ABSTRACTS

REPORTS AND OPEN LITERATURE
VOL. VII, NO. 6

ENTRIES, 71,646–72,015

JUNE 1963

JET PROPULSION LABORATORY

CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CALIFORNIA

ASTRONAUTICS INFORMATION ABSTRACTS

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PREFACE

This issue of the *JPL Astronautics Information Abstracts—Reports and Open Literature* covers the month of June 1963.

As in the past, the Astronautics Information series is selective. Report and open literature citations are restricted to the subject of space flight and to applicable data and techniques. Data and techniques arising from other technologies are reported only if their relationship to astronautics is clear. The intent is to give full coverage to astronautics but to exclude peripheral material.

Except under unusual circumstances, the JPL Library is not able to lend copies of the material cited herein. However, when known, the ASTIA AD numbers are included in the citations. Users should request reports from the originator. Subscribers to most of the periodicals covered are listed in the Union List of Serials published by the H. W. Wilson Company of New York and in the list of periodicals abstracted by the Chemical Abstracts Service of Ohio State University.

CONTENTS

ASTRONAUTICS INFORMATION ABSTRACTS

ABLATION

71,646 AN EXPERIMENTAL INVESTIGATION OF SEVERAL ABLATION MATERIALS IN AN ELECTRIC-ARC-HEATED AIR JET
Chapman, A. J.
April 1963
National Aeronautics and Space Administration, Washington, D.C.
TN D-1520

An investigation to determine the ability of several ablation materials to reduce surface heat transfer in an electric-arc-heated airstream has shown that ammonium chloride has a higher heat of ablation, and thus greater ability to reduce surface heat transfer, at stagnation enthalpy potential below 8500 Btu/lb than teflon, nylon, Avcoat 19, or GE-124. The trend of results indicates that, for stagnation enthalpy potential above 8500 Btu/lb, nylon would have a higher heat of ablation than ammonium chloride because of an increased transpiration effect. Results obtained for a wide range of test stream conditions with subsonic and supersonic flow from the present investigation and several references indicate that the heat of ablation is primarily sensitive to stagnation enthalpy potential.

AIRGLOW

71,647 DYNAMICAL STUDIES OF THE OXYGEN GREEN LINE IN THE AIRGLOW
Tohmatsu, T., Nagata, T.
***Planetary and Space Science*, v. 10, pp. 103–116, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

Variations in intensity of the oxygen green line [OI]5577 Å in the airglow are discussed on the basis of the photochemical excitation theory, with special reference to the dynamical behavior of the oxygen transition region for photodissociation.

71,648 METALLIC EMISSIONS IN THE TWILIGHT AND THEIR BEARING ON ATMOSPHERIC DYNAMICS
Jones, A. V.
***Planetary and Space Science*, v. 10, pp. 117–127, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

The possibilities are reviewed of obtaining information about dynamic processes in the upper atmosphere by observing variations in the concentrations of naturally occurring and artificially introduced metallic atoms detected by their twilight fluorescence. In the case of natural sodium, it is concluded that dynamic effects are probably responsible for the seasonal variation, although the exact processes involved remain obscure. Even less is known in the cases of natural lithium, potassium, and calcium. Theories of the origin and seasonal variation of upper atmospheric sodium are reviewed. The observation of the twilight fluorescence of lithium, after the injection of quantities of the metal into the mesosphere and lower thermosphere, seems to be a promising technique for the study of upper atmospheric dynamics.

71,649 LIGHTNING-ENHANCED N_2^+ RADIATION IN THE NIGHT AIRGLOW
Moore, J. G.
***Journal of Geophysical Research*, v. 68, no. 5, pp. 1335–1337, March 1, 1963**

During the night of July 27–28, 1962, a zenith night airglow photometer recorded intense flashes of the O–0 band of the first negative system of N_2^+ caused by lightning strokes in an electrical storm some 60-km distant. The peak intensity of the brightest flash was about 50 rayleighs above the background of 28 rayleighs for the 3914 Å emission in the airglow above China Lake.

71,650 OBSERVATION OF THE DAY AIRGLOW
Wallace, L.
***Journal of Geophysical Research*, v. 68, no. 5, pp. 1559–1560, March 1, 1963**

A Littrow spectrograph was flown in a balloon on September 24, 1962 to observe the day airglow. The spectrum in the region 4500 to 7500 Å was photographed in the second order. This spectrum showed a stronger Fraunhofer spectrum than had been expected, and the 6300 Å line of atomic oxygen was present but not prominent.

ANNA 1B

71,651 GEODETIC STUDIES WITH THE ANNA 1B SATELLITE
***American Geophysical Union, Transactions*, v. 44, no. 1, pp. 241–246, March 1963**
(Also available in *National Academy of Sciences, IGY Bulletin*, no. 68, February 1963)

The orbital data, experiments, and instrumentation of the *Anna 1B* are described.

ANTENNAS

71,652 DESIGN AND CONSTRUCTION OF THE HORN ANTENNA
Blackmore, R. W.
***Bell Laboratories Record*, v. 41, no. 4, pp. 122–129, April 1963**

The design, fabrication technique, and materials for the Andover, Maine, horn antenna are described, and a table of operating parameters is given.

ANTENNAS (Cont'd)

71,653 THE HORN ANTENNA DIRECTION SYSTEM
Klahn, R., Byrne, E. R.
***Bell Laboratories Record*, v. 41, no. 4, pp. 130–134, April 1963**

The design of the directional control system used on the horn antenna at Andover, Maine, and its operation during a tracking event are described.

APOLLO PROJECT

71,654 PROJECT APOLLO'S MISSION: GET TWO AMERICANS TO THE MOON
Reid, M.
***Electronics*, v. 36, no. 6, pp. 18–20, February 8, 1963**

A general description of the *Apollo* project is given, and the electronic equipment to be used is described.

ASTEROIDS

71,655 THE 1963 APPROACH OF MINOR PLANET 1580 BETULIA
Hodgson, R. G.
***Strolling Astronomer, The*, v. 17, no. 1–2, p. 1, January–February 1963**

An unusual opportunity to observe a minor planet in relatively close proximity is afforded in 1963 when 1580 Betulia approaches to within only 0.157 AU from the Earth. The predicted magnitude is 16.1 on April 21 and June 20. An ephemeris adapted from Harvard Announcement Card 1580 is included in this brief discussion of the asteroid's approach.

ASTRONAUTS

71,656 MEDICAL PROBLEMS OF MANNED SPACE FLIGHT
Gazenko, O. G.
***Space Science Reviews*, v. 1, no. 3, pp. 369–398, March 1963**

Certain medical problems of human space flight are surveyed on the basis of experimental research carried out in the USSR during recent years. Problems considered are (1) the influence of the factors of space flight upon the organism, (2) acceleration, (3) weightlessness, (4) cosmic radiation, and (5) biological telemetry.

71,657 THE STATE OF CERTAIN NATURAL IMMUNITY FACTORS IN DOGS DURING COSMIC FLIGHT
Alekseeva, O. G.
***Artificial Earth Satellites*, v. 12, pp. 69–82, March 1963**

71,658 COMMENTS ON THE INCORPORATION OF MAN INTO THE ATTITUDE DYNAMICS OF SPACECRAFT
Roberson, R. E.
***Journal of the Astronautical Sciences, The*, v. 10, no. 1, pp. 27–28, Spring 1963**

Man is discussed as a source of attitude disturbance within the vehicle.

71,659 ASTROPHYSICAL AND RADIOBIOLOGICAL ASPECTS OF HUMAN SPACE FLIGHT (ASPETTI ASTROFISICI E RADIOBIOLOGICI DEL VOLO UMANO NEL COSMO)
Pasinetti, A., Pasinetti, L. E.
***Rivista di Medicina Aeronautica e Spaziale*, v. 25, no. 3, pp. 466–499, July–September, 1962**
(Abstracted in *Aerospace Medicine*, v. 34, no. 3, pp. 279–280, March 1963)

The astrophysical characteristics, origin, and distribution of ionizing, solar, cosmic, and Van Allen radiation found in space are discussed. Calculations are given of the dosage for cosmic radiations affecting both the interior and exterior of a space vehicle traveling through the Van Allen belt. Consideration is given to the reduction by biological shielding of the radiation dose and the cutaneous lesions caused by protons and by weak and ultrashort X-photons. Radioprotection of pilots by means of drugs (i.e., sulfhydryl compounds) administered parenterally about half an hour prior to radiation exposure is suggested.

71,660 BIOLOGICAL CONSIDERATIONS ON THE PRESENT STATE OF SPACE FLIGHT (CONSIDERAZIONI BIOLOGICHE SUI VOLI SPAZIALE ESEGUITI FINO AD OGGI)
Lomonaco, T.
***Rivista di Medicina Aeronautica e Spaziale*, v. 25, no. 3, pp. 431–449, July–September 1962**
(Abstracted in *Aerospace Medicine*, v. 34, no. 3, p. 271, March 1963)

Physiobiological data derived from Russian, American, and French suborbital and orbital flights from 1949 to 1961 utilizing animals and humans are reviewed. During the orbital flights of Gagarin and Titov in 1961, neither Soviet astronaut showed any significant change in cardiovascular or respiratory function during the active phase of the flight. No changes were observed during the period of weightlessness, and no disorders of motion or muscle coordination were recorded. Only Titov suffered from nausea and vertigo for several moments. Telemetered biological parameters showed that in Glenn's 1962 orbital flight his cardiovascular functions in hyper- and zero-gravity corresponded to previously observed data. A reduction of twilight vision was the only change in sensory function. Although the astronaut attempted to elicit labyrinthine disorders by voluntary head movements, none were observed during zero-gravity. During his 1962 flight, Carpenter exhibited tachycardia during weightlessness and great changes in blood pressure.

71,661 ASTRONAUTICS AND MEDICINE (ASTRONAUTICA E MEDICINA)
Warren, J. K.
***Rassegna Medica e Culturale*, Milano, v. 39, no. 9, pp. 15–18, September 1962**
(Abstracted in *Aerospace Medicine*, v. 34, no. 3, p. 271, March 1963)

Results of recent American and Russian research projects and space missions are reviewed in relation to man in space as affected by magnetic fields, solar radiations, gravitational forces, weightlessness, accelerations, decelerations, and psychological factors. A space environment simulator and gondola used for study of disorientation and of the effects of accelerative forces are pictured.

ASTRONOMICAL UNIT

71,662 THE ASTRONOMICAL UNIT OF LENGTH
Mikhailov, A. A.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 449–458, January–February 1963**

The basic principles and results of the determination of the astronomical unit of length and the solar parallax by the trigonometric, dynamic, spectroscopic, and radar methods are discussed. Some of the sources of uncertainty of these determinations are pointed out and possible errors evaluated. Future possibilities are considered.

ATTITUDE CONTROL SYSTEMS

71,663 SPACECRAFT FLIGHT CONTROL SYSTEMS
Walter Kidde & Co., Inc., Kidde Aero Space Div., Belleville, N.J.
0310-700

Technical information on flight control systems for spacecraft attitude control is presented. The various types of reaction are discussed, including cold gas, monopropellant, and bipropellant systems. Information is also provided concerning several types of thrust vector control systems, including secondary injection, nozzle gimballing, and jet vanes.

71,664 INVESTIGATION OF FEASIBILITY OF A POSITIVE DISPLACEMENT INJECTOR FOR ATTITUDE CONTROL PROPULSION
January 1963
Curtiss-Wright Corporation, Wright Aeronautical Div., Wood-Ridge, N.J.
CTR .00-270

Positive displacement injection is basically a variant of a conventional bipropellant reaction control system which uses solenoid valves to control propellant flow. It differs in that mechanically linked fuel and oxidizer injectors coupled with an actuator replace the propellant solenoid valves. The objective of this feasibility study has been to measure the potential of this device for attitude control propulsion.

AURORAE

71,665 THE DIRECTIONS OF AURORAL RAYS
Cole, K. D.
***Australian Journal of Physics*, v. 16, no. 1, pp. 32–39, March 1963**

The geometry of the radiation point of an auroral corona is examined. The radiation point of two rays is the antidirection of the point within the Earth at which the rays meet or appear to meet. It is therefore incorrect to identify the radiant point of a corona with local auroral zenith. The difference in direction is commonly 0.5 deg of zenith distance. The importance of rays as magnetic disturbance indicators in the 100- to 1000-km height range is stressed, particularly in view of possible deformations of the magnetosphere whose full effects may not be estimated from ground-based observations of the geomagnetic field.

71,666 THE DYNAMICAL MORPHOLOGY OF THE AURORA POLARIS
Akasofu, S.-I.
***Journal of Geophysical Research*, v. 68, no. 6, pp. 1667–1673, March 15, 1963**

Simultaneous changes of auroral form, brightness, and motion over the whole polar region are studied, using IGY all-sky camera records from widely distributed stations in eastern Siberia, Alaska, Canada, northern United States, and Greenland. Large-scale dynamical features of the auroras, such as the breakup, formation of large loops, and drift motions, are discussed.

71,667 MOTIONS OF THE AURORA AND RADIO-AURORA AND THEIR RELATIONSHIPS TO IONOSPHERIC CURRENTS
Cole, K. D.
***Planetary and Space Science*, v. 10, pp. 129–164, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

Observations of magnetic disturbances, aurorae, radio-aurorae, and ionospheric movements are reviewed. Correlations between these phenomena are discussed. Distinction is made between aurora which is attributable to the emission of light from particles of the upper atmosphere and radio-aurora which is a feature of upper atmosphere ionization observed by the reflection of radio waves. Some ideas relevant to explanation of the movements are presented. A listing of 160 references is included.

71,668 REFLECTION MECHANISMS FOR RADIO AURORA
Forsyth, P. A.
***Planetary and Space Science*, v. 10, pp. 179–186, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

Attempts to derive useful information concerning the degree of ionization in the auroral atmosphere from radio meas-

AURORAE (Cont'd)

urements have been the subject of some controversy. One view is that the radar echoes result from relatively slight variations in the spatial distribution of ionization which cause partial reflection of the radio waves. The alternative view is that the radio waves are totally reflected by isolated strong concentrations of ionization. Recently, the main features of both mechanisms were combined in one treatment by Moorcroft. This treatment seems to be physically reasonable and is consistent with recent radar measurements. It appears that multiple-frequency radio observations can now be used to measure peak electron densities (concentrations) with considerable confidence, and more detailed interpretations involving the spatial distribution of the ionization are a distinct possibility.

71,669 PROTON BOMBARDMENT IN AURORA
Galperin, Y. I.
***Planetary and Space Science*, v. 10, pp. 187–193, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

Studies are described of a recently discovered type of aurora, the proton aurora, which systematically appears in the auroral zone, often during quiet magnetic conditions, and moves towards the equator with rising magnetic disturbance. The "hydrogen field" is a wide nearly homogeneous band with borders along magnetic parallels. There is no conclusive evidence of the concentration of hydrogen emission in any other distinct auroral form. The magnetic zenith emission profile is nearly constant with only minor variations. The height of the emission in the hydrogen field and the low energy part of the initial proton energy spectrum cannot be found from published data.

The discovery of the proton aurora as a distinct phenomenon completes the picture of particle bombardment and stresses the lack of understanding of the auroral accelerating mechanisms.

71,670 OPTICAL STUDIES OF PARTICLE BOMBARDMENT IN POLAR CAP ABSORPTION EVENTS
Sandford, B. P.
***Planetary and Space Science*, v. 10, pp. 195–213, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

The intensities of the polar-glow auroral emissions produced by bombarding protons during a polar cap absorption event are calculated. The first negative bands of N_2^+ have a maximum brightness at a height of 65 km. The enhancement of the forbidden atomic oxygen line at 5577 Å is most likely produced by dissociative recombination of O_2^+. Comparison of the calculated and observed polar-glow intensities indicates that the proton energy spectrum is approximately the same at all geomagnetic latitudes above 60 deg. This implies that there is a terrestrial cutoff at about 1 Mev, even at the geomagnetic pole, or that there are relatively few protons of less than 1-Mev energy emitted from the solar flare. The time variations of the polar-glow indicate that the magnetic field in the plasma cloud produced by the flare may be the main trapping region for the protons. The observations tend to support Parker's blast model for the propagation of solar flare particles through interplanetary space. The origin of the great auroral displays observed during the large magnetic storms is briefly reviewed.

71,671 THE PART PLAYED BY AND SOURCE OF PARTICLES OBSERVED IN THE IONOSPHERE AND AURORAE
Ivanov-Kholodny, G. S.
***Planetary and Space Science*, v. 10, pp. 219–232, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

The source and acceleration of electrons which penetrate deep into the atmosphere are discussed. Experimental data on the connection of the radiation belts with the aurorae are presented. The question of the origin of aurorae and radiation belt particles is discussed. A listing of 98 references is included.

71,672 OBSERVATIONS AND EXPERIMENTS PERTINENT TO AURORAL THEORIES
Omholt, A.
***Planetary and Space Science*, v. 10, pp. 247–262, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

Evidence is discussed which supports the conclusion that electrons dominate the energetic particles impinging upon the atmosphere during aurora. Data accumulated by rocket work are included. Available observations and theoretical interpretations of the dynamics of aurora are reviewed. The most recent and important satellite observations of energetic particles and magnetic fields in space are described and discussed.

BIOLOGY

71,673 DOSES OF COSMIC RADIATION
Ivanov, V. I., Keirim-Markus, I. B., Kovalev, E. E.
***Artificial Earth Satellites*, v. 12, pp. 40–51, March 1963**

In an assessment of the biological effect of radiation, the following aspects are considered: the magnitude of the absorbed tissue dose in rad due to radiation inside the vehicle, and the relative biological effectiveness of the radiation.

The dose rate due to the natural radiation environment in which life has developed on Earth is adopted as a scale for the assessment of cosmic radiation doses. Hazards from the intense radiation of solar flares, cosmic rays, and the Van Allen belts are discussed.

71,674 BIOLOGICAL EFFECTS OF HIGH ENERGY PROTONS
Sondhaus, C. A. (University of California, Donner Laboratory, Berkeley)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 309–342, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D.C.
TID-7652, Paper C-4

At present, laboratory whole body exposure to a proton flux is impractical for large animals. Since exposures in space flight are almost certain to occur under omnidirectional conditions, and since a high but variable ratio of superficial to midline dose is expected to result from solar flare proton energy distributions, a means of irradiating large animals with the proton beam of the 184-in. cyclotron at Berkeley is being developed in such a way as to permit simulation of solar-flare energy and geometry. Apparatus now under construction, which is described, should thus permit direct experimental studies of biological effects, depth dose patterns, and shielding configurations under approximately isotropic flux conditions.

71,675 INVESTIGATION OF THE HIGHER NERVOUS ACTIVITY OF WHITE RATS AFTER FLIGHT IN THE SECOND SATELLITE-SPACESHIP
Lukyanova, L. D.
***Artificial Earth Satellites*, v. 12, pp. 56–61, March 1963**

Investigations conducted by Soviet scientists on the effects of space flight on white rats are discussed. The preparation and training of the experimental animals are described, and postflight examinations and results are presented.

71,676 FIRST RESULTS OF TESTS CONDUCTED WITH A CHLORELLA CULTURE EXPOSED IN SPACE ON THE SECOND SATELLITE-SPACESHIP
Semenenko, V. E., Vladimirova, M. G.
***Artificial Earth Satellites*, v. 12, pp. 62–68, March 1963**

An investigation of the radiation effects on unicellular green algae has been conducted as a prelude to the study of complete ecological systems, and in an attempt to solve the problems of air regeneration and food provision for flights of long duration.

A description of the culture and the experimental conditions under which the study was performed is given. Results of an examination of the culture upon its return to Earth are cited. A comparison of the experimental and control cultures of algae in regard to growth kinetics, production of organic matter, morphology, size, and dry weight of the cells, and rate of photosynthetic evolution of oxygen shows that the differences between the experimental and control cultures lay within the range of errors of measurement.

BOOSTER ROCKETS

71,677 LAUNCH VEHICLE PERFORMANCE
Amster, W. H. (Aerospace Corp., El Segundo, Calif.)
American Rocket Society, Inc., New York, N.Y.
(Presented at the Lunar Missions Meeting, Cleveland, Ohio, July 17–19, 1962)

An analysis is made of launch vehicle size and staging requirements for conducting a manned lunar landing and return mission. Velocities required of rocket stages for each phase of the mission are determined, and the total mission velocity is established. Four types of lunar mission profiles are considered: direct launch, Earth orbit rendezvous, lunar orbit rendezvous, and lunar surface rendezvous. Spacecraft weights for each type of mission are assumed for the purpose of comparing launch vehicle needs.

71,678 HIGH RESOLUTION WIND MEASUREMENTS: A LAUNCH DESIGN PROBLEM
Scoggins, J. R.
***Astronautics and Aerospace Engineering*, v. 1, no. 3, pp. 106–107, April 1963**

Two systems for measuring high-resolution winds to altitudes above the maximum dynamic pressure region (10–14 km) for use in vehicle design and performance analyses are described. These are (1) the smoke-trail/photographic technique, and (2) the radar/spherical balloon technique. New data revealed by these techniques show features never before measured in detail which are important to the design of vertically rising vehicles.

CELESTIAL MECHANICS

71,679 NEW EXAMPLES OF CAPTURE IN THE THREE-BODY PROBLEM
Alekseev, V. M.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 565–572, January–February 1963**

New examples are given of "capture" phenomena in the problem of three mass points moving under mutual Newtonian attraction. Purely qualitative methods are used, and numerical integration is not employed. The examples are general and contain the maximum number of free parameters.

71,680 AN EMPIRICAL RELATION BETWEEN THE ROTATIONAL AND ORBITAL MOMENTA OF THE MAJOR PLANETS
Goloborodko, T. A.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 592–593, January–February 1963**

It is found that there is an exponential relation between the rotational and orbital angular momenta of the major

CELESTIAL MECHANICS (Cont'd)

planets. Cosmogonically, the relation is consistent with the separation of the planets from a central body.

71,681 **ON THE ELLIPTIC CASE OF THE RESTRICTED PROBLEM OF THREE BODIES AND THE REMOTE HISTORY OF THE EARTH-MOON SYSTEM**
Kopal, Z., Lyttleton, R. A.
***Icarus*, v. 1, no. 5–6, pp. 455–458, April 1963**

An attempt is made to show that the Jacobi integral is an entirely special property of the circular three-body problem, and that no equivalent relation, time-dependent or time-varying, exists when orbital eccentricity is present.

71,682 **PERIODIC SOLUTIONS OF THE RESTRICTED THREE BODY PROBLEM REPRESENTING ANALYTIC CONTINUATIONS OF KEPLERIAN ELLIPTIC MOTIONS**
Arenstorf, R. F.
May 1963
National Aeronautics and Space Administration, Washington, D.C.
TN D-1859

A detailed mathematical proof is given in this report for the following new result: In the restricted three body problem with small mass ratio there exist one-parametric analytic families of synodically closed solution curves, which are near rotating Keplerian ellipses with rational sidereal frequencies and appropriate positive eccentricities.

CHARGED PARTICLES

71,683 **SOME RESULTS OF EXPERIMENTS CARRIED OUT BY MEANS OF CHARGED-PARTICLE COLLECTORS CARRIED BY SOVIET SPACE ROCKETS**
Gringauz, K. I.
***Artificial Earth Satellites*, v. 12, pp. 131–144, March 1963**

COATINGS

71,684 **PORTABLE INTEGRATING SPHERE FOR MONITORING REFLECTANCE OF SPACECRAFT COATINGS**
Fussell, W. B., Triolo, J. J., Jerozal, F. A. (Continental Technical Service, Inc., Silver Spring, Md.)
April 1963
National Aeronautics and Space Administration, Washington, D.C.
TN D-1714

In the thermal design of spacecraft, the input term in the radiation balance equation for a space vehicle in free space — removed from significant Earth radiation — is directly proportional to the solar absorptivity of the illuminated portion of the vehicle. For opaque spacecraft coatings, incident solar radiation which is not absorbed must be reflected; thus, the solar absorptivity of such coatings can be computed from spectrally resolved total reflectance measurements. It is shown that total reflectance data at wavelengths between 0.27 and 1.65 μ enable the solar absorptivities of common spacecraft coatings to be estimated to within approximately $\pm$ 20 percent or better. An integrating sphere is the most convenient device for measuring the total reflectance of opaque coatings of different degrees of curvature, specularity, and diffusivity. A portable, 8-lb, single-beam, 6-in.-D integrating sphere reflectometer has been designed and fabricated at the Goddard Space Flight Center and has been used extensively to detect changes in the solar absorptivity of spacecraft coatings due to environmental testing, aging, or contamination.

71,685 **PIGMENTED SURFACE COATINGS FOR USE IN THE SPACE ENVIRONMENT**
Searle, N. Z., Hirt, R. C., Schmitt, R. G. (American Cyanamid Co., Central Research Div., Stamford, Conn.)
January 1963
Aeronautical Systems Division, Directorate of Materials and Processes, Wright-Patterson AFB, Ohio
ASD TDR 62-840, Part I

Photochemical stabilities of pigmented surface coatings to ultraviolet radiation and vacuum conditions simulating those present in the upper atmosphere were determined for various systems. The amount of photodegradation incurred was determined from the change in solar absorptivity based on reflectance measurements over the range 0.25 to 2.6 μ.

COMETS

71,686 **ON THE PLASMA NATURE OF A COMET'S HEAD**
Marochnik, L. S.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 532–539, January–February 1963**

On the basis of all available observational data, it is concluded that in many cases the gas of the cometary head is plasma with a high degree of ionization. Two aspects of the problem are considered—the shape of the comet's head and the origin of the ionization.

71,687 **THE STRUCTURE OF ICY COMET NUCLEI**
Levin, B. Yu.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 593–595, January–February 1963**

Instead of conventional ideas on the presence of inclusions of stony substances in icy cometary nuclei, a hypothesis is proposed that these substances are present in the form of separate atoms and molecules embedded in the amorphous noncoherent condensate of different volatile substances. In the course of evaporation of outer layers of the icy nucleus the nonvolatile substances form a porous matrix, the pieces and fragments of which are meteoric particles.

71,688 ON THE NATURE AND ORIGIN OF COMETS
Fesenkov, V. G.
Soviet Astronomy—AJ, v. 6, no. 4, pp. 459–464, January–February 1963

The high instability of cometary nuclei and the frequently observed breakup of the nuclei into discrete parts demonstrate that they must constitute compact agglomerations of fairly unstable particles. The total mass of the comet may be estimated from the brightness of the cometary head and the rate of fall-off of brightness with time, and also from the reaction effects attendant upon the rotation of the head about the comet's axis. The presence of reactive forces imparted to the entire mass of the nucleus demonstrates that the distance between the component parts must be quite short. Such compact clusters of unstable particles capable of producing explosions in response to even moderate illumination could not conceivably originate in volcanic eruptions from the interior of a planet.

71,689 OBJECTIVE-PRISM SPECTROGRAMS OF COMET HUMASON (1961*e*)
Miller, F. D.
Astronomical Society of the Pacific, Publications of the, v. 74, no. 441, pp. 528–529, December 1962

Sketches of a CO^{+} band of comet Humason (1961 e) are reproduced from spectrograms made on August 7, 1962 with the Curtis Schmidt telescope at a time interval of 2 hr 25 min. Apparent changes in structure during this period are noted and explanations suggested. Photographic equipment used is described.

COMMUNICATION SYSTEMS

71,690 ON COMMUNICATION SYSTEMS FOR SATELLITE TELEMETRY
Schwartz, J. W.
November 1961
Yale University, Department of Electrical Engineering, New Haven, Conn.
Technical Note 1

This research concerns memory systems for use in spacecraft. The study covers the functions performed by memory, component and data storage techniques, and the problems associated with the interfaces between memory and the remainder of the spacecraft telemetry system. Consideration is given to the form in which data must be presented to the modulator, since this places boundaries within which the telemetry system must be designed.

CONTROL SYSTEMS

71,691 REMOTE CONTROL OF SPACE VEHICLES
Green, J. S.
ISA Journal, v. 10, no. 3, pp. 71–72, March 1963

COSMIC DUST

71,692 INTERPLANETARY MATTER
Ingham, M. F.
Space Science Reviews, v. 1, no. 3, pp. 576–588, March 1963
(Paper presented at the European Preparatory Commission for Space Research Symposium on The Interplanetary Medium, Paris, France, June 19, 1962)

Most interplanetary matter is considered to consist mainly of dust particles with a radius of about 0.3 μ which can be detected only indirectly by the sunlight which they scatter. The characteristics of this dust are investigated by a study of the solar corona and the zodiacal light, the dust cloud about the Earth, and the gegenschein. The origin of the dust particles and scattering by small particles in interplanetary space are also considered.

71,693 ROCKET AND SATELLITE STUDIES OF METEOR DUST
Nazarova, T. N.
Artificial Earth Satellites, v. 12, pp. 154–158, March 1963

71,694 ON THE ORIGIN OF THE CONDENSATION OF INTERPLANETARY DUST SURROUNDING THE EARTH
Ruskol, E. L.
Artificial Earth Satellites, v. 12, pp. 159–165, March 1963

71,695 ON THE "DUST ENVELOPE" OF THE EARTH
Moroz, V. I.
Artificial Earth Satellites, v. 12, pp. 166–174, March 1963

COSMIC RAYS

71,696 AN EVALUATION OF THE RADIATION HAZARD DUE TO SOLAR COSMIC RAYS
Webber, W. R., Freier, P. S. (University of Minnesota, Minneapolis)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 12–32, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D.C.
TID-7652, Paper A-2

The problem of radiation exposure from solar cosmic-ray outbursts is confined to exposure from the few largest events. The total integrated dose from these events may present a problem, the seriousness of which depends on the amount of shielding—as can be seen from the doses due to particles with energies above 30 and 100 Mev. It is quite certain that the appearance of active regions producing major cosmic-ray bursts is not strongly correlated with the maximum in the eleven-year cycle of solar activity. During the recent maximum, 1957–1958, no such major cosmic-ray bursts were recorded, and the yearly integrated solar cosmic-ray intensities at energies greater than 30 and 100 Mev were lower than for

COSMIC RAYS (Cont'd)

adjacent years of lower solar activity. From the limited number of large events available for study, it appears that the bursts are most frequent during periods of increasing and, particularly, decreasing solar activity, with the periods near maximum and minimum relatively free from such events.

71,697 COMPOSITION OF SOLAR COSMIC RAYS
Fichtel, C. E. (NASA/Goddard Space Flight Center, Greenbelt, Md.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 33–43, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D.C.
TID-7652, Paper A-3

In the treatment of solar particle composition, and within the scope of present incomplete knowledge, relative abundances of the less plentiful components (i.e., helium nuclei, heavier nuclei, electrons, and γ-rays) are given.

71,698 DETAILS OF INDIVIDUAL SOLAR PARTICLE EVENTS
Fichtel, C. E., Guss, D. E., Ogilvie, K. W. (NASA/Goddard Space Flight Center, Greenbelt, Md.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 44–85, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D.C.
TID-7652, Paper A-4

A time history is presented of the intensities and energies of solar cosmic-ray particles detected at or near the Earth. The survey begins with the event on February 23, 1956—the first event for which there is an estimate of both the low- and high-energy flux components. From that date to the present all of the largest events and some of the smaller ones for which particularly complete data are available have been selected for examination. All events for which there was a riometer reading in excess of 10 db have been included; any event with a high-energy component sufficiently large to be detected on the neutron monitor has been studied. The various detectors used to study the solar particles are described and the individual events are discussed in order to emphasize the interesting features and the variety of geophysical effects occurring from time to time. A listing of 76 references is included.

71,699 INFORMATION ON SOLAR PROTON EVENTS (PCA'S) DEDUCED FROM RADIO OBSERVATIONS
Bailey, D. K. (National Bureau of Standards, Boulder Labs., Colo.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 86–87, Book 1 (Abstract)
Atomic Energy Commission, Division of Technical Information, Washington, D.C.
TID-7652, Paper A-5

In the last decade, use of the probing radio wave has enabled ionospheric workers to contribute a considerable quantity of information concerning the nature and occurrence of solar proton events. Radio observations have been made continuously at fixed positions, whereas observations with particle detectors in balloons, rockets, and satellites are conspicuously lacking in continuity, either in space or time. Ground-based cosmic-ray monitors, while operating continuously, detect less than one-fifth of the events related to the problem of radiation hazards in space.

71,700 SOME SPECIFIC CONSIDERATIONS OF THE POTENTIAL HAZARDS OF HEAVY PRIMARY COSMIC RAYS
Curtis, H. J. (Brookhaven National Lab., Upton, N.Y.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 291–308, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D.C.
TID-7652, Paper C-3

The ionization produced by the heavy cosmic-ray particles is almost entirely highly concentrated along single tracks; the microscopic dose in tissue within these tracks may be quite high, but the over-all dose rate from these particles in outer space would be very low. Since these particles cannot be produced in the laboratory, a microbeam of deuterons has been developed which simulates the ionization pattern of these particles. Using this microbeam on mice, it is found that this type of radiation causes very little effect in either the brain or the eye, and presumably also in other vital organs. However, it will cause greying of the hair. It is concluded that this type of radiation will cause no serious hazard for space flight.

71,701 THE EQUATOR OF COSMIC RAYS FROM DATA OF THE THIRD SOVIET SHIP-SATELLITE
Savenko, I. A., Nesterov, V. E., Shavrin, P. I., Pisarenko, N. F.
Cleaves, H. F., Translator
***Planetary and Space Science,* v. 11, no. 1, pp. 87–91, January 1963**
(Translated from *Iskusstvennye Sputnik Zemli,* no. 11, p. 30, 1961)

The latitudinal dependence of the cosmic radiation for each crossing of the equator was measured by *Sputnik 6.* Instruments used were a gas-discharging halogen counter STS-5, a scintillation counter (a crystal of NaJ(Tl)), and a photomultiplier FEU-15. Charts and maps are included.

71,702 ON THE ISOTROPY OF PRIMARY COSMIC RAYS
Getmantsev, G. G.
***Soviet Astronomy—AJ,* v. 6, no. 4, pp. 477–479, January–February 1963**

Various mechanisms leading to the isotropy of primary cosmic rays are discussed on the basis of existing ideas concerning the interstellar magnetic field.

71,703 COSMIC RAYS AND SOME ASTROPHYSICAL PHENOMENA
St. Kalitsin, N.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 591–592, January–February 1963**

The existence of extragalactic cosmic rays having fantastically high energies, up to the order of 10^{80} ev, is suggested.

71,704 ASYMMETRIES IN THE FORBUSH DECREASES OF THE COSMIC RADIATION
1. DIFFERENCES IN ONSET TIMES
Lockwood, J. A., Razdan, H.
***Journal of Geophysical Research*, v. 68, no. 6, pp. 1581–1591, March 15, 1963**

The cosmic-ray neutron intensity at 15 stations is analyzed to determine the differences in onset times of the large Forbush decreases occurring from 1957 to 1961. From the directional response characteristics of the neutron detectors, these differences in onset times relate to directions in space beyond the geomagnetic field. Results are explained in terms of the configuration of the solar plasma cloud, and conclusions are drawn about the plasma velocity and the magnitude of the associated magnetic field.

71,705 ASYMMETRIES IN THE FORBUSH DECREASES OF THE COSMIC RADIATION
2. SUPERIMPOSED INTENSITY VARIATIONS DURING A FORBUSH DECREASE
Lockwood, J. A., Razdan, H.
***Journal of Geophysical Research*, v. 68, no. 6, pp. 1593–1604, March 15, 1963**

A study has been made of superimposed intensity variations during a Forbush decrease, utilizing the neutron monitor data from many stations distributed in latitude and longitude. The anisotropies recorded as decreased intensities occurred from the west of the Earth-Sun line and those recorded as increases occurred from the east. These anisotropies were both long and short lived. The long-lived anisotropies shifted westward as time progressed. Besides the anisotropies, superimposed intensity increases occurred at all stations at the same universal time, and the magnitudes were larger at stations sampling particles from directions east of the Earth-Sun line at the time of the increase. A qualitative explanation of these observed effects is given in terms of the configuration and the possible instabilities of the plasma cloud.

71,706 EXPONENTIAL RIGIDITY SPECTRUMS FOR SOLAR-FLARE COSMIC RAYS
Freier, P. S., Webber, W. R.
***Journal of Geophysical Research*, v. 68, no. 6, pp. 1605–1629, March 15, 1963**

It is shown how exponential rigidity spectrums fit the data obtained over the energy range from 1 Mev to several Bev. Proton spectrums were derived at 53 different times during 16 different flares. The solar α-particle flux and the proton to α-particle ratio were determined for the flares in which emulsion measurements were made. Using the measured exponential rigidity spectrums, both the riometer and neutron monitor response for the different flares are calculated. The agreement between the predicted and measured responses for these methods of detection is shown.

71,707 ANALYSIS OF BALLOON OBSERVATIONS DURING THE APRIL 1960 SOLAR COSMIC RAY EVENTS
Masley, A. J.
April 1961
Minnesota, University of, Minneapolis
Technical Report CR-35

This article appeared in the *Journal of Geophysical Research*, v. 67, no. 9, pp. 3243–3269, August 1962, and was abstracted in the *Astronautics Information Abstracts*, v. 6, no. 5, November 1962. (See Entry #61,310.)

71,708 STUDIES OF THE COMPOSITION OF PRIMARY COSMIC RADIATION AT AN ALTITUDE OF 320 km
Alekseeva, K. I., Gabuniya, L. L., Zhdanov, G. B., Zamchalova, E. A., Shcherbakova, M. N., Tretyakova, M. I.
***Artificial Earth Satellites*, v. 12, pp. 7–17, March 1963**

71,709 ENERGY SPECTRA OF VARIOUS GROUPS OF COSMIC RAY NUCLEI WHICH WERE OBTAINED IN MEASUREMENTS BY MEANS OF CERENKOV COUNTERS ON SATELLITE-SPACESHIPS
Kurnosova, L. V., Logachev, V. I., Razorenov, L. A., Fradkin, M. I.
***Artificial Earth Satellites*, v. 12, pp. 18–35, March 1963**

71,710 A CASE OF A SHORT-TERM RISE IN THE INTENSITY OF HEAVY NUCLEI DURING THE FLIGHT OF SATELLITE-SPACESHIP III
Kurnosova, L. V., Razorenov, L. A., Fradkin, M. I.
***Artificial Earth Satellites*, v. 12, pp. 36–39, March 1963**

71,711 THE BIOLOGICAL ACTION OF COSMIC RADIATION
Gyurdzhian, A. A.
***Artificial Earth Satellites*, v. 12, pp. 83–113, March 1963**

Various methods for studying the biological action of cosmic radiation are discussed. These methods include experiments conducted on the ground and during flight. Some features of ionization of body tissues caused by the particles of cosmic radiation, possible genetic action, and the combined action of cosmic radiation and other factors in flight are considered. A total of 196 references is included.

CRYOGENICS

71,712 LOW TEMPERATURES IN SPACE TECHNOLOGY
Fowle, A. A. (Arthur D. Little, Inc., Cambridge, Mass.)
January 1962
In "Cryogenics," pp. 12–14
Society of Automotive Engineers, Inc., New York, N.Y.
SP-225

Three applications of low temperature engineering to space ventures are discussed: (1) the cold storage of propellants as liquefied gases; (2) the simulation of the low-temperature and high-vacuum characteristics of outer space in environmental test facilities; and (3) the sub-zero refrigeration of electronic components, such as infrared detectors, inertial guidance devices, and optical masers.

71,713 CRYOGENIC SYSTEMS IN MISSILES AND SPACECRAFT
Parker, W. F. (North American Aviation, Inc., Downey, Calif.)
January 1962
In "Cryogenics," pp. 15–18
Society of Automotive Engineers, Inc., New York, N.Y.
SP-225

Several of the various uses of cryogenics in missile and spacecraft systems are discussed briefly; the most widely used applications of liquid rocket propellants are mentioned; and areas of interest to research are brought into focus.

DATA PROCESSING

71,714 DATA STORAGE FOR METEOROLOGICAL SATELLITES
Schneebaum, M. I., Stampfl, R. A.
***Astronautics and Aerospace Engineering*, v. 1, no. 3, pp. 48–51, April 1963**

The advanced research being conducted by the Goddard Space Flight Center (GSFC) in the field of electronic and magnetic data storage of video information in meteorological satellites is discussed.

EARTH

71,715 AXIS CHANGES IN THE EARTH FROM LARGE METEORITE COLLISIONS
Dachille, F.
***Nature*, v. 198, no. 4876, p. 176, April 13, 1963**

Gallant has evaluated axis change in the Earth caused by collisions of large meteorites. He calculates that a Juno-sized meteorite (about 190-km D) colliding at 20 km/sec would cause an axis displacement of 0° 45′. However, by using the correct criterion of interaction of the Earth's angular momentum with the moment of momentum of the colliding body, the actual displacement would be only about 0° 02′. In fact, a bigger body (e.g., 320-km D) colliding at a maximum possible velocity of 72 km/sec would produce only 0° 32′ axis shift despite an energy 75 times the Juno example. Examples are given of maximum effects of collisions with the Earth and the Moon. The assumptions made are (1) a collision path tangential to a great circle perpendicular to the equator, (2) a density of 3.5, (3) a velocity of 72 km/sec, and (4) a complete rebound caused by a reverse-directed jet of explosion products to approximate as a maximum a twofold momentum exchange.

71,716 A STUDY OF THE FREE OSCILLATIONS OF THE EARTH
MacDonald, G. J. F., Ness, N. F.
1962
National Aeronautics and Space Administration, Washington, D.C.
TR R-136

Published observations on the toroidal oscillations of the Earth are critically reviewed. A supplementary analysis of the record obtained by the Lamont strain seismometer is presented. Eleven toroidal modes are identified, and it is concluded that the periods are known to within 1 percent. A perturbation scheme involving the ratio of the angular velocity of the Earth to the resonant frequency. Rotation removes a degeneracy and results in a splitting of a spectral peak of order l into $2l+1$ peaks. The fractional displacement in frequency for the lowest-order toroidal oscillations is 1/206 and of the same order as the Q of the peak, so that splitting will probably not be observed in the toroidal oscillations. The perturbations of the toroidal oscillations due to core-mantle interaction are treated in detail. Observations on the ${}_0T_2$ oscillations lead to an estimate of the toroidal magnetic field in the lower mantle. A calculation of elastic energy in the low-order oscillations suggests a value of 10^{18} erg/cph for the energy density at low frequencies in the Chilean earthquake. It is shown that the Gutenberg model Earth fits the observations more closely than the Lehmann model and that a slight alteration of the Gutenberg model gives a significantly better fit to the observations. The alteration involves a lower shear-wave velocity in the lower mantle while the Gutenberg velocity distribution is maintained in the upper mantle. The results confirm Birch's earlier statement that a temperature gradient in excess of 6 to 7°/km is needed to produce a decrease in velocity. The distribution of thermal conductivity and radioactivity consistent with the low-velocity layer is also considered.

ELECTRICAL PROPULSION SYSTEMS

71,717 FORTSCHRITTE BEI KONTINUIERLICHEN ELEKTROMAGNETISCHEN ANTRIEBSANLAGEN (ADVANCES IN CONTINUOUS ELECTROMAGNETIC PROPULSION SYSTEMS)
Au, G.
***Luftfahrttechnik Raumfahrttechnik*, v. 9, no. 3, pp. 88–94, March 1963**

The problems involved in a propulsion system composed of a plasma source and an electromagnetic post-accelerator are discussed.

ELECTRONIC EQUIPMENT

71,718 **SURFACE EFFECTS OF RADIATION ON TRANSISTORS**
Peck, D. S., Blair, R. R., Brown, W. L., Smits, F. M. (Bell Telephone Laboratories, Inc., Murray Hill, N.J.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 136–200, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D.C.
TID-7652, Paper B-2

A wide variety of effects of high-energy radiation on semiconductor materials and devices has been recognized and studied for a number of years. The major emphasis in this field has been on effects involving the bulk properties of semiconductors. Radiation effects on semiconductor surfaces have also been observed. This study is concerned with some special aspects of surface phenomena that have recently come to light. A type of measurement program is indicated that has been found appropriate for dealing with devices intended for use in a radiation environment such as that of the Van Allen belts. Included are (1) a brief discussion of the two broad classes of bulk radiation effects, (2) description of the early observations that provoked the present work, (3) a proposed model of the basic process, (4) results of a number of experiments carried out to test the mechanisms of the process, (5) characterization of effects with significant numbers of devices, and (6) the process of testing and selection undertaken for *Telstar* devices.

71,719 **THE EFFECTS OF PROTONS ON SEMICONDUCTOR DEVICES**
Honaker, W. C. (NASA/Langley Research Center, Langley Field, Va.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 220–229, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D.C.
TID-7652, Paper B-4

Experimental results are given covering the data obtained from the bombardment of several transistors with 40- and 440-Mev protons. The data indicate a proton energy as well as a transistor frequency dependence on degradation. Figures are presented showing relative degradation of transistors with integrated flux.

71,720 **PROTON RADIATION DAMAGE IN SEMICONDUCTOR DEVICES**
Gandolfo, D. A., Arnold, D. M., Parker, J. R., Vollmer, J. (RCA, Camden, N.J.), Baicker, J. A., Flicker, H., Vilms, J. (RCA, Princeton, N.J.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 230–242, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D.C.
TID-7652, Paper B-5

The objective of the study is to interpret observed changes in transistor electrical characteristics in terms of fundamental damage in the semiconductor crystal structure, and, in so doing, to predict the effects of proton bombardment. Proton and neutron displacement production rates are calculated. These rates are used in conjunction with neutron irradiation data and an assumed similarity of defect clusters to determine the effects of protons on transistors. Reasonable agreement with experiment is obtained. The life expectancy of transistors in satellites orbiting in the inner Van Allen belt is given.

71,721 **THERMAL DESIGN OF THE ELECTRONICS CANISTER**
Haury, P. T.
***Bell Laboratories Record*, v. 41, no. 4, pp. 161–166, April 1963**

Design, construction, and environmental testing of the *Telstar* electronics package are described.

ENVIRONMENTAL CONTROL SYSTEMS

71,722 **SPACE HARDWARE ASPECTS OF THE SATELLITE**
West, J. W.
***Bell Laboratories Record*, v. 41, no. 4, pp. 167–173, April 1963**

An account is given of the design and testing procedures used in development of the environmental and attitude control systems for *Telstar*.

ENVIRONMENTAL SIMULATORS

71,723 **SIMULATION OF DEEP SPACE ENVIRONMENTS FOR WORKING VEHICLES**
Hnilicka, M. P., Geiger, K. A. (National Research Corp., Cambridge, Mass.)
Institute of the Aerospace Sciences, Inc., New York, N.Y. Paper 63-56
(Presented at the IAS 31st Annual Meeting, New York, N.Y., January 21–23, 1963)

The second generation of simulators of large size offers realistic simulation of solar thermal effect and, by using LN_2 shield cryoarrays at 20°K, reasonable reliability testing of mechanisms of propulsion and mission support in lower orbit levels up to 700 km. An improved generation of ground simulators will need chilling of containment walls to reduce gas

ENVIRONMENTAL SIMULATORS (Cont'd)

loads from wall materials. Reduction of gas leakage and mass rejection from the tested vehicle will offer high returns in cost of that type of simulator which can establish valid reliability testing of steering, guidance, and communication devices aboard the spacecraft. The efficiency of capturing molecules on walls of the heat sink will need substantial improvement over present cryopumping arrays. Several promising concepts, using cryoadsorption techniques and offering nearly perfect accommodation, even of hydrogen molecules, are described.

71,724 A SURVEY OF LARGE SPACE CHAMBERS
Hollingsworth, R. T.
April 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1673

Construction has been authorized for a number of large thermal-vacuum chambers to simulate orbital altitudes in the environmental testing of complete spacecraft. The proposed facilities shall be capable of simulating the low temperatures, solar and Earth radiation, and vacuum of outer space. We have outlined in this report the individual specifications and capabilities of each of the proposed space simulation facilities. Since the field of space simulation is growing rapidly, it is recognized that this survey will be out of date upon issue.

71,725 JPL 25-FOOT SPACE SIMULATOR SOLAR PERFORMANCE AND MARINER TEST RESULTS COMPARED TO FLIGHT DATA
Howard, W. R.
April 24, 1963
Jet Propulsion Laboratory, California Institute of Technology, Pasadena
TM 33-137

The JPL 25-ft space simulator solar simulation system has recently been modified to concentrate all of the available radiant energy in a light beam of sufficient size and intensity to test the *Ranger* and *Mariner*. Solar simulation system characteristics are compared with the solar environment in space, calibration of the system is described, and flight data are compared with ground-test data for the *Mariner* Venus probe. Plans for improving the solar simulation system are outlined.

71,726 JPL ADVANCED SOLAR SIMULATOR, DESIGN TYPE A
Barnett, R. M., Thiele, C.
April 23, 1963
Jet Propulsion Laboratory, California Institute of Technology, Pasadena
TM 33-141

A description of the JPL Advanced Solar Simulator Type A is presented, together with the results of analytical and experimental studies verifying its performance at the subsystem level. A program of subsystem optimization is underway which indicates performance capability far beyond that reported here. A complete full-sized system is currently under construction, and final evaluation at the testing volume will be undertaken as soon as possible. These results, as well as those of the subsystem optimizations, will be published when available. Finally, a program of improvement will be initiated to extract the untapped potential of the system in order to provide large, integrated Sun simulators for use in such applications as the *Voyager* spacecraft.

71,727 NASA SPACE RADIATION EFFECTS LABORATORY
Duberg, J., Rind, E. (NASA/Langley Research Center, Langley Field, Va.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 201–219, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper B-3

NASA, Langley Research Center, Virginia has proposed a ground-based Space Radiation Effects Laboratory which will simulate most of the particulate energy spectrum found in space and which can be used in an effective, accelerated, radiation research program to minimize or eliminate deleterious radiation effects. To achieve these results in a minimum time, a 600-Mev proton synchrocyclotron of proven design with variable energy and variable external beam size, and a 1- to 30-Mev electron accelerator with the same capabilities, have been incorporated into the proposed facility. Although these devices will be used as engineering tools, provision has been made to maintain the basic research capabilities of these accelerators.

ESCAPE SYSTEMS

71,728 LEAP—A ONE-MAN LUNAR ESCAPE AMBULANCE PACK
Carton, D. S. (College of Aeronautics, Cranfield, Bletchley, Buckinghamshire, England)
American Rocket Society, Inc., New York, N. Y.
2485-62
(Presented at the Lunar Missions Meeting, Cleveland, Ohio, July 17–19, 1962)

LEAP is a one-man vehicle intended for operation from the lunar surface in the event of an emergency. The concept involves the launching of the *LEAP* payload into a trajectory which will place it close to an orbiting space station. A "soft" rendezvous will permit the transfer of the affected crew member into the spacecraft. As presently foreseen, the orbiting space station will be of an *Apollo* type, but with only two men on board. A "normal" *Apollo* and three-man crew will be on the lunar surface for an extended exploration.

EXOSPHERE

71,729 **THE STRUCTURE OF THE IONIZED GASEOUS ENVELOPE OF THE EARTH ACCORDING TO THE DATA OF DIRECT MEASUREMENTS OF LOCAL CHARGED-PARTICLE CONCENTRATIONS CARRIED OUT IN THE USSR**
Gringauz, K. I.
***Artificial Earth Satellites*, v. 12, pp. 114–130, March 1963**

71,730 **DISTRIBUTION OF HYDROGEN IN THE OUTER ATMOSPHERE**
Donahue, T. M., Thomas, G.
***Planetary and Space Science*, v. 10, pp. 65–72, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

The experiments relating to the Lyman-α radiation observed from rockets in the night sky are reviewed. In part, the radiation appears to be solar Lyman-α transported by the exosphere below 3 Earth radii. However, an important fraction must be attributed also to single scattering in a very extensive envelope of hydrogen moving with the Earth out to 50–100 Earth radii. The amount of hydrogen needed is about 50 times as much as should be present in the escape component of the exosphere required. The principal problem at present is to account for this hydrogen.

71,731 **AN ANALYTIC SOLUTION FOR DENSITY DISTRIBUTION IN A PLANETARY EXOSPHERE**
Shen, C. S.
***Journal of the Atmospheric Sciences*, v. 20, no. 2, pp. 69–72, March 1963**

An analytical expression $\rho(r) = N_0[e^{(1-R/r)E} - (1-R^2/r^2)e^{-(rE/r+R)}]$, where E is a temperature dependent parameter and R is the radius of the base of exosphere, is derived for the density distribution in a planetary exosphere. The difference between this distribution and the barometric (Boltzmann) formula is small near the base of the exosphere but becomes significant at large r; at $r = \infty$ the barometric formula gives a finite density where this distribution tends to zero. It is shown that according to a strict collisionless exosphere model the particles in the velocity space are confined in a region bounded by a hyperbola and a quarter circle. Outside this region there are no particles; inside, they are distributed by a Maxwellian law. The physical significance of this difference and its effect on the escape rate are discussed.

EXPLORER 15

71,732 **EXPLORER XV ENERGETIC-PARTICLES SATELLITE**
***American Geophysical Union, Transactions*, v. 44, no. 1, pp. 252–257, March 1963**
(Also available in *National Academy of Sciences, IGY Bulletin*, no. 68, February 1963)

The *Explorer 15* was launched on October 27, 1962 to study the artificial radiation belt created by the July 9, 1962 high-altitude nuclear test. The satellite and its experiments are described.

F REGION

71,733 **THE RELATIONSHIP OF *F*-LAYER CRITICAL FREQUENCIES TO THE INTENSITY OF THE OUTER VAN ALLEN BELT**
Muldrew, D. B.
***Canadian Journal of Physics*, v. 41, no. 1, pp. 199–202, January 1963**

With the use of the *Alouette*, certain characteristics of the ionosphere between 1000 km and the height of maximum electron density, together with the intensity (counting rate) of high-energy particles at orbital heights, are measured as a function of latitude.

71,734 **ÉTUDE DE LA COUCHE *F* D'APRES L'ÉMISSION DE LA RAIE ROUGE DU CIEL NOCTURNE (STUDY OF THE F LAYER FROM RED LINE EMISSIONS IN THE NIGHT SKY)**
Barbier, D.
***Planetary and Space Science*, v. 10, pp. 29–35, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

Intertropical arcs and the western sheet show a strong correlation with the electronic recombination in the F layer. These phenomena are described on a world-wide basis.

71,735 **OBSERVATION OF MOVEMENT OF PERTURBATIONS IN THE *F*-REGION**
Heisler, L. H.
***Journal of Atmospheric and Terrestrial Physics*, v. 25, no. 2, pp. 71–86, February 1963**

A summary is given of investigations into the phenomenon of traveling ionospheric disturbances in the F region made at the Radio Research Laboratories, University of Sydney, Australia. The results of these investigations are compared with those obtained by other methods, and discrepancies are noted. It is proposed that the Mitra method in particular is not entirely satisfactory and should be supplemented by other techniques.

71,736 **THE ELECTRON SCATTERING CROSS-SECTION IN INCOHERENT BACKSCATTER**
Greenhow, J. S., Sutcliffe, H. K., Watkins, C. D.
***Journal of Atmospheric and Terrestrial Physics*, v. 25, no. 4, pp. 197–207, April 1963**

Some measurements of the electron scattering cross section carried out using two 25-m radio telescopes are described. Both the diurnal variations of the cross section and its absolute values are examined.

F REGION (Cont'd)

71,737 TIME OF ONSET OF SPREAD-*F* IN RELATION TO POST SUNSET *h'F* VARIATIONS
Krishnamurthy, B. V., Ramachandra Rao, B.
Journal of Atmospheric and Terrestrial Physics, v. 25, no. 4, pp. 209–210, April 1963

71,738 DRIFT SPEED ESTIMATES FROM LARGE MOVING IRREGULARITIES IN THE *F*-REGION AT COLLEGE, ALASKA
Ansari, Z. A.
Journal of Atmospheric and Terrestrial Physics, v. 25, no. 4, pp. 210–212, April 1963

The horizontal component of the speed of the moving irregularities in the F region is presented. Drift speeds for July–September 1960 were estimated.

F_2 LAYER

71,739 GEOMAGNETIC CONTROL OF DIFFUSION IN THE *F2* REGION OF THE IONOSPHERE—II NUMERICAL RESULTS
Kendall, P. C.
Journal of Atmospheric and Terrestrial Physics, v. 25, no. 2, pp. 87–91, February 1963

The equation governing electron diffusion in the F_2 region along the lines of force of a geocentric magnetic dipole, whose axis coincides with the Earth's, is solved numerically in the equilibrium case when there is electron production, loss by recombination, but no transport of electrons by electrodynamic drift.

71,740 IONOSPHÈRE—UNE ÉCLIPSE DE SOLEIL PEUT-ELLE MODIFIER L'IONOSPHERE AU POINT MAGNETIQUEMENT CONJUGUÉ? (IONOSPHERE—AN ECLIPSE OF THE SUN. MIGHT IT MODIFY THE IONOSPHERE AT THE MAGNETICALLY CONJUGATE POINT?)
Haubert A., Laloë, F.
Journal of Atmospheric and Terrestrial Physics, v. 25, no. 2, pp. 105–107, February 1963

Observations at Garcy, France, for August 11, 1961 indicate a variation in the F_2 region during a period of quiet solar activity. At Capetown, South Africa, a point roughly conjugate to Garcy, a solar eclipse was visible at the same time. This same correlation was observed during the eclipse of February 15, 1961, and it is suggested that the phenomenon be analyzed during future eclipses.

GEGENSCHEIN

71,741 THE GEGENSCHEIN AS AN EFFECT PRODUCED BY THE SCATTERING OF LIGHT FROM PARTICLES OF INTERPLANETARY DUST
Gindilis, L. M.
Soviet Astronomy—AJ, v. 6, no. 4, pp. 540–548, January–February 1963

The optical theory of the gegenschein is considered. It is shown that the scattering of light by particles of interplanetary dust allows an explanation of the main features of the gegenschein: the observed photometric profile and the energy distribution in the gegenschein spectrum.

GEOMAGNETIC DISTURBANCES

71,742 IONOSPHERIC STORMS AND THE MORPHOLOGY OF MAGNETIC DISTURBANCES
Rishbeth, H.
Planetary and Space Science, v. 11, no. 1, pp. 31–43, January 1963

The forms of magnetic changes which accompany ionospheric storms are discussed. Magnetic data from four stations are used to derive *SD* and *Dst* variations, for groups of ionospherically "positive" and "negative" storms. The *SD* variation of the magnetic *H* element is found to differ for "positive" and "negative" storms at three mid-latitude stations (Washington, U.S.A., Greenwich, England, and Christchurch, New Zealand). The meaning of these differences is discussed. At a lower latitude station (Hawaii), the magnetic *SD* is the same for both types of ionospheric storms. The magnetic *Dst* variations are also essentially similar for both types.

71,743 THE INFLUENCE OF THE MOON ON GEOMAGNETIC DISTURBANCES
Bigg, E. K.
Journal of Geophysical Research, v. 68, no. 5, pp. 1409–1413, March 1, 1963

It is shown that occurrences of geomagnetic disturbances of various intensities are not uniformly distributed in lunar phase. There is a tendency for storms to occur preferentially near first and third quarters and to avoid dates corresponding to new Moon.

GEOMAGNETIC FIELD

71,744 THE INTERACTION BETWEEN THE GEOMAGNETIC FIELD AND THE SOLAR CORPUSCULAR RADIATION
Blume, R.
Icarus, v. 1, no. 5-6, pp. 459–488, April 1963

71,745 INTERACTIONS OF SOLAR PLASMA WITH THE GEOMAGNETIC FIELD
Dungey, J. W.
Planetary and Space Science, v. 10, pp. 233–237, 1963
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

The Chapman-Ferraro theory is outlined. The interaction when there is an interplanetary field is considered and leads to an interpretation of the auroral zones. Early results from *Explorer 12* tend to confirm this model. The motion of the auroral primaries is briefly discussed.

71,746 THE ENERGIZATION OF PLASMA IN THE MAGNETOSPHERE: HYDROMAGNETIC AND PARTICLE-DRIFT APPROACHES
Hines, C. O.
***Planetary and Space Science*, v. 10, pp. 239–246, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

Two approaches to the description of the energy changes experienced by the low-energy plasma and the high-energy particles which exist in the magnetosphere are discussed. It is demonstrated that these two approaches, hydromagnetic and particle-drift, are quite equivalent on the differential scale, and that some degree of equivalence can be maintained on the integral scale.

71,747 LUNAR EFFECT ON THE DIURNAL VARIATION OF THE GEOMAGNETIC HORIZONTAL FIELD NEAR THE MAGNETIC EQUATOR
Onwumechilli, A.
***Journal of Atmospheric and Terrestrial Physics*, v. 25, no. 2, pp. 55–70, February 1963**

Magnetogram studies at Ibadan, Nigeria during the season of northern winter indicate that the lunar tide accounts for about 11 percent of the daily range of the geomagnetic horizontal field. A new method is presented for separating the lunar effect at certain hours on individual days, and this has shown that the ratio of intensities of lunar to solar daily variation varies from hour to hour on the same day.

71,748 *C–F* HOLLOWS FOR SOLAR STREAMS PARTIALLY INCIDENT ON THE EARTH
Kendall, P. C.
***Journal of Atmospheric and Terrestrial Physics*, v. 25, no. 2, pp. 93–97, February 1963**

The shape of the geomagnetic hollow is calculated for a corpuscular flux corresponding to the edge of a unidirectional stream of charged particles which partially surrounds the Earth. The solar stream, only partially incident on the Earth, gives rise to geomagnetic hollows different in shape from the usual. The equatorial cross section of the hollow is considered.

71,749 MOTIONS OF CHARGED PARTICLES TRAPPED IN THE EARTH'S MAGNETOSPHERE
Hones, E. W., Jr.
***Journal of Geophysical Research*, v. 68, no. 5, pp. 1209–1219, March 1, 1963**

Motions of charged particles trapped in the distorted magnetosphere are computed by using, as a model of the magnetosphere, the field of a weak magnetic dipole in the presence of a strong magnetic dipole. Drift paths through this field are calculated both for particles whose motion is confined to the magnetic equatorial plane and for particles mirroring at low altitudes. The paths of particles of various energies moving in the magnetic equatorial plane under the combined influences of field gradient-induced drift and field rotation are also calculated. It is found that, in the model used, the field rotation energizes trapped particles on the morning side and de-energizes them on the evening side of the Earth. It is suggested that this effect must occur in any realistic model of the distorted magnetosphere, and that it may play a role in the accumulation of the energetic particles that constitute the Van Allen zones.

71,750 THE DISTANT GEOMAGNETIC FIELD 2. MODULATION OF A SPINNING COIL EMF BY MAGNETIC SIGNALS
Sonett, C. P.
***Journal of Geophysical Research*, v. 68, no. 5, pp. 1229–1232, March 1, 1963**

The modulation of a spinning search coil signal by time-variant magnetic fields is discussed. For typical spacecraft usage, dipolar inhomogeneity produces a trivial signal. The primary contributions to the signal arise from the coil spin and field time variance. Variations in the scalar value of the field produce both amplitude and phase modulation. In a base field like the Earth's with superimposed fluctuations, amplitude modulation from Alfvén waves is usually trivial. The amplitude power spectrum depends on both the spin rate of the spacecraft and the Fourier decomposed frequencies of the fluctuations. Where frequencies near the spin are encountered, spectral inversion can result from what becomes effectively the mixing of two carrier signals. The results described in the previous paper of this series are discussed in relation to these conditions. (Part 1 of this article appeared in the *Journal of Geophysical Research*, v. 67, no. 4, pp. 1191–1207, April 1962, and was abstracted in the *Astronautics Information Abstracts*, v. 6, no. 1, July 1962, Entry #60,094.)

71,751 THE DISTANT GEOMAGNETIC FIELD 3. DISORDER AND SHOCKS IN THE MAGNETOPAUSE
Sonett, C. P., Abrams, I. J.
***Journal of Geophysical Research*, v. 68, no. 5, pp. 1233–1263, March 1, 1963**

The second part of the computer reduction of magnetometer data from the flight of *Pioneer 1* is reported. The data include the analysis of selected swaths and are primarily concerned with hydromagnetic disorder as seen at distances of 12.3–14.6 Earth radii on the sunlit hemisphere of the magnetopause. The vehicle orbit and orientation are reviewed; the instrumentation is discussed as directly applicable to the experiment; data handling are discussed with details of

GEOMAGNETIC FIELD (Cont'd)

the computer program given in appendices; the gross structure of the distant field is described; and numerous power spectrums of both field amplitude and direction are included.

71,752 THE DISTANT GEOMAGNETIC FIELD 4. MICROSTRUCTURE OF A DISORDERED HYDROMAGNETIC MEDIUM IN THE COLLISIONLESS LIMIT
Sonett, C. P.
Journal of Geophysical Research, v. 68, no. 5, pp. 1265–1294, March 1, 1963

The fine-scale structure of the geomagnetic field data given in a previous paper is examined. Primary concern is given to the microscopic view of the data, with particular concern to fitting it into some pattern having at least qualitative consistency with viewpoints established in the past concerning the behavior pattern both of the geomagnetic termination and of collisionless plasma.

71,753 A NOTE ON THE COMPRESSION OF THE EARTH'S MAGNETIC FIELD AND HYPOTHETICALLY RELATED PHENOMENA
Henrich, L. R.
Journal of Geophysical Research, v. 68, no. 5, pp. 1295–1302, March 1, 1963

The magnetic field of the Earth is assumed compressed by an incident stream of ionized particles from the Sun. A time-dependent magnetic and electric field is propagated as part of this interaction. A simplified model, a mirror dipole moving in space but of constant magnetic moment, is chosen to calculate the manner in which this electric field will compress and possibly accelerate ions already trapped in the Earth's magnetosphere. This model would tend to dump radiation from the terrestrial belts into the atmosphere. For geometrical reasons the effects might be most pronounced in early morning and late evening.

71,754 THE EFFECT OF THE EARTH'S MAGNETIC FIELD ON IRREGULARITIES OF IONIZATION IN THE *E* LAYER
Villars, F., Feshbach, H.
Journal of Geophysical Research, v. 68, no. 5, pp. 1303–1320, March 1, 1963

Solutions are investigated of the equation for diffusion and transport of ionization in a weakly ionized turbulent plasma in the presence of a magnetic field. Because of space charge effects, the problem is nonlinear in the ionization density $n(x, t)$. It is shown that in the linearized approximation, the effect of the magnetic field on turbulence does not lead to irregularities of a scale sufficiently small to explain the observed data. Nonlinear effects may play a role and are being investigated. Preliminary results show that they are capable of increasing density gradients in irregularities of sufficient amplitude. The present study is an outgrowth of attempts to understand the structure responsible for the backscattering of radio waves by aurora.

71,755 THE EFFECT OF A UNIFORM EXTERNAL PRESSURE ON THE BOUNDARY OF THE GEOMAGNETIC FIELD IN A STEADY SOLAR WIND
Spreiter, J. R., Hyett, B. J.
Journal of Geophysical Research, v. 68, no. 6, pp. 1631–1642, March 15, 1963

Approximate solutions are given for the shape of the boundary separating the geomagnetic field from the interplanetary plasma for a model that assumes the plasma pressure to be composed of two components. One is a dynamic pressure proportional to the normal component of the momentum of the particles of a steady and undisturbed uniform incident stream as is customary in the usual formulation of the steady-state Chapman-Ferraro problem. The other is a static pressure considered over the boundary surface. Results are determined for the traces of the boundary in the equatorial plane and in the meridian plane containing the Sun-Earth line for a complete range of values for the ratio between the two pressure components. Results indicate that the asymmetry between the distances to the boundary of the geomagnetic field on the day and night sides of the Earth may be greatly exaggerated by the results of the usual calculations in which the static pressure is disregarded.

GEOMAGNETIC STORMS

71,756 A SUGGESTION FOR IMPROVING FORECASTS OF GEOMAGNETIC STORMS
Hakura, Y., Lincoln, J. V.
Journal of Geophysical Research, v. 68, no. 5, pp. 1563–1564, March 1, 1963

It is suggested that forecasts of geomagnetic storms may be improved by a technique based on the monitoring of HF transmissions from a station within the north polar cap.

GRAVITATIONAL FIELDS

71,757 EARTH'S GRAVITATIONAL POTENTIAL: EVALUATION OF EVEN ZONAL HARMONICS FROM THE 2nd TO THE 12th
King-Hele, D. G., Cook, G. E., Rees, J. M.
Nature, v. 197, no. 4869, p. 785, February 23, 1963

A new determination of the even harmonics in the Earth's gravitational potential has been made using the motion of seven satellites. These satellites were chosen with the intention of sampling the gravitational field as thoroughly and evenly as possible; their orbits were inclined to the equator at angles between 28 and 97 deg.

GRAVITY

71,758 GRAVITATIONAL RADIATION
Pirani, F.A.E. (King's College, London, England)
May 1962
Aeronautical Research Laboratories, Wright-Patterson AFB, Ohio
ARL 62-455

A survey is presented of gravitational radiation theory up to the end of 1961. Some technical details, but no calculations, are included.

GROUND SUPPORT EQUIPMENT

71,759 THE GROUND STATION TRANSMITTER AND RECEIVER
Schill, J., Perks, A. F.
***Bell Laboratories Record*, v. 41, no. 4, pp. 135–141, April 1963**

Solutions are described for the special design problems which arose in connection with construction of adequate transmitter and receiver units for the Andover, Maine, horn antenna. Schematic diagrams describe transmitter and receiver operation.

GUIDANCE SYSTEMS

71,760 MIDCOURSE GUIDANCE USING RADIO TECHNIQUES
Gates, C. R., Cutting, E. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena)
American Rocket Society, Inc., New York, N. Y.
2462-62
(Presented at the Lunar Missions Meeting, Cleveland, Ohio, July 17–19, 1962)

A lunar midcourse guidance system using Earth-based radio tracking and computation is discussed. Primary emphasis is on engineering factors, including requirements placed on spacecraft, tracking stations, and computing facilities. Performance is described, and maneuver size, number of maneuvers, and tracking and guidance accuracy are treated.

71,761 MEASURE DIRECTION BY SPINNING LIGHT RAY
***Product Engineering*, v. 34, no. 5, p. 95, March 4, 1963**

A new method for sensing the rotation rate of a vehicle uses coherent light moving in opposite directions around a traveling wave laser, and is based on the physical principle of the constancy of the velocity of light. This method, called a ring laser, may replace the gyroscope as an automatic guidance system as it requires neither bearings nor other moving parts and would be cheaper to produce and more sensitive than present equipment.

HYDROMAGNETIC WAVES

71,762 ON THE FREQUENCY CUTOFF OF HYDROMAGNETIC WAVES IN THE UPPER ATMOSPHERE
Kahalas, S. L.
***Journal of Geophysical Research*, v. 68, no. 6, pp. 1776–1778, March 15, 1963**

A mechanism is discussed which involves Landau damping of hydromagnetic waves by thermal protons in the exosphere and below.

INFRARED RADIATION

71,763 THE INFRARED HORIZON OF THE PLANET EARTH
Hanel, R. A., Bandeen, W. R., Conrath, B. J.
***Journal of the Atmospheric Sciences*, v. 20, no. 2, pp. 73–86, March 1963**

Horizon sensors are essential elements in the orientation systems of many space vehicles and satellites. Their design and an evaluation of their capabilities and limitations require a knowledge of the spectral radiance emitted by the Earth. The discontinuity between the surface, the atmosphere, and outer space for various latitudinal, seasonal, climatic, and meteorological conditions is investigated. Calculations are carried out for the following spectral intervals: (1) the water vapor band from 6.33 to 6.85 μ, (2) the ozone band from 8.9 to 10.1 μ, (3) the atmospheric window from 10.75 to 11.75 μ, (4) the carbon dioxide band from 14 to 16 μ, and (5) the rotational water vapor band from 21 to 125 μ. The superior properties of the carbon dioxide band and the rotational water vapor region for horizon sensor purposes are shown.

INSTRUMENTATION

71,764 THE SATELLITE MICROWAVE REPEATER
Hutchison, P. T.
***Bell Laboratories Record*, v. 41, no. 4, pp. 151–155, April 1963**

The electrical features and design considerations peculiar to satellite-borne communication repeaters of the type used in *Telstar* are discussed.

INTERPLANETARY ENVIRONMENT

71,765 REMARKS ON THE LIMITATIONS OF OPTICAL METHODS FOR MEASURING ELECTRON DENSITIES IN THE CORONA AND INTERPLANETARY SPACE
Blackwell, D. E.
***Space Science Reviews*, v. 1, no. 3, pp. 612–614, March 1963**
(Paper presented at the European Preparatory Commission for Space Research Symposium on The Interplanetary Medium, at Paris, France, June 19, 1962)

Difficulties in measuring electron densities in the outer corona and interplanetary space are discussed which arise

INTERPLANETARY ENVIRONMENT (Cont'd)

because some of the light of the corona is due to scattering by interplanetary dust.

INTERPLANETARY MAGNETIC FIELDS

71,766 MAGNETIC FIELDS IN INTERPLANETARY SPACE 1961
Air Force Cambridge Research Center, Geophysics Research Directorate, Bedford, Mass.
AFCRL-62-225, Final Engineering Report
ASTIA AD-272,831

This report concerns (1) a study of existing measurements and theories regarding the magnetic fields in interplanetary space, (2) development of a magnetic field model from the available measurements for refining the magnetic field model, and (3) design of a rocket probe magnetometer instrument package suitable for making the required measurements.

71,767 MAGNETIC FIELD MEASUREMENTS IN SPACE
Cahill, L. J., Jr.
***Space Science Reviews*, v. 1, no. 3, pp. 399–414, March 1963**

A brief account is given of the general conception of the outer geomagnetic field and of the interplanetary magnetic field prior to satellite magnetometer investigations. An objective account of the important findings of each of the satellite magnetometer experiments, and an interpretation of the effects of these findings on the present status of understanding of the outer geomagnetic field, the boundary region, and interplanetary magnetic field are given.

INTERPLANETARY MATTER

71,768 INTERPLANETARY PLASMA
Lüst, R.
***Space Science Reviews*, v. 1, no. 3, pp. 522–552, March 1963**
(Paper presented at the European Preparatory Commission for Space Research Symposium on The Interplanetary Medium, at Paris, France, June 19, 1962)

All available evidence concerning the gaseous component of the interplanetary medium is summarized, and the theoretical picture which has been developed is discussed. The discussion is restricted to the undisturbed conditions in the interplanetary space.

71,769 THE PLASMA TAILS OF COMETS AND THE INTERPLANETARY PLASMA
Biermann, L.
***Space Science Reviews*, v. 1, no. 3, p. 553, March 1963**
(Paper presented at the European Preparatory Commission for Space Research Symposium on The Interplanetary Medium, at Paris, France, June 19, 1962)

A few of the points discussed in the previous paper ("Interplanetary Plasma", by Dr. Lüst) are considered in greater detail, and the significance of the observations of the comets' plasma tails as natural probes for the interplanetary plasma is reemphasized.

71,770 METEORS AND THE ABUNDANCE OF INTERPLANETARY MATTER
Kaiser, T. R.
***Space Science Reviews*, v. 1, no. 3, pp. 554–575, March 1963**
(Paper presented at the European Preparatory Commission for Space Research Symposium on The Interplanetary Medium, at Paris, France, June 19, 1962)

Estimates of the spatial density of interplanetary dust are derived from meteor accretion and zodiacal cloud observations. When the most recent data are considered, it is found that there is no longer any serious discrepancy between the extrapolated meteor values and those from the other sources, and a density distribution is obtained which extends from meteoroids capable of producing the brightest optical meteors to particles approaching the limiting size beyond which they are removed from the solar system by solar radiation pressure. Impacts on rocket and satellite vehicles lead to much higher estimates of spatial densities, and it is concluded that these impacts originate from particles in geocentric orbits belonging to a dust cloud encompassing the Earth. The evidence tends to support the view that these particles are captured from the interplanetary dust cloud rather than being produced, as suggested by Whipple, through the impact of meteorites on the Moon. Some suggestions are made for the direction of future rocket and satellite investigations.

71,771 LIGHT SCATTERING BY SMALL PARTICLES AND MODELS OF INTERPLANETARY MATTER DERIVED FROM THE ZODIACAL LIGHT
Giese, R. H.
***Space Science Reviews*, v. 1, no. 3, pp. 589–611, March 1963**
(Paper presented at the European Preparatory Commission for Space Research Symposium on The Interplanetary Medium, at Paris, France, June 19, 1962)

A model of interplanetary matter having the same optical properties as those observed in the zodiacal light and involving the presence of small particles ($< 0.2\,\mu$) is suggested. Methods and results of an analysis of light scattering by single particles and by mixtures of particles are presented in detail.

71,772 INTERPLANETARY MATTER: A BIBLIOGRAPHY, 1962 SUPPLEMENT
Magnolia, L. R.
April 1963
Space Technology Laboratories, Inc., Redondo Beach, Calif.
9990-6380-KU-000
Research Bibliography 46

This bibliography consists of 567 annotated references on asteroids, comets, meteorites, meteors, micrometeorites, noctilucent clouds, nonterrestrial dust, origin of the solar system, tektites, the zodiacal light, and related subjects. The majority of the references are those published in 1962, and include those released in 1962 by ASTIA and NASA. A few references not listed in the original edition are included.

IONOSPHERE

71,773 **ROCKET OBSERVATIONS OF ION DENSITY, ELECTRON DENSITY AND ELECTRON TEMPERATURE IN THE IONOSPHERE**
Aono, Y., Hirao, K., Miyazaki, S.
***Journal of the Radio Research Laboratories,* v. 9, no. 46, pp. 407–419, November 1962**

Ionospheric measurements made by sounding rockets at the Michikawa Rocket Range, Japan, in June and October 1961 are reported. The rockets, carrying various combinations of Langmuir and resonance probes, measured ion density, electron density, and electron temperature in the ionosphere at altitudes between 60 and 200 km. Instrumentation and measurement methods are described.

71,774 **A METHOD FOR SIMULTANEOUS RECORDING OF THE ECHO AMPLITUDE WITH h'-f CURVE IN THE IONOSPHERIC SOUNDING AND SOME APPLICATION TO THE MEASUREMENT OF IONOSPHERIC PARAMETERS**
Wakai, N., Ishizawa, K.
***Journal of the Radio Research Laboratories,* v. 9, no. 46, pp. 421–442, November 1962**

A method and apparatus for recording the echo amplitude and $h'(f)$ records on the same film are described. Ten pages of such film records are reproduced and their application discussed.

71,775 **IONOSPHERIC EFFECTS OF A HIGH ALTITUDE NUCLEAR EXPLOSION**
***Journal of Atmospheric and Terrestrial Physics,* v. 25, no. 2, pp. 99–100, February 1963**

Ionospheric stations of the New Zealand network recorded marked effects after the July 9, 1962 thermonuclear event over Johnston Island. Observations are compared with those of the 1958 events, and a correlation between height of explosion and time of onset is noted.

71,776 **THE REFRACTIVE INDEX AND THE ABSORPTION INDEX OF THE IONOSPHERE**
Murty, Y. S. N., Khastgir, S. R.
***Journal of Atmospheric and Terrestrial Physics,* v. 25, no. 2, pp. 102–105, February 1963**

Analytical expressions have been obtained for computing the refractive index and the absorption index for various values of electron number density, electron collisional frequency and wave frequency. The derivation of the expressions for the refractive index and the absorption index for radio-wave propagation through the ionosphere is given.

71,777 **NONUNIFORM LAMINATION ANALYSIS OF IONOSPHERIC $h'(f)$ RECORDS, USING WAVE REFRACTIVE INDEX**
Unz, H.
***Journal of Atmospheric and Terrestrial Physics,* v. 25, no. 4, pp. 189–196, April 1963**

71,778 **IONOSPHERIC EFFECTS FOLLOWING DISTANT NUCLEAR DETONATIONS**
Saha, A. K., Karabin, M., Mahajan, K. K.
***Journal of Atmospheric and Terrestrial Physics,* v. 25, no. 4, pp. 212–218, April 1963**

Preliminary results are given of observations made at Delhi of some ionospheric effects following the Russian nuclear detonations during August and September 1962.

71,779 **A MODEL OF THE QUIET IONOSPHERE**
Seddon, J. C.
***Journal of Geophysical Research,* v. 68, no. 5, pp. 1339–1345, March 1, 1963**

The electron and ion density results obtained with rockets under quiet ionospheric conditions and reasonably favorable scientific conditions are discussed. A simple model of the quiet ionosphere is obtained which can be expressed in analytical form. The model is used to develop a means of obtaining from ionograms an approximate electron density profile and total electron content. It is also shown how such data used in conjunction with total electron content measurements make possible the determination of the electron density profile above h_{max} F_2.

71,780 **EFFECTS OF THE HIGH-ALTITUDE THERMONUCLEAR EXPLOSION OF JULY 9, 1962, 0900 UT, OBSERVED AT JAMAICA**
Armstrong, R. J., Wharton, A. E. B.
***Journal of Geophysical Research,* v. 68, no. 6, pp. 1779–1780, March 15, 1963**

Unusual effects observed at Jamaica soon after the high-altitude thermonuclear explosion of July 9, 1962 are discussed.

71,781 **SCALE HEIGHTS OF THE UPPER IONOSPHERE FROM TOP-SIDE SOUNDINGS**
Nelms, G. L.
***Canadian Journal of Physics,* v. 41, no. 1, pp. 202–206, January 1963**

Data from *Alouette* have been used to calculate electron density profiles of the upper ionosphere.

IONOSPHERE (Cont'd)

71,782 ELECTRIC FIELDS IN THE IONOSPHERE AND THE EXCITATION OF THE RED LINES OF ATOMIC OXYGEN
Megill, L. R., Rees, M. H., Droppleman, L. K.
***Planetary and Space Science*, v. 11, no. 1, pp. 45–56, January 1963**

A detailed formulation for obtaining the excitation rate of optical emissions by electrons heated by a dc electric field is presented. The energy distribution of the electrons is obtained by solving the Boltzmann equation, including all the inelastic collisions of importance in the region of the atmosphere from which airglow and auroral radiations originate. The consequences are examined of a postulated dc electric field in the ionosphere sufficient to excite the $O(^1D)$ levels from which the airglow and auroral radiation at λλ 6300–6364 Å originate.

An electric field of 2×10^{-3} v/cm orthogonal to the geomagnetic field results in an intensity of the red lines of atomic oxygen of about 5 kR, such as is observed in the midlatitude subvisual red arcs, with the height of maximum emission at approximately 400 km.

71,783 SOME RESULTS OF ROCKET MEASUREMENTS OF THE ELECTRON CONCENTRATION IN THE IONOSPHERE UP TO HEIGHTS OF 200 KM MADE IN 1959–1960
Rudakov, V. A.
Massey, H. S. H., Translator
***Planetary and Space Science*, v. 11, no. 1, pp. 59–60, January 1963**
(Translated from *Iskusstvennye Sputniki Zemli*, no. 10, p. 102, 1961)

The distributions of $n_e(h)$–the relationship of the concentration of free electrons in the ionosphere to height–determined in 1959 and 1960 during firings of USSR Academy of Sciences sounding rockets to heights of 200 km are given. A chart is included which shows the values of the function $n_e(h)$ obtained during the firings.

71,784 TURBULENCE IN ATMOSPHERIC MOTIONS BETWEEN 90 AND 130 KM OF ALTITUDE
Blamont, J.-E.
***Planetary and Space Science*, v. 10, pp. 89–101, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

Data on the structure of the field of motion of the atmosphere are reviewed. These include turbulence spectrum, diffusion coefficients, and limit of turbulence.

71,785 VARIATIONS IN THE MEAN MOLECULAR WEIGHT OF NIGHT AIR AT HEIGHTS FROM 100 TO 210 KM SHOWN BY MASS SPECTROMETRY
Pokhunkov, A. A.
***Artificial Earth Satellites*, v. 12, pp. 145–153, March 1963**

71,786 A METHOD OF DETERMINATION OF IONOSPHERIC ELECTRON DENSITY PROFILES FROM FARADAY ROTATION OF SATELLITE BORNE RADIO SIGNALS
Gonzalez, V.
September 1962
Illinois, University of, Electrical Engineering Research Lab., Urbana
Ph.D. Thesis, N 63 10168

Faraday rotation records received at a ground station from a transmitting satellite are analyzed in detail. A set of parameters of a Chapman ionosphere model is assumed, and the faraday effect corresponding to a given satellite passage is calculated by means of an electronic computer, using the ray tracing technique. The calculated result is compared with the experimental observations to generate a new set of parameters. The whole calculations are then repeated with the new ionosphere until the differences between the calculated and experimental values have been minimized. Since the ray tracing requires the longest computer time in this self-consistent approach, it is found that in most cases a second-order formula is much simpler to use and gives almost equal satisfaction. The phenomenon of one-hop propagation when the satellite moves below the height of maximum electron density, and the occurrence of the minima and maxima in the number of faraday rotations between satellite and station are also examined.

IQSY

71,787 PROVISIONAL PROGRAMME INTERNATIONAL YEARS OF THE QUIET SUN, 1964–1965
***American Geophysical Union, Transactions*, v. 44, no. 1, pp. 261–275, March 1963**
(Also available in *National Academy of Sciences, IGY Bulletin*, no. 69, March 1963)

71,788 SPACE RESEARCH AND THE IQSY PROPOSED CONTRIBUTIONS OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
***American Geophysical Union, Transactions*, v. 44, no. 1, pp. 228–235, March 1963**
(Also available in *National Academy of Sciences, IGY Bulletin*, no. 67, January 1963)

JUPITER

71,789 SUR LA POSSIBILITÉ DE LA LUMINESCENCE DES SATELLITES DE JUPITER (ON THE POSSIBILITY OF LUMINESCENCE OF JUPITER'S SATELLITES)
Link, F.
***Astronomical Institutes of Czechoslovakia, Bulletin of the*, v. 14, no. 1, p. 23, 1963**

71,790 DYNAMIC SPECTRA OF JUPITER'S DECAMETRIC EMISSION, 1961
Warwick, J. W.
Astrophysical Journal, The, v. 137, no. 1, pp. 41–60, January 1963

Observations and a theoretical explanation of Jupiter's low-frequency radio emission are presented. The explanation leans heavily on recent demonstrations that Jupiter possesses energetic radiation belts similar to the Earth's Van Allen belts.

71,791 THE RADIO EMISSIONS FROM JUPITER AND THE DENSITY OF JOVIAN EXOSPHERE
Ellis, G. R. A.
Australian Journal of Physics, v. 16, no. 1, pp. 74–81, March 1963

The properties of cyclotron radiation from bunches of electrons trapped in a Jovian exosphere are discussed. It is shown that, if the polar magnetic field intensity is 15 gauss and the magnetic axis is inclined 10 deg to the rotation axis, the calculated properties agree with those observed for the decametric radiation provided Jupiter is surrounded by an extensive exosphere. The electron density of the exosphere varies mainly in proportion to the magnetic field intensity, and at $1.5R_j$ is equal to $10^3/cm^3$.

71,792 LONG BASELINE INTERFEROMETRY OF JOVIAN DECAMETRIC RADIO BURSTS
Slee, O. B., Higgins, C. S.
Nature, v. 197, no. 4869, pp. 781–783, February 23, 1963

Exploratory observations of Jupiter made with a long baseline interferometer during the 1962 opposition are reported. The observations were made at 19.7 Mc with a N-S baseline of 32.3 km, equivalent to 1940 λ at the declination of the planet. Information was obtained on the sizes and distribution of the decametric burst sources.

LANDINGS

71,793 DESIGN CONSIDERATIONS OF EARTH LANDING SYSTEMS FOR A MANNED SPACECRAFT
Smith, A. M., Hartung, R. M., McMullen, J. C., Burns, T. A. (General Electric Co., Missile and Space Div., Philadelphia, Pa.)
American Rocket Society, Inc., New York, N. Y.
2491-62
(Presented at the Lunar Missions Meeting, Cleveland, Ohio, July 17–19, 1962)

The problems attendant to the design of a reliable and optimal Earth landing system are among the most critical in achieving mission success. Two limiting requirements tend to emphasize the magnitude of the design problem: (1) from the instant of launch, the Earth landing system must be capable of performing its prescribed function; and (2) in such a role, it must "know" the flight status at all times so that it can react to an infinite number of situations and perform its function within established design bounds. The system must possess a high degree of reliability and contain an adequate sensory control capacity to maintain operation within established constraints. Some system design concepts embodied in these two requirements are described, and the interplay between the total vehicle design problems and those related to the landing system design is discussed. The crew functions in this system are shown to be a major consideration in the achievement of design flexibility and high reliability.

LAUNCHING

71,794 DURATION OF A COUNTDOWN WHEN CONSIDERED AS AN INTERRUPTED SERVICE PROCESS
Firstman, S. I.
Operations Research, v. 11, no. 2, pp. 210–227, March–April 1963

A countdown could be interrupted by several kinds of problems, and, following each interruption, could continue according to one of several policies; seven such policies are discussed. The problem considered is that of accounting for the randomly occurring problems and the time required to deal with them when estimating the distribution of interrupted countdown durations.

71,795 LAUNCH OPERATIONS AT CAPE CANAVERAL
Upthegrove, H. N.
Bell Laboratories Record, v. 41, no. 4, pp. 174–180, April 1963

Prelaunch testing procedures and final launch operations for the *Delta-Telstar* combination are described.

LIQUID PROPULSION SYSTEMS

71,796 VARIABLE-THRUST PROPULSION FOR A SOFT-LANDING VEHICLE
Williamson, F., Jr., Yim, E., Jr. (Naval Ordnance Test Station, China Lake, Calif.)
American Rocket Society, Inc., New York, N. Y.
2481-62
(Presented at the Lunar Missions Meeting, Cleveland, Ohio, July 17–19, 1962)

One of the engineering problems involved in placing a man on the Moon is the soft-landing of the manned lunar module. In early 1959, the U.S. Naval Ordnance Test Station (NOTS) postulated that a NOTS variable-thrust propulsion system could be used as the retro-propulsion system. In early 1961, NOTS designed, built and flight-tested a vehicle, conclusively demonstrating that a variable-thrust propulsion system could be precisely controlled to soft-land a vertically descending craft.

LUNAR CRATERS

71,797 KLEIN'S "NEW" CRATER—ANOTHER LUNAR PUZZLE
Manasek, F. J.
Strolling Astronomer, The, v. 17, no. 1–2, p. 18, January–February 1963
(Abstract of paper presented at the Association of Lunar and Planetary Observers Convention, Montreal, Canada, 1962)

Klein's discovery in 1877 of a new crater in the Mare Vaporum near Hyginus is discussed, and although it is concluded that modern observations substantiate the existence of the crater, positive identification is not possible because of insufficient data.

71,798 LUNAR-TYPE TERRESTRIAL VULCANOIDS
Moore, P.
Strolling Astronomer, The, v. 17, no. 1–2, pp. 23–26, January–February 1963
(Presented at the Association of Lunar and Planetary Observers Convention, Montreal, Canada, 1962)

The resemblance of terrestrial vulcanoids, such as those in French West Africa and the Lake Mývatn area of Iceland, to lunar forms is pointed out. The view is expressed that the form and distribution of lunar features indicate an origin which was neither cataclysmic nor violently explosive, and that a milder uplift-and-subsidence process is much more likely.

71,799 DIMENSIONS OF THE LINNÉ CRATERLET
Ashbrook, J.
Strolling Astronomer, The, v. 17, no. 1–2, pp. 26–28, January–February 1963

Observations made and techniques used in the investigation of the lunar craterlet located within the Linné white patch are described in detail. These observations are important for extending the empirical diameter-depth and diameter-height relationships to smaller objects.

71,800 A NOTE ON THE DARWIN DOME AS SEEN IN SMALL AND LARGE APERTURES
Olivarez, J.
Strolling Astronomer, The, v. 17, no. 1–2, pp. 34–35, January–February 1963

An account is given of recent observations (made with a 12½-in reflector) of the Darwin dome – one of the largest, most rugged, and spectacular domes on the lunar surface.

LUNAR LANDINGS

71,801 LUNAR AND PLANETARY SOFT LANDINGS BY MEANS OF GAS-FILLED BALLOONS
Schrader, C. D. (Aerospace Corp., El Segundo, Calif.)
American Rocket Society, Inc., New York, N. Y.
2480-62
(Presented at the Lunar Missions Meeting, Cleveland, Ohio, July 17–19, 1962)

NASA has developed a theoretical and experimental concept for achieving lunar and planetary soft landings by means of gas-filled balloons. This paper discusses the application of the method for soft landings of instruments such as the University of California-Aerospace Corporation neutron-gamma experiment for the quantitative chemical analysis of the lunar surface. This geometry-independent scientific payload would be suspended by a net of nylon threads at the center of a spherically shaped balloon. At the moment it lands – when the kinetic energy has been transformed into compressional energy of the inflating gas – the balloon is ripped open to allow the gas to escape and the instrument to fall to the surface. It appears that a 50-lb payload could be landed with an impact of about 200 Earth g's by a 41-lb balloon system. This assumes that a retrorocket similar to that used on *Rangers 3, 4,* and 5 could slow the package to a velocity of about 300 ft/sec at impact.

LUNAR MAGNETIC FIELD

71,802 LUNAR SURFACE AND SUBSURFACE MAGNETIC SUSCEPTIBILITY INSTRUMENTATION
Bollin, E. M.
December 1962
Jet Propulsion Laboratory, California Institute of Technology, Pasadena
TR 32-343

Multicoil induction measurements of the lunar surface and subsurface magnetic susceptibility are under study. Major considerations are the improvement of the accuracy and logging ability of various probe configurations. Special boundary conditions of high vacuum, extreme ambient temperature variation, restriction to mechanically passive systems, simple electronics, low power and light weight all contribute to degradation of the accuracy of the instrument.

This report also appears in *IRE Transactions on Instrumentation,* v. I-II, no. 3–4, December 1962.

LUNAR MISSIONS

71,803 THE INDIRECT LUNAR APPROACH SCHEME
Straly, W. H.
October 17, 1960
George C. Marshall Space Flight Center, Huntsville, Ala.
MTP-M-S&M-F-60-2

The advantages of the indirect lunar approach scheme over the direct approach are shown, including: (1) an earlier opportunity to improve astronomical data, (2) improved mission flexibility, (3) increased mission reliability, and (4) development of a more useful method of subsequent exploration. Other advantages inherent to the indirect scheme are that it provides an economical method of conducting seismic experiments; makes possible minute inspection of the surface before landing and viewing the landing operations from short range; and utilizes the superior electronic capabilities of the orbiting vehicle. The described approach is based on large payloads of the *Saturn* family, but can be applied to any size payload.

LUNAR MISSIONS (MANNED)

71,804 **LUNAR LOGISTIC SYSTEM, VOLUME III, EARTH-MOON TRANSITS**
Braud, N. J.
March 15, 1963
George C. Marshall Space Flight Center, Huntsville, Ala.
MTP-M-63-1, Volume III

Preliminary results are reported of investigations into the problems of Earth-Moon transits, where particular emphasis was placed on the class of trajectories considered for *Apollo* and support vehicle flights. Flight profiles, velocity budgets, and launch windows are among the areas given most attention. One of the primary points of interest is a newly conceived method of establishing a flight mechanical classification of the transits. The classification is made by use of a simplified time invariant coordinate system. The results are empirical and are generated by the integration of the equations of motion by Cowell's method. Impact and flyby transits are treated, and results are extended to three dimensions.

71,805 **LUNAR LOGISTIC SYSTEM, VOLUME VI, TRACKING AND MISSION CONTROL**
March 15, 1963
George C. Marshall Space Flight Center, Huntsville, Ala.
MTP-M-63-1, Volume VI

Results of the Lunar Logistic System (LLS) studies in the following related areas are presented: (1) tracking and orbit determination, (2) midcourse maneuver requirements, and (3) mission control. The principal conclusions derived in each area are given.

71,806 **LUNAR LOGISTIC SYSTEM, VOLUME VII, TESTING ASPECTS**
Tidd, J. L., Guyton, B., Yarbrough, L. S.
March 15, 1963
George C. Marshall Space Flight Center, Huntsville, Ala.
MTP-M-63-1, Volume VII

The underlying philosophy and data resulting from an investigation of Lunar Logistic System test requirements, and the most effective means of satisfying these requirements are presented. Test parameters and methodology are emphasized along with test facility requirements and availability of government and private facilities. Transportation of large hardware items is studied, and boosters are evaluated for flight testing. Recommendations are made for flight modes and test ranges.

71,807 **LUNAR LOGISTIC SYSTEM, VOLUME X, PAYLOADS**
March 15, 1963
George C. Marshall Space Flight Center, Huntsville, Ala.
MTP-M-63-1, Volume X

Design criteria for Lunar Logistic System payloads, and conceptual designs for three specific payloads are presented. The design criteria are presented in a narrative and parametric form, with numerous parametric trade-off illustrations. Conceptual designs are presented for the following payloads: (1) four-man shelter, (2) two-man large roving vehicle, and (3) two-man shelter and small roving vehicle. Each of the three payloads is designed for the *Saturn* 5 Lunar Logistic Vehicle as the carrier, with a lunar soft-landing capability of 25,000 lb. The difference between the 25,000-lb total payload weight and the dry weight of any of the shelters and roving vehicles can be used for expendables, thus permitting long-time missions on the Moon. Several representative missions are described.

71,808 **LUNAR LOGISTIC SYSTEM, VOLUME XI, LUNAR TOUCHDOWN**
Lavender, R. E.
March 15, 1963
George C. Marshall Space Flight Center, Huntsville, Ala.
MTP-M-63-1, Volume XI

Results are presented of analytical touchdown dynamics investigations conducted to determine the influence of various lunar and configurations design parameters on the touchdown dynamic stability of spacecraft intended to soft-land logistic payloads on the Moon. Parameters used in the analysis include the local lunar slope, coefficient of friction, initial touchdown vertical and horizontal velocity components, vehicle weight and radius of gyration, height of center of gravity, displacement of the center of gravity from the vehicle's longitudinal axis, thrust of stabilization rocket motors, and crushing force of energy absorbing material. The landing-gear spread required to obtain touchdown stability has been determined for various combinations of the investigated parameters for configurations with four extended legs. In addition, some results are presented for configurations with three and five legs.

71,809 **LUNAR LOGISTIC SYSTEM PAYLOAD PERFORMANCE STUDY, FINAL REPORT, VOLUME I TECHNICAL DIGEST**
January 1963
Northrop Corp., Northrop Space Labs., Hawthorne, Calif.
NSL 63-4, Volume I

The results are presented of an engineering study to aid NASA in the selection of appropriate payloads for the Lunar Logistic System and in the planning of their development. Volume I, which was prepared as a digest of the technical contents of Volume II (cited in the following entry), is organized to present in condensed form the content and scope of the engineering work performed during the study. The sections on Definitions, Study Program, Operations Research, Conclusions, and Recommendations are quoted directly from Volume II without summary or reduction.

LUNAR MISSIONS (MANNED) (Cont'd)

71,810 LUNAR LOGISTIC SYSTEM PAYLOAD PERFORMANCE STUDY, FINAL REPORT, VOLUME II TECHNICAL
January 1963
Northrop Corp., Northrop Space Labs., Hawthorne, Calif.
NSL 63-4, Volume II

Technical results are presented of the study on Lunar Logistic System payload performance. The study program is outlined, study methodology described, payload performance and conceptual designs are presented, conclusions drawn, and recommendations offered. This volume is intended to serve as a source of information for other LLS studies.

71,811 LUNAR LOGISTIC SYSTEM PAYLOAD PERFORMANCE STUDY, FINAL REPORT, VOLUME III DEVELOPMENT PROGRAMS, AND ESTIMATED SCHEDULES AND COSTS
January 1963
Northrop Corp., Northrop Space Labs., Hawthorne, Calif.
NSL 63-4, Volume III

Development programs are presented with estimated development times and estimated development and production costs for a number of the concepts presented in Volume II of the Lunar Logistic System Payload Performance Study, cited in the preceding entry. The development programs for the roving base payload and four typical function units are covered. Since all the designs are conceptual in nature, the approach in planning the development programs has been to explore the critical and pacing factors affecting each development. Estimated development and production costs are also given for an additional twenty-six concepts presented in Volume II.

71,812 LUNAR LOGISTIC SYSTEM PAYLOAD PERFORMANCE STUDY, FINAL REPORT, SUMMARY
January 1963
Northrop Corp., Northrop Space Labs., Hawthorne, Calif.
NSL 63-4, Summary

The work accomplished, conclusions reached, and recommendations offered as a result of completion of the study on Lunar Logistic System payload performance are briefly summarized.

71,813 STUDY OF SPACECRAFT BUS FOR LUNAR LOGISTICS SYSTEM VOLUME I, SUMMARY
December 22, 1962
Space Technology Laboratories, Inc., Redondo Beach, Calif.
8689-6007-TU000

The results are presented of a 12-week engineering study of unmanned spacecraft bus concepts for use in a Lunar Logistics System to support the manned lunar landing program. The objective of the LLS is to soft-land a variety of payloads at or near the *Apollo* landing site, both before and following *Apollo* manned missions. The LLS is being studied by NASA as a means of assuring the highest probability of safe crew return and the maximum benefits from lunar surface operations. Essential characteristics of such a program include (1) minimum system development costs and maximum system reliability by utilizing available state-of-the-art components and subsystems to the greatest extent possible, (2) flexibility in LLS mission capability and schedules, (3) operational capability by earliest practicable dates, and (4) maximum potential for growth in mission capability.

71,814 STUDY OF SPACECRAFT BUS FOR LUNAR LOGISTICS SYSTEM VOLUME IIA, TECHNICAL PLAN (SECTIONS I–IV)
December 22, 1962
Space Technology Laboratories, Inc., Redondo Beach, Calif.
8689-6002-TU000

71,815 STUDY OF SPACECRAFT BUS FOR LUNAR LOGISTICS SYSTEM VOLUME III, DEVELOPMENT AND TEST PLAN
December 22, 1962
Space Technology Laboratories, Inc., Redondo Beach, Calif.
8689-6006-TU000

71,816 ABORT PROBLEMS OF THE LUNAR LANDING MISSION
Bartos, G., Greenberg, A. (Aerospace Corp., El Segundo, Calif.)
American Rocket Society, Inc., New York, N. Y.
2490-62
(Presented at the Lunar Missions Meeting, Cleveland, Ohio, July 17–19, 1962)

The abort problems associated with the manned lunar landing mission are investigated. The purpose of incorporating abort provisions in the vehicle is the same throughout the mission, i.e., to safely return the crew capsule to the vicinity of the Earth; however, the characteristics of the abort maneuvers required for this purpose differ significantly for the various phases of the mission. The phases considered in this study include the Earth-Moon transfer, the lunar landing, and the subsequent ascent from the lunar surface.

71,817 THE GEO-SCIENCES APPLIED TO MANNED LUNAR EXPLORATION
Green, J.
July 5, 1961
North American Aviation, Inc., Space and Information Systems, Div., Downey, Calif.
SID 61-217

The application of the geo-sciences to manned lunar exploration may be divided into five groups: terrain, rocks, minerals, power, and tools. Understanding the processes which formed certain features on Earth aids in realizing the advantages of impacted and volcanic terrains on the Moon. Volcanic terrains offer more natural protection to man. Volcanic rocks would also be more useful to the lunar astronaut because of the adaptability of certain volcanic materials for insulation and because their water content (approximately 1 percent by weight) is much higher than meteoritic rocks.

LUNAR ROVING VEHICLES

71,818 **INSTRUMENTATION AND PAYLOAD DESIGN FOR LUNAR ROVING VEHICLES**
Walthall, E. R. (RCA, Camden, N. J.)
Society of Automotive Engineers, Inc., New York, N. Y.
632H
(Presented at the Automotive Engineering Congress, Detroit, Mich., January 14–18, 1963)

Prior to manned landing, unmanned lunar vehicles will explore the Moon's surface. These vehicles, which will be controlled from Earth, will gather data on elevation contours and surface roughness, soil conditions and classification, electromagnetic radiation and micrometeorite conditions, and the substrate makeup and seismic conditions. Considered are lunar environment, radiation hazard, payload design criteria, environmental control, control and guidance systems, communication systems, and scientific instrumentation.

LUNAR TRAJECTORIES

71,819 **ABORT CONSIDERATIONS FOR MANNED LUNAR MISSIONS**
Kelly, T. J., Adornato, R. J., Speiser, K. (Grumman Aircraft Engineering Corp., Bethpage, N. Y.)
American Rocket Society, Inc., New York, N. Y.
2478-62
(Presented at the Lunar Missions Meeting, Cleveland, Ohio, July 17–19, 1962)

Direct and indirect abort trajectory requirements of the lunar orbit and descent phase of a manned lunar mission are considered. Indirect aborts, treated through an intermediate lunar parking orbit, are shown to be possible from any point on the trajectory down to the final touchdown, but regions from which direct aborts can commence are restricted. Velocity increment and time-to-return for several direct and indirect abort sequences are established, with emphasis on how the initial trajectory is shaped to facilitate the abort maneuver.

71,820 **TRAJECTORY CONSIDERATIONS FOR THE RETURN TO EARTH PHASE OF LUNAR MISSIONS**
Gapcynski, J. P., Tolson, R. H. (NASA/Langley Research Center, Langley Field, Va.)
American Rocket Society, Inc., New York, N. Y.
2487-62
(Presented at the Lunar Missions Meeting, Cleveland, Ohio, July 17–19, 1962)

The lunar injection conditions are discussed which are required to establish Earth-return trajectories satisfying specified re-entry conditions. It has been assumed in this analysis that the return trajectory is initiated from either a circular lunar orbit having an arbitrary inclination and nodal position with respect to the Earth-Moon plane, or from an arbitrary position on the lunar surface. In the latter case, it is further assumed that a lunar parking orbit is established prior to injection. No consideration is given to the use of orbital plane changes to ensure proper Earth re-entry.

71,821 **PREDICTION OF VELOCITY REQUIREMENTS FOR MINIMUM TIME ABORTS FROM THE MIDCOURSE REGION OF A LUNAR MISSION**
Merrick, R. B., Callas, G. P.
April 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1655

Abort trajectories were computed at several ranges for various fuel capabilities and impulsive velocity increments on both the outgoing and incoming legs of a typical circumlunar trajectory. A two-body equation was used for determining the direction of the abort rocket thrust in the orbit plane and a modification to this equation is presented which markedly reduces the altitude error, at perigee, due to four-body effects. Errors due to inaccuracy in the knowledge of position and velocity at abort and the inaccuracies in the magnitude and aiming of the abort rocket are considered statistically; the last is found to be by far the most significant.

71,822 **DIRECT-ASCENT VS PARKING-ORBIT TRAJECTORY FOR LUNAR-SOFT-LANDING MISSIONS**
Gautschi, T. F., Clarke, V. C., Jr.
December 3, 1962
Jet Propulsion Laboratory, California Institute of Technology, Pasadena
TM 33-114

Differences between direct-ascent and parking-orbit modes of transit to the Moon and their effects on a lunar landing mission are studied within the context and constraints of the *Surveyor* project. Constraints considered (at both "current" and "minimum" levels) include lunar lighting, launch-window duration, landing location, launch azimuth, launch vehicle capability, transit time, observability of landing from Earth, launch opportunities per period, and desired mission frequency. A listing of advantages and disadvantages provides some basis for conclusions. Appendices furnish source material and amplification, together with a glossary of terms used.

MARS

71,823 **SOME GEOLOGIC PROBLEMS OF MARS**
Loomis, A. A.
March 4, 1963
Jet Propulsion Laboratory, California Institute of Technology, Pasadena
TR 32-400

Geological and geophysical knowledge and uncertainties concerning the surface and body of Mars are briefly discussed

MARS (Cont'd)

and evaluated. It is pointed out that accurate values for the figure of the planet and the radii, seismic evidence of internal structure, and measurements of the outward heat flux across the surface are necessary and important in order to achieve a satisfactory description of the body of Mars. Some geological inferences which can be drawn from available photographic and photometric data concerning topography, areas of water accumulation, and biological activity are discussed. The priority of scientific geologic experiments is presented, and some present instrumentation capabilities and deficiencies are listed.

71,824 HEAT BALANCE ON THE SURFACE OF MARS
Hattore, A.
1962
Institute of Astrophysics and Kwasan Observatory, University of Kyoto, Japan
Contribution 115

The insolations for (τ = 0, 0.1, 0.2, and 0.3) and the heat loss on the Martian surface are calculated for various seasons. The heat balance on the surface and the effects of Martian clouds are discussed. The theoretical results are shown to be in fairly good agreement with observations.

MATERIALS

71,825 SPACE ENVIRONMENTAL EFFECTS ON SEALS, GASKETS, ADHESIVES AND OTHER ELASTOMERIC AND POLYMERIC MATERIALS: AN ANNOTATED BIBLIOGRAPHY
Abbott, H. M.
September 1961
Lockheed Missiles and Space Co., Sunnyvale, Calif.
SB-61-40
ASTIA AD-267,531

This bibliography contains selected references on seals, gaskets, adhesives, sealants and other elastomeric and polymeric materials under space conditions. Any applications of adhesives in fabricating pressurized containers and attaching solar cell plates were included, as were tests conducted on materials used for seals and gaskets in contact with reactive fluids. Materials used for inflatable space vehicles and structures are included as general applications of plastics or polymers.

71,826 COMPOSITE MATERIALS: AN ANNOTATED BIBLIOGRAPHY
Abbott, H. M.
February 1963
Lockheed Missiles and Space Co., Sunnyvale, Calif.
SB-62-58

This annotated bibliography of 190 selected references pertains to composite materials. Material composites are broadly considered as physical combinations of two or more dissimilar materials. Boron carbide impregnated with aluminum (Boral), metal fibers in glass or plastics, or glass fibers in aluminum are some examples of the various combinations being studied. Sandwich materials were not included in the search, although few fabricated articles cannot in some way be referred to as composites.

71,827 THE EFFECT OF HYDROGEN ON ALUMINUM: AN ANNOTATED BIBLIOGRAPHY
Gros, C. G.
March 1963
Lockheed Missiles and Space Co., Sunnyvale, Calif.
SB-62-68

The effect of hydrogen on aluminum is treated, with reference to welding at room temperature and the ultimate reliability in space applications of such aluminum. The period from 1950 through 1962 is covered. A few citations to material on nonferrous metals which might lead to information about aluminum have been included in the 49 annotated references.

71,828 FRICTION MEASUREMENTS ON A LOW EARTH SATELLITE
Rittenhouse, J. B., Jaffe, L. D., Nagler, R. G., Martens, H. E.
April 15, 1963
Jet Propulsion Laboratory, California Institute of Technology, Pasadena
TR 32-402

During the flight of the *Ranger 1*, the coefficient of sliding friction for a number of materials was measured. Flat disks of materials of interest were rotated at a speed of 8 to 14 in./min while in contact with ⅛-in.-D hemispherical riders. Because of the low orbit achieved by *Ranger 1*, the experiment was exposed to vacuum in the range of 3×10^{-6} to 8×10^{-9} mm Hg. For unlubricated metals sliding on metals, the friction coefficient averaged about 0.5; for some combinations of metals, it occasionally exceeded 1.0. Lower values were observed with lubricants of grease or gold-plate, and for ceramics sliding against metals. The coefficient of friction was very low, averaging 0.04, for metallic pairs lubricated with molybdenum disulfide and for polytetrafluoroethylene sliding against metals and ceramics. Relatively low friction coefficients were found for metallic materials sliding against unlubricated metallic and ceramic materials when at least one member of the pair was of high hardness. The coefficients observed for unlubricated metal pairs were not inconsistent with the hypothesis that high friction tends to correlate with high mutual solid solubility. In general, the coefficients in space and in a laboratory vacuum of 5×10^{-6} mm Hg were not systematically different. For unlubricated metallic materials, friction in vacuum was higher than in air at shorter running times.

71,829 CARBONIZED PLASTICS COMPOSITES FOR HYPERTHERMAL ENVIRONMENTS PART II, SYNTHESIS OF IMPROVED THERMALLY PROTECTIVE PLASTICS AND COMPOSITES
Forcht, B. A., Haviland, J. K., McKinney, A. R.
(Ling-Temco-Vought, Dallas, Texas)
February 1963
Aeronautical Systems Division, Directorate of Materials and Processes, Wright-Patterson AFB, Ohio
ASD TDR 62-352, Part II

New and improved compositions and constructions of pyrolyzed plastic composites were prepared for use as either high-temperature structural or ablative-insulative materials. The use of high density precursory plastics and three dimensional reinforcements resulted in high strength pyrolyzed plastics, having a room-temperature flexural strength up to 14,000 psi.

MERCURY PROJECT

71,830 FIRST DETAILS ON MERCURY SPACECRAFT COMMAND RECEIVER
Elliott, R.
Electronics, v. 36, no. 5, pp. 32–35, February 1, 1963

METEOR TRAILS

71,831 UNUSUAL OBSERVATION OF A METEOR TRAIN
Bumba, V.
Astronomical Institutes of Czechoslovakia, Bulletin of the, v. 14, no. 1, pp. 22–23, 1963

An observation of a shadow projected on the solar disk by a shock-wave of a meteor in the terrestrial atmosphere is described.

METEORITES

71,832 ULTRA-VIOLET-ABSORBING COMPOUND(S) REPORTED PRESENT IN THE MURRAY METEORITE
Oró, J.
Nature, v. 197, no. 4869, pp. 756–758, February 23, 1963

Investigations reported were undertaken to ascertain whether water-soluble ultraviolet-absorbing compounds detected in meteoritic extracts are indigenous to the meteorite, or are the result of contamination by the analytical technique used. Water extracts from the Murray meteorite were used in the analysis.

71,833 IMPACTS ON THE EARTH AND MOON
Hawkins, G. S.
Nature, v. 197, no. 4869, p. 781, February 23, 1963

The ratio of stony to iron meteorites is examined. The maximum size of an object which has collided with the Earth and Moon in geologic history is estimated.

METEOROIDS

71,834 SPRAY EJECTED FROM THE LUNAR SURFACE BY METEOROID IMPACT
Gault, D. E., Shoemaker, E. M., Moore, H. J.
April 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1767

Fragments ejected from the lunar surface by meteoroid impact are analyzed on the basis of experimental studies of hypervelocity impact in rock and sand. It is shown that the flux of fragments of a given mass which are ejected from the lunar surface is at least 10^3 and probably 10^4 times greater than the flux of interplanetary debris of the same mass. Most of the fragments are ejected at velocities less than lunar escape velocity and contribute to secondary impact events. A small fraction of the ejecta, however, will escape from the gravitational field of the Moon and even from the Earth-Moon system.

METEOROLOGICAL SATELLITES

71,835 NIMBUS DATA IN OPERATIONAL METEOROLOGY
Johnson, D. S., Hall, W. F., Bristor, C. L.
Astronautics and Aerospace Engineering, v. 1, no. 3, pp. 52–56, April 1963

National Operational Meteorological Satellite System (NOMSS) data processing and data dissemination are described. Approximately one-quarter billion bits of meteorological data will be obtained from each orbit of the early *Nimbus*. The basic computer to be used at the NOMSS Data Processing Center is an IBM 7094. The experimental digitizing and mapping of cloud pictures are discussed and illustrated.

71,836 DATA COLLECTION BY SATELLITES
Moody, A. B., Widger, W. K., Jr.
Astronautics and Aerospace Engineering, v. 1, no. 3, pp. 57–58, April 1963

The concept of ambient sensors immersed in the atmosphere as an approach to augmenting the data collection capabilities of global weather satellites such as *Tiros* and the forthcoming *Nimbus* is considered. Several methods of implementing such a system are suggested.

71,837 TOWARDS THE SYNCHRONOUS METEOROLOGICAL SATELLITE
Jones, W. W.
Astronautics and Aerospace Engineering, v. 1, no. 3, pp. 59–60, April 1963

The initial concept of a synchronous meteorological satellite as the only economically feasible means of continually viewing the Earth's weather processes is discussed.

METEOROLOGICAL SATELLITES (Cont'd)

71,838 DIRECT READOUT WEATHER SATELLITES
Cowan, L. W., Hubbard, S. H., Singer, S. F.
Astronautics and Aerospace Engineering, v. 1, no. 3, pp. 61–66, April 1963

The approaches to an operational direct-readout satellite system are discussed along with testing of the *Nimbus* Automatic Picture Transmission (APT) system to be initiated during the latter part of 1963. The APT system, which takes a picture every 208 sec while the satellite is in daylight, is described and its potential evaluated. The major international aspects of a direct-readout satellite system are also briefly appraised.

71,839 RESEARCH WITH TIROS RADIATION MEASUREMENTS
Nordberg, W.
Astronautics and Aerospace Engineering, v. 1, no. 3, pp. 76–83, April 1963

Radiometric experiments performed by meteorological satellites are described. The importance of supplementing TV photographs with radiometric observations is emphasized. Measurements discussed resulted from rather simple instruments reflecting the state of satellite radiometry of several years ago.

71,840 PHYSICAL MEASUREMENTS FROM METEOROLOGICAL SATELLITES
Hanel, R. A., Wark, D. Q.
Astronautics and Aerospace Engineering, v. 1, no. 3, pp. 85–88, April 1963

Experiments in IR radiation, ozone distribution, cloud top heights, the solar constant, and "sferics" are discussed as part of a possible future effort in meteorological observations from satellites. Instrumentation to carry out the planned experiments is described.

71,841 NON-METEOROLOGICAL OBSERVATIONS FROM WEATHER SATELLITES
Singer, S. F., Popham, R. W.
Astronautics and Aerospace Engineering, v. 1, no. 3, pp. 89–92, April 1963

Although the primary function of an operational meteorological satellite system will continue to be aimed toward obtaining observations of direct meteorological significance, experience has shown that such a system may well fulfill the needs of scientists in other fields for broad-scale observations on a real-time basis. Studies of ice, snow, forest fires, and locust swarms are discussed as potentials for nonmeteorological applications.

METEOROLOGY

71,842 RESEARCH WITH SATELLITE CLOUD PICTURES
Fritz, S.
Astronautics and Aerospace Engineering, v. 1, no. 3, pp. 70–74, April 1963

Types of cloud patterns observed from *Tiros* satellites are compared with laboratory experiment and theory to emphasize the hydrodynamical implications shown by the satellite pictures.

METEORS

71,843 A LUNAR EFFECT ON THE INCOMING METEOR RATE
Bowen, E. G.
Journal of Geophysical Research, v. 68, no. 5, pp. 1401–1403, March 1, 1963

Following the recent discovery of a lunar influence on rainfall and on the freezing nucleus count, it is now shown that the radar meteor rate varies in a similar way with lunar phase. The physical mechanism is uncertain, but an electrostatic charge on the Moon could produce an effect on micrometeorites of the right order of magnitude.

71,844 DETERMINATION OF THE HEIGHT OF THE HOMOGENEOUS ATMOSPHERE AND THE EXTRA-ATMOSPHERIC VELOCITY OF A METEOR
Katasev, L. A.
Soviet Astronomy—AJ, v. 6, no. 5, pp. 583–584, January–February 1963

Formulas are derived for computing, from photographic observations, the extra-atmospheric velocity of a meteoroid and the coefficient entering into the formula for the height of the homogeneous atmosphere. These quantities can be obtained directly from the observations.

MOON

71,845 THEORETICAL ASPECTS OF THE LUNAR METEOR
Chalk, K.
Strolling Astronomer, The, v. 17, no. 1–2, pp. 19–23, January–February 1963
(Presented at Association of Lunar and Planetary Observers Convention, Montreal, Canada, 1962)

The purpose and theoretical definition of the A.L.P.O. Lunar Meteor Search are detailed. It is pointed out that an indirect aim of the search is to discover the approximate extent of the tenuous lunar atmosphere.

71,846 GRAVITATIONAL HEATING OF THE MOON
Kopal, Z.
Icarus, v. 1, no. 5–6, pp. 412–421, April 1963

Gravitational heating of the lunar interior is discussed. Numerical calculations to ascertain the actual amount of possible gravitational contribution to the internal temperature of the Moon are presented.

71,847 **AN UNSOLVED ASTROMETRICAL PROBLEM**
Yakovkin, A. A.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 573–579, January–February 1963**

Attention is drawn to the need for developing methods for computing the coordinates of the Moon's center of mass from observations. Observations at six points are intercompared and yield direct results, depending on no prior hypothesis. A description is given of four models of the Moon used to reduce heliometric observations.

71,848 **LUNAR DUST AND TERRESTRIAL ICE NUCLEUS CONCENTRATION**
Vand, V.
***Nature*, v. 198, no. 4876, pp. 176–177, April 13, 1963**

Bigg demonstrated a relation between summer ice nucleus concentration and lunar phase. Assuming that increase of ice nuclei causes increase in precipitation, relations between precipitation and lunar phase can be accounted for. Predictions of arrival of lunar dust could be improved by using a system of radio telescopes to survey the actual meteor flux coming from the antilunar point. Analysis of the dust at times of maxima might give clues to the chemical composition of the lunar surface. The surface of the Moon may contain appreciable amounts of material which could act as efficient ice nuclei.

71,849 **THE INFLUENCE OF THE MOON ON ATMOSPHERIC OZONE**
Adderley, E. E.
***Journal of Geophysical Research*, v. 68, no. 5, pp. 1405–1408, March 1, 1963**

Evidence is presented for a lunar effect on the amount of atmospheric ozone at Arosa, Switzerland, and Canberra, Australia. The amount of ozone increases at the vernal equinox about the first and third lunar quarter and decreases at the same lunar phases at the autumnal equinox. There is no effect at midwinter or midsummer. The explanation of this lunar effect is unknown, and further investigation is needed.

71,850 **AN ORIGIN OF THE MOON BY ROTATIONAL FISSION DURING FORMATION OF THE EARTH'S CORE**
Wise, D. U.
***Journal of Geophysical Research*, v. 68, no. 5, pp. 1547–1554, March 1, 1963**

Darwin's hypothesis of lunar origin from a rapidly rotating Earth can be modified in substitution of excessive rotation rate and unstable spin driven by conservation of angular momentum during formation of the Earth's core for Darwin's now discredited tidal resonance mechanism. Criticisms which caused rejection of the older hypothesis are considered in the light of this modification and of subsequent discoveries and ideas; most severe is lack of angular momentum in the present Earth-Moon system, a criticism which is itself open to question in terms of possible magnetic frictions during the early history of the solar system. Other criticisms are (1) observed but presently unexplainable components in rate of change in rotation of the Earth, and (2) possible changes in diameter of the Earth with time. Among the explanations provided by the hypothesis are relatively circular lunar orbit, specific gravity of the Moon, apparent nonhydrostatic figure of the Moon, constant face toward the Earth, and gross sequence of geologic events recorded on the lunar face. Several proposed tests of the hypothesis should soon be possible. Until more data become available, it is suggested that a lunar birth from the Earth be reinstated among our current working hypotheses.

71,851 **CHARGING GRAINS OF DUST**
Coffman, M. L.
***Journal of Geophysical Research*, v. 68, no. 5, pp. 1565–1566, March 1, 1963**

An independent calculation is given of the maximum charge possible for a grain of dust and the bearing this charge has on the erosion of the surface of the Moon.

71,852 **BIBLIOGRAPHY OF THE MOON**
July 1960
Department of the Army, Chief of Engineers, Washington, D. C.
Bibliography

Since this bibliography pertains to the Moon as a physical object, no attention was directed to the movement of the Moon as a heavenly body, nor to its effect upon the Earth. Entries were compiled by the U.S. Geological Survey in connection with the preparation of the Engineer Special Study of the Surface of the Moon.

71,853 **LUNAR THERMAL EMISSION MEASUREMENTS**
Castelli, J. P., Ferioli, C. P.
September 1962
Air Force Cambridge Research Laboratories, Office of Aerospace Research, Bedford, Mass.
AFCRL-62-882

During two lunar eclipses, March 15, 1960 and August 25, 1961, simultaneous records of the lunar thermal emission at 1200 and 3100 Mc were obtained with the 84-ft radio telescope of the USAF Sagamore Hill Radio Observatory. No change in lunar temperature was measured at either frequency during the eclipses. A simple straightforward method is described to convert antenna temperatures to average disk temperatures of the Moon; the latter were found to be 230°K at 1200 Mc and 223°K at 3100 Mc.

NAVIGATION

71,854 AN EMERGENCY MIDCOURSE NAVIGATION PROCEDURE FOR A SPACE VEHICLE RETURNING FROM THE MOON
Havill, C. D.
March 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1765

A manual emergency navigation procedure for a vehicle returning from the Moon is presented. The procedure involves photographing the Earth from various positions along the trajectory returning from the Moon and deducing from image measurements the required midcourse corrections. Preliminary tests of the accuracy with which required image measurements can be obtained together with machine computations of the over-all accuracy of the guidance procedure indicate the accuracy could be within the corridor depth of a lifting entry vehicle.

NEUTRONS

71,855 NEUTRON FLUX AND ENERGY SPECTRUM ABOVE THE ATMOSPHERE
Bame, S. J., Conner, J. P., Brumley, F. B., Hostetler, R. L., Green, A. C.
Journal of Geophysical Research, v. 68, no. 5, pp. 1221–1228, March 1, 1963

Neutron detectors consisting of $B^{10}F_3$ proportional counters and $Li^6I(Eu)$ scintillation counters, surrounded by varying amounts of moderating material, have been flown above the atmosphere in a number of vehicles. The shape of the neutron energy spectrum given by Hess, Canfield, and Lingenfelter has been verified within experimental limitations, and the flux of neutrons at 650-km altitude and 36.5°N geomagnetic latitude has been determined to be 0.28 ± 30 percent neutrons per cm^2 sec, whereas at 320-km altitude and 8.7°S the flux is 0.12 ± 40 percent neutrons per cm^2 sec. This flux determination gives an absolute neutron flux a factor of 3 lower than previously reported determinations.

NIMBUS PROJECT

71,856 NIMBUS SPACECRAFT DEVELOPMENT
Press, H., Michaels, J. V.
Astronautics and Aerospace Engineering, v. 1, no. 3, pp. 42–45, April 1963

Preliminary design of the *Nimbus* spacecraft was completed in 1960. The approach used in the system is described, a brief history of the development is presented, and design achievements to date are assessed in the light of the original design objectives.

71,857 NIMBUS TESTING
Butler, H. I.
Astronautics and Aerospace Engineering, v. 1, no. 3, pp. 46–47, April 1963

The *Nimbus* test program will determine the ability of the spacecraft design to meet all performance requirements and demonstrate the dependability of the flight hardware. Currently in the prototype phase, the program consists of two levels of environmental tests: prototype and flight acceptance tests. Photographs of design and test models are included.

OGO PROJECT

71,858 INSIDE THE ORBITING GEOPHYSICAL OBSERVATORY
Glaser, P. F., Spangler, E. R.
Electronics, v. 36, no. 7, pp. 61–65, February 15, 1963

ORBITAL OBSERVATORIES

71,859 THE OBSERVATORY GENERATION OF SATELLITES
March 1963
National Aeronautics and Space Administration, Office of Scientific and Technical Information, Washington, D. C.
SP-30

The American Astronautical Society held its second annual regional meeting as part of the 129th meeting of the American Association for the Advancement of Science in Philadelphia, Pennsylvania, December 1962. Session II of the Special Astronautics Symposium, "Scientific Satellites—Mission and Design," on December 27, 1962, was comprised of the following six papers:

"The Mission of the Orbiting Geophysical Observatories," Scull, W. E.

"The Engineering Design of the Orbiting Geophysical Observatories," Gleghorn, G. E.

"The Mission of the Advanced Orbiting Solar Observatory," Lindsay, J. C.

"One Approach to the Engineering Design of the Advanced Orbiting Solar Observatory," Cervenka, A. J.

"The Mission of the Orbiting Astronomical Observatory," Zeimer, R. R., Kupperian, J. E., Jr.

"The Engineering Design of the Orbiting Astronomical Observatory," Scott, W. H.

71,860 HELIOS TO RELAY MORE ACCURATE SOLAR DATA
Wetmore, W. C.
Aviation Week & Space Technology, v. 78, no. 9, pp. 48–53, March 4, 1963

Helios, which is an advanced orbiting solar observatory scheduled for launching in 1966, will be designed to have a pointing accuracy of 5 sec of arc and 70-percent over-all system reliability. Phenomena which might be studied by *Helios* are listed and design objectives are outlined; block diagrams and illustrations are included. Some of the results obtained to date from the *OSO-1* are given.

ORBITS

71,861 ORBITS RETURNING FROM THE MOON TO A SPECIFIED GEOGRAPHIC LANDING AREA
Cicolani, L. S.
April 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1652

This paper develops a method of computing approximate trajectories returning from the Moon to a fixed landing site. The gravitational field of a spherical Earth is assumed to govern orbital motion and the entry phase of the trajectories is described by a linear relation between entry range and flight time in the atmosphere. As an example, data were computed for trajectories returning to Edwards Air Force Base during the month of February 1966 and an analysis of these data is presented.

71,862 THE CRITICAL INCLINATION PROBLEM IN SATELLITE ORBIT THEORY
Mersman, W. A.
1962
National Aeronautics and Space Administration, Washington, D. C.
TR R-148

Solutions of the satellite orbit problem are obtained that do not exhibit singularities at the critical inclination angle. Series representations are obtained, their regions of convergence are exhibited, and quantitative measures of their speeds of convergence are provided for use in numerical computations.

71,863 ON THE USE OF INTERPLANETARY PROBE ORBITS OF PERIODS COMMENSURABLE WITH ONE YEAR
Roy, A. E.
***Astronautica Acta,* v. 9, no. 1, pp. 31–46, 1963**

The problem of placing vehicles into interplanetary orbits of periods that are fractions or multiples of one year is discussed. Two missions—an eccentric orbit in the ecliptic and a circular orbit at an inclination to the ecliptic—are studied. It is shown that such missions are practical using present day rockets and guidance techniques and have a number of advantages over interplanetary orbits of periods noncommensurable with one year.

PHYSIOLOGY

71,864 RECENTI RICERCHE IN ITALIA NEL CAMPO DELLA MEDICINA AERONAUTICA E SPAZIALE (RECENT ADVANCES IN ITALY IN THE FIELD OF AEROSPACE MEDICINE)
Lomonaco, T.
***Rivista di Medicina Aeronautica e Spaziale,* v. 26, no. 1, pp. 5–25, January–March 1963**

The research being conducted in Italy is surveyed, with special emphasis on experiments carried out at the Aerospace Medical Center in Rome. A bibliography of nearly 120 references is included.

71,865 NUOVE ACQUISIZIONI DI FISIOLOGIA E FISIOPATOLOGIA VESTIBOLARE NEL VOLO SPAZIALE (RECENT ADVANCES IN VESTIBULAR PHYSIOLOGY, AND PHYSIOPATHOLOGY OF SPACE FLIGHT)
Mazza, G.
***Rivista di Medicina Aeronautica e Spaziale,* v. 26, no. 1, pp. 99–136, January–March 1963**

The several functions of the inner ear are reviewed, and the reactions of this organ to various degrees of acceleration are described. In relation to the effects of weightlessness, the neurovegetative syndrome of disorientation (satellite sickness) is considered, and an explanation of this condition from a physiological standpoint is attempted. The problem of providing an artificial gravity on prolonged flights is briefly discussed.

71,866 PERCEPTION OF MOTION, EQUILIBRIUM, AND ORIENTATION IN CONDITIONS OF ZERO GRAVITY (LA PERCEZIONE DEL MOTO, L'EQUILIBRIO E L'ORIENTAMENTO IN CONDIZION' DI GRAVITATIONE NULLA)
Margaria, R., Gualtierotti, T.
***Rivista di Medicina Aeronautica e Spaziale,* v. 25, no. 3, pp. 450–465, July–September 1962**
(Abstracted in *Aerospace Medicine,* v. 34, no. 3, pp. 276–277, March 1963)

The main systems controlling body sensations in space are reviewed, namely, vestibular and visual systems, and cutaneous exteroceptors. These systems all converge at the level of the cerebellar cortex which analyzes accelerations via labyrinthine connections and integrates visual, acoustic, and other data. The mechanism of action of vestibular receptors is discussed in relation to their anatomical position and to the constant stimulus of 1 g. Gravity receptors appear to follow the Weber-Fechner law that for a sensation to increase by equal amounts (arithmetical progression), the stimulus must increase by geometrical progression. An hypothesis is presented that under zero-g conditions responses to a given acceleration will be greater than when sense organs are already subjected to a constant stimulus of 1 g. It is also postulated that the otoliths work as a differential inertia meter. Experimental verification of these hypotheses is suggested by means of comparing—in

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the same animal—the response to acceleration on Earth and during orbital flight.

PLANETS

71,867 CONVECTION IN PLANETARY INTERIORS
Kopal, Z.
Icarus, v. 1, no. 5–6, pp. 391–400, April 1963

An attempt is made to formulate explicitly the linearized equations safeguarding the conservation of mass, energy, and momentum of viscous flow inside a heterogeneous, compressible fluid sphere in which the coefficient of viscosity is an arbitrary function of central distance. The results are compared with those previously obtained by Chandrasekhar. An application of such equations to the problem of convection in lunar or planetary interiors is considered.

71,868 THE EQUILIBRIUM FIGURES OF THE EARTH AND THE MAJOR PLANETS
James, R., Kopal, Z.
Icarus, v. 1, no. 5–6, pp. 442–454, April 1963

The form, exterior potential, and moments of inertia of the terrestrial globe as influenced by its axial rotation are determined correctly to quantities of second order in superficial distortion, assuming the Earth to be in hydrostatic equilibrium, on the basis of both "standard" and "minimum" distribution of density inside the Earth as deduced by Bullen from seismological evidence. A similar study is presented of all consequences of the axial rotation of Jupiter and Saturn, on the basis of their models of internal structure worked out recently by de Marcus.

71,869 RADIO EMISSION FROM THE PLANETS
Roberts, J. A.
Planetary and Space Science, v. 11, no. 3, pp. 221–259, March 1963

The history and present state of knowledge of the radio emissions from planets are reviewed. The emission from each planet is discussed in order of increasing distance from the Sun. The two types of nonthermal emission received from Jupiter are discussed in detail, and the theories of origin of these emissions are reviewed.

PLASMA

71,870 DENSITY FLUCTUATIONS IN A NONEQUILIBRIUM PLASMA
Salpeter, E. E.
Journal of Geophysical Research, v. 68, no. 5, pp. 1321–1333, March 1, 1963

A dilute ionized gas is considered for which electron-ion collisions can be neglected and which deviates from thermal equilibrium by having an ion temperature T_i different from the electron temperature T_e. These conditions apply to the ionosphere in the F layer and above. Methods are reviewed for treating statistical mechanics at thermal equilibrium and the Boltzmann equation for general problems. The electron-electron, electron-ion, and ion-ion pair correlation functions are derived for general T_e/T_i and an arbitrary time-independent magnetic field. The total cross section for scattering of an electromagnetic wave from such a gas is derived for general T_e/T_i. The results are shown to agree with the integral of the theoretical frequency spectrum derived previously by a number of authors. For long wavelength and $T_i/T_e << 1$ the cross section is proportional to T_i/T_e. The sources of error for an incorrect result stated by Renau are explained.

PLASMA ACCELERATORS

71,871 ELECTROSTATIC ACCELERATION OF NEUTRAL PLASMA—MOMENTUM TRANSFER THROUGH MAGNETIC FIELDS
James, G. S., Dotson, J., Wilson, T.
September 1962
Avco Corp., Avco-Everett Research Lab., Everett, Mass.
Research Report 150

Electrostatic plasma accelerators which avoid the space-charge limitations of conventional ion rockets are described. Additional advantages for these devices include moderate requirements on magnetic field strength and on power level. In cylindrical and annular geometries, neutral plasmas can exhibit axial acceleration under the influence of externally applied axial electrostatic fields in the presence of radial magnetic fields. A critical engineering question concerns the effectiveness of the radial magnetic field in inhibiting the upstream diffusion of electrons. This diffusion is an energy loss mechanism. Both classical and anomalous (Bohm type) electron diffusion models are considered. Experiments are described which substantiate the existence of the mechanism for momentum transfer to neutral plasmas. The experiments are in approximate agreement with the anomalous (Bohm type) diffusion model and are in clear disagreement with the classical diffusion model. The engineering significance of this result and possible approaches for dealing with it are considered.

PROPULSION SYSTEMS

71,872 STATUS AND TRENDS—SPACE PROPULSION
Tischler, A. O.
Mechanical Engineering, v. 85, no. 3, pp. 48–55, March 1963

Some of the engines available and in development for propulsion for space launch vehicles are listed and discussed, including the H-1, the F-1, the A-3, the J-2, and the M-1. The trend toward hydrogen-oxygen as a propellant for upper stages, and its value in the light of the economics of a vehicle system development are noted. Other advantages and disadvantages of hydrogen-oxygen as a propellant are discussed, followed by a similar discussion concerning solid propellants. The propulsion requirements ot a typical spacecraft system—the proposed *Apollo*—are examined, including the command, service, and lunar landing modules. Nuclear rockets are described and their advantages cited. Advantages and limitations of electric rockets are discussed. Several charts and illustrations are included.

71,873 **SPACECRAFT PROPULSION REQUIREMENTS FOR LUNAR EXPLORATION MISSIONS**
Bresheärs, R. R. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena)
Institute of the Aerospace Sciences, Inc., New York, N. Y.
Paper 63-76
(Presented at the IAS 31st Annual Meeting, New York, N. Y., January 21-23, 1963)

Some of the spacecraft propulsion system requirements for lunar orbiting and landing missions are presented. Included are requirements imposed by flight path, accelerometer errors, altitude determination errors, and impulse errors. Major consideration was given to determining the effect on the spacecraft system of minimizing the propulsion system requirements. Of particular concern is minimization of the number of maneuvers, number of engines, and throttling requirements.

RADIATION

71,874 **SUMMARY OF PRESENT KNOWLEDGE ON SPACE RADIATION**
Geodeke, A. D.
February 1963
Douglas Aircraft Co., Inc., Missile and Space Systems Div., Santa Monica, Calif.
Engineering Paper 1567

Present knowledge concerning the nature and properties of interplanetary plasma and of galactic, solar, and trapped radiations is discussed. Particular emphasis is placed upon solar cosmic radiation, solar flares, solar-terrestrial relationships, and time variations. Results of analyses of various events are described in the light of biological dose restrictions. Present research programs on prediction of solar cosmic rays and their time variations are also covered.

71,875 **RADIATION EFFECTS ON SOLAR CELLS AND GLASS: AN ANNOTATED BIBLIOGRAPHY**
Beltran, A. A., Graziano, E. E.
October 1961
Lockheed Missiles and Space Co., Sunnyvale, Calif.
SB-61-58
ASTIA AD-271,036

A selected list is presented of annotated references to literature regarding ionizing radiation effects on (1) photovoltaic cells, and (2) glasses of various compositions which might be considered for solar battery glass cover slides. The literature search covered the period from January 1948 to August 1961.

71,876 **EFFECT OF ELECTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF A COMPOSITE FOIL FOR INFLATABLE SATELLITES**
James, T. G. (NASA/Langley Research Center, Langley Field, Va.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5-7, 1962," pp. 260-268, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper B-7

The primary effect of electron irradiation on the *Echo 2* skin material is an increased brittleness which leads to an early and brittle failure in both the burst strength and ultimate strength tests. Severe surface damage, which occurs at doses on the order of 10^{17} e/cm^2, causes mechanical damage to the aluminum foil portion of the skin and may lead to changes in the temperature control characteristics of the surface.

71,877 **ACUTE EFFECTS OF RADIATION EXPOSURE IN MAN**
Nickson, J. J. (Memorial Hospital & Sloan Kettering Institute, New York, N. Y.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5-7, 1962," pp. 269-274, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper C-1

The data discussed are derived primarily from observations of radiation exposure in man. The events described take place less than three months after the onset of the exposure. The data arise from three sorts of observation: (1) those on patients who receive total body radiation in an attempt to ameliorate some ailment, (2) accounts of nuclear accidents involving reactors, and (3) the consequences of exposure to the events after the use or testing of nuclear devices.

71,878 **EFFECTS OF ACUTE RADIATION EXPOSURE ON HUMAN PERFORMANCE**
Payne, R. B. (Air Force School of Aerospace Medicine, Austin, Texas)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5-7, 1962," pp. 343-374, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper C-5

In an effort to ascertain the effects of acute radiation exposure on human performance, three well-known perceptual-

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motor tasks were given to a group of male adult volunteers, from 19 to 76 years of age, who were usually in advanced stages of neoplastic disease not correctible by surgical intervention or localized radiation therapy. Results are given in charts and tables. Except for the curvature aspect of the 10-day performance sequence for complex coordination, the two studies show no dependable evidence that exposure to ionizing radiation affected the variables measured. Infra-human primate studies are discussed, and 55 references are included.

71,879 **SECONDARY-PARTICLE DOSE CONTRIBUTIONS INDUCED BY SOLAR PROTON RADIATION**
Wilson, R. K., Miller, R. A. (General Dynamics/Fort Worth, Texas)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 595–607, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper D-5

A study was made to determine the biological hazard due to secondary radiation components produced in bulk shielding by high-energy extraterrestrial protons. An idealized shield system—spherical-shell shield with a differential-volume water-target at the center—was chosen for the study. A comparison was made of the physical dose due to primary protons penetrating the shield and the secondaries produced in the shield. It was found that (1) shield-target geometry and target model greatly influence the ratio of primary proton-to-secondary component dose, and (2) secondaries may well be important for shield thicknesses greater than about 10 gm/cm^2 in the case of an aluminum shield and a solar-flare proton spectrum.

71,880 **SPACE PROTON DOSES AT POINTS WITHIN THE HUMAN BODY**
Dye, D. L. (The Boeing Co., Seattle, Wash.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 633–661, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper D-8

In a man exposed to space radiations, e.g., an astronaut, body self-shielding produces nonuniform dose distributions which depend upon external shielding configurations and the incident radiation parameters. This paper presents the doses at twelve specific points in the body of a seated man exposed to isotropic incident space protons, where the man is inside various thicknesses of external vehicle shell shielding. The body points, selected for their radiobiological interest, are in (or on) sternum, chest skin, femur, spinal column, eye, central gut, and a series at various lateral depths on the waist. The protons reaching these specific points from all directions traverse tissue thicknesses that were determined from scale drawings of a statistically standard man (75-percentile). The proton penetration, secondary radiation generation, and total dose delivered to each specific body point were calculated using an IBM (Fortran) computer code.

71,881 **A CALCULATIONAL PROCEDURE FOR ESTIMATING SPACE RADIATION EXPOSURE DURING LUNAR MISSIONS**
Miller, R. A., Cranford, W. (General Dynamics/Fort Worth, Texas)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 739–759, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper E-7

In the effort to determine shielding requirements for the protection of man from the hazards of space radiation, a space trajectory radiation exposure procedure (STREP) has been developed to estimate the magnitude of this radiation hazard by calculating the time-integrated spectra incident on a vehicle on a simulated trajectory during missions in cislunar space. STREP will calculate the dose received from radiation penetrating a thin shield. The trajectory and radiation computational techniques are briefly described. Some results are given for calculations of the integrated spectra and dose incident on a vehicle subjected to trapped radiation, cosmic radiation, and solar-flare radiation during a lunar mission of about seven days.

71,882 **RADIATION DOSAGES FROM ELECTRONS AND BREMSSTRAHLUNG IN THE VAN ALLEN BELTS**
Russak, S. L. (Martin-Marietta Corp., Baltimore, Md.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 760–772, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper E-8

Radiation dose rates have been calculated for six electron spectra. The decrease in dose rate with shielding was determined, and in each case the electron dose becomes insignificant with 2 to 6 gm/cm^2 of aluminum. Electron bremsstrahlung dose rates versus absorber thickness were also calculated. Detailed dosage calculations for an *Apollo*-type spacecraft were made and mission dosages for four lunar trajectories are given to show the effects of trajectory selection. These are compared with the dosages from protons and secondary neutrons in the Van Allen belt. Doses as a function of orbital altitude, inclination and absorber thickness are also presented for the latest version of the inner belt.

71,883 **MEASUREMENT OF RADIATION DOSES ON THE SECOND, FOURTH, AND FIFTH SATELLITE-SPACESHIPS**
Keirim-Markus, I. B., Kovalev, E. E., Uspenskii, L. N.
***Artificial Earth Satellites*, v. 12, pp. 52–55, March 1963**

71,884 SPACE FLIGHTS AND THE RADIATION HAZARD (KOSMICHESKIE POLETY I RADIATSIONNAIA OPASTNOST)
Savenko, I. A., Pisarenko, N. F., Shavrin, P. I.
***Priroda*, Moskva, no. 2, pp. 40–48, February 1962**
(Abstracted in *Aerospace Medicine*, v. 34, no. 3, p. 280, March 1963)

The following topics are discussed: (1) measurement of radiation dosage in rads, (2) cosmic radiation at the Earth's surface and at low altitudes, (3) the effect of solar radiation on primary cosmic radiation, (4) the radiation belts of Earth, (5) radiation from solar flares, and (6) radiation measurements made on board the second and third Soviet satellites in August and December 1960. The maximum permissible dose in the USSR for individuals working with radioactive materials and ionozing radiation sources is 0.1 rem/working week. In 1959, a period of intense solar activity, the magnitude of the flux of primary radiation particles in space was established as 2 particles/cm^2/sec behind a 1 g/cm^2 thick shield, resulting in 15 mrad/24 hr. A third radiation belt was discovered approximately 50,000 to 60,000 km from the Earth's center, but because of the low energy of its particles (a few hundred ev) it does not constitute a radiation hazard. Shielding provides sufficient protection from the outer radiation belt, but is not adequate for protection from the inner radiation belt; therefore, this zone should be avoided. The main radiation hazard, however, is from the infrequent solar flares. A special well-shielded cabin should be provided for retreat during a flare, or it should be possible to terminate the space flight in time to avoid the flare.

71,885 SPACE RADIATION GUIDE
Saylor, W. P., Winer, D. E., Eiwen, C. J., Carriker, A. W.
(American Machine and Foundry Co., Alexandria, Va.)
August 1962
Aerospace Medical Research Labs. (6570th), Aerospace Medical Div., Wright-Patterson AFB, Ohio
AMRL-TDR-62-86
(Abstracted in *Aerospace Medicine*, v. 34, no. 3, p. 279, March 1963)

The Space Radiation Guide is intended to be a reliable, easily understood handbook that will provide sufficient knowledge of the nature of space radiations to permit comprehension of the total space radiation problem as it pertains to the hazards of manned space flight. The guide is not intended to provide answers to all problems, but to present much of the factual data currently known and to indicate areas where information is sketchy and inconclusive. The radiations considered are cosmic rays, solar radiation, and the geomagnetically trapped (Van Allen) radiations. Included are chapters on instruments used for measuring these radiations, on shielding techniques, and on biological effects. A total of 34 references is included.

RADIATION BELTS

71,886 RADIO MEASUREMENTS OF A MANMADE RADIATION BELT
***National Bureau of Standards, Technical News Bulletin*, v. 47, no. 3, pp. 38–39, March 1963**

In cooperation with the Geophysical Institute of Peru, the NBS Observatory at Jicamarca has made a series of measurements of the synchrotron radiation emitted by the man-made belt of high energy electrons formed by a high altitude nuclear detonation. From these measurements, made at 30 to 50 Mc, the number, energy spectrum, and decay rate of the electron have been derived.

RADIO ASTRONOMY

71,887 BIBLIOGRAPHY ON ATMOSPHERIC ASPECTS OF RADIO ASTRONOMY INCLUDING SELECTED REFERENCES TO RELATED FIELDS
Nupen, W.
May 1, 1963
National Bureau of Standards, Boulder Labs., Colo.
Technical Note 171

This bibliography contains over a thousand abstracts or titles from literature published between 1900 and 1961, inclusive; however, the bulk of the literature follows the discovery (Jansky, 1932) of radio-frequency radiation from the Sun, and especially the building of radio telescopes since World War II. Subject matter is confined to (1) the effects of the Earth's atmosphere on radio-frequency radiation from the Sun, planets, stars, the galaxies and intergalactic space, or (2) knowledge of atmospheric or ionospheric structure, composition, or physics.

RADIO TELESCOPES

71,888 RADIO TELESCOPE STRUCTURES
Feld, J.
***Annals of the New York Academy of Sciences*, v. 93, Article 10, pp. 351–456, May 31, 1962**

The new radio astronomy technique, its purposes, and some of the announced results are explained as a background to discussion of the radio telescope itself. Loading criteria which must be taken as the basis of structural design are discussed, and differences in approach from normal structural design are noted. Feasibility studies of large telescopes are reported, and the design procedure for a 600-ft parabaloid dish is given. Actual constructions in England, The Netherlands, Germany, USSR, and Australia are described. Comparative studies and design of the 140-ft telescope of the Associated Universities, Inc., are reported, and fixed-shell radio telescopes now in use in the U.S. are described. Forty-six pages of illustrations and diagrams are included.

RE-ENTRY TRAJECTORIES

71,889 **BIOSATELLITE RECOVERY FROM CIRCULAR ORBITS**
Swet, C. J.
October 1962
Johns Hopkins University, Applied Physics Lab., Silver Spring, Md.
CM-1026

This report is a primer for the nonballistician who is concerned with the design or selection of biospace experiments, and provides him with some feeling for the ballistics of biosatellite recovery. Some results of a recent parametric study of a wide variety of likely descent trajectories from near-Earth orbits are presented in nonspecialized terms. Although computed by approximate methods, these results are believed to be sufficiently accurate for most planning purposes. No attempt is made to describe the computational methods or the underlying physics.

RE-ENTRY VEHICLES

71,890 **OPTIMIZATION OF LIFTING RE-ENTRY VEHICLES**
Hankey, W. L., Jr.
March 1963
Aeronautical Systems Division, Wright-Patterson AFB, Ohio
ASD TDR-62-1102

Aerodynamic lift is used during re-entry to provide range maneuverability so that a precise site can be selected and a horizontal landing capability provided. Maximum maneuverability may be achieved by modulating the hypersonic lift-to-drag ratio (L/D). In this study the lifting re-entry configuration was optimized to maximize hypersonic L/D within the heating, stability, and landing constraints. A flat bottom surface, clipped delta planform with a 0.32 taper ratio, dorsal delta fins, and elliptical (2:1) nose and leading edges were ascertained to produce maximum hypersonic L/D for the prescribed constraints.

RELATIVITY THEORY

71,891 **GRAVITATIONAL ENERGY RADIATION**
Møller, C.
***Physics Letters*, v. 3, no. 7, pp. 329–331, February 15, 1963**

71,892 **ON THE INVARIANT SPATIAL DISTANCE IN A CURVED SPACE-TIME WITH SPHERICAL SYMMETRY. II—THE PROBLEM OF THE ALLOWABLE MEAN VALUE FOR THE DISTANCES AMONG SEVERAL OBSERVERS**
Nariai, H., Ueno, Y.
***Progress of Theoretical Physics*, v. 27, no. 4, pp. 707–731, April 1962**

An attempt is made to study in detail the problem of the allowable mean value for the invariant spatial distances among several observers in a certain class of the space-time with spherical symmetry. It is found that, except in a few cases, a simultaneous determination can be made of the functional form of the allowable mean value and the metric tensor for the space time under consideration. The results thus obtained are applied to various space-times present in cosmology.

RENDEZVOUS ORBITS

71,893 **A PARAMETRIC INVESTIGATION OF THE LUNAR-ORBIT-RENDEZVOUS SCHEME**
Thomas, D. F., Bird, J. D.
April 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1623

This study was made for various crew sizes, transported weights, lunar-orbit altitudes, types of lunar orbits, and fuels. The results indicate a substantial saving in initial vehicle weight for the lunar-orbital-rendezvous mission as compared with the direct lunar mission for all conditions studied. Also, entry into an elliptic lunar orbit at perilune presents a saving in initial vehicle weight when compared with circular lunar orbits and elliptic lunar orbits entered at apolune with each of the three orbits having the same maximum altitude.

SATELLITES

71,894 **SCIENTIFIC SATELLITES, AN ASTIA REPORT BIBLIOGRAPHY**
Bjorge, S.
December 1962
Armed Services Technical Information Agency, Arlington, Va.
ASTIA AD-290,800

This select bibliography covers the design and instrumentation of scientific satellites, properties of the ionosphere derived from satellite research, and meteorological satellites. It was prepared for members attending the Scientific Satellite Symposia sponsored by the American Astronautical Society on December 27, 1962.

71,895 **BRIEF DATA ON SOVIET ARTIFICIAL EARTH SATELLITES, SATELLITE-SPACESHIPS, AND SPACE ROCKETS**
***Artificial Earth Satellites*, v. 12, pp. 3–6, March 1963**

71,896 **LONG LIFE SATELLITE RELIABILITY PROGRAM**
Walsh, T. M., Heubner, D. F.
August 1962
General Electric Co., Missile and Space Div., Philadelphia, Pa.
Document 62SD4299

As a portion of the *Advent* Communications Satellite Program, the General Electric Co.'s Missile and Space Division has developed an approach for assuring long life to nonmaintainable space vehicles, which is based on strength degradation theories and the utilization of design standards, part specifications, and design data sheets. Particular emphasis is placed on methods for evaluating long-life capabilities and the development of screening tests. Analysis of results of tests completed on commercial and MIL specification resistors, capacitors, and semiconductors indicates that (1) physical laws exist in nature which quantitatively define irreversible strength degradation processes for electronic parts; (2) a mathematical relation exists between progressive stress and constant stress test results on like parts; (3) the application of selected screening tests such as current noise, thermal resistance, X-ray, proof tests, etc., on a 100-percent basis will identify and eliminate potentially short-lived parts; and (4) the theoretical failure distribution which best fits life data, specifically capacitors, is the Weibull with a shape parameter, β, less than 1. Data from tests and investigations of materials and electromechanical parts normally found in spacecraft design are also discussed.

71,897 SATELLITE SITUATION REPORT, VOLUME 3, NO. 6
March 13, 1963
National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
X-533-63-1

Tables of data on the status of satellites which were computed and compiled by the Goddard Space Flight Center, Norad, and the Smithsonian Astrophysical Observatory are given.

SATURN

71,898 ON THE OBSERVATION OF THE OCCULTATION OF STARS BY SATURN'S RINGS
Bobrov, M. S.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 525–531, January–February 1963**

Observations of the occultation of stars by Saturn's rings can be used to obtain the following important parameters and data: (1) the optical thickness τ_0 of the rings as a function of the distance to the center of the planet; (2) the dimensions of the rings; (3) the position, width, and optical thickness of the divisions; (4) the influence of ring matter on the diffraction pattern and the spectra of the occulted stars; (5) the presence or absence of rarefied matter beyond the visible region of the rings; and (6) the variations of the parameters and structure with time. Available observations of occultations are discussed, and recommendations for future observations made.

SATURN PROJECT

71,899 RESULTS OF NASA-LVO SOUND PRESSURE LEVEL MEASUREMENTS DURING SA-3 LAUNCH
Byrne, F., Crowell, J.
March 7, 1963
George C. Marshall Space Flight Center, Huntsville, Ala.
MTP-LVO-63-4

Sound pressure level data recorded during the launch and flight of the *Saturn* 3 on November 16, 1962 are presented. The instrumentation systems, measurement locations, systems calibration, and the data reduction system utilized in the recording and/or reduction of the acoustic data are described. The acoustic data presented were reduced primarily from the thirty measurements taken by the Launch Vehicle Operations Division, Marshall Space Flight Center, Cape Canaveral, Florida, and represent the Division's contribution to the *Saturn* Environmental Measurement Program. This program is a combined effort by several groups to define the induced environment experienced by the vehicle, the ground support equipment and facilities, and the neighboring populated areas during the launch and flight of *Saturn* vehicles. The acoustic data are shown in both tabular and graphical forms.

71,900 SATURN ASCENDING PHASE GUIDANCE AND CONTROL TECHNIQUES
Moore, F. B., Brooks, M. (NASA/George C. Marshall Space Flight Center, Huntsville, Ala.)
American Rocket Society, Inc., New York, N. Y.
2458-62
(Presented at the Lunar Missions Meeting, Cleveland, Ohio, July 17–19, 1962)

The *Saturn* guidance and control concept must be sufficiently broad to accommodate a variety of vehicle configurations and engine specifications, coupled with a large assortment of mission objectives and flight paths. The Adaptive Guidance Mode, the guidance concept under development at the Marshall Space Flight Center, meets these requirements. This mode functions by accepting the present vehicle flight variables and engine parameters as initial conditions and defining the optimum path ahead which meets the mission requirements. This information is supplied in the form of attitude and cutoff commands.

SELENOCENTRIC ORBITS

71,901 ON A MODIFICATION OF HANSEN'S LUNAR THEORY
Musen, P.
***Journal of Geophysical Research*, v. 68, no. 5, pp. 1439–1456, March 1, 1963**

A modification of Hansen's lunar theory is given in a form that permits a purely numerical treatment of solar perturbations of planetary satellites or of perturbations caused by the

SELENOCENTRIC ORBITS (Cont'd)

Earth in the motion of hypothetical lunar satellites. The development of the coordinates and of the velocities of a satellite is obtained in the form of a trigonometric series in four arguments with numerical coefficients. Hansen's basic *W* function is not used at the earlier stages of the computation. Rather than compute *W*, two characteristic features of Hansen's theory—the fictitious mean anomaly and the replacement "bar" operation—are used to set up a process of iteration in a convenient form. The preference given to the method of iteration was motivated by the circumstance that an input information must not necessarily be limited to the choice of the rotating ellipse as an intermediary orbit. A systematic investigation of the orbital stability of lunar satellites can be based on the development given in this article.

71,902 GEOMETRICAL CHARACTERISTICS OF LUNAR ORBITS ESTABLISHED FROM EARTH-MOON TRAJECTORIES
Tolson, R. H.
April 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1780

An iterated two-body or patched-conic technique was used to relate the transfer-trajectory injection conditions to the selenocentric orbital parameters through a set of simultaneous transcendental equations. Solutions to these equations are presented for typical sets of injection conditions. These solutions suggest a further approximation which leads to some approximate, simple relationships between the lunar orbital parameters and the transfer-trajectory characteristics.

SELENOGRAPHY

71,903 PITON—A LUNAR PROTEUS
Bartlett, J. C., Jr.
***Strolling Astronomer, The,* v. 17, no. 1–2, pp. 3–12, January–February 1963**

The apparent protean transformations of the lunar mountain Piton during a series of systematic observations, beginning in April 1961 and ending in October of the same year, are discussed in detail. The cause of high-Sun darkenings in the semicircular area immediately east of Piton is explored.

71,904 TOPOGRAPHY AND TECTONICS OF THE LUNAR STRAIGHT WALL
Fielder, G.
***Planetary and Space Science,* v. 11, no. 1, pp. 23–30, January 1963**

The Straight Wall region of the Moon is surveyed, and the Wall is found to be a dip-slip fault with the upthrow dipping gently away from the fault. Data are drawn from (1) measurement of sunrise shadows, (2) measurement of the width of the face of the Straight Wall at sunset, (3) photometric measurements of the slope of the country in the immediate vicinity of the Wall, and (4) photographic and visual observations. Igneous activity undoubtedly caused the dominant tectonic forces in the region.

SELENOLOGY

71,905 PROPERTIES OF THE LUNAR SURFACE AS REVEALED BY THERMAL RADIATION
Muncey, R. W.
***Australian Journal of Physics,* v. 16, no. 1, pp. 24–31, March 1963**

On the assumption that the thermal properties are proportional to the temperature, the uniform lunar surface corresponding to the observed optical values is calculated. Possible mixed surfaces are also evaluated. These are examined to estimate the likely variation in microwave radiation, and by comparison with observed results it is shown that the most probable surface consists (1) partly of rock or gravel overlaid by a thin layer of fine dust, and (2) partly of areas with dust extending to beyond the depth from which the microwave radiation emanates.

SHIELDING

71,906 TECHNIQUES USED IN SHIELDING CALCULATIONS FOR HIGH-ENERGY ACCELERATORS: APPLICATIONS TO SPACE SHIELDING
Wallace, R., Sondhaus, C. (University of California, Lawrence Radiation Lab., Berkeley)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 829–851, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper F-4

The secondary neutron spectrum produced inside of a thick shield is predicted. The multiplicity of cascade and evaporation secondaries, as well as subsequent moderation of the secondary spectrum, is described quantitatively. Experimental thick-target neutron yields and Monte Carlo cascade data are the bases for these estimates.

71,907 LONG RANGE NASA SHIELDING REQUIREMENTS
Keller, J. W. (National Aeronautics and Space Administration, Washington, D. C.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 662–681, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper E-1

In many cases future missions will present much more severe shielding problems than those encountered in *Apollo,* primarily because of their longer duration in affected regions in space. Several types of future missions are discussed to establish the magnitude of the shielding problems that may exist. Available on-board mass in the form of equipment, fuel, etc., must be utilized as shielding where possible. However, high effectiveness in the utilization of such mass may be difficult. The importance of accurate determination of such effectiveness is cited, and an effort is made to outline a general approach to the space vehicle shielding problem.

71,908 MEASUREMENTS OF SECONDARY SPECTRA FROM HIGH-ENERGY NUCLEAR REACTIONS
Strauch, K. (Harvard University, Cambridge, Mass.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5 7, 1962," pp. 409–432, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper D-2

The mechanism of the interaction of a high-energy nucleon with a complex nucleus is discussed, and the various types of reaction are described. The available experimental data on secondary particles are summarized, with emphasis on those secondaries that might be important for shielding considerations.

71,909 SYNTHESIS OF MINIMUM WEIGHT PROTON SHIELDS
Krumbein, A. D., Mittelman, P. S., Troubetzkoy, E. S., Nakache, F., Celnik, J. (United Nuclear Corp., Development Div., White Plains, N. Y.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 773–793, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper E-9

A shield optimization technique originally developed for reactor shields has been applied to proton shields. The cases of both spherical and nonspherical shields have been studied, and the effects of certain special constraints and of secondary neutrons have been included in the analysis. The method indicates the materials which should go into making up the minimum weight shield as well as the order and the thickness of each material. The amount of weight saved is found to be a function of the radius of the shielded void and of the specified attenuation required.

71,910 THE PROSPECTS FOR ACTIVE SHIELDING
Levy, R. H. (Avco Corp., Avco-Everett Research Lab., Everett, Mass.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 794–807, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper F-1

Various methods of shielding are discussed which might be used instead of the standard method of interposing a substantial amount of matter between the astronaut and the radiation. The importance of such methods is directly related to the weight involved in bulk shielding. Only the radiation hazard due to high-energy protons is considered since it appears at present that such protons constitute the most important natural source of danger to the astronaut. Shielding methods discussed are electrostatic and magnetic.

71,911 COMPARISON OF MONTE CARLO AND IONIZATION CALCULATIONS FOR SPACECRAFT SHIELDING
More, K. A., Tiffany, O. L. (The Bendix Corp., Bendix Systems Div., Ann Arbor, Mich.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 682–697, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper E-2

Various methods have been used to calculate shield designs for manned space vehicles. The methods differ in the approximations used to describe the spacecraft geometry and the physical interactions of the space particles in the vehicle shield. Since calculation time is least for the methods with the most approximations, it is desirable to know what degree of approximation is permissible in designing shields. Results of shield calculations using the Monte Carlo method are compared with those obtained using the more approximate ionization loss method.

71,912 THE COMBINATION OF ACTIVE AND PASSIVE SHIELDING
Norwood, J. M. (General Dynamics/Fort Worth, Texas)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 819–828, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper F-3

It is conceivable that improved shielding of space vehicles against high-energy charged-particle radiation can be obtained by combining active and passive shielding. Methods of shielding calculations and some preliminary observations pertaining to active-passive shielding are given. An analysis based upon the field of a magnetic dipole indicates that weight savings in bulk shielding can be accomplished.

71,913 EXPERIMENTAL TECHNIQUES FOR THE MEASUREMENT OF NUCLEAR SECONDARIES FROM THE INTERACTIONS OF PROTONS OF A FEW HUNDRED MEV
Maienschein, F. C., Blosser, T. V., Brashear, H. R., Burrus, W. R., Glass, F. M., Gibson, W. A., Hill, N. W., Johnson, C. F., Love, T. A., McKay, V. A., Peelle, R. W.,

SHIELDING (Cont'd)

Santoro, R. T., Scroggs, R. J., Sliski, T. F., Stripling, H. J., Zobel, W. (Oak Ridge National Lab., Tenn.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 523–594, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper D-4

Preparations are described for a set of experiments designed to check space shielding calculations. Since the experiments are at an early stage, all information must be considered as preliminary. The approximate calculations of Alsmiller have been used to estimate that spectral measurements are most important for secondary neutrons, protons, and gamma rays arising from the interactions of incident protons in the energy range from 20 to 600 Mev. Both "thin" and "thick" targets are needed to check the two pertinent types of calculations—those for the prediction of cross sections and secondary spectra for intranuclear cascades, and those for transport through shields. Previous measurements exist only for thin targets, all of which are limited in energy resolution or in the range of energies and angles covered.

71,914 SHIELDING OF SPACE VEHICLES BY MAGNETIC FIELDS
Edmonson, N., Verwers, C. D., Gibbons, F. L. (General Dynamics/Fort Worth, Texas)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 808–818, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper F-2

Protons emitted by solar flares represent a significant radiation hazard to crew members of an interplanetary space vehicle. Shielding the vehicle from charged particles by the use of magnetic fields is an obvious possibility. Reduction of secondary radiation otherwise produced in bulk shielding is an added incentive for study of magnetic shielding. In a program initiated to study various aspects of this shielding, a procedure has been formulated and coded for the IBM 7090 computer for rapidly computing the field of an optimized superconducting solenoid.

SNAP PROJECT

71,915 AUXILIARY POWER SOURCES IN SPACE: TECHNICAL DOCUMENTATION VOLUME II OF III (SNAP)
July 30, 1962
North American Aviation, Inc., Space and Information Systems Div., Downey, Calif.
SID 62-708, Volume II

This bibliographic search surveys the literature on Systems for Nuclear Auxiliary Power (*SNAP*) from 1957 to July 1962, with special emphasis on space applications of these devices.

SOLAR ACTIVITY

71,916 AN ANALYSIS OF PERIODIC SOLAR ACTIVITY
Gudzenko, L. I., Chertoprud, V. E.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 590–591, January–February 1963**

A preliminary study, reported in a brief communication, has yielded empirical equations for the variations in solar activity. The equations may be useful for predicting activity and for studying physical processes on the Sun.

SOLAR CELLS

71,917 SOLAR CELL DEGRADATION BY PROTONS IN SPACE
Madey, R. (Republic Aviation Corp., Farmingdale, N. Y.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 243–259, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper B-6

An analytical expression for the decrease in efficiency of a solar cell behind a protective cover glass exposed to a spectral distribution of protons is formulated on the basis that the time rate of decrease in output power is proportional to the proton dose rate absorbed at the surface of the solar cell.

71,918 N-ON-P SOLAR CELLS GAINING WIDER USE
Miller, B.
***Aviation Week & Space Technology*, v. 78, no. 9, pp. 88–91, March 4, 1963**

Recent tests conducted by NASA indicate that production-type *n*-on-*p* silicon solar cells of seven different solar-cell manufacturers show a factor of 10 improvement in their ability to resist degradation of 1-Mev electrons compared with conventional *p*-on-*n* cells.

71,919 RADIATION DAMAGE TO SOLAR CELLS
Baicker, J. A., Rappaport, P. (Radio Corporation of America, RCA Labs., Princeton, N. J.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 118–135, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper B-1

The construction, operation, and performance characteristics of solar cells are described. The radiation damage process is discussed, and proton and electron damage to silicon cells detailed. The degradation of the photovoltaic current-voltage characteristics and the spectral response is shown, and a comparison made of various types of solar cells, including silicon, gallium arsenide and cadmium sulfide. Differences between *p/n* and *n/p* silicon cells are discussed and explained in terms of basic properties of the radiation defects.

SOLAR CORONA

71,920 CORONAL TEMPERATURE GRADIENT AND THE SOLAR WIND
Billings, D. E., Lilliequist, C. G.
***Astrophysical Journal, The,* v. 137, no. 1, pp. 16–20, January 1963**

An extremely detailed study of λ 5303 in one portion of the corona—from 20°N to 20°S of the equator on the west limb on October 13, 1959—has resulted in evidence for a negative temperature gradient in the inner corona. The significance of such a temperature gradient to solar wind theories is discussed.

71,921 CORONAL IONIZATION BY TWO-STEP COLLISION PROCESSES
Athay, R. G., Hyder, C. L.
***Astrophysical Journal, The,* v. 137, no. 1, pp. 21–25, January 1963**

It is suggested that ionization by electron impact for some coronal ions may take place via the double process of collisional excitation to metastable levels, thence collisional ionization from these excited levels rather than by direct ionization from the ground state. The relative efficiency of this double-collision process depends primarily on the mean decay lifetimes for the excited levels. A specific computation based on estimated upper limits to the mean lifetimes of excited levels in the Fe x–Fe xv sequence shows a flatter spectrum of ion densities and a somewhat lower ionization temperature than is obtained from direct collisional ionization from the ground state, assuming that the abundance of Fe x equals that of Fe xiv. The two-step collision mechanism permits the possibility of a density dependence in the ionization equilibrium.

71,922 RADIATION TRANSFER PROBLEMS IN THE ROCKET ULTRA-VIOLET LINES
Pecker, C., Thomas, R. N.
***Journal of Quantitative Spectroscopy and Radiative Transfer,* v. 3, no. 2, pp. 163–165, April–June 1963**
(Paper presented at the Third Colloquium on the Theory of Stellar Atmospheres, England, August 15–16, 1962)

An investigation of the radiative transfer problem in the solar corona and its effect upon the excitation state of coronal ions is summarized. This investigation is one phase of a systematic treatment of the influence of ionic configuration and physical environment upon the excitation state of an ion. A high-temperature plasma, $T_e \sim 10^5$–10^6, is treated, with interest lying in the radiation from an impurity in the plasma. A two-level-atom representation of the actual ionic configuration is used.

71,923 DISCUSSION OF PAPER BY L. M. NOBLE AND F. L. SCARF, "HYDRODYNAMIC MODELS OF THE SOLAR CORONA"
Parker, E. N.
***Journal of Geophysical Research,* v. 68, no. 6, p. 1769, March 15, 1963**

Physical interpretations associated with Noble and Scarf's theoretical calculations of the solar corona are discussed. The original paper appeared in the *Journal of Geophysical Research,* v. 67, no. 12, pp. 4577–4584, November 1962, and was abstracted in the *Astronautics Information Abstracts,* v. 7, no. 2, February 1963. (See Entry #70,550.)

71,924 AUTHORS' REPLY TO PRECEDING DISCUSSION
Noble, L. M., Scarf, F. L.
***Journal of Geophysical Research,* v. 68, no. 6, pp. 1770–1772, March 15, 1963**

71,925 SOME ASSOCIATIONS BETWEEN RISING PROMINENCES AND THE SOLAR CORONA
Kleczek, J., Hansen, R. T.
***Astronomical Society of the Pacific, Publications of the,* v. 74, no. 441, pp. 507–510, December 1962**

Coronal spectrograms made during the past ten years at the High Altitude Observatory of Climax, Colorado and the Sacramento Peak Observatory were studied in an attempt to find the time-dependent association between a specific kind of prominence—that rising upward from the Sun—and the corona. Photographs of three documented cases are reproduced and are discussed separately.

71,926 ON THE SPATIAL STRUCTURE OF THE SOLAR CORONA. PART II.
Mustel, E. R.
***Soviet Astronomy—AJ,* v. 6, no. 4, pp. 488–496, January–February 1963**

The physical and geometrical properties of R-rays (coronal rays above active regions) are considered. From a large number of investigations, it is concluded that these R-rays are very long, stretching beyond the Earth's orbit, and approximately radial. Deviations from radiality are discussed. The geometrical and physical properties of streamers and R-rays are compared and shown to differ radically with respect to their most important properties. Coronal rays in the belt of active regions, but not above the active regions themselves, are considered. It is pointed out that these rays should be similar to R-rays but have a smaller gas density, and that they

SOLAR CORONA (Cont'd)

therefore cannot produce appreciable geometric disturbances. (Part I of this paper was abstracted in *Astronautics Information Abstracts,* v. 7, no. 3, March 1963, Entry #70,849.)

SOLAR CORPUSCULAR RADIATION

71,927 THE SUN AS A SOURCE OF INTERPLANETARY GAS
de Jager, C.
***Space Science Reviews,* v. 1, no. 3, pp. 487–521, March 1963**
(Paper presented at European Preparatory Commission for Space Research Symposium on The Interplanetary Medium, at Paris, France, June 19, 1962)

The quasi-stationary streaming, emerging from the solar activity region, and the flare-associated bursts of particles are discussed. The paper is divided into the following sections: the solar activity centers and the magnetic chromospheric network, quasi-stationary gas flow from the solar active regions, comparison with observations, solar flares, acceleration of particles near a flare acceleration of electrons, solar proton streams with $v \approx 1500$ km/sec, relativistic particles accelerated in connection with flares, and a summary model of flare events.

71,928 SOME CONSEQUENCES OF NONUNIFORMITY OF SOLAR WIND VELOCITY
Sarabhai, V.
***Journal of Geophysical Research,* v. 68, no. 5, pp. 1555–1557, March 1, 1963**

Conditions in interplanetary space along the solar equatorial plane are examined that are likely to arise when the radial velocity of the solar wind is a function of solar longitude. Some broad consequences of the growth and decay of regions of activity and enhanced wind velocity as a function of time are also examined. It is shown that the resulting two-dimensional model has attractive features relevant to the interpretation of several observed cosmic-ray time variations.

SOLAR FLARES

71,929 COMPARISON OF PRIMARY PROTON DOSE WITH THE DOSE FROM GAMMA RAYS PRODUCED BY INELASTIC SCATTERING OF SOLAR FLARE PROTONS
Alsmiller, F. S., Alsmiller, R. G., Jr., Trubey, D. K. (Oak Ridge National Lab., Tenn.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 718–724, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper E-5

The primary proton dose resulting from solar-flare (May 10, 1969) protons incident on an aluminum shield is compared with the dose from gamma rays produced by inelastic collisions of the primary protons. Both spherical shell and slab shields are considered.

71,930 RECORDING THE IONISING EMISSION OF FLARES AND ERUPTIVE PROMINENCES BY THE ATMOSPHERIC RECEIVER AT THE ONDREJOV OBSERVATORY
Křivský, L., Salava, T., Šnejdárek, I.
***Astronomical Institutes of Czechoslovakia, Bulletin of the,* v. 14, no. 1, pp. 5–9, 1963**

71,931 STATISTICAL PREDICTION OF SOLAR PROTON EVENTS
Weddell, J. B. (North American Aviation, Inc., Downey, Calif.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 88–95, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper A-6

A method of correlating solar flares in time with several indices of activity of solar regions is described. The method determines (1) the probability of occurrence of a flare if each of two indices exceeded given limits, and (2) the average time between measurement of these indices and the outbreak of the flare. Significant correlations are listed; the most important is the tendency for major flares to occur in the second passage across the solar disk of regions exceeding 2000 millionths of the solar hemisphere in area which during their first passage gave rise to small flares. These criteria permit prediction of 69 percent of Class III flares at least 14 days in advance. Flare positions have been correlated with the magnetic field in active regions. The field near the sites of flares tends to be frozen into the solar atmosphere to a greater extent than other portions of the field.

71,932 COMMENTS ON THE PRODUCTION OF SOLAR HIGH ENERGY PARTICLES
Chapman, M. C., Fortney, R. E., Morrison, M. R. (Northrop Corp., Northrop Space Labs., Hawthorne, Calif.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 96–117, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper A-7

A general qualitative model for the production of solar high-energy particles which can explain several observed flare phenomena is used in the analysis of a specific flare event. The model explains the occurrence of solar radio emission, the initial anisotropic and later isotropic distribution of flare particles, Forbush decreases in cosmic-ray intensity, decreases in cosmic radio noise, and fluctuations in the Earth's magnetic field due to solar flare particles. Also explained qualitatively are phenomena such as the occurrence of shock waves during flare events, observed surges in the active region, and movement of magnetic "bumps" before the start of the flare.

SOLAR MAGNETIC FIELDS

71,933 **RELATION BETWEEN MOTIONS AND LOCAL MAGNETIC FIELDS IN THE PHOTOSPHERE**
Bumba, V.
Astronomical Institutes of Czechoslovakia, Bulletin of the, **v. 14, no. 1, pp. 1–5, 1963**

An attempt is made to show that the photospheric plasma moves approximately along the lines of force of the intense local field; i.e., that the organization of the radial motions of the photospheric plasma is largely subordinated to the configuration of the local field of the sunspot group.

SOLAR POWER SUPPLIES

71,934 **THE SATELLITE POWER SYSTEM**
Anderson, R. E. D., Meszaros, G. W., Ciccolella, D. F.
Bell Laboratories Record, **v. 41, no. 4, pp. 142–150, April 1963**

The development of the solar power supply used in *Telstar* is described. Selection of the individual type of solar cell and its integration into the complete system are covered. High- and low-power regulators, and storage batteries are also discussed along with the methods of testing the complete system.

SOLAR PROBES

71,935 **VEHICLE TECHNOLOGY CONSIDERATIONS FOR A SOLAR PROBE**
Foschetti, J. A.
April 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1747

This report demonstrates that solar probes are feasible from the viewpoint of presently planned vehicle technology. For the early attempts the *Saturn C-1* is considered to be the most likely vehicle to place the final stage or stages into a circular orbit. If two slightly modified but identical *Centaur, Jr.,* vehicles are used for the upper stages, then this four-stage configuration will be capable of placing from 400 to 2500 lb at perihelion distances of 0.120 to 0.245 AU. A more reliable three-stage configuration, using one *Centaur, Jr.,* for the upper stage but requiring greater modification in the original design of the vehicle, would place payloads of 400 to 2500 lb at perihelion distances of 0.185 to 0.290 AU. Analysis of the upper stages was based on the payload value obtained for the *Saturn* vehicle by using the "Generalized Powered Flight Trajectory Program." At burnout there would be a payload of 24,612 lb in a 100-nm parking orbit.

SOLAR PROMINENCES

71,936 **PHYSICAL CONDITIONS IN LIMB FLARES AND ACTIVE PROMINENCES VI. SELECTIVE EXCITATION CONDITIONS**
Tandberg-Hanssen, E.
Astrophysical Journal, The, **v. 137, no. 1, pp. 26–37, January 1963**

The complex surge prominence of November 18, 1960 is studied spectroscopically. It is shown that the surge consists of different regions where the physical conditions (temperature and/or internal motions) differ from one region to another. The metal and helium regions are shot out from an underlying flare in different directions. The emission from Fe II is considerably fainter than that from Ti II or Ba II.

A finer spectroscopic classification of flares and prominences than that previously introduced is discussed. It is found, as a general rule, that while Ti II lines are stronger than Fe II lines in prominences, the reverse holds true in flares. As a new classification criterion, the line-intensity ratio $M = [I(\text{Fe II}, 4584)/I(\text{Ti II}, 4572)]$ is introduced.

71,937 **HYDROGEN LINES IN THE SPECTRA OF PROMINENCES**
Sobolev, V. V.
Soviet Astronomy—AJ, **v. 6, no. 4, pp. 497–503, January–February 1963**

Equations which simultaneously determine the intensities and profiles of the Balmer emission lines are obtained. The prominence is assumed to be a homogeneous sphere, the optical radius of which in the Balmer lines can be greater than unity. The equations are solved numerically for two particular cases and the relative intensities and profiles of the H_α, H_β, and H_γ lines are found. It is shown that the theory is in satisfactory agreement with observations. From a comparison of the theory with the observations of one prominence, its optical radius (of the order of 10) and the mean velocity of random motions of hydrogen atoms (about 11 km/sec) are determined.

SOLAR RADIATION

71,938 **THE MEASUREMENT OF FAR ULTRAVIOLET HELIUM RADIATION ON THE SUN**
Bruns, A. V., Prokofev, V. K.
Matthews, R., Translator
Planetary and Space Science, **v. 11, no. 1, pp. 73–80, January 1963**
(Translated from *Iskusstvennye Sputniki Zemli,* no. 11, p. 15, 1961)

Measurements of the solar radiation in the He^{II} λ 303.8 Å line are presented which were carried out on December 1 and 2, 1960 employing a photoelectric diffraction spectrometer installed on *Sputnik 6.* These measurements were carried out only in the range of visibility of the Sun, and the

SOLAR RADIATION (Cont'd)

resulting data stored in the memory and later transmitted to Earth. The analysis of these measurements is described. Charts and tables are included.

SOLAR RADIO EMISSION

71,939 **SOLAR DECIMETRE RADIO BURSTS**
Mullaly, R. F., Krishnan, T.
***Australian Journal of Physics*, v. 16, no. 1, pp. 8–23, March 1963**

Results are presented of observations at 1420 Mc of about 50 burst events made during 1958–1961 using the Christiansen grating interferometer which operated, on most occasions, to provide a fan beam with 2′ of arc resolution to half-power points in the E-W direction. The aim of the study is to determine typical physical characteristics of the decimeter burst sources—their sizes, positions, brightness temperatures, and movements. These results have bearing on both the physical nature of the burst sources and on questions of the possible classification of microwave bursts into distinct types.

71,940 **UNUSUAL DECREASE OF SOLAR RADIO EMISSION ON 56 cm WAVELENGTH DURING FLARE ON MAY 13, 1960**
Tlamicha, A.
***Astronomical Institutes of Czechoslovakia, Bulletin of the*, v. 14, no. 1, p. 24, 1963**

71,941 **OBSERVATIONS OF THE SOLAR EMISSION ON METER WAVELENGTHS DURING THE TOTAL SOLAR ECLIPSE OF FEBRUARY 15, 1961**
Alekseev, Yu. I., Babii, V. I., Vitkevich, V. V., Gorelova, M. V., Sukhovei, A. G.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 504–510, January–February 1963**

The multichannel radio spectrograph of the Crimean Research station has been recently modified and its wavelength range extended to cover a 40- to 150-Mc range which is divided into four subranges. Results of observations of solar radio emission in the 1.5- to 4-m range during the total solar eclipse of February 15, 1961 for the frequencies 70 to 207 Mc, and data on residual intensities, effective radio diameters, and solar intensity on the day of observations are given.

71,942 **CATALOG OF TYPE II (SLOW-DRIFT) AND TYPE IV (CONTINUUM) SOLAR RADIO BURSTS**
Maxwell, A., Hughes, M. P., Thompson, A. R.
***Journal of Geophysical Research*, v. 68, no. 5, pp. 1347–1354, March 1, 1963**

Complete lists are given of solar radio bursts of spectral types II (slow-drift) and IV (continuum) recorded at Fort Davis, Texas, over a five-year period beginning January 1, 1957. These radio bursts are generally accompanied by flares of considerable importance and often precede large-scale geophysical phenomena.

SOLAR SPECTRUM

71,943 **INFLUENCE DES ECARTS A L'EQUILIBRE THERMODYNAMIQUE LOCAL DE L'HYDROGENE SUR LE SPECTRE CONTINU DU SOLEIL ET DES ETOILES (INFLUENCE OF VARIATIONS IN THE LOCAL THERMODYNAMIC EQUILIBRIUM OF HYDROGEN ON THE CONTINUOUS SPECTRA OF THE SUN AND STARS)**
***Journal of Quantitative Spectroscopy and Radiative Transfer*, v. 3, no. 2, pp. 129–132, April–June 1963**
(Paper presented at the Third Colloquium on the Theory of Stellar Atmospheres, England, August 15–16, 1962)

71,944 **FIRST RESULTS OBTAINED WITH THE DOUBLE PASS SOLAR SPECTROGRAPH AT THE JUNGFRAUJOCH, SWITZERLAND**
Delbouille, L., Neven, L., Roland, G.
***Journal of Quantitative Spectroscopy and Radiative Transfer*, v. 3, no. 2, pp. 189–193, April–June 1963**
(Paper presented at the Third Colloquium on the Theory of Stellar Atmospheres, England, August 15–16, 1962)

SPACE SUITS

71,945 **A THERMAL PROTECTION SYSTEM FOR EXTRA-VEHICULAR SPACE SUITS**
Whisenhunt, G. B., Knezek, R. A. (Chance Vought Corp., Dallas, Texas)
American Rocket Society, Inc., New York, N. Y. 2472-62
(Presented at the Lunar Missions Meeting, Cleveland, Ohio, July 17–19, 1962)

A pressure suit system is described that will provide (1) thermal protection for a worker performing tasks outside a space vehicle, and (2) emergency pressurization within the vehicle.

SPACE VEHICLES

71,946 **PROBLEMS IN THE DESIGN OF UNMANNED SPACECRAFT FOR PLANETARY AND INTERPLANETARY EXPLORATION**
Miles, J. R., Sr. (National Aeronautics and Space Administration, Washington, D. C.)
Institute of the Aerospace Sciences, Inc., New York, N. Y. Paper 63-36
(Presented at the IAS 31st Annual Meeting, New York, N. Y., January 21–23, 1963)

Problems are discussed that will be encountered in the design of spacecraft hardware for unmanned planetary and interplanetary missions for gathering scientific information about planets, other deep space bodies, and the interplanetary medium. Topics mentioned include: biological sterilization and its effects upon spacecraft hardware; midcourse maneuvers; capsule ejection; entry, landing, and deployment; power requirements; thermal control; and communications.

71,947 THEORETICAL STABILITY ANALYSIS OF SKID-ROCKER LANDINGS OF SPACE VEHICLES
Fralich, R. W., Kruszewski, E. T.
April 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1625

The governing equations for an arbitrary rigid body sliding on a landing surface are used to derive a stability criterion which relates the critical values of initial velocities to the coefficient of friction, center-of-gravity location, and initial angle of contact. A numerical application of the stability criterion is made for a vehicle used in an experimental investigation.

SPECTRAL ANALYSIS

71,948 INTENSITIES OF WEAK LINES AT THE SOLAR LIMB
Houtgast, J., Koelbloed, D.
***Journal of Quantitative Spectroscopy and Radiative Transfer,* v. 3, no. 2, pp. 173–179, April–June 1963**
(Paper presented at the Third Colloquium on the Theory of Stellar Atmospheres, England, August 15–16, 1962)

A spectral analysis of the intensities of weak lines in the Fraunhofer spectrum of the Sun's limb and in the emission spectrum of the low chromosphere is discussed. The absolute intensities presented are integrated ones, as observed with a slitless spectrograph, and refer to the radiation from a slice of 1-cm width, through photosphere and chromosphere, parallel to the dispersion in the spectrum, extending outward from the level where the Moon's limb is projected, expressed in 10^{14} erg/sec/ster/Å.

71,949 PHASE CURVES AND ALBEDOS OF TERRESTRIAL PLANETS
de Vaucouleurs, G.
June 1961
Geophysics Corp. of America, Bedford, Mass.
GCA TR-61-26-A
ASTIA AD-261,165

This study was undertaken as part of an investigation of navigation within the solar system by optical means. The objective of the investigations was to evaluate the suitability of various physical phenomena as sources of navigational information and to estimate the accuracy of navigational information obtained by various techniques. Ten figures and seven tables are included.

71,950 COMMENT ON EMPIRICAL INFERENCE OF DOPPLER WIDTHS
Thomas, R. N.
***Astrophysical Journal, The,* v. 137, no. 1, pp. 38–40, January 1963**

The region of validity of Athay's suggested method for isolating the effect of a wholly random, microscopic, depth-independent velocity field in strong Fraunhofer lines is investigated. The applicability of this method to several classes of solar lines is presented.

SPECTROSCOPES

71,951 A SPECTROMETER FOR THE MEASUREMENT OF SOLAR RADIATION IN THE REMOTE ULTRAVIOLET
Bruns, A. V., Prokofev, V. K.
Cleaves, H. F., Translator
***Planetary and Space Science,* v. 11, no. 1, pp. 81–86, January 1963**
(Translated from *Iskusstvennye Sputniki Zemli,* no. 11, p. 23, 1961)

The two-channel diffraction spectrometer (installed on *Sputnik 6*) which was used to carry out investigations in the region of the remote ultraviolet radiation of the Sun outside the atmosphere is described. Several illustrations and charts are included.

71,952 A ROCKET-BORNE HELIUM MASS SPECTROMETER
Sauermann, G., Herzog, R.
November 1961
Geophysics Corp. of America, Bedford, Mass.
GCA TR-61-8-N

The special design, construction, and test performance of a prototype rocket-borne mass spectrometer capable of measuring the helium-partial-density profile in the Earth's atmosphere up to satellite heights are described in detail. To check the possibility of detecting the helium in normal air, a feasibility study was first carried out on a workbench test model. The results of these experiments which led to the design of the rocket-borne prototype are given.

STRATOSCOPE 2

71,953 AIMING A 3-TON TELESCOPE HANGING FROM BALLOON
Schlesinger, E. R.
***Electronics,* v. 36, no. 6, pp. 47–51, February 8, 1963**

The guidance command and the telemetry subsystems for the *Stratoscope 2* are described in detail.

SUN

71,954 THE EARLY EVOLUTION OF THE SUN
Ezer, D., Cameron, A. G. W.
Icarus, v. 1, no. 5–6, pp. 422–441, April 1963

Hayashi has predicted that the early contracting Sun should be highly luminous and fully convective if a correct choice of the photospheric boundary condition is made in constructing solar models in the contracting stages. These predictions are investigated. The results presented are preliminary in the sense that isolated solar models have been calculated rather than evolutionary sequences of models. No nuclear energy generation has been included, so that the luminosity derives entirely from the release of gravitational potential energy. An assumption is made regarding the distribution of this energy source. All models are assumed to be in homologous contraction so that the relative structure would not change in an infinitesimal contraction.

71,955 INVESTIGATIONS OF THE SUN'S X-RADIATION —II MEASUREMENTS WITH SPACE SATELLITES
Mandelshtam, S. L., Tindo, I. P., Voronko, Yu. K., Vasilyev, B. N., Shurygin, A. I.
Daisley, R. E., Translator
Planetary and Space Science, v. 11, no. 1, pp. 61–71, January 1963
(Translated from *Iskusstvennye Sputniki Zemli*, no. 11, p. 3, 1961)

The results are reported of measurements of the Sun's X-radiation intensity at wavelengths less than 10 Å on August 19 and 20 and December 1 and 2, 1960 during the flights of the second and third USSR satellites. The purpose of the measurements was to study the intensity of radiation over an extended period. A number of charts, maps, and drawings are included. (Part I of this article was abstracted in *Astronautics Information Abstracts*, v. 7, no. 3, March 1963, Entry #70,929.)

71,956 SOLAR NEUTRINO FLUX
Bahcall, J. N., Fowler, W. A., Iben, I., Jr., Sears, R. L.
Astrophysical Journal, The, v. 137, no. 1, pp. 344–345, January 1963

A detailed calculation of the expected B^8 solar neutrino flux has been made, using recently obtained accurate values for the Be^7 electron-capture cross section and the Be^7 formation cross section.

SUN TRACKING SYSTEMS

71,957 A SOLAR TRACKING HEAD
Vasilev, I. G., Shapov, A. I.
Cornish, J., Translator
Planetary and Space Science, v. 11, no. 1, pp. 93–98, January 1963
(Translated from *Iskusstvennye Sputniki Zemli*, no. 11, p. 87, 1961)

The tracking head described is intended to work in combination with a diffraction spectrometer for measuring solar radiation in the far ultraviolet. The task of this head is to direct the beam of solar rays reflected by a mirror into the slit of the spectrometer when the spectrometer is in various positions. Diagrams and a photograph of the tracking head are included.

SUNSPOTS

71,958 ENERGY TRANSPORT IN A SUNSPOT
de Jager, C.
Journal of Quantitative Spectroscopy and Radiative Transfer, v. 3, no. 2, pp. 181–184, April–June 1963
(Paper presented at the Third Colloquium on the Theory of Stellar Atmospheres, England, August 15–16, 1962)

The process of the inhibition of the convective energy transport which may cause the darkness in sunspots is discussed.

71,959 DIRECT OBSERVATIONAL EVIDENCE FOR A SMALL VALUE OF THE TURBULENCE IN SUNSPOT UMBRAE
Elste, G.
Journal of Quantitative Spectroscopy and Radiative Transfer, v. 3, no. 2, p. 185, April–June 1963
(Paper presented at the Third Colloquium on the Theory of Stellar Atmospheres, England, August 15–16, 1962)

71,960 DIFFICULTIES IN THE EXPLANATION OF THE WINGS OF THE BALMER LINES IN SUNSPOT UMBRAE
Elste, G.
Journal of Quantitative Spectroscopy and Radiative Transfer, v. 3, no. 2, pp. 187–188, April–June 1963
(Paper presented at the Third Colloquium on the Theory of Stellar Atmospheres, England, August 15–16, 1962)

71,961 THE ACTIVATION OF A DARK FILAMENT
Venugopal, V. R., Alvi, H.
Astronomical Society of the Pacific, Publications of the, v. 74, no. 441, pp. 529–532, December 1962

Spectrohelioscopic observation from November 12 to 16, 1957, of the solar disk at Nizamiah Observatory, India, reveals the activation and movement of a quiescent dark filament which originated in the vicinity of a group of sunspots and, having moved across the solar disk, was last observed on the limb as a prominence. A connection between spot groups and the disintegration of filaments is noted.

71,962 THE SUNSPOT AREAS AND THE WOLF NUMBERS. A STUDY OF THE ANALYTICAL RELATIONS GIVEN BY J. XANTHAKIS AND J. MERGENTALER
Xanthakis, J., Banos, G.
1962
Academy of Athens, Research and Computing Center, Greece
Series I (Astronomy) No. 9

New analytical relations between the sunspot areas and the corresponding Wolf numbers have recently been given by J. Xanthakis and J. Mergentaler. A comparative study of these relations is reported, and an effort is made to explain the great differences arising in some years between the ratio resulting from observational data and the relations given by Xanthakis.

TEKTITES

71,963 **RARE-EARTH ELEMENTS IN TEKTITES**
Haskin, L., Gehl, M. A.
***Science*, v. 139, no. 3539, pp. 1056–1058, March 15, 1963**

The rare-earth element content of three tektites has been determined by neutron activation analysis. The relative abundance patterns are all nearly alike and are identical to the pattern characteristic of well-differentiated terrestrial sediments. Possible consequences of finding this pattern in truly extraterrestrial matter are considered.

71,964 **THE MORAVIAN MOLDAVITES AND THEIR BEARING ON THE TEKTITE PROBLEM**
Simon, R.
***Astronomical Institutes of Czechoslovakia, Bulletin of the*, v. 14, no. 1, pp. 24–25, 1963**

TELEMETRY SYSTEMS

71,965 **SATELLITE COMMAND AND TELEMETRY SYSTEM**
Moore, E. P., Maybach, W. J.
***Bell Laboratories Record*, v. 41, no. 4, pp. 156–160, April 1963**

A description is given of the *Telstar* VHF system, including command and telemetry circuits.

TELSTAR PROJECT

71,966 **PROJECT TELSTAR—ITS AIMS AND PURPOSES**
Dickieson, A. C.
***Bell Laboratories Record*, v. 41, no. 4, pp. 116–121, April 1963**

The early history of the *Telstar* project is described, including (1) antenna sites and equipment, (2) frequency band selection, and (3) orbital path limitations.

TELSTAR 2

71,967 **TELSTAR II SATELLITE LAUNCHED**
***Bell Laboratories Record*, v. 41, no. 4, p. 181, April 1963**

Orbital data, operational characteristics, and equipment changes (based on *Telstar 1* data) are considered.

TEMPERATURE CONTROL

71,968 **SIMILITUDE IN THERMAL MODELS OF SPACECRAFT**
Katzoff, S.
April 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1631

Scaling criteria for the design and testing of thermal models of spacecraft are discussed. Four dimensionless similitude parameters are derived concerning radiation, internal heat generation, thermal conductivities of materials, and heat capacities of materials. Difficulties in achieving accurate simulation are pointed out and methods of effecting compromises without seriously affecting the validity of the data are suggested.

THERMOELECTRIC CONVERTERS

71,969 **THERMOELECTRIC GENERATORS AND MATERIALS: RADIATION EFFECTS, RELIABILITY, LIFETIME, AND FAILURE. AN ANNOTATED BIBLIOGRAPHY**
Graziano, E.
January 1962
Lockheed Missiles and Space Co., Sunnyvale, Calif.
SB-61-60
ASTIA AD-273,953

This literature search was conducted as part of research on the problems of using thermoelectric generators which would directly convert heat from nuclear sources into electricity. The purpose of the search was to bring to light any information regarding reliability, lifetime, and mean time of failure of thermoelectric generators and materials due to oxidation, cracking, galvanic action, short circuits, radiation effects, and sublimation.

THRUST VECTOR CONTROL

71,970 **A STUDY OF THRUST VECTOR CONTROL BY LIQUID INJECTION INTO ROCKET NOZZLES**
Sehgal, R., Wu, J. M.
May 1, 1963
Jet Propulsion Laboratory, California Institute of Technology, Pasadena
TM 33-138

Analytical studies are presented of thrust vector control by the injection of a volatile liquid into the expansion cone of a rocket motor. An analytical model is constructed to represent the interaction between the injected liquid and the supersonic stream by considering the mechanism of atomization, the rate of evaporation, and the motion of droplets, based on the injectant and gas properties. The injectant liquid considered has a higher vapor pressure relative to the pressures

THRUST VECTOR CONTROL (Cont'd)

it encounters during the injection process, thus eliminating the phenomenon of flash evaporation. The body shape due to the generated vapor is calculated from basic drag equations. A method for calculating reasonable values of drag coefficient other than Stokes flow is presented.

TIROS PROJECT

71,971 TIROS ACHIEVEMENTS
Rados, R. M.
***Astronautics and Aerospace Engineering*, v. 1, no. 3, pp. 28–29, April 1963**

The record of success of the *Tiros* satellites is summarized. The significance of each component—spacecraft, launch vehicle, data-acquisition facilities and data-utilization areas—is evaluated in terms of the over-all success of the *Tiros* project.

71,972 TIROS OPERATIONS
Powers, E. F.
***Astronautics and Aerospace Engineering*, v. 1, no. 3, pp. 29–31, April 1963**

The Technical Control Center (TCC) at NASA Goddard Space Flight Center exercises operational control for the *Tiros* satellites. TCC is responsible for the monitoring and operational evaluation of both spacecraft performance and Command and Data Acquisition station performance, and for the direction and coordination of the operational phase of the *Tiros* mission. The manner in which these functions are performed is explained briefly.

71,973 TIROS METEOROLOGICAL OPERATIONS
Jones, J. B., Mace, L. M.
***Astronautics and Aerospace Engineering*, v. 1, no. 3, pp. 32–36, April 1963**

The development of the *Tiros* meteorological data-utilization experiment through exploratory, evolutionary, and interim operational phases is discussed. *Tiros* storm surveillance capability from data-sparse regions is described and illustrated.

71,974 TOSS: TIROS OPERATIONAL SATELLITE SYSTEM
Glaser, A. H., Christensen, F. E.
***Astronautics and Aerospace Engineering*, v. 1, no. 3, pp. 38–41, April 1963**

TOSS, an interim system based on existing proved components and techniques using two *Tiros* satellites in orbits in phase opposition, is described as a step toward (1) implementation of the eventual National Operational Meteorological Satellite System (NOMSS), and (2) making possible picture coverage of much of the Earth's surface on a programmed basis each day.

TIROS 3

71,975 A RADIATION VIEW OF HURRICANE ANNA FROM THE TIROS III METEOROLOGICAL SATELLITE
Bandeen, W. R., Conrath, B. J., Nordberg, W., Thompson, H. P.
April 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1713

The *Tiros 3* meteorological satellite (*1961* $\rho 1$), containing two television cameras and a family of electromagnetic radiation experiments, was launched on July 12, 1961. Nine days later, the satellite passed directly over Hurricane Anna, the first hurricane of the 1961 Atlantic season. Data gathered by a five-channel medium resolution radiometer during one pass over the hurricane are presented in the form of maps; and certain implications of the data are discussed. Supporting television pictures are also given. The design and calibration of the medium resolution radiometer are briefly described.

TOPSIDE SOUNDER PROJECT

71,976 PERTURBATION OF THE LOCAL ELECTRON DENSITY BY ALOUETTE SATELLITE
Warren, E.
***Canadian Journal of Physics*, v. 41, no. 1, pp. 188–189, January 1963**

Data obtained during the first two weeks of *Alouette* operation have been examined. Top-side sounder ionograms are presented which give some information concerning the effects produced by a satellite upon its environment.

71,977 TOP-SIDE SPREAD ECHOES
Petrie, L. E.
***Canadian Journal of Physics*, v. 41, no. 1, pp. 194–195, January 1963**

Top-side ionograms from *Alouette,* recorded from September 29 to October 4, 1962, have been examined for spread echoes. The geographic area covered was 25 to 70° N, and 50 to 105° W, between 1030 to 1230 and 2015 to 2215 hr local time.

71,978 PLASMA AND CYCLOTRON SPIKE PHENOMENA OBSERVED IN TOP-SIDE IONOGRAMS
Lockwood, G. E. K.
***Canadian Journal of Physics*, v. 41, no. 1, pp. 190–194, January 1963**

The existence of the plasma that surrounds the satellite transmitter gives rise to certain phenomena—the Z-wave pulse propagation, the plasma spike, and the cyclotron spike—which can be used to calculate the electron density of the medium as well as the magnitude and direction of the Earth's magnetic field at the satellite.

71,979 A PRELIMINARY STUDY OF THE ELECTRON DENSITY AT 1000 KILOMETERS
Hagg, E. L.
***Canadian Journal of Physics*, v. 41, no. 1, pp. 195–199, January 1963**

Top-side ionograms from *Alouette* for September 29 to October 3, 1962 have been analyzed to determine the electron density near the height of the satellite. Ordinary-wave reflections from the ionosphere near the satellite are not observed on the ionograms; consequently, the plasma frequency was obtained from the frequency at which the extraordinary-wave trace approached the satellite height. Gyrofrequencies were calculated from the magnetic field intensities at the surface of the Earth, using the inverse-cube law.

TRACKING SYSTEMS

71,980 GODDARD RANGE AND RANGE RATE SYSTEM DESIGN EVALUATION REPORT
November 23, 1962, Revised
Motorola, Inc., Scottsdale, Ariz.
Report W2719-2-1, Revision 1

Results are reported of the Range and Range Rate System design evaluation performed by Motorola under contract with the NASA Goddard Space Flight Center. A technical discussion of the system's operational configuration is presented along with an analysis of performance based upon that system in order to establish performance limits and an optimum design. A sound analytic basis is established for ensuring that all specified performance characteristics will be realized with a reasonable margin of safety.

TRAJECTORIES

71,981 EFFECT OF LIFT ON SEPARATION DISTANCE AND LOADS FOR AN ABORTING VEHICLE AT MAXIMUM DYNAMIC PRESSURE OF A LUNAR MISSION
Janos, J. J., Unangst, J. R.
April 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1775

This investigation considers some of the effects of using lifting trajectories for abort of a lunar mission during the early part of the launch phase. Particular emphasis is placed on determining the effects of lifting abort trajectories on the possibility of a collision of the launch vehicle and spacecraft if abort is initiated at maximum dynamic pressure of the launch trajectory. Abort trajectories are computed with a range of constant values of lift-drag ratio from −1.0 to 1.0 and thrust levels of 83,450 and 151,300 lb.

71,982 ON THE ACCURACY OF APPROXIMATE THRUST STEERING SCHEDULES IN OPTIMAL CORRECTIONAL MANEUVERS
Moskowitz, S. E.
***Astronautica Acta*, v. 9, no. 1, pp. 20–30, 1963**

For a correctional maneuver, standards of approximation are developed by which the extent of proximity to true or exact values can be ascertained numerically for the dependent variables and the burning time. The degree of relevancy of the linear program as opposed to the more general bilinear program is indicated. A numerical verification is given by examination of a typical example and comparison of the results with the exact solution obtained by numerical integration.

71,983 A METHOD FOR DETERMINING APPROXIMATE INITIAL CONDITIONS FOR INTERPLANETARY TRAJECTORIES
Rowell, L. N.
***Journal of the Astronautical Sciences, The*, v. 10, no. 1, pp. 1–7, Spring 1963**

A method to determine an approximate set of the required cutoff conditions for any interplanetary trajectory is described. The method employs a patched conic technique and requires a repeated solution of the two-body problem. The trajectory considered is assumed to consist of two parts: (1) a geocentric hyperbolic orbit, which starts at the cutoff point and ends at the Earth's sphere of influence; and (2) a heliocentric elliptical orbit, based on massless planets, which ends at the destination planet. Elliptical and noncoplanar planetary orbits are used and planetary perturbations ignored.

TRANSFER ORBITS

71,984 AN ANALYTIC PROOF THAT THE HOHMANN-TYPE TRANSFER IS THE TRUE MINIMUM TWO-IMPULSE TRANSFER
Barrar, R. B.
***Astronautica Acta*, v. 9, no. 1, pp. 1–11, 1963**

71,985 MINIMUM TIME TRANSFER BETWEEN COPLANAR, CIRCULAR ORBITS BY TWO IMPULSES AND THE PROPULSION REQUIREMENTS
Wang, K.
***Astronautica Acta*, v. 9, no. 1, pp. 12–19, 1963**

The problem of minimum time transfer between coplanar circular orbits by two impulses is studied and an approximate solution obtained. A convenient procedure is also presented for the determination of the propulsion requirements for two-impulse rendezvous between satellites in circular orbits.

UPPER ATMOSPHERE

71,986 HYDROXYL EMISSION IN THE UPPER ATMOSPHERE
Krassovsky, V. I.
Massey, H. S. H., Translator
***Planetary and Space Science*, v. 10, pp. 7–17, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

The main factual data which have become available on upper atmospheric emissions since the recent accumulation of observational material in the USSR are surveyed. The mechanisms causing these emissions and their variations are analyzed.

71,987 VIBRATIONALLY EXCITED MOLECULES IN ATMOSPHERIC REACTIONS
Dalgarno, A.
***Planetary and Space Science*, v. 10, pp. 19–28, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

The production in the atmosphere of vibrationally excited molecules in the ground electronic states by collisional processes is discussed, and it is estimated that the corresponding yield of vibrationally excited oxygen, O_2^*, is of the order of 10^{12} cm^{-2} sec^{-1}; of vibrationally excited nitric oxide, NO^*, is of the order of 10^{11} cm^{-2} sec^{-1}; and of vibrationally excited nitrogen, N_2^*, is of the order of 10^{10} cm^{-2} sec^{-1}. It is pointed out that the fundamental vibration bands of NO and possibly of NO^+ should appear in emission with sufficient intensity to be detectable by balloon or rocket observations, especially during periods of auroral activity.

71,988 THE PRODUCTION OF N_2^+ IN THE ATMOSPHERE
Hunten, D. M.
***Planetary and Space Science*, v. 10, pp. 37–45, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

Studies of the emission of the first negative bands of N_2^+ in aurora (normal and sunlit) and twilight are reviewed. Ion densities of 10^3 ions/cm^3 are deduced for sunlit aurora. A very rapid loss process appears to limit the ion density below 150 km, and reactions of charge-transfer or ion-atom interchange are suggested. The normal twilight must therefore occur in the F region, the ions being produced by solar extreme ultraviolet (EUV). It is suggested that this effect may be observable only near sunspot maximum, when the EUV flux is largest and perhaps the N_2 concentration in the F region is unusually large. Quantitative difficulties in accounting for the intensity of the twilight and of high sunlit aurora seem to require this enhanced N_2 concentration when solar activity is high, and especially during large magnetic disturbances. Satellite-drag and ionospheric observations support this idea.

71,989 UPPER ATMOSPHERIC DISTURBANCES DUE TO HIGH ALTITUDE NUCLEAR EXPLOSIONS
Obayashi, T.
***Planetary and Space Science*, v. 10, pp. 47–63, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

The geophysical effects due to high-altitude nuclear explosions are reviewed. The sources of information are mainly from the high-altitude detonations of August–September 1958 in the Pacific and in the South Atlantic. The October 1961 nuclear tests at Novaya Zemlya are also included. Various upper atmospheric phenomena, such as ionospheric and geomagnetic storms, airglows, trapped particles and blast waves are identified as a consequence of nuclear explosions. Disturbance effects are explained, and the significance of controlled experiment in the upper atmosphere is discussed.

71,990 HELIUM IN THE UPPER ATMOSPHERE
Shefov, N. N.
***Planetary and Space Science*, v. 10, pp. 73–77, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

During a study of the problem of upper atmosphere emissions, displays of twilight enhancement of λ 10830 Å helium and λ 8446 Å oxygen were discovered. Recordings of λ 10830 Å were made during the solar eclipse of February 15, 1961, and a twilight enhancement of λ 10830 Å of HeI in the absence of aurora was observed with a spectrograph and a Fabry-Perot étalon. Emission of λ 10830 Å is observed only in the sunlit atmosphere and appears to be due to fluorescence. The excitation of the helium emission, λ 10830 Å, essentially depends on ultraviolet solar radiation with $\lambda < 304$ Å and λ 584 Å. The variations of this radiation are examined.

71,991 TEMPERATURE AND CORPUSCULAR HEATING IN THE AURORAL ZONE
Mulyarchik, T. M., Shcheglov, P. V.
***Planetary and Space Science*, v. 10, pp. 215–218, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

Results of observations of the polar atmosphere temperature are discussed. Several heating mechanisms—ultraviolet radiation of the Sun, corpuscular streams, and hydromagnetic waves—are examined.

71,992 **IMPROVED FORMULAE FOR DETERMINING UPPER ATMOSPHERE DENSITY FROM THE CHANGE IN A SATELLITE'S ORBITAL PERIOD**
King-Hele, D. G.
***Planetary and Space Science,* v. 11, no. 3, pp. 261–268, March 1963**

Improved formulas are derived for determining the air density at a specified height above the perigee of a satellite's orbit from the decrease in orbital period, when due allowance is made for atmospheric rotation and oblateness, and the variation of scale height with altitude. The density is evaluated at a height chosen so that the formulas are insensitive to errors in the value used for scale height H_p at perigee.

71,993 **NOTE ON THE THICKNESS OF THE HELIUM ION LAYER**
Bauer, S. J.
March 1963
National Aeronautics and Space Administration, Washington, D. C.
TN D-1686

On the basis of recent experimental results as well as theoretical considerations of the temperature dependence of the light constituents (hydrogen and helium) in the upper atmosphere, a model of the helium ion belt—the "heliosphere"—is constructed. The thickness of the helium ion layer varies significantly with atmospheric temperature: about 2000 km at 1600°K and only about 200 km at 600°K. Correspondingly charged particle profiles in the topside ionosphere may show a slope corresponding to He^+ at high temperature, but not at low temperatures when the thickness of the helium ion layer is comparable to or less than the scale height of helium ions.

VAN ALLEN RADIATION BELTS

71,994 **INTENSITY OF ELECTRONS IN THE EARTH'S INNER RADIATION ZONE**
Frank, L. A., Van Allen, J. A.
***Journal of Geophysical Research,* v. 68, no. 5, pp. 1203–1207, March 1, 1963**

The intensities of electrons as measured with *Injun 1* during its deepest penetrations into the Earth's inner radiation zone are reported for the period July 16 to August 10, 1961. The basic detector was a collimated Anton-type 213 end-windowed Geiger-Müller tube. The unidirectional intensity of electrons of energy greater than 40 kev was 5×10^6 electrons/cm^2 sec ster in a direction perpendicular to **B** at $L = 1.22$ in the magnetic equatorial plane. The corresponding omnidirectional intensity is estimated to be $1 \times 10^7/cm^2$ sec. No temporal variations greater than the experimental uncertainty of 30 percent were found in this region during the period of observation.

71,995 **ABSOLUTE INTENSITIES OF GEOMAGNETICALLY TRAPPED PARTICLES WITH EXPLORER 14**
Frank, L. A., Van Allen, J. A., Whelpley, W. A., Craven, J. D.
***Journal of Geophysical Research,* v. 68, no. 6, pp. 1573–1579, March 15, 1963**

This is the initial report on a new series of observations on the absolute intensities of geomagnetically trapped protons and electrons in the Earth's outer radiation zone and on the nature of the outer boundary of the magnetosphere. The equipment was carried on *Explorer 14,* which was launched on October 2, 1962 into an eccentric orbit whose apogee was initially at 16.5 Earth radii from the center of the Earth on a line at 71 deg to the line from the center of the Earth to the Sun. Sample omnidirectional intensities of electrons at a geocentric radial distance of 39,000 km and of electrons and protons at a geocentric radial distance of 20,000 km were taken on October 5, 1962. There are large fluctuations from day to day.

71,996 **AURORAL X-RAYS, ELECTRON BOMBARDMENT AND TRAPPED RADIATION**
Kellogg, P. J.
***Planetary and Space Science,* v. 10, pp. 165–178, 1963**
(Paper presented at the International Astronomical Union Symposium No. 18 on Theoretical Interpretation of Upper Atmosphere Emissions, Paris, France, June 25–29, 1962)

Recent measurements of the characteristics of energetic particles incident on the top of the atmosphere and presumably precipitated from the Earth's trapped radiation are discussed. The incident flux varies widely, from 10^8 to 10^{10} particles/cm^2 sec for electrons. Other characteristics of the flux also vary from event to event, independent of the flux and of each other. During the most intense events—those which correspond to aurorae—the lifetime of an electron in the trapping region is only a few seconds. Clearly, violent processes take place during such events—so violent as to destroy the effectiveness of the trap. Several mechanisms are examined, and it is concluded that no one process accounts for all observations.

71,997 **BRIEF NOTE ON THE RADIATION BELTS OF THE EARTH**
Van Allen, J. A. (State University of Iowa, Iowa City)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 1–11, Book 1
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper A-1

A brief graphical summary is presented of one of the aspects of the Earth's radiation belts, namely, the positional dependence of the absolute intensity of several selected components of the trapped particle population.

VAN ALLEN RADIATION BELTS (Cont'd)

71,998 PROTON FLUXES ALONG TRAJECTORIES THROUGH THE INNER VAN ALLEN BELT
Perry, F. C. (The Boeing Co., Seattle, Wash.)
In "Proceedings of the Symposium on the Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., November 5–7, 1962," pp. 725–738, Book 2
Atomic Energy Commission, Division of Technical Information, Washington, D. C.
TID-7652, Paper E-6

A method is formulated to calculate, by means of high-speed digital computing equipment, the total time-integrated proton flux for an arbitrary trajectory through the inner Van Allen belt. To this end, a map of the inner belt proton flux has been prepared in the (B,L) coordinate system, where B is computed from the 48-term spherical harmonic expansion of the Earth's magnetic potential due to Finch and Leaton, and L is the McIlwain parameter. This map is feasible since the high-energy trapped proton component is generally quite stable with respect to geomagnetic activity.

71,999 REVIEW OF STUDIES OF TRAPPED RADIATION WITH SATELLITE-BORNE APPARATUS
O'Brien, B. J.
Space Science Reviews, v. 1, no. 3, pp. 415–484, March 1963

A comprehensive review of studies of trapped radiation in both the Van Allen radiation belts and the artificial radiation belts is given. The aim is to provide for experimentalists a comprehensive set of references and very brief descriptions of experiments concerning radiation zone studies, and to provide for theoreticians a review of some measurements which have been misinterpreted. Parameters involved in studies of the geomagnetically trapped radiation are discussed. An historical outline of studies with a tabulation of relevant experiments from 1957 to 1961 is given. The current experimental knowledge of the radiation zones is presented, and a separate discussion of the artificial radiation belt included. Revised interpretations of data are listed, proceeding chronologically from satellite to satellite. Information from ground-based observations is also included. A few of the requirements for an ideal experimental study of the radiation zones are given. A total of 147 references is included.

VENUS

72,000 ON THE VENUS CUSP EFFECT REPORTED BY BRINTON AND MOORE
Cruikshank, D. P.
Strolling Astronomer, The, v. 17, no. 1–2, pp. 1–2, January–February 1963

Filar micrometer measurements of Venus both in visual light and with color filters indicate that the reported cusp anomaly is due entirely to contrast. The view is also expressed that low magnification and consequent high contrast logically explain many "phenomena" of Venus.

72,001 A NOTE ON PHASE ANOMALIES OF VENUS
Hartmann, W. K.
Strolling Astronomer, The, v. 17, no. 1–2, pp. 2–3, January–February 1963

It is concluded that no real evidence has been given to show that any of the phase anomalies associated with Venus are due to anything more unusual than contrast effects and the rapid decrease in brightness near the terminator.

72,002 VERTICAL DISTRIBUTION OF NEUTRAL GASES ON VENUS
Shimizu, M.
Planetary and Space Science, v. 11, no. 3, pp. 269–273, March 1963

The vertical distribution of neutral CO_2, O_2, CO and O gases on Venus is calculated, photochemical equilibrium being assumed. Kaplan's model of the atmospheric structure is adopted, and the spectral distribution of solar ultraviolet radiations in the wavelengths from 1250 to 1950 Å is described as that of a 5000°K black body, taking into account the superposition of the Fraunhofer lines on the photospheric emission. An investigation of the photo dissociation process in the cytherean upper atmosphere is attempted.

72,003 CARBON DIOXIDE ABSORPTION FOR PATH LENGTHS APPLICABLE TO THE ATMOSPHERE OF VENUS
Plass, G. N., Stull, V. R.
Journal of Geophysical Research, v. 68, no. 5, pp. 1355–1363, March 1, 1963

Calculations of the spectral transmittance of CO_2 from 500 to 9500 cm^{-1} have been extended to pressures of 31 atm and CO_2 amounts of 2.34×10^7 atm cm. From the tables and figures presented, it is possible to obtain the transmittance of the atmosphere of Venus for a wide range of assumed conditions. It is possible that the high surface temperature of Venus can be explained as a CO_2 greenhouse effect if the amount of CO_2 is of the order of 2×10^7 atm cm or the surface pressure is 60 atm. If the amount of CO_2 is 10^6 atm cm and the surface pressure is 20 atm, the addition of 10 g cm^{-2} of H_2O to the atmosphere may be sufficient to explain the surface temperature.

72,004 MARINER REVEALS 800F VENUS TEMPERATURE
Kolcum, E. H.
Aviation Week & Space Technology, v. 78, no. 9, pp. 30–31, March 4, 1963

According to measurements made by the *Mariner* 2 payload, Venus has a uniform surface temperature of 800°F and is surrounded by a dense cloud layer, 17 miles thick, which has a base temperature of 200°F and a top temperature of −65°F.

72,005 **THE ELECTRICAL CHARACTERISTICS OF THE ATMOSPHERE AND SURFACE OF VENUS FROM RADAR OBSERVATIONS**
Muhleman, D. O.
***Icarus*, v. 1, no. 5–6, pp. 401–411, April 1963**

Radar observations of Venus were made at wavelengths of 12.5 and 68 cm during several months surrounding the 1961 inferior conjunction. These observations are quantitatively compared for possible dispersion effects caused by the atmosphere of Venus and the interplanetary medium. The fundamental results of these observations, pertinent to the investigation of the atmosphere and surface electrical characteristics of Venus, are summarized.

72,006 **ON THE RADIUS OF VENUS. II**
Martynov, D. Ya.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 511–517, January–February 1963**

A new determination of Venus' radius has been carried out on the basis of occultations of Regulus by the planet, incorporating hitherto unknown observations. Auwers' value of the radius, $8''.41 \approx 6100 \pm 30$ km, was confirmed. The possibility of a gap in the cloud layer of Venus is discussed, as well as the diurnal variations of the height of the cloud layer.

72,007 **OBSERVATIONS OF RADIO EMISSION FROM VENUS AND JUPITER AT 8 MM WAVELENGTH**
Kuzmin, A. D., Salomonovich, A. E.
***Soviet Astronomy—AJ*, v. 6, no. 4, pp. 518–524, January–February 1963**

Results of observations of radio emission from Venus at 8 mm on the 22-m radio telescope of the Lebedev Physics Institute during the period March through May 1961 are cited. The minimum disk-average brightness temperature near inferior conjunction was determined. Confirmation is forthcoming for the phase dependence of the disk-average brightness temperature. Some 8-mm wavelength observations of radio emission from Jupiter are also reported.

72,008 **RADAR OBSERVATIONS OF THE PLANET VENUS**
Kotelnikov, V. A., Dubrovin, V. M., Kislik, M. D., Korenberg, E. B., Minashin, V. P., Morozov, V. A., Nikit-skii, N. I., Petrov, G. M., Rzhiga, O. N., Shakhovskoi, A. M.
***Soviet Physics—Doklady*, v. 7, no. 8, pp. 728–731, February 1963**

72,009 **A SEARCH FOR WATER VAPOR AND TRACE CONSTITUENTS IN THE VENUS ATMOSPHERE**
Spinrad, H.
October 1, 1962
Jet Propulsion Laboratory, California Institute of Technology, Pasadena
TR 32-256

This article appeared in *Icarus*, v. 1, no. 3, pp. 266–270, October 1962, and was abstracted in the *Astronautics Information Abstracts*, v. 6, no. 6, December 1962. (See Entry #61,879.)

VENUS MISSIONS

72,010 **MANNED VENUS-MARS FLY-BY IN 1970 STUDIED**
Alibrando, A. P.
***Aviation Week & Space Technology*, v. 78, no. 9, p. 56, March 4, 1963**

Interplanetary flights in which three-man spacecraft would fly by both Venus and Mars on missions launched in 1970 or 1972 have been suggested. Trip times would vary from about 460 to about 680 days if launched during opportunities in the 1970–1972 period. Re-entry techniques, spacecraft weights, and life support allotments are discussed.

VENUS TRAJECTORIES

72,011 **EARTH-VENUS TRAJECTORIES, 1964**
Clarke, V. C., Jr., Roth, R. Y., Bollman, W. E., Hamilton, T. W., Pfeiffer, C. G.
March 15, 1963
Jet Propulsion Laboratory, California Institute of Technology, Pasadena
TM 33-99, Volume 1C

This volume is one of five giving key characteristics of Earth-to-Venus trajectories during the period 1964–1970. See *Astronautics Information Abstracts,* v. 7, no. 3, March 1963, Entry #70,927, for abstract.

72,012 **EARTH-VENUS TRAJECTORIES, 1965–66**
Clarke, V. C., Jr., Roth, R. Y., Bollman, W. E., Hamilton, T. W., Pfeiffer, C. G.
April 15, 1963
Jet Propulsion Laboratory, California Institute of Technology, Pasadena
TM 33-99, Volume 2A

See *Astronautics Information Abstracts,* v. 7, no. 3, March 1963, Entry #70,927.

WEIGHTLESSNESS

72,013 **GLI EFFETTI DELLA SUBGRAVITA' E I METODI PER RIPRODURLA A TERRA E IN VOLO (SUBGRAVITY EFFECTS AND SIMULATION METHODS IN LABORATORY SITUATIONS AND IN FLIGHT)**
Meineri, G.
***Rivista di Medicina Aeronautica e Spaziale*, v. 26, no. 1, pp. 80–98, January–March 1963**

WHISTLERS

72,014 WHISTLER EVIDENCE OF A "KNEE" IN THE MAGNETOSPHERIC IONIZATION DENSITY PROFILE
Carpenter, D. L.
***Journal of Geophysical Research*, v. 68, no. 6, pp. 1675–1682, March 15, 1963**

Study of a new whistler phenomenon shows that the magnetospheric ionization profile often exhibits a "knee", i.e., a region at several Earth radii in which the ionization density drops rapidly from a relatively normal level to a substantially depressed one. The new whistler phenomenon (called the "knee whistler") is compared with ordinary whistlers and is illustrated by a number of examples recorded at middle- and high-latitude stations. It is suggested that the knee exists at all times in the magnetosphere, and that its position varies, moving inward with increasing magnetic activity. There are indications that conditions of whistler-mode propagation may be unusually favorable on the low-latitude side of the knee, and that the region on the high-latitude side may be favorable for the production of triggered ionospheric noise. It is pointed out that the knee whistlers account for a substantial number of the observations of deep density depressions during magnetic storms. Several questions of interpretation are raised, and future investigation is indicated.

X-RAYS

72,015 INTERPRETATION OF X-RAY PHOTOGRAPH OF THE SUN
Blake, R. L., Chubb, T. A., Friedman, H., Unzicker, A. E.
***Astrophysical Journal, The*, v. 137, no. 1, pp. 3–15, January 1963**

An X-ray picture of the Sun was obtained on April 19, 1960, using a pinhole-camera flown in an *Aerobee-Hi* rocket. Photometric analysis of the picture has shown that at least 75 percent of the X-radiation passed by the pinhole window material emanated from condensations in the lower corona localized above CaK plages. The solar X-ray flux at the Earth was estimated. A detailed quantitative evaluation of the intensities and geometries of localized X-ray sources and their relationship to plage formations is given. A second set of exposures was obtained in several different wavelength bands, up to 90 Å, from a rocket flight on June 21, 1961.

AUTHOR INDEX*

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Source	Report No.	Entry	Source	Report No.	Entry
American Rocket Society, Inc. (Cont'd)	2480-62	71,801	American Rocket Society, Inc. (Cont'd)	2561-62	70,411
	2481-62	71,796		2562-62	70,390
	2485-62	71,728		2563-62	70,412
	2487-62	71,820		2565-62	70,413
	2490-62	71,816		2566-62	70,272
	2491-62	71,793		2567-62	70,273
	2497-62	70,281		2568-62	70,274
	2498-62	70,005		2569-62	70,560
	2501-62	70,288		2570-62	70,315
	2502-62	70,302		2571-62	70,316
	2503-62	70,309		2572-62	70,317
	2504-62	70,547		2573-62	70,319
	2505-62	70,163		2574	70,561
	2507-62	70,498		2575-62	70,580
	2508-62	70,499		2577-62	70,477
	2509-62	70,500		2578A-62	70,225
	2510-62	70,352		2586-62, Part II	70,507
	2511-62	70,501		2598-62	70,354
	2513-62	70,054		2602-62	70,403
	2514-62	70,337		2603-62	70,484
	2515-62	70,055		2604-62	70,368
	2516-62	70,204		2606-62	70,454
	2517-62	70,310		2609-62	70,520
	2519-62	70,205		2610-62	70,485
	2520-62	70,206		2614-62	70,600
	2521-62	70,182		2617-62	70,377
	2522-62	70,183		2618-62	70,587
	2523-62	70,145		2619-62	70,584
	2524-62	70,502		2620-62	70,517
	2525-62	70,207		2622-62	70,404
	2526-62	70,208		2623-62	70,369
	2527-62	70,184		2624-62	70,486
	2528-62	70,276		2625-62	70,370
	2529-62	70,277		2626-62	70,487
	2531-62	70,278		2627-62	70,589
	2532-62	70,244		2628-62	70,594
	2533-62	70,279		2629-62	70,488
	2534-62	70,280		2630-62	70,597
	2535-62	70,221		2632-62	70,458
	2536-62	70,548		2633-62	70,496
	2537-62	70,185		2636-62	70,399
	2538-62	70,033		2638-62	70,347
	2541-62	70,209		2644-62	70,451
	2542-62	70,186		2645-62	70,400
	2543-62	70,222		2647-62	70,356
	2545-62	70,223		2649-62	70,393
	2546-62	70,224		2649-62	70,393
	2547-62	70,107		2654-62	70,394
	2548-62	70,108		2659-62	70,467
	2550-62	70,313		2661-62	70,814
	2551-62	70,062		2663-62	70,721
	2552-62	70,343		2664-62	70,722
	2554-62	70,314		2666-62	70,720
	2555-62	70,804		2674-62	70,815
	2556-62	70,210		2678-62	70,903
	2558 62	70,149		2679-62	70,851
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