares," Physical Review Letters, 6: 334-336, 1961.

Anderson, Kinsey A., "Solar X-Ray Burst on September 28, 1961," abstract in Journal of Geophysical Research, 67: 1627, 1962.

C. The solar radiation in the far ultra-violet has been better determined by instrumentation on rockets.

Hinteregger, H. E., "Interplanetary Ionization by Solar Extreme Ultraviolet Radiation," Astrophysical Journal 132: 801-811, 1960.

IV. DUST PARTICLES

A. Very good, new observations of the zodiacal light have led to new estimates of the interplanetary dust density and distribution.

Ingham, M. F., "Observations of the Zodiacal Light from a Very High Altitude Station; IV. The Nature and Distribution of the Interplanetary Dust," Monthly Notices of the Royal Astronomical Society, 122: 157-176, 1961.

B. More data are becoming available on the number of very small particles in meteor streams near the Earth.

Nazarova, T. N., "Investigations of Meteoric Particles on the Third Soviet Artificial Earth Satellite," Planetary and Space Science, 8: 82-85, 1961.

Alexander, W. M., C. W. McCracken, and H. E. LaGow, "Interplanetary Dust Particles of Micron-Size Probably Associated with the Leonid Meteor Stream," Journal of Geophysical Research, 66: 3970-3973, 1961.

C. A statistically significant momentum spectrum of dust particles near the Earth has finally been obtained with a single satellite experiment, thus getting around the difficulties of combining data from experiments performed at different times and places.

McCracken, C. W., W. M. Alexander, and M. Dubin, "Direct Measurement of Interplanetary Dust Particles in the Vicinity of Earth," Nature, 192: 441-442, 1961.

D. It is now suspected that the concentration of dust particles near the Earth is greater than that in interplanetary space.

Whipple, F. L., "The Dust Cloud about the Earth," Nature, 189: 127, 1961.

Hibbs, A. R., "The Distribution of Micrometeorites near the Earth," Journal of Geophysical Research, 66: 371-378, 1961.

Singer, S. F., "Interplanetary Dust near the Earth," Nature, 192: 321-323, 1961.

V. SUMMARIES OF INTERPLANETARY ENVIRONMENT

Johnson, F. S., Editor, Satellite Environment Handbook, Stanford University Press, 1961.

Jaffe, L. D., and J. B. Rittenhouse, "Behavior of Materials in Space Environments," Jet Propulsion Laboratory Technical Report No. 32-150, November 1, 1961.