PLANETARY ATMOSPHERES

A CONTINUING BIBLIOGRAPHY

NASA SP-7017

PLANETARY ATMOSPHERES

A CONTINUING BIBLIOGRAPHY

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA Information System during the period January, 1962–February, 1965.

Scientific and Technical Information Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. JUNE 1965

INTRODUCTION

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Each entry in the bibliography consists of a citation and abstract. The listing of entries is arranged in two major groups. All report literature references appear in the first group and are subdivided according to their date of announcement in *TPA* or *STAR*. The second group contains published literature references subdivided according to their date of announcement in *IAA*. All reports and articles cited were introduced into the NASA Information System during the period January, 1962–February, 1965. Supplements to this bibliography will be issued if user response is sufficient and future references accumulate to an acceptable level.

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TPA ENTRIES

N62-10031 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE PROBLEM OF NITROGEN PEROXIDE IN THE ATMOSPHERES OF PLANETS.
Su-Shu Huang. Jan. 1962, 8 p. 6 refs. (NASA TN D-1125) OTS, $0.50

It has been theorized that the atmospheres of Jupiter, Venus, and Mars contain nitrogen peroxide, a mixture of NO_2 and N_2O_4. It would seem that if the mixture does exist in these atmospheres, it could continue to exist there; but it is not known how the nitrogen peroxide came to be there. There would appear to be two possible explanations: a thermal process in the early history of the planet or a special activation mechanism operating under present conditions. But there are arguments against both of these explanations. At the present time, therefore, the field is completely open to discussion and doubt.

N62-10045 Armour Research Foundation, Chicago.
LIFE IN EXTRATERRESTRIAL ENVIRONMENTS.
Kenneth B. Basa and Ervin J. Hawrylewicz. Feb. 1962, 29 p. 63 refs. (Report ARF 3194-4) (ARF Project C 194; NASA Contract NASr-22)

Martian environment was simulated to study the survival of terrestrial life. Types of organisms tested were: Bacteria, Algae, Lichen and Bryophytes. **Clostridium tetani** and **Escherichia coli** decreased rapidly in number, but tetanus toxin remained active during the 127-day experiment; **Bacillus subtilis** increased in number; **Trebouxia erici** survived for two weeks; Lichen survival results were incomplete. Of the Bryophytes tested, only one unidentified moss survived. Color changes on Martian surface are explained partially by color changes in surface vegetation resulting from moisture content.

N62-10119 Yerkes Observatory, Williams Bay, Wis.
UPPER ATMOSPHERES OF THE PLANETS.
Joseph W. Chamberlain. [1961] 27 [4] p. 24 refs. (NASA Grant NsG 118-61) To be published in Astrophys. J. Available from OTS: ph $3.60, mi $1.13.

Knowledge of the earth's upper atmosphere is obtained by experiment or remote observations that permit fairly direct interpretation. For the other planets, including Mars, indirect and theoretical procedures are necessary to construct models of their atmospheres. Deductive models can be obtained by applying basic physical processes that govern the structure of a planetary high atmosphere even when only the chemical composition and temperature of the lower atmosphere and the incident solar flux are specified. A comparison of the earth's atmosphere with Mars is obtained by deriving theoretically a model of the Martian atmosphere. This comparison shows that CO in the upper atmosphere of Mars serves as a thermostat and keeps the temperature at the escape level (1500 km) from exceeding 1100°K. This is cool enough for Mars to retain atomic oxygen. The mesopause is determined by CO_2 radiation. Near the mesopause CO_2 becomes dissociated and the free O atoms form a thin layer of O_2; this effect has no analogy on earth. The ionosphere has considerably smaller densities of ionization than comparable regions in the earth's atmosphere. The E region is split into two distinct portions, with X-rays forming the higher one (E_2) and ultraviolet light ionizing O_2 near the mesopause (E_1). There is no Martian analog to the terrestrial F_2 region, and the entire ionosphere is depleted at night.

N62-10156 Space Sciences Lab., U. of Calif., Berkeley.
BIOCHEMICAL ACTIVITIES OF TERRESTRIAL MICROORGANISMS IN SIMULATED PLANETARY ENVIRONMENTS.
Project # 109 Report, Ser. 3, Issue 1.
1961. [44]p. refs. (NASA Grant NsG 126-61) Available from OTS: ph $4.60, mi $ 1.52.
CONTENTS:

THE EXPERIMENTAL MICROBIOLOGY PROGRAM. Stanley Scher. 2 p.

EVIDENCE FOR CYTOPLASMIC DNA IN *EUGLENA GRACILIS*. Lynn Sagan and Stanely Scher. 2 p. Presented at the meeting of the Soc. of Protozoology, Denver, Colo., Dec. 1961.

INTERSTELLAR PANSPERMIA. Carl Sagan. 6 p. Presented at the Symposium on Extraterrestrial Biochemistry and Biology, American Association for the Advancement of Science, Denver, Colo., Dec. 1961.

STRUCTURE OF THE LOWER ATMOSPHERE OF VENUS. Carl Sagan. 6 p. To be published in Icarus.

MICROWAVE RADIATIVE TRANSFER IN THE ATMOSPHERE AND CLOUDS OF VENUS. Carl Sagan and Lawrence Giver. 16 p. 27 refs. Abbreviated version presented at the Symposium on Radio Emission and Thermal Structure of the Venus Atmosphere, American Geophysical Union, UCLA, Dec. 27, 1961.

N62-10330 Wisconsin U., Madison.
STUDIES OF THE THREE-DIMENSIONAL STRUCTURE OF THE PLANETARY BOUNDARY LAYER.
[First] Annual Report [Covering Period 1 July 1959 through 30 June 1961.]
Heinz H. Lettau, *et al.* Aug. 1961. viii, 170p. refs. Supported by U.S. Army Electronic Proving Ground, Ft. Huachuca, Ariz. (USAEPG Technical Program DS Project 3A99-27-005; Contract DA-36-039-SC-80282)

1. GENERAL INTRODUCTION. Heinz H. Lettau. p.1-3. 2. EXPERIMENTAL INVESTIGATION OF THE THERMAL RESPONSE OF THE AIR-SOIL SYSTEM TO CONTROLLED RADIATION PULSES. James H. Lienesch. p.5-26. 3. DERIVATION OF ROUGHNESS PARAMETERS FROM WIND PROFILE DATA ABOVE TALL VEGETATION. Ernest Kung. p. 27-35. 4. AERODYNAMIC DRAG IN TALL VEGETATION. Robert H. Burgy. p.37-43. 5. REGIONAL AND MERIDIONAL DISTRIBUTIONS OF CONTINENTAL VEGETATION COVER AND AERODYNAMIC ROUGHNESS PARAMETERS. Ernest C. Kung and Heinz H. Lettau. p.45-61. 6. A METHOD FOR MACHINE COMPUTATION OF WIND PROFILE PARAMETERS. Stephen M. Robinson. p.63-70. 7. INVESTIGATIONS OF THE MODIFICATION OF WIND PROFILES BY ARTIFICIALLY CONTROLLED SURFACE ROUGHNESS. John E. Kutzbach. p.71-113. 8. A GENERALIZED MATHEMATICAL MODEL OF THE MEAN-VELOCITY DISTRIBUTION IN FULLY TURBULENT DUCT FLOW. Heinz H. Lettau. p.115-142. 9. THEORETICAL WIND SPIRALS IN THE BOUNDARY LAYER OF A BAROTROPIC ATMOSPHERE. Heinz H. Lettau. p.143-170.

N62-10404 Rand Corp., Santa Monica, Calif.
STUDIES OF THE PHYSICAL PROPERTIES OF THE MOON AND PLANETS.
Quarterly Technical Progress Report (6).
Comp. by M. H. Davis. Dec. 1961. 12 p.
(RM-3022-JPL) (Contract N-33561 (NASw-6)

Company research is proceeding in the following fields: (1) *Light scattering and radiative transfer.* The Chandrasekhar X and Y functions are being computed for optical thicknesses greater than unity in order to provide results for dense or extensive atmospheres; a mathematical investigation of the radiative-transfer problem has shown that certain properties which had formerly been assumed for the X and Y functions do not, in fact, hold. Elsasser-band models have been found that fit laboratory measurements of the infrared-absorption spectrum of carbon dioxide to within about 10 percent. (2) *Planetary atmospheres.* A paper has been completed which summarizes variations of pressure, temperature, and density with altitude for the Martian atmosphere; also, theoretical analysis of the seasonal atmospheric circulation of Mars has been completed. (3) *Planetary experiments.* An entirely different concept is being considered for moving the exploring instruments about the surface of the planets in unmanned planetary explorations: it is believed that a balloon could be used for measurements of planetary atmospheres or for transporting suitable instruments from the landing point to other areas. (4) *Lunar and planetary geology and magnetism.* Papers completed and in progress discuss the optical ellipticity and internal structure of Mars, the age of the Earth-Moon system, and the magnetic fields of Mars and Venus. A harmonic analysis of lunar typography is under way.

N62-10421 Space Science Board, National Academy of Sciences, Washington, D.C.
THE ATMOSPHERES OF MARS AND VENUS.
A report by the Ad Hoc Panel of Planetary Atmospheres.
William Kellogg (Rand Corp.) and Carl Sagan (Calif. U.). 1961. vi, 151 p. refs.
(NAS NRC-944) (The work of Drs. Kellogg and Sagan was supported by a NASA grant.)
Available from the National Academy of Sciences/ National Research Council, Washington 25, D.C., at $5.00 a copy.
APPENDIXES: 1. DIRECT PHOTOGRAPHY IN THE EXPLORATION OF PLANETARY ATMOSPHERES. A.G. Wilson (Rand Corp.). p. 61-71. 2. VISUAL AND PHOTOGRAPHIC OBSERVATIONS OF VENUS AND MARS. Clyde W. Tombaugh (N. Mex. State U.). p. 72-75. 3. RADIO FREQUENCY RADIOMETRY OF THE PLANETS. Bernard K. Burke (Carnegie Institution of Wash., D. C.). p. 76-79. 4. POTENTIALITIES OF RADAR FOR THE STUDY OF PLANETARY ATMOSPHERES. Van R. Eshleman (Stanford U.). p. 80-84. 5. OBSERVATIONS WITH SATELLITE-SUBSTITUTE VEHICLES. John Strong (Johns Hopkins U.). p. 85-99. 7 refs. 6. SPACECRAFT EXPERIMENTS ON PLANETARY ATMOSPHERES. Richard W. Davies, A. R. Hibbs, Gary Neugebauer, and Ray L. Newburn (Jet Propulsion Lab.). p. 100-104. 7. INTERPRETATION OF PLANETARY PROBE MEASUREMENTS. Lewis D. Kaplan (Mass. Inst. of Tech.). p. 105-106. 5 refs. 8. THE GENERAL CIRCULATION OF PLANETARY ATMOSPHERES. Yale Mintz (U. of Calif.). p. 107-146. 18 refs. 9. THE INTERPRETATION OF ULTRAVIOLET SPECTRA OF PLANETARY ATMOSPHERES AND THE NEAR-INFRARED CO2 BANDS OF VENUS. Joseph W. Chamberlain (Yerkes Obs.). p. 147-151. 6 refs. (NASA Grant NsG 118-61).

N62-10641 Laboratory of Astrophysics and Physical Meteorology, Johns Hopkins U., Baltimore.
ASTRONOMICAL OBSERVATIONS USING THE ONR STRATO-LAB.
John Strong and Associates. 1961. 102 p. refs.
(Contract Nonr 248 (52); NSF Grants G-4880 and G-9262)

To make astronomical observations, high altitude balloons are used to carry observing instruments above the curtaining infrared absorption of the earth's atmosphere. At high altitudes, infrared absorption of the earth's atmosphere is almost completely eliminated. The telescopes used in the high altitude balloons are free of interference from water vapor, carbon dioxide and oxygen from the earth's atmosphere. Venus and Mars were studied to ascertain the composition of their atmospheres. A photomultiplier detected the water vapor present in Mars' atmosphere. The balloon's gondola-contained spectrometer was used to study Venus' atmosphere. The presence of water vapor in the atmosphere of Venus was detected but the amount present is uncertain due to lack of knowledge of the pressure of the reflecting cloud layer in Venus' atmosphere. (Author Abstract)

N62-10675 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OBJECTIVES OF THE MARINER VENUS MICROWAVE RADIOMETER EXPERIMENT.
A. H. Barrett (Mass. Inst. of Tech.), J. Copeland (Army Rocket and Guided Missile Agency), D. E. Jones (JPL), and A. E. Lilley (Harvard U.) Aug. 22, 1961. vii, 27 p. 32 refs.
(JPL-TR-32-156) (NASA Contract NASw-6)

At present, there are several models involving the surface, atmosphere (and ionosphere), and cloud conditions of the planet Venus which attempt to account for the observed high brightness temperature of 600° K in the microwave temperature region. None of these models can be definitely accepted or rejected on the basis of presently available data, and it is the goal of the microwave radiometer experiment planned for the *Mariner* Venus mission to determine which of the proposed models most nearly approximates Venusian conditions. The disc of the planet will be scanned at 4 wavelengths—4, 8, 13.5 and 19 mm—to measure the temperature distribution across the planet. Measurement accuracy is expected to be to within 2%. In addition to the study of gross thermal characteristics of surface and atmosphere (or ionosphere), some information regarding the fine-scale thermal variations will be obtained. (Author Abstract)

N62-10772 Institute of Aerophysics, U. of Toronto
THE ENTRY OF MANNED MANOEUVREABLE SPACECRAFT INTO PLANETARY ATMOSPHERES.
B. Etkin. Oct. 1961 13[20] p. (UTIA-Rev.-20; AFOSR-1963)
(UTIA-Rev.-20; AFOSR-1963) (Contract No. AF 49(638)-761)
Written version of lecture given by author at Symposium on Interplanetary Explorations, U. of Toronto, Oct. 26—27, 1961.
(Author Abstract)

N62-11279 Maryland U., College Park
THE ATMOSPHERE AND HAZE OF MARS.
E. J. Öpik (Armagh Observatory). [1962?] 15 p. 17 refs.
(NASA Grant NsG 58-60)
OTS: ph $1.60, mi $0.80.

The optical properties of the Martian atmosphere and some aspects of its chemical composition are analyzed. The low reflecting power of the Martian atmosphere and its complete opacity in the shorter wavelengths lead to the optical interpretation of extinction by true absorption with little scattering. The "blue haze" is considered to be a general absorbing veil of smoke, dark in reflection and red in transmission, whose coefficient of transmission decreases with decreasing wavelength. The transmission is critical in the blue wavelength, where small fluctuations in the relative opacity may cause large variations in the marginal visibility of Martian surface detail. The "limb darkening" of Mars is also considered to be the result of absorption by the smoke. The blackout in the blue-violet appears as the result of a general continuous trend affecting the whole spectrum and not as an isolated phenomenon of "blue haze". The blue clearing is explained by the variation of the overall concentration of the absorbing particles due to surface winds or particle settling.

Dollfus' polarimetric estimate, corrected for self-absorption, corresponds to a Martian atmospheric pressure of 87 mm Hg. The photochemical breakup of CO_2 and the escape of O_2 must lead to considerable concentrations of carbon monoxide in the Martian atmosphere. Carbon dioxide must be replenished from volcanic sources. (M.P.G.)

N62-11284 Rand Corp., Santa Monica, Calif.
STUDIES OF THE PHYSICAL PROPERTIES OF THE MOON AND PLANETS.
Quarterly Technical Progress Report (3).
Comp. and ed. by M. H. Davis. Apr. 28, 1961. 97 p. refs.
(RM-2769-JPL) (JPL Contract N-33561 (NASw-6))
OTS: ph $8.60, mi $3.11.

The following basic studies are included in a summary reporting research conducted on the properties of the moon and planets: (1) Some of the methods of modern abstract operator theory have been applied (Mullikin) to the theory of radiation transfer, and important simplifications have been made in the theoretical development. (2) Discrepancies between optical and dynamical analyses of the shapes of the earth, moon and Mars may be accounted for by a theory proposing that phase changes in the minerals of the rock mantle cause density variations which possibly contribute to gravitational fields of the planets while permitting isostatic equilibrium. (3) Owing to the greater resolution of radiation measurements from planetary probes, infrared measurements from the Mars capsule should make it possible to determine whether the Sinton bands are due to gaseous absorption or to the surface's reflective properties. The CO_2 concentration in the Venus atmosphere can be determined with precision from measurements of scattered solar radiation in the ultraviolet. (4) Preliminary estimates of air densities in the earth's exosphere have been based on the orbit of Echo I. A new method of analysis is presented which includes the effects of radiation pressure. (5) In evaluating the future role of surface, balloon, and satellite observatories, and planetary probes, it is shown that much would be gained by an intensive coordinated program of observation from ground observatories, from platforms outside earth's atmosphere, and from probe vehicles. (6) Strong evidence is presented (Kaplan) against a recently published interpretation (Kiess, Karrer, and Kiess) that certain spectra indicate the presence of nitrogen oxides in the Mars atmosphere. It is shown in contradiction to this interpretation that no more than trace amounts of nitrogen peroxide can exist on Mars or Venus. (7) A method has been suggested by which the mean molecular weight of the gases in the Mars atmosphere might be determined from measurements of pressure and velocity made on the Mariner B capsule during its free-fall descent. It has been speculated that the Mars atmosphere may be like the atmosphere of Earth above the 10-km level. Also, on the basis of a thorough analysis, it has been concluded that the mean temperature of the air near the Mars surface is somewhat lower than had been generally suspected, being about −25°C day and night at 1 km above the Mars equatorial surface. (8) The published values of the surface gravity on Mars are discussed, and words of caution are given on how they should be used. (9) Despite the consistency of investigation results on the surface pressure of Mars, the likelihood of systematic errors could lead to a 50 percent error in reported values. (V.D.S.)

N62-11286 Rand Corp., Santa Monica, Calif.
STUDIES OF THE PHYSICAL PROPERTIES OF THE MOON AND PLANETS.
Quarterly Technical Progress Report No. 5, July 1-Sept. 30, 1961.
Comp. and ed. by M. H. Davis and S. M. Greenfield. Sept. 1961. 56 p. 14 refs.
(Memo. RM-2900-JPL) (JPL Contract N-33561; NASA Contract NASw-6)
OTS: ph $5.60, mi $2.00.

Basic research studies on the properties of the moon and the planets deal with: (1) possibility of the Martian blue haze being produced by solar protons; (2) radiative temperature distribution in a planetary atmosphere; (3) study of planetary atmospheres by stellar occultations; (4) general circulation of planetary atmospheres, (5) use of a parachute in the Mars atmosphere; (6) age of the earth-moon systems; and (7) optical ellipticity and internal structure of Mars. (J.R.C.)

N62-11298 Yerkes Observatory, Williams Bay, Wis.
FLUORESCENT SCATTERING IN PLANETARY ATMOSPHERES. I. BASIC THEORETICAL CONSIDERATIONS.
Joseph W. Chamberlain and Yousef Sobouti. [1962] 31 [3] p. 11 refs.
(NASA Grant NsG 118-61)
OTS: ph $3.60, mi $1.28.
To be published in Astrophys. J. See N62-11299 05-28 for Part II: Coupling Among Transitions.

Resonance scattering, fluorescence, and pure absorption are considered as mechanisms governing the daytime ultraviolet spectrum of a planet observed from above. It is assumed throughout that continuous absorption prevents any sunlight from being reflected by the ground (or cloud surface) and that the scattered continuum is weak compared with scattering in spectral lines. These considerations are appropriate to the ultraviolet, when ozone (or some other substance) is strongly absorbing in the high atmosphere. Such a spectrum is qualitatively different from a reflected Fraunhofer spectrum; this scattered light constitutes a daytime airglow of emission lines. To aid interpretation of such spectra, in terms of atomic and molecular relative abundances, several alternative models of line formation are investigated. (Author Abstract)

N62-11299 Yerkes Observatory, Williams Bay, Wis.
FLUORESCENT SCATTERING IN PLANETARY ATMOSPHERES. II. COUPLING AMONG TRANSITIONS.
Yousef Sobouti. 1962. 42 [3] p. 8 refs.
(NASA Grant NsG 118-61)
OTS: ph $4.60, mi $1.61.
To be published in Astrophys. J. See N62-11298 05-28 for Part I: Basic Theoretical Considerations.

The ground energy level of an atmospheric constituent absorbs the solar radiation in those frequencies which arise from this level. Reemission may take place to the original level (resonant transition) or some other levels (fluorescent transitions). When more than one lower level is populated, an upper level may become populated through any one of several absorption transitions. Scattered radiation in one line

may be absorbed again and then reemitted in another line. The radiative-transfer equation for each line must therefore involve all transitions capable of populating the same upper level; the intensities of different emissions having a common upper level will be "coupled" to one another.

The coupled transfer equations appropriate to a planetary atmosphere are developed and solved for diffusely reflected and transmitted radiations. In both optically finite and semi-infinite atmospheres, the zeroth and first iterates of the integral equations have been obtained in terms of Chandrasekhar's X-, Y-, and H-functions. These iterates are sufficient for analytic solutions in the case of nearly symmetric coupling between every pair of transitions. The problem of coupling is treated when continuous absorption exists across the line profiles. The principle of reciprocity is extended to the problem of coupled fluorescent scattering. (Author Abstract)

N62-11301 Yerkes Observatory, Williams Bay, Wis.
THE INTERPRETATION OF ULTRAVIOLET SPECTRA OF PLANETARY ATMOSPHERES AND THE NEAR-INFRARED CO_2 BANDS OF VENUS.
Joseph W. Chamberlain. [1961?]
(NASA Grant NsG 118-61).
OTS: ph $1.60, mi $0.80.

Since the ultraviolet spectra of the atmospheres of the various planets, including the Earth, will probably soon be obtained from outside those planetary atmospheres, an attempt is made to summarize the interpretational problems that will almost certainly arise in the ultraviolet. To illustrate these problems, an analogy is drawn to the near-infrared CO_2 absorption bands of Venus which are evidently formed in an optically thick scattering atmosphere as is the planetary atmosphere in some of the emissions observed. The optically thick scattering atmosphere imposes the necessity of having good angular resolution, i.e., spectra taken over different parts of the planetary disk for a proper interpretation of spectra in the ultraviolet. When an atmosphere is optically thin, or if negligible secondary scattering occurs, it is possible to derive absolute abundances, but in the cases where multiple scattering is important, only relative abundances can be obtained. The only way of determining whether the Venus problem involves multiple scattering, with CO_2 mixed with the scattering substance, or whether it involves a CO_2 atmosphere lying above a sharp cloud deck, depends on measurements as a function of phase angle or on measurements over the surface of the disk with high angular resolution. To determine the absolute abundance of the CO_2 it is necessary to have some idea of the scattering coefficient and distribution with height of the particles producing the continuous opacity. Without sufficient information to be able to derive the ratio of the desired abundances, a model most appropriate for the particular atmosphere cannot be ascertained. (J.R.C.)

N62-11353 Space Sciences Lab., General Electric Co., Philadelphia
AN ANNOTATED BIBLIOGRAPHY OF ARTICLES ON THE ATMOSPHERES OF VENUS AND MARS.
L. Hobbs. Nov. 1961. 57 p. 103 refs.
(R61SD175) (Contract AF 04(647)-476)

N62-11375 Maryland U., College Park
THE AEOLOSPHERE AND ATMOSPHERE OF VENUS.
E(rnst) J. Öpik. [1961] 30 p. 28 refs.
(NASA Grant NsG-58-60)
Presented at the Forty-Second Annual Meeting, Sessions on Planetary Science, American Geophysical Union, Wash., D.C., April 18-21, 1961.
OTS: ph $2.60, mi $1.10.

A self-consistent model of the Venus atmosphere which satisfies the multitude of existing observational data is proposed. Its main properties and the line of reasoning are described as follows.

The radiative greenhouse effect cannot account for a surface temperature of 570° K. The blanketing must be due to dust and the main source of energy wind friction at the surface.

The term "aeolosphere" is proposed for the region between the surface and the clouds of Venus, where wind is responsible for grinding and raising the dust, as well as for the heating. Self-consistency requires the opacity to be so high as to impose an adiabatic vertical lapse rate. The potential temperature in the aeolosphere must be nearly constant. Horizontal pressure gradients driving the wind are caused by climatic differences near the top of the dust clouds. The dust may consist of calcium and magnesium carbonates with impurities. Pressure estimates from CO_2 bands and optical scattering point to the presence of two distinct reflecting layers, the visible cloud level at about 0.6 atm. and 340° K and an upper haze level at 0.08 atm. and 234° K. In the visual and near infrared the upper haze is virtually transparent, owing to forward scattering. In the ultraviolet, and in the infrared beyond 1.4 micron it is opaque.

Vertical cross sections of the Venus atmosphere are constructed for 80, 40, and 20 percent CO_2. For 80 per cent CO_2 the results are somewhat more consistent, yielding a pressure of 4.3 atm. at 570° K at the surface, 22 km below the visible cloud level.

Despite uncertainties in the H_2O content, its amount is so small as to be nowhere condensable. (Author Abstract)

N62-11446 Yerkes Observatory, Williams Bay, Wis.
THE INTERPRETATION OF ULTRAVIOLET SPECTRA OF PLANETARY ATMOSPHERES AND THE NEAR-INFRARED CO_2 BANDS OF VENUS.
Joseph W. Chamberlain. Repr. from the Atmospheres of Mars and Venus. Washington, National Academy of Sciences—National Research Council, 1961. Appendix 9, p. 147-151. (see N62-10421 02-28) 6 refs.
(Research Paper No. 3) (NASA Grant NsG-118-61)
For abstract see N62-11301 05-28.

N62-11460 Air Force Cambridge Research Labs., Geophysics Research Directorate, Bedford, Mass.
SPACE AND PLANETARY ENVIRONMENTS.
Shea L. Valley, ed. Jan. 1962. 220 p. 288 refs.
(Air Force Surveys in Geophysics-139; AFCRL-62-270)
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1. INTERPLANETARY GAS AND MAGNETIC FIELDS. Marvin L. White and A. A. Wyller. Aug. 1961. p. 1-13. 32 refs.
2. THE TERRESTRIAL MAGNETIC FIELD. Paul Fougere. June 1961. p. 15-31. 30 refs.
3. THE EXTERNAL TERRESTRIAL GRAVITY FIELD. Bela Szabo. June 1961. p. 33-39. 29 refs.
4. CORPUSCULAR RADIATION IN THE VICINITY OF EARTH. Shea L. Valley. Oct. 1961. p. 41-62. 22 refs.
5. SOLAR ELECTROMAGNETIC RADIATION. H. E. Hinteregger. June 1961. p. 63-90. 10 refs.
6. THE LUNAR ENVIRONMENT. John W. Salisbury. July 1961. p. 91-126. 62 refs.
7. PLANETARY ENVIRONMENTS. John W. Salisbury. July 1961. p. 127-161. 40 refs.
8. SPACE ENVIRONMENT OF THE SOLAR SYSTEM. Gordon W. Wares. Nov. 1961. p. 163-220. 63 refs.

N62-11496 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
OBSERVATIONS OF MARS MADE IN 1961 AT THE PIC DU MIDI OBSERVATORY.

J. H. Focas (Athens Observatory). Jan. 30, 1962. 11 p. 5 refs. (JPL-TR-32-151) (NASA Contract NAS7-100; JPL Contract 1-109412/013550)

Results are presented of observations of Mars made in 1961 through the 24-in. refractor of the Pic du Midi Observatory. The following measurements were included in the observation program: polarimetric measurements of the proportion of polarized light coming from various regions of the planet; photometric measurements, using photographic negatives, of the contrast between selected areas; and photographic and visual observations of the upper atmosphere of Mars (in ultraviolet and blue light) and of the fine surface markings of the planet. (Author Abstract)

N62-11561 Rand Corp., Santa Monica, Calif.
RADIATIVE TEMPERATURE DISTRIBUTION IN A PLANETARY ATMOSPHERE.
Neil Divine. Apr. 1962. vii, 44 p. 16 refs.
(Memo. RM-2958-JPL) (JPL subcontract N-33561(NAS7-100))
OTS: ph $4.60, mi $1.67.

Equations are derived for the time-dependent temperature distribution of a planetary atmosphere above a thermally conducting ground. The Elsasser-band model is used to describe the infrared molecular band spectra governing radiative transfer in the atmosphere. Methods are suggested for machine handling of the resulting integro-differential equations. (Author Abstract)

N62-11709 Maryland U., College Park.
ATMOSPHERE AND SURFACE PROPERTIES OF MARS AND VENUS.
Ernst J. Öpik. Repr. from Progress in the Astronautical Sciences, S. F. Singer, ed. Amsterdam, North-Holland Publ. Co., 1962. v. 1, p. 263–342. 95 refs.
(NASA Grant NsG-58-60)
OTS: ph $8.60, mi $3.05.

From a critical study of the available evidence, conclusions are drawn regarding the surface properties of the two nearest planets. Particular attention is given to controversial problems which have been weighed with due consideration for all existing data.

N62-11766 Maryland U., College Park.
THE AEOLOSPHERE AND ATMOSPHERE OF VENUS.
E. J. Öpik. Repr. from J. Geophys. Research, v. 66, No. 9, Sept. 1961. p. 2807–2819. 33 refs.
(NASA Grant NsG-58-60)
Previously published in report form, see N62-11375 05-28.

A self-consistent model of the Venus atmosphere that satisfies the multitude of existing observational data is proposed. Its main properties and the line of reasoning are described as follows. The radiative greenhouse effect cannot account for a surface temperature of 570° K. The blanketing must be due to dust; and the main source of energy, wind friction at the surface. The term 'aeolosphere' is proposed for the region between the surface and the clouds of Venus, where wind is responsible for grinding and raising the dust, as well as for the heating. Self-consistency requires the opacity to be so high as to impose an adiabatic vertical lapse rate. The potential temperature in the aeolosphere must be nearly constant. Horizontal pressure gradients driving the wind are caused by climatic differences near the top of the dust clouds. The dust may consist of calcium and magnesium carbonates with impurities. Pressure estimates from CO_2 bands and optical scattering point to the presence of two distinct reflecting layers, the visible cloud level at about 0.6 atm and 340° K, and an upper haze level at 0.08 atm and 234° K. In the visual and near infrared, the upper haze is virtually transparent, owing to forward scattering. In the ultraviolet and in the infrared beyond 1.4 microns, it is opaque. Vertical cross sections of the Venus atmosphere are constructed for 80, 40, and 20 percent CO_2. For 80 percent CO_2, the results are somewhat more consistent, yielding a pressure of 4.3 atm at 570° K at the surface, 22 km below the visible cloud level. Despite uncertainties in the H_2O content, its amount is so small as to be nowhere condensable.
(Author Abstract)

N62-11777 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FREE-FLIGHT MEASUREMENTS OF THE STATIC AND DYNAMIC STABILITY AND DRAG OF A 10° BLUNTED CONE AT MACH NUMBERS 3.5 and 8.5.
Peter F. Intrieri. Washington, NASA, May 1962. 36 p. 11 refs.
(NASA TN D-1299)
OTS: $1.00.

Static and dynamic stability and drag were measured in a pressurized ballistic range at nominal Mach numbers of 3.5 and 8.5 and at a nominal Reynolds number of 0.15×10^6. The experimental static-stability data were found to fit a cubic pitching-moment curve. The measured dynamic-stability results were used to calculate the oscillatory behavior of the configuration flying an example entry trajectory through a model of the Martian atmosphere. (Author Abstract)

N62-12106 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MOTIONS OF A SHORT 10° BLUNTED CONE ENTERING A MARTIAN ATMOSPHERE AT ARBITRARY ANGLES OF ATTACK AND ARBITRARY PITCHING RATES.
Victor L. Peterson. Washington, NASA, May 1962. 41 p. 9 refs.
(NASA TN D-1326)
OTS: $1.00

Dynamic behavior of two vehicles, one with and one without an afterbody, was obtained from machine-calculated solutions of the six-degree-of-freedom rigid-body equations of motion. Experimental static and dynamic aerodynamic characteristics were used in the calculations. The investigation included consideration of a 10-rpm vehicle spin rate and model atmospheres encompassing the probable extremes for the planet. (Author Abstract)

N62-12107 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STATIC AERODYNAMIC CHARACTERISTICS OF SHORT BLUNT CONES WITH VARIOUS NOSE AND BASE CONE ANGLES AT MACH NUMBERS FROM 0.6 TO 5.5 AND ANGLES OF ATTACK TO 180°.
Stuart L. Treon. Washington, NASA, May 1962. 36 p. 4 refs.
(NASA TN D-1327)
OTS: $1.00.

Short blunt cones having nose half-angles of 10° and 20° were investigated. The model with the 10° nose half-angle was tested with a flat base and with base cones of 50° and 70° half-angle. The 20° nose cone half-angle model had a 50° half-angle base cone. Reynolds number ranged from 0.6 to 1.8 million based on the model maximum diameter. Estimates of the aerodynamic coefficients were made by means of a modified Newtonian theory. (Author Abstract)

N62-12688 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY I: ABSORPTION AND PHOTOIONIZATION COEFFICIENTS OF PROPYLENE AND BUTENE-1 IN THE VACUUM ULTRAVIOLET.

J. A. R. Samson, F. F. Marmo, and K. Watanabe. Apr. 1962. 18 p. 16 refs.
(NASA Contract NASw-395)
(GCA Technical Report No. 62-4-N) OTS: $1.60 ph, $0.80 mf.

The total absorption coefficient of propylene and butene-1 vapors in the region from 1500 to 2000 Å and the photoionization coefficient in the region 1050 Å to the onset of ionization were measured by photoelectric methods. Pressures ranging from 0.04 to 0.2 mm Hg were used for the total absorption coefficient determination, and three pressures from 0.05 to 2 mm Hg were used for the photoionization absorption coefficient determination. For propylene, the absorption spectrum between 1500-2000 Å exhibited a broad band with a maximum at 1720 Å; below 1300 Å the absorption spectrum was essentially continuous; but between 1300-1500 Å two probable Rydberg series were identified along with some vibrational structure. For butene-1, the absorption spectrum between 1500-2000 Å was more diffuse than that of propylene, with a maximum at 1760 Å; below 1300 Å the spectrum was essentially continuous; and between 1300-1500 Å some absorption bands were observed which were too diffuse and unresolved to identify any Rydberg series. Ionization potentials obtained directly for the two vapors agreed with previously published data. (M.P.G.)

N62-12776 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESULTS OF EXPERIMENTS IN SPACE.
Robert Jastrow. [1961] 27 p. For presentation as the 25th Wright Brothers Lecture, Inst. for Aeronautical Sciences, Wash., D.C., Dec. 18, 1961.
OTS: $2.60 ph; $1.01 mf.

This review is confined to the major lines of scientific inquiry in the space program, which include: (1) the structure of the stars and the galaxies: stellar evolution, nucleosynthesis, and the cosmic abundances of the elements; (2) the origin and evolution of the solar system: the formation of the sun, and the early histories and present structures of the planets; and (3) solar control over the earth's atmosphere: the causes of weather activity in the lower atmosphere and the structure of the upper atmosphere. (M.P.G.)

N62-12797 North American Aviation, Inc., Downey, Calif.
PROCEEDINGS OF THE [ELEVENTH] LUNAR AND PLANETARY EXPLORATION COLLOQUIUM, BURBANK, CALIF., NOV. 28–29, 1961. VOL. III, NO. 1.
E. M. Fallone, ed. May 15, 1962. 89 p. refs.

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1. PLANETARY ATMOSPHERES. p. 1-21. refs.
2. SOLAR PHENOMENA. p. 23-49. refs.
3. THE ATMOSPHERE OF THE MOON. p. 51-68. refs.
4. PROBLEMS OF LUNAR AND PLANETARY EXPLORATION. p. 69-79. refs.

N62-12820 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH SUMMARY NO. 36-14 FOR THE PERIOD FEB. 1, 1962 TO APRIL 1, 1962.
May 1, 1962. 160 p. refs.
(NASA Contract NAS7-100)
(JPL-RS-36-14)

Research in the fields of space sciences, space systems, guidance and control, telecommunications, chemistry, gas dynamics, physics, engineering, and propulsion is summarized. Areas of interest include microbiology, planetary spectra analysis, trajectories, orbits, thin films, computers, superconductors, coding (telecommunications), radio signals, low noise amplifiers, molecular structure and synthesis, boundary layer flow, shock wave structure, plasma oscillation, photon dispersions, solid state research, plasma sources, combustion and injection, polyoxyalkylenes, polymer degradation, and elastomers. (M.P.G.)

N62-13170 Space Sciences Lab., General Electric Co., Philadelphia, Pa.
THE DENSITY STRUCTURE OF THE UPPER ATMOSPHERE OF MARS.
D. N. Vachon. May 1962. 44 p. 11 refs.
(R62SD58)

A model atmosphere has been developed for the planet Mars which is more realistic than the presently available isothermal model at high altitudes. Results of the parametric study conducted in the evaluation of the effect of various layers on the upper level density structure are included. (Author Abstract)

N62-13351 North American Aviation, Inc., Downey, Calif.
SOME AEROTHERMODYNAMIC CONSIDERATIONS FOR MARTIAN ENTRY AND HEAT SHIELD DESIGN.
M. G. Boobar and R. M. Foster (Aeronutronic). N.Y., Inst. of the Aerospace Sciences [1962]. 12 p. 17 refs. Presented at the IAS National Summer Meeting, Los Angeles, June 19–22, 1962.
(IAS Paper 62-163) IAS: $0.50 members, $1.00 nonmembers.

A study has been made of some of the aerothermodynamic considerations associated with entry into the Martian atmosphere and the heat shield requirements for such entries. Previous investigators have concentrated on the determination of convective heat transfer rates. However, real gas effects, including their influence on radiant heat transfer and the characteristics of the plasma sheath, generally have been ignored. This investigation shows that radiation can contribute significantly to the total heating at the stagnation point for high angle, high velocity entry trajectories because of the CN which may be formed in the shock layer. A Mollier diagram and equilibrium concentrations of CN for an N_2-CO_2 system, which typifies the reported Martian atmosphere, are presented. Convective and radiant heating rates for different entry velocities and angles are compared. Stagnation point electron densities and collision frequency values for the plasma sheath are also indicated. After an analysis of the effects of uncertainties in the atmospheric properties (e.g., density gradients, composition, etc.) on entry heating, the requirements and criteria for the selection of a heat protection system are discussed.
(Author Abstract)

N62-13374 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFECTS OF MARS ATMOSPHERIC UNCERTAINTIES ON ENTRY VEHICLE DESIGN.
Joseph M. Spiegel. N.Y., Inst. of the Aerospace Sciences, 1962. 16 p. 6 refs. Presented at the IAS National Summer Meeting, Los Angeles, Calif., June 19–22, 1962.
(IAS Paper 62-96) IAS: $0.50 members, $1.00 nonmembers.

The effects of uncertainties in the knowledge of the Martian atmosphere are examined in relation to the design of unmanned ballistic entry vehicles. Expressions are utilized for ablation, insulation, and structural weights as a function of vehicle and atmospheric parameters. A range of possible model atmospheres for Mars is presented, and a specific example is given to show the variation in payload weight with these uncertainties. (Author Abstract)

N62-13493 Missile and Space Systems Div., Douglas Aircraft Co., Inc., Santa Monica, Calif.
MANNED ENTRY MISSIONS TO MARS AND VENUS. Engineering Paper No. 1223.

Robert L. Lowe and Robert L. Gervais. N.Y., American Rocket Society, Oct. 1961. 63 p. 27 refs. American Rocket Society Space Flight Report to the Nation, New York Coliseum, Oct. 9–15, 1961.
(ARS Paper 2158-61) ARS: $0.50 members, $1.00 nonmembers.

The objective is to establish the aerothermodynamic criteria of manned entry into Mars and Venus. Since the vehicle chosen for this analysis is not an entry vehicle per se, a system interplay between sizing, configuration, and materials is pointed out for a nuclear powered spacecraft system that must be capable of planetary entry. Environmental restrictions are established and imposed throughout various phases of the mission. The ecological and cryogenic fuel requirements of the interplanetary transfer phase, as well as the entry phase, are discussed. An aerothermodynamic analysis of the planetary entry phase is also performed. Particular attention is given to the cryogenic fuel containment problems associated with interplanetary transfer, atmospheric braking, and planetary surface storage during surface exploration. The interplay and limitations of these criteria are then shown to affect the total misssion in terms of mission requirements and total vehicle capability. Conclusions show that through proper choice of flight mechanics, insulating structure, and materials, a three man payload with its sustenance material, shielding and equipment is capable of voyages to the near planets where direct entry onto these planets is accomplished by the spacecraft itself.
(Author Abstract)

N62-13515 Rand Corp., Santa Monica, Calif.
VENUS: A CHAPTER FROM ISSLEDOVANIYE FIZICHESKIH USLOVII NA LUNYE I PLANETAKH (INVESTIGATIONS OF THE PHYSICAL CONDITIONS OF THE MOON AND PLANETS). KHARKOV, 1952.
N. P. Barabashev. June 1962. 37 p. 23 refs. Transl. by Douglas Scott and Dolores Mohr.
(JPL Contract N-33561(NAS7-100))
(Memo RM-3194-JPL) OTS: $3.60 ph, $1.31 mf.

Important observational data about Venus are summarized, particularly the brightness distribution, albedo, color index and indicatrix of scattering as obtained by Schoenberg, Müller, Danjon, King, Barabashev, and others. (Author Abstract)

N62-13633 Rand Corp., Santa Monica, Calif.
STUDIES OF THE PHYSICAL PROPERTIES OF THE MOON AND PLANETS. Quarterly Technical Progress Report (4).
June 30, 1961. 91 p. 24 refs.
(JPL Contract N-33561(NASw-6))
(RM-2817-JPL) OTS: $8.60 ph, $2.93 mf.

The report contains factual and conjectural data of the physical properties of the moon and the planets. Included in the report are studies pertaining to a survey of the Moon's magnetic field, acceleration of plasma particles, the Martian atmosphere, the gravity field and internal structure of Mars, a suggestion for determination of wind vectors on Mars, a parametric comparison of model atmospheres of the Earth and Mars, and a survey of observational methods for observing planetary atmospheres. (P.F.E.)

N62-13791 High Altitude Observatory, Boulder, Colo.
THE DIRECTOR'S REPORT, 1 JULY THROUGH 31 DECEMBER 1961.
John W. Firor. [1962] 18 p. 23 refs.

Activities have included the following: solar eclipse expedition to New Guinea; IGY solar maps; chromospheric research; coronal research; studies of the planet Jupiter; studies of the Earth's atmosphere; and astrogeophysics. (J.R.C.)

N62-14059 Rand Corp., Santa Monica, Calif.
THE ENERGY BUDGET AND ATMOSPHERIC CIRCULATION ON A SYNCHRONOUSLY ROTATING PLANET
Yale Mintz (UCLA). July 1962. 10 p. 7 refs. Submitted as a Letter to the Editor to Icarus.
(JPL Subcontract N-33561(NAS7-100))
(Memo RM-3243-JPL) OTS: $1.10 ph, $0.80 mf.

The wind speed is derived for a two-layer-model atmosphere on a planet that keeps the same face toward the sun. Some implications for Venus are shown. (Author Abstract)

N62-14715 Institute of Aerophysics, U. of Toronto (Canada).
STABILITY OF FLIGHT PATHS OF LIFTING VEHICLES DURING ENTRY INTO PLANETARY ATMOSPHERES.
J. H. Fine. July 1961. 54 p. 10 refs.
(UTIA-TN-48; AFOSR-1488)

Small pitching oscillations in a manned lifting vehicle about its trim angle of attack were analyzed for their ability to deflect the vehicle from its trim trajectory. Several planetary atmospheres along with both circular and hyperbolic velocities were considered. The results of this investigation were conclusive. Except for those cases when the static margin of the vehicle was so small as to be impractical, i.e. less than 10^{-3}, the pitching oscillations were unable to cause an appreciable deviation from the reference path. (Author Abstract)

N62-15035 Armour Research Foundation, Chicago, Ill.
RADIATIVE ENERGY TRANSFER ON ENTRY INTO MARS AND VENUS. Quarterly Report No. 1.
William O. Davies. Mar. 1, 1962. 46 p. 17 refs.
(NASA Contract NASr-65(01))
(ARF-1200-1) OTS: $4.60 ph, $1.58 mf.

The experimental program for the determination of radiative energy transfer to probes traveling at high speed in the Martian and Venusian atmospheres has been initiated with observations of hot carbon dioxide infrared emission. A plane shock wave was passed through mixtures of carbon dioxide and argon to heat and compress the test gas to the desired temperature and pressure. The argon served as a heat bath and permitted variations of CO_2 partial pressures for constant total gas pressure. Emission was monitored with an InSb rapid response detector and displayed on an oscilloscope. Absolute intensities were obtained by a comparison of the emission signals of a known volume of hot gas with those from a known area of a globar lamp. The emissivity of the globar was obtained from the literature and the temperature was measured pyrometrically. The emission intensity for CO_2 at a temperature of 2000° K and a total gas pressure of one atmosphere was determined for optical densities from 0.04 atm-cm to 4.00 atm-cm and wavelengths from 4.40μ to 5.00μ. The maximum intensities, obtained for the highest optical densities at the shortest wavelengths, were approximately 10^{-1} watts/cm^3-ster-μ. Although the data were obtained for a passband of .046μ, it was experimentally shown that the intensity per unit wavelength is independent of the passband from 0.02μ to 0.08μ.
(Author Abstract)

N62-15036 Armour Research Foundation, Chicago, Ill.

RADIATIVE ENERGY TRANSFER ON ENTRY INTO MARS AND VENUS. Quarterly Report No. 2.

William O. Davies. June 1962. 82 p. 23 refs.
(NASA Contract NASr-65(01))
(ARF-1200-2) OTS: $8.10 ph, $2.66 mf.

The results of research for the determination of radiative heating of probes to Mars and Venus, and the determination of composition of these planet's atmospheres is reported. A shock tube is used to heat and compress the test gas. Emission is monitored with an InSb detector and displayed on an oscilloscope. Intensities are obtained by comparing the hot gas signals with the emission signal from a globar. The emission from CO_2 at temperatures of 1500° K to 3000° K and a total pressure of one atm has been measured for wavelengths from 4.40μ to 5.30μ and optical densities up to 4.0 atm-cm. The intensities for an optical density of 2 atm-cm at a wavelength of 4.40μ are 0.14, 0.20, 0.35 and 0.46 watts/cm^3 -ster-μ at temperatures of 1500° K, 2000° K, 2500° K and 3000° K, respectively. The intensities are reduced to less than 10 percent of these values at a wavelength of 5.0μ. A comparison of measured emissivities with those calculated from strong and weak line approximations show better agreement with the weak line theory. (Author Abstract)

N62-15054 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THREE-DIMENSIONAL TRAJECTORY ANALYSIS FOR ROUND-TRIP MISSIONS TO VENUS.

Charles L. Zola and Gerald Knip, Jr. Washington, NASA, Aug. 1962. 106 p. 6 refs.
(NASA TN D-1319) OTS: $2.50.

For orbit-to-orbit round-trip missions to Venus, the dependence of mission velocity-increment requirements on mission time, wait time, atmospheric braking, and synodic period of departure was investigated. The analysis is characterized by noncoplanar, elliptical planetary orbits, successive two-body approximations, and impulsive velocity increments. Round trips from 100 to 780 days and wait times from 40 to 510 days were studied for departure dates in 1979 and 1980. (Author Abstract)

N62-15143 Space Sciences Lab., General Electric Co., Philadelphia, Pa.

MOLECULAR OPTICAL THICKNESS OF THE ATMOSPHERES OF MARS AND VENUS.

K. L. Coulson and M. Lotman. July 1962. 60 p. 17 refs.
(R62SD71)

The volume-scattering coefficient and optical thickness for molecular scattering of sunlight in several different models of the atmospheres of Mars and Venus are presented. The computations are based on Rayleigh's well-known scattering law. Data are given for eight different wavelengths from 2500A to 10,000A, as a function of altitude above the planetary surface. Fractional transmission of direct solar radiation is then computed for selected cases. Comparison of results with similar data for Earth's atmosphere shows that light-scattering techniques are applicable up to higher altitudes in the atmospheres of both Mars and Venus than in Earth's atmosphere. Under the assumption that a normal optical thickness of 0.001 represents a lower limit for practical application, it is found that light-scattering techniques can yield useful results up to altitudes of 90 km to 100 km on both Mars and Venus. The corresponding altitude for Earth's atmosphere is less than 60 km. (Author Abstract)

N62-15183 Committee on Space Research (COSPAR), The Hague (Netherlands).

HIGH ATMOSPHERE AND OUTER SPACE. 1. ROCKET INVESTIGATIONS. National Report of the USSR Academy of Sciences on the Investigations of Outer Space Carried Out in the Soviet Union in 1961.

A. A. Blagonravov (Acad. of Sci., USSR). [1962] 14 p. Presented at Third International Space Science Symposium and Fifth COSPAR Plenary Meeting, Washington, Apr. 30 to May 9, 1962. Meeting cosponsored by NASA.

Soviet accomplishments in outer space for 1961 are reviewed. The review includes the following: Atmosphere and outer space rocket investigations; the Venus probe; the first manned flights into space; satellite optical tracking; and plans for future scientific investigations. (J.R.C.)

N62-15229 Committee on Space Research (COSPAR), The Hague (Netherlands).

NEW DETAILS IN THE INFRARED SPECTRUM OF VENUS (1-25μ)

V. I. Moroz. [1962] 4 p. Presented at Third International Space Science Symposium and Fifth COSPAR Plenary Meeting, Washington, Apr. 30 to May 9, 1962. Meeting cosponsored by NASA.

Some new details in the infrared spectrum of Venus are detected. Upper boundaries of N_2O, CO and CH_4 equivalent paths are estimated. Some remarks are given on the nature of the cloud layer and absorption in the 9 to 13μ region. (Author Abstract)

N62-15231 Committee on Space Research (COSPAR), The Hague (Netherlands).

MODEL OF VENUS AND MARS IONOSPHERES.

A. D. Danilov (USSR). [1962] 17 p. 20 refs. Presented at Third International Space Science Symposium and Fifth COSPAR Plenary Meeting, Washington, Apr. 30 to May 9, 1962. Meeting cosponsored by NASA.

Models of the Venus and Mars ionospheres were constructed, based on an analysis of photochemical reactions of the Earth's atmosphere. The Venus ionosphere was adopted to be composed mainly of carbon dioxide; and the Mars ionosphere, of molecular nitrogen. The CO_2^+, CO^+, and O^+ ions are found in the Venus ionosphere, with maximum electron concentration of the order of 10^6 electrons/cm^3 situated at an altitude of about 100 km. The N_2^+ and N^+ ions are found in the Mars ionosphere, with maximum electron concentration of the order of 10^5 electrons/cm^3 at an altitude of about 300 km. (Author Abstract)

N62-15240 Committee on Space Research (COSPAR), The Hague (Netherlands).

ALBEDO RADIATION FROM THE MOON AND THE PLANETS.

Satio Hayakawa (Nagoya U.). [1962] 9 p. 9 refs. Presented at Third International Space Science Symposium and Fifth COSPAR Plenary Meeting, Washington, Apr. 30 to May 9, 1962. Meeting cosponsored by NASA.

A study is made of the albedo radiation from the moon and the planets. Because of the shadow effect of a planet or the moon, the albedo radiation may be stronger than the primary radiation, if one observes a flux of radiation near the planet with a unidirectional detector. Moreover, a substantial part of the albedo radiation consists of those components that are very weak in the primary radiation and are of lower energies than the primary component. The investigation is restricted to qualitative considerations, since quantitative evaluation of the intensities of albedo radiations will

have to be made after one sees whether the observations of interest are feasible or not. A semiempirical method is used which is based on observations of cosmic rays in the earth's atmosphere and radioactivities in meteorites. Among various components of cosmic rays the N-component is most responsible for the production of albedo radiation due to nuclear collisions. The evaporation process gives protons, neutrons, and alpha particles. The disintegration of a light nucleus results, in most cases, in the breakup into protons, neutrons, and alpha particles with nearly equal numbers. Gamma rays associated with the evaporation process are mostly of low energies, their energy spectrum having an exponential shape. The angular distribution of secondary particles may be isotropic. These approximations, using the semiempirical method, bring about an error of a factor of two or so in the intensity of albedo radiations but have an advantage in getting rid of complicated calculations. (J.R.C.)

N62-15332 Committee on Space Research (COSPAR), The Hague (Netherlands).

EXPLORATION CIRCUMPLANÉTAIRE DES ATMOSPHÈRES. [CIRCUMPLANETARY EXPLORATION OF ATMOSPHERES].

F. Link (Acad. Sci., Prague). [1962]. 7 p. 4 refs. In French. Presented at Third International Space Science Symposium and Fifth COSPAR Plenary Meeting, Washington, Apr. 30 to May 9, 1962. Meeting cosponsored by NASA.

Photometry from a spacecraft, during occultation of stars by a planet will permit the gathering of planetary atmospheric data when a spacecraft makes a close pass or flyby of a planet. It is not necessary for the craft to touch the planet or even penetrate the dense regions of the planetary atmosphere. Two examples are given for the atmospheres of Venus and Mars. (Author Abstract trans. by P.F.E.)

N62-15346 Committee on Atmospheric Sciences, National Academy of Sciences, National Research Council, Washington, D.C.

THE ATMOSPHERIC SCIENCES, 1961-1971.

1962. 262 p. refs. A Report to the Special Assistant to the President for Science and Technology.

(NAS-NRC/Pub-946)

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Vol. I. GOALS AND PLANS. Sverre Petterssen (Chicago U.) and Marshall V. Jamison (Rand Corp.). 101 p. refs.

Vol. II. SUMMARIES OF PLANNING CONFERENCES. Sverre Petterssen (Chicago U.) and Marshall V. Jamison (Rand Corp.). 125 p.

Vol. III. GOALS AND PLANS FOR AERONOMY. C. Gordon Little (National Bur. of Standards). 36 p.

N62-15738 Kyoto U. Inst. of Astrophysics (Japan).

THE GREAT YELLOW CLOUD AND THE ATMOSPHERE OF MARS. REPORT OF VISUAL OBSERVATIONS DURING THE 1956 OPPOSITION.

S. Miyamoto. 1957. 43 p. 17 refs.

(Kyoto U. Inst. of Astrophys. and Kwasan Obs. Contrib. no. 71, p. 239-281)

The surface markings during the 1956 opposition before the appearance of the great yellow cloud are described. Emergence of the cloud, its development and its disappearance have been described. The motion of the cloud is assumed geostrophic, and the pressure distribution in the southern summer is derived. The south polar region was occupied with the anticyclone. The thermal equator was the belt of anticyclone. The centers of anticyclone were located over Syrtis Major, Mare Cimmerium and Margaritifer Sinus, and inter-anticyclone areas between them: Solis Lacus Mare Sirenum and Sinus Sabaeus Mare Serpentis. The belt of temperature zone is identified with the cyclonic zone, and the pressure difference between anticyclone and cyclone is estimated from the wind velocity as about 2 mb. The great yellow cloud turned round the south pole along the temperate zone in the westward direction within 16 days. This suggests that the wind in the lower Martian atmosphere is dominated by the easterlies contrary to the case of our globe. A brief comparison is given of Mars and our planet. A characteristic feature of the Martian atmosphere is the smallness of its water vapor content. Under normal conditions, the water vapor is insufficient to warm up the air by the absorption of long wave radiations. The emergence of the great yellow cloud is attributed to the rapid increase of water vapor supplied through the channel of Hellespontus from the south polar cap at the time of spring thawing. The increase of water vapor might have warmed up the air over the hottest region, Mare Serpentis-Noachis, and it subsequently gave rise to strong vertical convection and cloud formation. A list of observational data and drawings is included. (Author Abstract)

N62-15739 Kyoto U. Inst. of Astrophysics (Japan).

REPORT OF MARS OBSERVATIONS DURING THE 1958 OPPOSITION.

S. Miyamoto and M. Matsui. [1958] 25 p. 2 refs.

(Kyoto U. Inst. of Astrophys. and Kwasan Obs. Contrib. no. 87, p. 191-215).

General description of the surface markings and cloud observations during the 1958 opposition were given. The pattern of general circulation of the Martian atmosphere in the equinoctial season was derived from these data, and compared with those obtained in 1956 for southern summer and with our terrestrial case. It was found close to our atmosphere and considerably different from the 1956 pattern, as was expected theoretically. (Author Abstract)

N62-15740 Kyoto U. Inst. of Astrophysics (Japan).

ON THE GENERAL CIRCULATION OF THE MARTIAN ATMOSPHERE.

S. Miyamoto. [1960] 7 p. 6 refs.

(Kyoto U. Inst. of Astrophys. and Kwasan Obs. Contrib. no. 88, p. 216-222)

General circulation in the Martian atmosphere is studied from the viewpoint of heat balance at each latitude. Theoretical insolation combined with the observed long wave radiation suggests that polar and middle latitudes have energy surplus, and the opposite hemisphere the deficit in the solstitial seasons, while the equatorial belt has energy surplus and both polar regions a deficit in the equinoctial seasons. This means that the lateral mixing is taking place between two poles in the solstitial seasons, and between the equatorial belt and poles in the equinoctial seasons. Such a circulatory pattern was discussed in relation to the observed migration of moisture from pole to pole, and to the predominance of easterlies over middle latitude in southern summer deduced from the drift of the great yellow cloud in 1958. (Author Abstract)

N62-15745 Kyoto U. Inst. of Astrophysics (Japan).

METEOROLOGICAL OBSERVATIONS OF MARS DURING THE 1960-61 OPPOSITION.

S. Miyamoto and Y. Nakai. [1961] 67 p. 9 refs.
(Kyoto U. Inst. of Astrophys. and Kwasan Obs. Contrib. no. 105, p. 84-151)

Meteorological phenomena of Martian atmosphere during the 1960-61 opposition secured by the visual and photographic observations at the Kwasan observatory are described. First two sections are concerned with the general appearance of the surface markings in this opposition. Three dark belts—namely, through Nodus Laocoontis-Sinus Gomer, Nilokeras and Lunae Lacus, and Cerberus and Propontis—connecting the northern and southern hemisphere were remarkably developed.

The remaining parts are concerned with the records and interpretations of the meteorological phenomena. On the blue filtered photographs, it was noticed that both polar regions were almost always covered with white haze, and that a faint white belt of haze extended along the equator. The Martian atmosphere was very cloudy in this season of the year. White clouds were observed almost every night. A yellow cloud of considerable dimension emerged in the Neith and Casius area and drifted eastward. The retreat of the north polar cap has been traced. Evening and morning hazes and a rapid change of the atmospheric transparency were often observed. A peculiar behavior of the stratum of white clouds over Dioscuria and Cydonia and a semipermanent low over Niliacus Lacus suggest the existence of mountain ranges along Dioscuria and Cydonia. Also the afternoon brightening of white clouds hanging over Hellas suggests that this desert may be a high land. (Author Abstract)

N62-15892 Armour Research Foundation, Chicago, Ill.
LIFE IN EXTRATERRESTRIAL ENVIRONMENTS. Quarterly Status Report No. 6, May 15 to August 15, 1962.
Charles A. Hagen and Ervin J. Hawrylewicz. [1962] 14 p. 4 refs.
(NASA Contract NASr-22; ARF Proj. C-194)
(ARF-3194-6) OTS: $1.60 ph, $0.80 mf.

The survival of a strain of *Bacillus* under simulated Martian environment is studied. Experiments run with the strain of *B. subtilis* var *globigii* indicate that this strain can survive the simulated Martian environment. (R.C.M.)

N62-15914 Geophysics Corp. of America, Bedford, Mass.
PLANETARY ATMOSPHERE STUDIES I: THEORETICAL CONSIDERATIONS OF ATOMIC AND MOLECULAR PROCESSES.
A. Dalgarno and A. M. Arthurs (Queen's U.). Dec. 1961. 85 p. 56 refs.
(NASA Contract NASw-124)
(GCA-TR-61-12-N) OTS: $8.10 ph, $2.75 mf.

A theoretical treatment is presented for the scattering of particles by molecules, particularly for the diffusion and mobility of ions in molecular gases. It was found necessary to rigorously establish a familiar empirical rule, known as Blanc's law, which refers to the mobility and diffusion of a positive ion in a multicomponent gas. A theory is formulated to explain the spin-change that gives rise to important cooling mechanisms. This theory has been tested by application to the collision of two hydrogen atoms. With minor modifications, the theory can be extended to the collision of two oxygen atoms; so far, the interaction potentials have been tabulated that correspond to the eighteen different possible molecular states formed by the approach of two oxygen atoms. Finally, a preliminary study has been carried out on the subject of collision frequencies in atmospheres in an attempt to remove the obscurities normally surrounding the concept. (J.R.C.)

N62-15915 Geophysics Corp. of America, Bedford, Mass.
PLANETARY ATMOSPHERE STUDIES II: A MICROWAVE POWERED HYDROGEN LAMP FOR VACUUM ULTRAVIOLET PHOTOCHEMISTRY.
P. Warneck. Dec. 1961. 26 p. 15 refs.
(NASA Contract NASw-124; Contract AF 40(600)-906)
(GCA-TR-61-13-N) OTS: $2.60 ph, $0.98 mf.

An intense hydrogen light source for use in photochemistry is described, which yields intensities of up to 10^{16} quanta/sec in the 1100-1850Å spectral region. Intensity measurements were made employing the photochemical formation of ozone in a flow of oxygen and the photoelectric volume effect in a nickel cathode. The intensity distribution was obtained mainly from spectrometric work. Typical observed intensities were 3×10^{15} quanta/sec in the 1400 to 1650 Å region and 3×10^{15} quanta/sec for Lyman-alpha at 1216 Å. Under the influence of the discharge the transmittance of LiF windows gradually decreases; however, the percentage decrease is a well-reproducible function of time. (Author Abstract)

N62-15916 Geophysics Corp. of America, Bedford, Mass.
PLANETARY ATMOSPHERE STUDIES III: SUMMARY REPORT; EXPERIMENTAL RESULTS OF VACUUM ULTRAVIOLET SPECTROSCOPY.
J. A. R. Samson. Dec. 1961. 134 p. 77 refs.
(NASA Contract NASw-124)
(GCA-TR-61-15-N) OTS: $10.50 ph, $4.22 mf.

A critical analysis of the absorption and photoionization cross section data is given for O_2, N_2, and SO_2. The need for data below 1000 Å is discussed, especially data obtained with higher spectral resolution. The instrumentation necessary (e.g., light sources and detectors) to extend the wavelength coverage below 1000 Å is outlined and preliminary results of light source spectra down to 500 Å are given. Finally, the photoionization yields of twenty-seven gases and vapors are tabulated, including the most recently revised data on nitric oxide. These gases and vapors are nitric oxide, propylene, butene-1, acetylene, methyl acetylene, ethyl acetylene, ethylene oxide, acetone, 1,3-butadiene, mesitylene, bromobutane, benzene, toluene, methyl iodide, ethyl chloride, ethyl bromide, ethyl iodide, propyl bromide, methyl formate, ethyl formate, ammonia, carbon disulfide, furan, benzenethiol, o-xylene, *m*-xylene, and *p*-xylene.
(Author Abstract)

N62-15917 Geophysics Corp. of America, Bedford, Mass.
PLANETARY ATMOSPHERE STUDIES IV: PHOTOCHEMISTRY OF CARBON-OXYGEN SYSTEMS.
P. Warneck. Dec. 1961. 58 p. 45 refs.
(NASA Contract NASw-124)
(GCA-TR-61-16-N) OTS: $5.60 ph, $1.94 mf.

Photochemical processes occurring in planetary atmopsheres under the influence of solar radiation depend greatly upon the relative abundance of atmospheric constituents. While in the Earth's atmosphere oxygen is the major dissociable component, this role is assumed by carbon dioxide in the atmospheres of Mars and Venus. Accordingly, a complicated pattern of photochemical reactions is expected in this case, involving the various oxides of carbon, and also oxygen and ozone. The results of a number of experiments concern the pressure and temperature dependence of the CO quantum yield in the ultraviolet photodecomposition of CO_2; the pressure dependence of ozone formation in the photolysis of oxygen and carbon dioxide, respectively; the corresponding absolute ozone quantum yields; and finally, the measurement of absorption coefficients of carbon monoxide at the wavelengths 1216 A, 1236 A, and 1470 A.
(Author Abstract)

N62-15918 Geophysics Corp. of America, Bedford, Mass.
PLANETARY ATMOSPHERE STUDIES V: PHOTOCHEMISTRY OF SULFUR-OXYGEN SYSTEMS.

J. Sullivan, P. Warneck, and F. F. Marmo. Dec. 1961. 64 p. 39 refs.
(NASA Contract NASw-124)
(GCA-TR-61-17-N) OTS: $6.60 ph, $2.12 mf.

To investigate the photodecomposition of pure SO_2 in the quartz ultraviolet spectral region, it was necessary to obtain data on the SO_2 absorption coefficients in the wavelength region 1800 to 3200 Å, and to develop a new method of wet chemical sulfate analysis. The SO_2 absorption spectrum was found to exhibit a dissociation continuum (overlapped by bands) below a wavelength of 2280 Å, yielding a new upper limit value for the SO_2 dissociation energy of 5.43 ev, corresponding to 125.3 kcal. In the spectral region above this wavelength, the SO_2 absorption spectrum is predominantly discrete. The only gaseous product found in the photolysis experiments was SO_3. The production of SO_3 was studied qualitatively in a closed static system at reduced pressures, and more quantitatively in a flow system at atmospheric pressure. The 2537 Å mercury line could be isolated from the rest of the spectrum by employing a Baird interference filter in combination with a Corning 7-54 filter. The results of these investigations indicated that the photochemical action of the 2537 Å mercury line is almost negligible when compared to that of the groups of lines around 3100 Å and 1850 Å. The SO_3 quantum yield for the 2537 Å alone was found to be about 0.01, whereas that for the 3100 Å and 1800 Å regions combined was found to be close to unity. These results can be interpreted in terms of a specific reaction mechanism which invokes dissociation and excitation of SO_2 as primary steps. (Author Abstract)

N62-16000 Geophysics Corp. of America, Bedford, Mass.
PLANETARY ATMOSPHERE STUDIES VIII: LABORATORY AND THEORETICAL STUDIES IN THE VACUUM ULTRAVIOLET FOR THE INVESTIGATION OF CHEMICAL PHYSICS OF PLANETARY ATMOSPHERES. Final Report.
F. F. Marmo. Dec. 1961. 217 p. refs.
(NASA Contract NASw-124)
(GCA-TR-61-20-N) OTS: $14.50 ph, $6.71 mf.

CONTENTS:

PART I: SUMMARIES OF WORK ACCOMPLISHED UNDER CONTRACT NO. NASw-124 AND PREVIOUSLY PUBLISHED AS GCA TECHNICAL REPORTS.
- A. PLANETARY ATMOSPHERE STUDIES I: THEORETICAL CONSIDERATIONS OF ATOMIC AND MOLECULAR PROCESSES. (GCA TR No. 61-12-N) A[lexander] Dalgarno. p. 1-5. Extract only; for abstract see N62-15914 15-12.
- B. PLANETARY ATMOSPHERE STUDIES II: A MICROWAVE POWERED HYDROGEN LAMP FOR VACUUM ULTRAVIOLET PHOTOCHEMISTRY. (GCA TR No. 61-13-N) P. Warneck. p. 1-16. 1 ref. To be published in Appl. Optics. Extract only; for abstract see N62-15915 15-12.
- C. PLANETARY ATMOSPHERE STUDIES III: SUMMARY REPORT: EXPERIMENTAL RESULTS OF VACUUM ULTRAVIOLET SPECTROSCOPY. (GCA TR No. 61-15-N) J. A. R. Samson. p. 1-10. Extract only; for abstract see N62-15916 15-28.
- D. PLANETARY ATMOSPHERE STUDIES IV: PHOTOCHEMISTRY OF CARBON-OXYGEN SYSTEMS. (GCA TR 61-16-N) P. Warneck. p. 1-20. 7 refs. Extract only; for abstract see N62-15917 15-28.
- E. PLANETARY ATMOSPHERE STUDIES V: PHOTOCHEMISTRY OF SULFUR-OXYGEN SYSTEMS. (GCA TR 61-17-N) J. Sullivan, P. Warneck, and F. F. Marmo. p. 1-21. 5 refs. Extract only; for abstract see N62-15918 15-28.
- F. PLANETARY ATMOSPHERE STUDIES VI: ELECTRON PRODUCTION IN THE E AND F REGIONS. (GCA TR 60-3-N) K. Watanabe. p. 1-23. 24 refs. To be published in J. Geophys. Research. Extract only.
- G. PLANETARY ATMOSPHERE STUDIES VII: PHOTOIONIZATION OF ATOMIC OXYGEN AND NITROGEN. (GCA TR 60-5-N) A[lexander] Dalgarno. p. 1-10. 9 refs. Extract only.

PART II: SUMMARIES OF WORK ACCOMPLISHED UNDER CONTRACT NO. NASw-124 BUT NOT PREVIOUSLY PUBLISHED AS GCA TECHNICAL REPORTS.
- A. ABSORPTION AND IONIZATION COEFFICIENTS OF BENZENE AND TOLUENE IN THE VACUUM ULTRAVIOLET. D. Golomb, F. F. Marmo, and K. Watanabe. p. 1-17. 15 refs. (See N62-16001 16-28)
- B. LUNAR SURFACE STUDIES BY ULTRAVIOLET TECHNIQUES. F. F. Marmo and J. Sullivan. p. 1-22. 7 refs. (See N62-16002 16-28)
- C. ABSORPTION AND IONIZATION COEFFICIENTS OF SULFUR DIOXIDE IN THE VACUUM ULTRAVIOLET. D. Golomb, K. Watanabe, and F. F. Marmo. p. 1-12. 8 refs. (See N62-16003 16-28)
- D. BRIEF NOTE ON THE DISCOVERY OF THE UNSTABLE ELECTRONIC $^2\Sigma$-STATE FOR NO. F. F. Marmo. p. 1-13. 10 refs. (See N62-16004 16-28)
- E. PHOTOCHEMICAL PROCESSES IN THE ATMOSPHERE OF MARS. F. F. Marmo and P. Warneck. p. 1-41. 20 refs. (See N62-16005 16-28)

N62-16005 Geophysics Corp. of America, Bedford, Mass.
PHOTOCHEMICAL PROCESSES IN THE ATMOSPHERE OF MARS.
F. F. Marmo and P. Warneck. *In its* Planetary Atmosphere Studies VIII: ... Final Report. Dec. 1961. 41 p. 20 refs. (See N62-16000 16-28)
(NASA Contract NASw-124)

The atmosphere of Mars is analyzed by the adoption of a greatly simplified model atmosphere for the investigation of the atmospheric absorption of solar radiation and photochemical effects. This treatment can lead to the formulation of a number of specific problems of which a solution is required for further studies. The height of the 90% absorption level is presented for the spectral region 1100 to 3000 A of an atmospheric model composed of nitrogen and carbon dioxide. Particle density distributions for CO_2, O_2, O_3, and O are given for both two- and three-body photochemical mechanisms. A summation of the particle densities for the three-body mechanism reveals that the total count of photochemically produced molecular oxygen is 1 cm NTP, while the total amount of ozone present is about 2×10^{-5} cm NTP. At an altitude of 150 km, 100% of the CO_2 was dissociated in the three-body system while only 40% dissociation occurred in the two-body system. (R.C.M.)

N62-16023 Laboratory of Astrophysics and Physical Meteorology, Johns Hopkins U., Baltimore, Md.
INFRARED SPECTROSCOPY AND INFRARED PROPERTIES OF ATMOSPHERIC GASES. Final Report, Feb. 1, 1951–June 30, 1961.
John Strong. May 1962. 31 p. 101 refs.
(Contract Nonr-248(01))

Advances in infrared spectroscopic instrumentation; instrumentation in the fields of astrophysics and physical meteorology; and the study of infrared properties of atmospheric gases, made with the developed instrumentation, are epitomized. The infrared properties include measurements of the infrared absorption by components of

the atmosphere at various pressures in a 600-foot optical-path absorption cell; and the determination of infrared line widths and line strengths, using a large infrared spectrometer. (Author Abstract)

N62-16253 Missile and Space Systems Div., Douglas Aircraft Co., Inc., Santa Monica, Calif.

PHYSICAL PROPERTIES OF THE PLANET VENUS.

D. C. Evans, comp. July 1962. 66 p. 93 refs.
(SM-41506)

The purpose of this report is to present a compilation of the orbital and physical properties of the planet Venus, for use as engineering design criteria. The main topics discussed are the orbital elements, mass, radius, gravity, density, rotation, atmospheric composition, atmospheric structure, atmospheric circulation, solar constant, albedo, color, temperature distribution, electromagnetic and particle fields, clouds, water, and the possible surface conditions on Venus. The latest information available in published journals was reviewed for evaluation of these physical properties. The information presented in this report is a compilation of existing data, and is not a presentation of new theories or new experimental data. (Author Abstract)

N62-16300 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THREE-DIMENSIONAL TRAJECTORY ANALYSIS FOR ROUND-TRIP MISSIONS TO MARS.

Gerald Knip, Jr., and Charles L. Zola. Washington, NASA, Oct. 1962. 164 p. 7 refs.
(NASA TN D-1316) OTS: $3.00.

For orbit-to-orbit round-trip missions to Mars, the dependence of mission velocity-increment requirements on mission time, wait time, atmospheric braking, and synoidic period of departure was investigated. The analysis is characterized by noncoplanar, elliptical planetary orbits, successive two-body approximations, and impulsive velocity increments. Round trips from 150 to 1000 days and wait times from 0 to 500 days were studied for departure dates in 1970 to 1971 and 1979 to 1980. (Author Abstract)

N62-16370 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SCIENTIFIC EXPERIMENTS FOR MARINER R-1 AND R-2.

R. C. Wyckoff, ed. July 15, 1962. 38 p. 42 refs.
(NASA Contract NAS7-100)
(JPL-TR-32-315) OTS: $3.60 ph, $1.34 mf.

This report is a description of the scientific experiments which will be carried aboard the *Mariner R* spacecraft. The mission of the *Mariner R* is to place an interplanetary probe in the close vicinity of the planet Venus in 1962. The scientific experiments include the investigation of the radiation emission from the planet Venus, and the magnetic fields and the charged particle and cosmic dust flux in interplanetary space and the vicinity of Venus. (Author Abstract)

N62-16447 Space Sciences Lab., General Electric Co., Philadelphia, Pa.

PLANETARY ATMOSPHERES AND RELATED INFORMATION; A SUPPLEMENTARY BIBLIOGRAPHY TO R61SD126, Oct. 1961-Aug. 1962.

E. Colabrese. Aug. 1962. 46 p. 110 refs.
(R62SD85)

N62-16618 Arizona U. Lunar and Planetary Lab., Tucson.

COMMUNICATIONS OF THE LUNAR AND PLANETARY LABORATORY, VOLUME I, NUMBERS 7-10.

Gerard P. Kuiper and Barbara Middlehurst, eds., et al. 1962. 32 p. 17 refs.
(NASA Grant NsG-161-61)

CONTENTS:

No. 7. ON THE SPECTRUM OF LIGHTNING IN THE ATMOSPHERE OF VENUS. A. B. Meinel and D. T. Hoxie. 6 p. 16 refs.

No. 8. ON THE PROBLEMS OF SELENODETIC PHOTOGRAMMETRY. D. W. G. Arthur. Dec. 8, 1961. 4 p.

No. 9. PRELIMINARY DRAWINGS OF LUNAR LIMB AREAS, II. Alika K. Herring. Apr. 13, 1962. 9 p.

No. 10. TOPOCENTRIC LIBRATIONS OF THE YERKES LUNAR PHOTOGRAPHS. Jan. 16, 1962. D. W. G. Arthur and C. S. Huzzen. 10 p.

N62-16682 Geophysics Corp. of America, Bedford, Mass.

PLANETARY AERONOMY II: NO_2 IN THE MARTIAN ATMOSPHERE.

P. Warneck and F. F. Marmo. May 1962. 21 p. 10 refs.
(NASA Contract NASw-395)
(GCA-TR-62-5-N) OTS: $2.60 ph, $0.83 mf.

The transmission curve of the Martian atmosphere derived by Öpik is compared with transmission curves of an atmosphere containing various amounts of nitrogen dioxide. It is found that the amount of 6×10^{18} cm^2 column NO_2 (or even less) given by Sinton as an upper limit for the Martian NO_2 content could adequately explain the phenomenon of the blue haze. This finding made it worthwhile to investigate the effect of the temperature and pressure sensitive equilibrium $2\,NO_2 \rightleftharpoons N_2O_4$ upon the total NO_2 content and the altitude-number density distributions of NO_2 and N_2O_4. Computations were carried out for surface temperatures of 273° K, 243° K, 213° K and 183° K and for three different temperature distributions. The discussion of the results leads to the suggestion of several important new experiments. (Author Abstract)

N62-17382 Ludwig-Maximilians-Universität. Meteorologisches Inst., Munich (W. Germany)

NEUERE FORSCHUNGSERGEBNISSE ÜBER DIE ATMOSPHÄREN DER PLANETEN MARS UND VENUS. EIN LITERATURBERICHT. [MORE-RECENT RESULTS OF RESEARCH ON THE ATMOSPHERES OF THE PLANETS MARS AND VENUS. A LITERATURE REPORT]

Hans-Jürgen Bolle June 18, 1962 61 p 47 refs In German

It appears that the Moon, Mars and Venus will be the only heavenly bodies that can be directly observed by space vehicles for some time to come. This report attempts to demonstrate how the knowledge of the atmospheres of these planets, obtained from earth observations, may be correlated with investigations made in the infrared spectral domain. Infrared methods have been applied in the study of Earth's atmosphere and have resulted in great advances. Infrared methods will also probably be applied successfully in investigations of other heavenly bodies. A.S.

N62-17425 Mount Wilson Observatory, Pasadena, Calif.

THE FORMATION OF THE SUN AND PLANETS

A. G. W. Cameron (Palomar Observ. and NASA. Goddard Inst. for Space Studies) Repr. from Icarus, v. 1, no. 1, May 1962 p 13-69 103 refs For abstract see N62-10169 02-28
(Contract AF 49(638)-21)

Extinct radioactivities presumably were present in the interstellar medium when it began condensing to form the solar system. The isotopes from extinct radioactivities in meteorites and in the atmosphere give a measure of the time interval between the start of the condensation and the cessation of chemical fractionation in the system in which they are found. The products of these extinct radioactivities indicate that a relatively short time passed between the start of the solar system's condensation and the formation and cooling of the meteorite parent bodies. If the main heat source required to melt iron in meteorites is Al^{26}, the time interval between the start of condensation and the formation and thermal insulation of the meteorite bodies is less than 6×10^6 years.

For the formation of the solar system it appears that an interstellar cloud must be fairly dense and fairly massive before it can undergo gravitational collapse. When the central temperature becomes 1800° K, the protostars become rotationally unstable at the equator and are on the verge of a dynamical instability associated with the dissociation of hydrogen molecules and the ionization of hydrogen and helium. In the collapse, which requires approximately 10^6 years, most or all of protostar's mass goes into the formation of a nebular disk. The evolution and dissipation of this disk probably take only a few million years at most. The time scale for this history appears to be consistent with the chronology deduced from the extinct radioactivities. V.D.S.

N62-17446 Aeronutronic, Newport Beach, Calif.

CARBON DIOXIDE ABSORPTION FOR PATH LENGTHS APPLICABLE TO THE ATMOSPHERE OF VENUS Technical Report

Gilbert N. Plass and V. Robert Stull Sept. 24, 1962 26 p 3 refs
(U-1844)

Calculations of the spectral transmissivity 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 here it is possible to obtain the transmissivity of the atmosphere of Venus for a wide range of assumed conditions. The high surface temperature of Venus can be explained as a CO_2 greenhouse effect if the CO_2 amount is of the order of 2×10^7 atm cm or the surface pressure is 60 atm. If the CO_2 amount is 10^6 atm cm and the surface pressure is 20 atm, the addition of 10 gm cm^{-2} of H_2O to the atmosphere is sufficient to explain the surface temperature. Author

N62-17774 Research and Advanced Development Div., Avco Corp., Wilmington, Mass.

ENTRY OF SPACE VEHICLES INTO PLANETARY ATMOSPHERES. PART II. LIFTING ENTRY Technical Memorandum

Philip Levine May 31, 1962 34 p 4 refs
(RAD-TM-62-20(Part II))

Closed-form expressions based on the approximations of P. Levine for the peak heat rate, loads, integrated heating, and corridor depth are presented; each expression is found to be a function of only two independent parameters. Comparison of the approximate calculations with numeric results are also presented. Author

N62-17885 California U., La Jolla. School of Science and Engineering

THERMODYNAMIC DATA ON THE FORMATION OF SOLID CARBON AND ORGANIC COMPOUNDS IN PRIMITIVE PLANETARY ATMOSPHERES

Hans E. Suess Jan. 1962 13 p 21 refs Prepared for journal publication
(NASA Grants NsG-97-60 and NsG-98-60)
OTS: $1.60 ph, $0.80 mf

Atmospheres of terrestrial planets lose the hydrogen originally present and produced by photolysis of CH_4, CH_3, and H_2O. With increasingly oxidizing conditions the gases may pass through a phase during which elementary carbon and various organic compounds are thermodynamically stable. Numerical calculation of the equilibrium concentrations of H_2, CH_4, CO, CO_2, and H_2O as a function of total H is difficult, but it has been carried out by Arnold Bainbridge at the La Jolla CDC-1604 computer for various temperatures, pressures, and carbon/oxygen ratios. The results show that at sufficiently low temperatures and sufficiently high carbon/oxygen ratios a range of total H will exist at which elementary carbon is thermodynamically stable. It seems possible that the surface rocks of Venus contain much more carbon than those of the Earth. This would explain the presence of large amounts of CO_2 in the absence of oxygen on Venus. Author

N62-18034 Ohio State U. Research Foundation, Columbus

FLIGHT ENVIRONMENT DESIGN PARAMETERS FOR MARS AND VENUS [Final] Technical Documentary Report, [Part II]

R. H. Zimmerman and C. D. Jones Wright-Patterson AFB, Ohio Flight Accessories Lab., Sept. 1962 168 p 32 refs
(Contract AF 33(616)-5914)
(ASD-TDR-62-805)

The physical characteristics of the planets Mars and Venus are assessed, and probable quantitative limits are defined as minimum, representative and maximum probable values for application to environmental studies and equipment design. These data are applied to Chapman's generalized analysis for bodies entering planetary atmospheres to produce probable minimum, representative and maximum flight environment design parameters. These planetary parameters are applied with body and trajectory parameters, using Chapman's analysis, to selected direct, multipass and graze entries. Author

N62-71073 Goddard Space Flight Center, Greenbelt, Maryland

THE LIMITING SIZES OF THE HABITABLE PLANETS.

Su-Shu Huang. September 1960. iii, 6p. OTS price, $0.50.
(NASA TECHNICAL NOTE D-499)

The astrobiological problem of the occurrence of life in the universe is discussed from the standpoint of the size and nature of planets upon which living organisms might arise. The conclusion is tentatively drawn that the most likely radius of a habitable planet lies between 10^8 cm and and 2×10^9 cm. Conditions of temperature and density also bear upon the occurrence of life; thus the moon and Mercury, although both fall within the range of favorable radii, are nevertheless believed uninhabited by indigenous life.

1963
STAR ENTRIES

N63-10142 Armour Research Foundation, Chicago, Ill.

RADIATIVE ENERGY TRANSFER ON ENTRY INTO MARS AND VENUS Quarterly Report No. 3

William O. Davies Sept. 1962 53 p 13 refs
(NASA Contract NASr-65(00))
(ARF-1200-3) OTS: $5.60 ph, $1.79 mf

Emission spectra of the molecular species present in the atmospheres of Mars and Venus are determined to provide quantitative information for evaluation of the radiative heating of probes

entering these atmospheres. Values of emission intensity from carbon dioxide and nitrogen mixtures are given, along with spectra for the infrared emission of carbon dioxide and ultraviolet, and visible emission of carbon monoxide. R.C.M.

N63-10225 Lowell Observatory, Flagstaff, Ariz.
PHYSICS OF THE PLANETS
William M. Sinton *In* Virginia Polytechnic Inst., Blacksburg. Physics of the Solar System, Part I. Proc. of the Conf. on Physics of the Solar System and Reentry Dynamics, July 31 to Aug. 11, 1961 p 126-165 (See N63-10220 01-05) VPI: $1.50
Portions of this paper appear in The Moon—Its Astronomy and Physics. N. Y., Academic Press., 1961

Planetary physics is discussed in terms of observations made from the earth. The methods of observing the planets are reviewed. The data obtained are related to planetary surfaces and atmospheres. R.C.M.

N63-10245 Jet Propulsion Lab., Calif., Inst. of Tech., Pasadena
SPECTROSCOPIC TEMPERATURE AND PRESSURE MEASUREMENTS IN THE VENUS ATMOSPHERE
Hyron Spinrad Repr. from Publ. Astron. Soc. Pacific, v. 74, no. 438, June 1962 p 187-201 15 refs
(NASA Contract NAS7-100)
(JPL-TR-32-251)

Spectroscopic observations of the Venus carbon dioxide band at λ7820 have allowed us to probe Venus atmosphere. The mean depth of penetration apparently varies irregularly; occasionally the CO_2 absorption originates in a region with $T \approx 440^\circ$ K, $P \approx 5$ atm. The surface conditions must be considerably more extreme. From the partial pressure of CO_2 derived from the equivalent CO_2 path needed to give the Venus λ7820 band and the total base pressure, a CO_2 abundance of about 4% has been obtained. Author

N63-10526 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS. ASTRONOMY AND SPACE, NO. 48, 1962
Gennadiy Vorob'yev Nov. 30, 1962 31 p 46 refs Contains abstracts, summaries, and translations of articles from recent publications of the Sino-Soviet Bloc countries
(JPRS-16455) OTS: Annual subscription, $16.00

This semimonthly serial publication consists of materials gathered from recent publications of the Sino-Soviet Bloc Countries, presented in the form of abstracts. Author

N63-10746 Avco Corp. Research and Advanced Development Div., Wilmington, Mass.
ENTRY OF SPACE VEHICLES INTO PLANETARY ATMOSPHERES. PART I. BALLISTIC ENTRY Technical Memorandum
Philip Levine Apr. 30, 1962 44 p 25 refs
(RAD-TM-62-20, Pt. I)

A literature review on planetary atmospheres is presented. The ranges of atmospheric scale heights for Mars and Venus are noted, and their subsequent effects and uncertainties in heating and loads discussed. Simplified relationships are developed for laminar and turbulent heat transfer and loads that are adequate for preliminary investigations of ballistic vehicle entries into the atmospheres of Venus and Mars. Comparison of the heat-transfer predictions with a limited amount of experimental data is included. Author

N63-11212 National Aeronautics and Space Administration, Washington, D.C.
RESULTS OF OBSERVATIONS OF MARS IN THE USSR DURING THE GREAT OPPOSITION OF 1956
G. A. Tikhov et al Dec. 1962 203 p 99 refs Transl. of articles from the book "Rezul'taty Nablyudeniy Marsa vo Vremya Velikogo Protivostoyaniya 1956 g. v SSSR" Moscow, USSR Acad. of Sci. Pub. House, 1959
(NASA-TT-F-93)
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3. PHOTOGRAPHIC PHOTOMETRY OF MARS WITH FILTERS N. P. Barabashov and I. K. Koval p 7-110 13 refs
4. PHOTOMETRIC STUDIES OF OPTICAL PROPERTIES OF THE ATMOSPHERE OF THE PLANET MARS N. N. Sytinskaya p 111-121 14 refs
5. THE SURFACE AND ATMOSPHERE OF MARS ACCORDING TO PHOTOGRAPHIC, PHOTOMETRIC, AND COLORIMETRIC OBSERVATIONS CONDUCTED IN 1956 AT TASHKENT V. V. Sharanov p 122-154 32 refs
6. AN EXPERIMENT TO DETERMINE CONTRASTS ON THE DISC OF MARS BY THE METHOD OF VISIBILITY V. V. Sharanov p 155-166 12 refs
7. SOME THOUGHTS ON THE STATE OF THE ATMOSPHERE OF MARS N. N. Sytinskaya p 167-174 17 refs
8. VISUAL OBSERVATIONS OF MARS DURING THE GREAT OPPOSITION IN 1956 V. A. Bronshten p 175-193 11 refs
9. PHOTOGRAPHIC PHOTOMETRY OF THE LIGHT REGION OF ARGYRE ON MARS LATE IN AUGUST 1956 V. A. Bronshten and O. V. Dluzhnevskaya p 194-201 7 refs

N63-11322 RAND Corp., Santa Monica, Calif.
THE STUDY OF PLANETARY ATMOSPHERES BY STELLAR OCCULTATION
H. L. Weisberg Oct. 1962 47 p 11 refs
(NASA Contract NAS7-100; JPL Contract N-33561)
(RM-3279-JPL) OTS: $4.60 ph, $1.61 mf

The vertical structure of a planetary atmosphere can be studied by observing the intensity of light from a star as it passes behind the atmosphere at the limb of the planet. The theory for interpreting such observations is reviewed. With balloon astronomy, this technique may be very useful. A possible study of the Martian atmosphere by observing eclipses of Phobos is also discussed. Finally, use of this technique with a flyby space probe, where it would complement other measurements, is proposed and analyzed. Author

N63-11407 RAND Corp., Santa Monica, Calif.
STUDIES OF THE PHYSICAL PROPERTIES OF THE MOON AND PLANETS Quarterly Technical Progress Report (8) [April 1, 1962 to June 30, 1962]
July 1962 12 p 4 refs
(NASA Contract NAS7-100; Contract JPL N-33561)
(AR-26-JPL) OTS: $1.60 ph, $0.80 mf

Studies of the physical properties of the moon and planets are reported. These include the following: planetary atmospheres, radiative transfer, atmospheric scattering, an isostatic model of the moon, cosmogonic studies, optical tracking of deep-space probes, and planetary orbiters. R.C.M.

N63-11920 New Mexico State U. Research Center, University Park

BLUE CLEARING DURING THE 1960-61 MARS APPARITION

Bradford A. Smith Repr. from Pub. Astron. Soc. Pacific, v. 73, no. 435, Dec. 1961 p 456-459 4 refs

(NASA Grant NsG-142)

During the 1960 to 1961 Mars apparition, the New Mexico State University Research Center conducted a photographic study of Mars in red, blue, and ultraviolet light. Blue clearing and an extensive network of fine and coarse lines on blue and ultraviolet plates were recorded. Blue plates of sufficiently good quality for determination of blue clearing were obtained. Opposition of Mars occurred on December 30, 1960, and a higher percentage of dates of blue clearing occurred following this date. This survey, at an effective wavelength of λ 4500, recorded many blue images with complete obscuration, but found none that showed complete visibility of surface markings. The survey does indicate that partial weak clearings are probably more common than is generally supposed. A.S.

N63-12040 RAND Corp., Santa Monica, Calif.

SOME ASPECTS OF THE SURVEY OF THE MAGNETIC FIELD OF THE MOON AND THE PLANETS

E. H. Vestine Dec. 1962 23 p 38 refs

(NASA Contract NASr-21(05))

(RM-3140-NASA) OTS: $2.60, $0.89 mf

Studies of the magnetic fields of planets and other solar-system bodies comprise a fundamental part of any systematic program of space research. The author describes a cursory and preliminary plan for magnetic surveys of other planets, discusses the magnetic instrumentation, and concludes that an impacting probe carrying presently available instruments together with one or, at most, a small number of magnetic observatories on the surface of the planet would be adequate for most scientific purposes. Then, on the basis of several theories of the origin of planetary magnetism, he estimates the steady-state magnetic fields of a number of planets and satellites. The crudely estimated planetary fields (at the surface) range from about 700 gauss for Jupiter to 0.03 gauss for Mercury; the fields estimated for natural satellites based on rock magnetism are uniformly very small, in the neighborhood of 0.0004 gauss. Transient planetary magnetic fluctuations due to solar streams of charged particles, or to solar magnetic fields transported to the planet by this solar stream,or to atmospheric electric currents may be substantially larger than the steady-state magnetic fields of the Moon and other bodies of the solar system. Author

N63-12091 National Aeronautics and Space Administration, Washington, D. C.

MARINER

Washington, GPO, 1962 8 p

(NASA FACTS-D-62) GPO: $0.15

The Mariner spacecraft and its flight past Venus are described in language for the layman in this NASA Educational Service Publication. The Mariner's path to Venus and the midcourse maneuver are described and illustrated. Instruments carried are enumerated and the purpose of each is explained. A description and artist's conception of the Advanced Mariners for launches towards Mars and Venus in 1964 are included. A.S.

N63-12577 California U., Berkeley. Space Sciences Lab.

MOLECULAR SPECTROSCOPY OF PLANETARY ATMOSPHERES

D. G. Rea Dordrecht, Holland, D. Reidel Pub. Co. Repr. from Space Sci. Reviews, v. 1, 1962 p 159-196 80 refs

(NASA Grant NsG-101-61)

Clearly spectroscopy has already provided considerable insight into the nature of the planetary atmospheres. Several molecular constituents have been positively identified, and upper limits have been placed on the abundances of others which are of particular significance in devising planetary models. But, equally clearly, the inadequacy of the spectral data, due to low spectral and/or spatial resolution, renders deductions of abundances, temperatures, and pressures very uncertain. With sole exception of the Martian CO_2 abundance, knowledge of the concentrations of planetary atmospheric constituents is unsatisfactory, and all numbers given must be regarded as only crude estimates. This latter comment applies equally well to the derived temperatures and pressures. What is urgently needed is the development of a reasonably complete theory of line formation in planetary atmospheres. This, coupled with more detailed spectroscopic work, should produce numerical values of atmospheric parameters which can be used with assurance. Author

N63-12581 RAND Corp., Santa Monica, Calif.

SOLAR SYSTEM SCIENCE: 1961 LITERATURE SURVEY, PART III. BOOK NOTES: A SELECTED LIST

Donna Wilson Repr. from Icarus, v. 1, no. 3, Oct. 1962 p 286-295 40 refs

(NASA Contract NASr-21(04))

Included in this survey are annotated listings of books on solar system science published in 1961. I.v.L.

N63-12686 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

Z-FUNCTION SOLUTIONS FOR THE MOTION AND HEATING DURING ATMOSPHERE ENTRY FROM EQUATORIAL ORBITS OF A ROTATING PLANET

Frederick W. Boltz Washington, NASA, Feb. 1963 195 p 15 refs

(NASA TN D-1555) OTS: $3.00

The two-dimensional equations of motion for atmosphere entry have been transformed into a pair of first-order differential equations or a single second-order differential equation in generalized coordinates. The transformation is similar to that introduced by Chapman (NASA TR R-11) and is based on the assumption of an exponential atmosphere. However, no terms are deleted from the initial equations, and the solutions obtained for a ballistic or a roll-modulated lifting vehicle of arbitrary shape, size, and weight are valid for the entire atmosphere trajectory. A number of numerical machine-computed (IBM 704) solutions are tabulated for entries at circular and supercircular velocity into the atmospheres of Earth, Mars, and Venus from nearly equatorial orbits. Author

N63-12899 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

MEASUREMENT OF PITCH DAMPING AT LARGE ANGLES OF OSCILLATION FOR PROPOSED MARS ATMOSPHERE-ENTRY VEHICLES

Bain Dayman, Jr., Duane A. Nelson, and Peter Jaffe N. Y., Inst. of the Aerospace Sciencies, [1963] 20 p 14 refs Presented at the IAS 31st Annual Meeting, N. Y., Jan. 21-23, 1963

(NASA Contract NAS7-100)

(IAS Paper-63-79) IAS: $0.50 members, $1.00 nonmembers

The particular aerodynamic, weight, reliability, and packaging requirements for a Mariner vehicle proposed for entry into the atmosphere of Mars suggest a high-drag body of revolution with length about equal to the maximum diameter. Even for the case of initial rearward entry, forward orientation with low oscillation amplitude of this vehicle during the heating pulse and just prior to parachute deployment must be accomplished passively, that is, without the need of

any activating control devices. As six-degree-of-freedom atmosphere-entry studies indicate the large effect of very small amounts of pitch damping on the envelope of the angle-of-attack oscillation at the time of parachute deployment, it is necessary to determine accurately the pitch damping of such a proposed vehicle up to large angles of oscillation. The purpose of this paper is to discuss the two wind-tunnel methods being developed to accomplish this objective, namely, "frictionless" gas-bearing mounted models and free-flight models. These methods complement the usual ballistic range firings and sting-flexure mounted model approaches for obtaining pitch-damping data. Author

N63-13151 National Aeronautics and Space Administration. Washington, D.C.

MARINER II MICROWAVE AND INFRARED RADIOMETER RESULTS News Release No. 63-36-1

Feb. 26, 1963 12 p

The microwave and infrared radiometer observations of Venus by Mariner II are described and the results of a preliminary analysis of the data and their implications are discussed. The microwave radiometer scanned the surface of Venus at wavelengths of 13.5 and 19 mm. The data obtained from the microwave radiometer will be compared to infrared emission data at 8.4 and 10.4 micron wavelengths. Preliminary results indicate a surface temperature of near 800° F, a cloud layer temperature of about -30° F, and a cold spot in the cloud layer over the Southern Hemisphere. R.C.M.

N63-13167 Yerkes Observatory, Williams Bay, Wis.

FLUORESCENT SCATTERING IN PLANETARY ATMOSPHERES. II. COUPLING AMONG TRANSITIONS Research Paper No. 5

Yousef Sobouti Repr. from Astrophys. J., v. 135, no. 3, 1962 p 938-954 8 refs Previously processed as a preprint; for abstract see N62-11299 05-28

(NASA Grant NsG-118-61)

N63-13168 Chicago U., Ill.

UPPER ATMOSPHERES OF THE PLANETS Research Paper No. 8

Joseph W. Chamberlain (Yerkes Observatory) Repr. from Astrophys. J., v. 136, no. 2, 1962 p 582-593 20 refs

(NASA Grant NsG-118-61)

Most of our knowledge of the earth's upper atmosphere is obtained from experiments *in situ* or remote observations that offer fairly direct interpretations. For the other planets, neither approach is as yet possible; so indirect, theoretical procedures are required to construct models of their atmospheres. Herein the wide variety of basic physical processes governing the structure of a planetary high atmosphere are set forth, with a view toward obtaining "deductive models"—i.e., models derived theoretically when only the chemical composition and temperature of the lower atmosphere and the incident solar flux are specified (in addition to various physical and astronomical constants). The procedures are applied to Mars, whose lower and middle atmosphere is already partially understood from earlier work, notably that of R. Goody. The uncertainties involved at various stages in the construction of such a model are emphasized, as are the major differences in physical processes and atmospheric characteristics between Mars and the Earth. The most significant result is that the CO that must be in the upper atmosphere of Mars should serve as an effective thermostat, keeping the temperature at the escape level (1500 km) from exceeding about 1100° K. This is cool enough for Mars to retain atomic oxygen. Were it not for CO cooling, the upper atmosphere of Mars would be so extensive and form such an effective thermal insulation between the upper ionosphere and the heat sink at the mesopause that the temperature would exceed 2000° K. The lifetime for the escape of oxygen is estimated at 10^9 years. The mesopause is determined by CO_2 radiation. Near the mesopause, CO_2 should become dissociated and the free O atoms form a thin layer of O_2; this effect has no analogy on Earth. The model ionosphere has considerably smaller densities of ionization than comparable regions in the Earth's atmosphere. The *E* region is split into two distinct portions, with X-rays forming the higher one (E_2) and ultraviolet light ionizing O_2 near the mesopause (E_1). The Martian analog to the terrestrial F_2 region may not develop a very high electron density, and the entire ionosphere should be depleted at night. Author

N63-13179 Yerkes Observatory, Williams Bay, Wisc.

FLUORESCENT SCATTERING IN PLANETARY ATMOSPHERES. I. BASIC PLANETARY CONSIDERATIONS Research Paper No. 4

Joseph W. Chamberlain and Yousef Sobouti Repr. from Astrophys. J., v. 135, no. 3, 1962 p 925-937 13 refs Previously processed as a preprint; for abstract see N62-11298 05-28

(NASA Grant NsG-118-61)

Resonance scattering, fluorescence, and pure absorption are considered as a mechanisms governing the daytime ultraviolet spectrum of a planet observed from above. It is assumed throughout that continuous absorption prevents any sunlight from being reflected by the ground (or cloud surface) and that the scattered continuum is weak compared with scattering in spectral lines. These considerations are appropriate to the ultraviolet, when ozone (or some other substance) is strongly absorbing in the high atmosphere. Such a spectrum is qualitatively different from a reflected Fraunhofer spectrum; this scattered light constitutes a daytime airglow of emission lines. To aid interpretation of such spectra, in terms of atomic and molecular relative abundances, several alternative models of line formation are investigated. Author

N63-13292 National Aeronautics and Space Administration, Washington, D.C.

OUR ORBITING OBSERVATORIES

James E. Webb Repr. from Grumman Horizons, Spring, 1962 2 p

Orbiting observatories are discussed. The Orbiting Solar Observatory is a stabilized space platform designed for continuous observation of that giant nuclear reactor, our sun, and its atmosphere in the X-ray, ultraviolet, and infrared regions of the spectrum. One of the instruments provided by NASA's Goddard Space Flight Center, for example, is an X-ray spectrometer. Sounding rocket experiments have shown that X-rays are generated by the sun. Knowledge of the intensity and "hardness" of this X-radiation is important in understanding the nature of the physical processes that take place in the sun. That knowledge, in turn, may have its practical applications in helping us to harness the power of hydrogen fusion for the benefit of mankind. A special feature of this observatory is its ability to point continuously at the center of the sun to an accuracy of two minutes of arc, or less. Our first Astronomical Observatory is scheduled for launching in 1965. The primary experiments for the first three Astronomical Observatories will be centered on stellar astronomy in the ultraviolet range. Instruments of later observatories will be trained on the sun and the planets. An active life of a year or more is desired for each observatory. All will be launched into circular orbits 500 miles above the earth. The Geophysical Observatories will be in 1963 and 1964. They will be used to study the earth's atmosphere, ionosphere, geomagnetic field, radiation belt, energy particles, cosmic rays, and the transition region between the ionosphere and true space. I.v.L.

N63-13448 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

A PRELIMINARY MODEL OF THE VENUS ATMOSPHERE

L. D. Kaplan Dec. 12, 1962 10 p 11 refs
(NASA Contract NAS7-100)
(JPL-TR-32-379) OTS: $1.10 ph, $0.80 mf

"Standard" and extreme model atmospheres of the planet Venus are calculated and presented, with temperature, density, and height given as functions of pressure, and with pressure, temperature, and density given as functions of height. Until more recent data are interpreted, the models are considered preliminary. Author

N63-13740 High Altitude Observatory, Boulder, Colo.
THE MAGNETIC FIELD OF JUPITER Scientific Report No. 1
James W. Warwick Dec. 1962 20 p Lecture before AAS, Dec. 29, 1961
(Contract AF 19(628)-224)
(AFCRL-62-721)

The observations and interpretations of radio emissions from Jupiter are studied to determine what bearing the emissions have on the planet's magnetic-field configuration and strength. The observations made confirm the original suggestion of Drake that the high-frequency source results from synchrotron emission by electrons surrounding Jupiter in a situation closely resembling the terrestrial Van Allen Belts. Either the low- or high-frequency observations unambiguously indicate the presence of Jupiter's magnetic field, which leaves an unmistakable imprint in the form of the polarization phenomena in the two widely separated frequency ranges. The computations made are geometric and include the oblate spherical surface of Jupiter as well as a complete three-dimensional structure of the dipole magnetic field. J.R.C.

N63-13843 Geophysics Corp. of America, Bedford, Mass.
THE METEOROLOGY OF MARS AND VENUS Annual Technical Report
George Ohring and Owen Cote' Jan. 1963 89 p 52 refs
(NASA Contract NASw-286)
(GCA-TR-63-6-N) OTS: $8.10 ph, $2.87 mf

The meteorology of Mars and Venus is studied with primary emphasis on the thermal structure and circulation processes of these two planetary atmospheres. Author

N63-13845 Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge
MARINER -2 MICROWAVE OBSERVATIONS OF VENUS
A. Edward Lilley (Harvard Coll. Observ.) and Alan H. Barrett [1963] 9 p Submitted for Publication
(NASA Grant NsG-250-62) OTS: $1.10 ph, $0.80 mf

Preliminary analyses of the Mariner-2 19-mm microwave observations of Venus are presented. During the 42 minutes of radio contact with Venus, the radiometer antenna scanned the planet's disk three times: the first scan crossed Venus' nightside, covering an arc of 10°; the second, in a 15° arc, crossed the terminator at a small angle and passed very close to the disk's center; and the third, 10° wide, crossed the sunlit side. The two scans near the limb of the planet recorded brightness temperatures significantly lower than the central scan. This limb darkening indicates radiation originating at the surface and attenuated near the limb by the atmosphere. The surface temperature of Venus, as derived from the recorded microwave brightness temperature, is approximately 700° K, which leads to a concept of Venus' surface as being extremely hot, dry, and hostile to terrestrial forms of life. M.P.G.

N63-14010 Arizona U. Lunar and Planetary Lab., Tucson
INFRARED SPECTRA OF STARS AND PLANETS, I: PHOTOMETRY OF THE INFRARED SPECTRUM OF VENUS, 1-2.5 MICRONS
Gerard P. Kuiper *In its* Communications of the Lunar and Planetary Laboratory, Vol. I, No. 15, Oct. 26, 1962 p 83-117 10 refs
(See N63-14008 09-05)

Spectrographs of Venus for the 1.0- to 2.5-micron region are given and compared to the spectra of CO_2 obtained in the laboratory. The Venus observations were made with the 36-inch telescope of the Kitt Peak Observatory in June 1962 and with the 82-inch telescope of the McDonald Observatory in August 1962. R.C.M.

N63-14678 Geophysics Corp. of America, Bedford, Mass.
A STUDY OF THE METEOROLOGY OF MARS AND VENUS Quarterly Progress Report No. 3, Apr. 6 thru July 5, 1962
G. Ohring, O. Cote, and W. Tang [1962] 9 p 2 refs
(NASA Contract NASw-286)
OTS: $1.10 ph, $0.80 mf

The effect of a cloud cover in a simple radiation balance model of the atmosphere of Venus is investigated theoretically in order to ascertain the credibility of Venus' 600° K surface temperature. This surface temperature is required in both the greenhouse model and the oelosphere model of Venus' atmosphere. It is in accord with microwave measurements, but is more than twice the surface temperature that would prevail if Venus had no atmosphere. The assumptions made when the cloud cover is introduced into the radiation balance model are: (1) the cloud is at a high elevation and radiates as a black body at a temperature of 235° K, and (2) there is no absorption of radiation above the cloud top. An equation is derived for radiative balance at the top of the atmosphere, and the computations indicate that the cloud cover enhances the greenhouse effect of the atmosphere of Venus. In addition to the study of Venus, two technical reports were published as a result of studies of the surface and atmospheric temperature distributions of Mars. M.P.G.

N63-14806 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOME POSSIBILITIES FOR DETERMINING THE CHARACTERISTICS OF THE ATMOSPHERES OF MARS AND VENUS FROM GAS-DYNAMIC BEHAVIOR OF A PROBE VEHICLE
Alvin Seiff Washington, NASA, Apr. 1963 36 p 12 refs
(NASA TN D-1770) OTS: $1.00

One of the early objectives of space probes sent to Mars and Venus will be to determine the characteristics of the atmospheres on those planets for scientific purposes. Characteristics of interest include profiles of gas density, temperature, and pressure above the planet surface, and chemical composition of the atmosphere. It is found that the density, pressure, and RT product profiles in the atmosphere can be obtained from measurements of axial acceleration and the angle-of-entry into the atmosphere. For a certain class of entry-body configurations, measurements of the static flight stability can be used to give information on the mean ratio of specific heats of the atmospheric gases. Measuring the ambient temperature so as to obtain the gas constant R from its product with temperature, RT, and hence determine the mean molecular weight of the atmospheric gases is discussed. Luminosity detectors that view the excited high-temperature gases in the probe shock layer for evidence of composition are discussed, as well as the possibility of determining the kind of gases from measurements of stagnation temperatures. An important characteristic of this kind of probe experiment is that the definition of atmospheric properties begins as high in the atmosphere as any detectable effect on the probe occurs—in general, around 300,000-feet altitude. Author

N63-15217 Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.
RADIO ASTRONOMY—A SURVEY

A. W. Barber and J. P. Mullen Jan. 1963 35 p 26 refs
(AFCRL-63-224)

The subject of radio astronomy is reviewed from both the historical and instrumentation viewpoints. Problem areas and fruitful areas are noted. Author

N63-15506 California U., Berkeley. Space Sciences Lab.
STRUCTURE OF THE LOWER ATMOSPHERE OF VENUS
Carl Sagan Repr. from Icarus, v. 1, no. 2, Sept. 1962 p 151–169
44 refs
(NASA Grant NsG-126-61)

If the centimeter microwave emission from Venus arises from its surface, the radar reflectivities and microwave brightness temperatures give mean darkside-surface temperatures of about 640° K. Extrapolations of the phase data to small phase angles indicate mean brightside-surface temperatures of about 750° K. If the cloudtop pressures and temperatures are known in both hemispheres, the surface pressures and darkside subadiabatic indices can be derived. A reanalysis of the CO_2 absorption bands near 0.8 and 1.6μ and of the Regulus occultation data indicates: (1) that the same cloud level, at $T_c \simeq 234°$ K, is responsible for the reflection and emission throughout the visible and infrared, and (2) that the brightside cloudtop pressure is at least as great as the darkside cloudtop pressure, the most probable values being 0.6 atm and 90 mb, respectively. Even with a small phase effect these cloudtop pressures give surface pressures $\simeq 50$ atm. The darkside lapse rates are substantially subadiabatic, in contradiction to the Aeolosphere Model. Failure of the Urey equilibrium on Venus results in surface pressures of this order or greater; and similar values are obtained from the atmospheric structure deduced from Spinrad's measurements of the near infrared CO_2 band at 7820 Å. The altitude of the cloudtops on the dark side is then $\simeq 80$ km, and is possibly even higher in the bright hemisphere. The surface pressures and phase effect lead to a sidereal period of rotation which exceeds 170 days, and is quite possibly equal to the period of revolution. For nonsynchronous rotation, the specific heat capacity of the atmosphere controls the nocturnal cooling. There is a smaller contribution from subsurface conduction. For synchronous rotation, the atmospheric circulation must supply the radiation emitted to space from the dark hemisphere. The effect of Rayleigh scattering on a cloudless day on Venus is to yellow the sky and redden the sun. The radiation scattered back to space will also have a yellow cast, and may explain the apparent color of Venus. The color index should therefore be a function of phase. In short visual wavelengths, the surface of Venus cannot be seen from space, even on a cloudless day. The observations of permanent dark markings at these wavelengths possibly represent clouds connected with surface features far below; they cannot be the surface features themselves. But near infrared photography has the promise of detecting surface markings on Venus. The high surface temperatures and pressures lead to melting and vaporization of surface material, and to greatly enhanced infrared opacities, facilitating the operation of the Greenhouse Effect on Venus. Direct exploration of the surface of Venus would seem to be a very difficult engineering problem. Author

N63-15800 General Electric Co. Missile and Space Vehicle Dept., Philadelphia
VENUS ATMOSPHERE PHYSICAL PROPERTIES
J. Brown Apr. 24, 1962 27 p 1 ref
(PIR-7250-26A, supersedes PIR-7250-26)

Tables giving the various physical properties of the Venus atmosphere are presented. These tables supersede those given in PIR 7250-26. J.A.J.

N63-16198 Kyoto U. Inst. of Astrophysics (Japan)
THE HEAT BALANCE ON THE SURFACE OF MARS
Akira Hattori 1962 8 p 5 refs Repr. from Mem. Coll. Sci., Univ. Kyoto, Ser. A, v. 30, no. 2, art. 2, 1962 p 125–135
(Kyoto U. Inst. of Astrophysics and Kwasan Obs. Contrib. no. 115)

The insolations (for τ = 0, 0.1, 0.2, and 0.3) and the heat loss on the Martian surface for various seasons have been calculated. Then, the heat balance on the surface and the effect of Martian cloud have been discussed. It is shown that the theoretical results agree fairly well with observations. Author

N63-16277 Naval Research Lab., Washington, D.C.
THE BRIGHTNESS TEMPERATURE OF VENUS AT 1.35 CM
J. E. Gibson and H. H. Corbett Apr. 11, 1963 9 p
(NRL-5937)

Measurements of the radiation of the planet Venus at 1.35-cm wavelength are being carried out in order to investigate the spectrum between previous millimeter- and centimeter-wavelength observations. The results obtained near lower conjunction indicate little change in brightness compared to 3-cm wavelength, and some of the resulting implications are discussed. Author

N63-16280 Liège U. Inst. d'Astrophysique (Belgium)
PHYSICS OF PLANETS. PROCEEDINGS OF THE ELEVENTH INTERNATIONAL ASTROPHYSICAL SYMPOSIUM, LIEGE, JULY 9-12, 1962
1963 624 p refs In English and French
(Contract AF 61(052)-586)
(AFCRL-63-457)

Papers presented at the Eleventh International Astrophysical Symposium and published in this volume cover the following: internal construction of the planets, planetary surfaces and atmospheres, and special papers on the successive planets. Mercury, Venus, Mars, Jupiter, and Saturn are discussed. J.A.J.

N63-16353 General Electric Co. Missile and Space Vehicle Dept., Philadelphia, Pa.
THE VENUS TERRAIN
R. W. Johnson May 4, 1962 18 p 20 refs
(R62SD153)

This report summarizes information on the environmental characteristics of Venus. Special emphasis is given to those characteristics operating to control or modify the character of the terrain and surface soil. The topics discussed are the atmosphere, climate, hydrographic features, physiographic features, soils, and soil-forming processes of Venus. Conclusions are made regarding the probable type and character of the terrain on Venus, based on analysis of known and inferred environmental data. Author

N63-16441 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A SEARCH FOR WATER VAPOR AND TRACE CONSTITUTENTS IN THE VENUS ATMOSPHERE
Hyron Spinrad Oct. 1, 1962 9 p 13 refs
(NASA Contract NAS7-100)
(JPL-TR-32-256) OTS: $1.10 ph, $0.80 mf

An unsuccessful spectroscopic search for water vapor and other gases in the Venus atmosphere is described. The resulting upper limit on the Cytherean water vapor/atmosphere mixing ratio down to a level of high temperature and pressure is about 10^{-5} Author

N63-16719 Maryland U., College Park
SELECTIVE ESCAPE OF GASES
E. J. Öpik (Armagh Obs., Northern Ireland) [1962] 34 p 14 refs Submitted for Publication
(NASA Grant NsG-58-60)
(NASA CR-50014, Tech. Rept. 276) OTS: $3.60 ph, $1.22 mf

Formulae for gas-kinetic escape of neutral and ionized gas from celestial bodies are set up, free from usual simplifications and applicable to the highest rates. It is shown that the isothermal model with a constant escape lifetime becomes physically meaningless when the atmospheric mass exceeds a certain, quite modest, limit and the exospheric base disappears; this defines an overall upper limit to the rate of gas-kinetic escape from a body of given mass; the limit is rather low, by cosmic standards. Absolute upper limits to selective escape are calculated. Author

N63-17152 Harvard Coll. Observatory, Cambridge, Mass.
THE ATMOSPHERE OF MARS
D. H. Menzel [1963] 4 p Repr. from Mem. Soc. Roy. Sci. Liege, ser. 5, v. 7, special issue
(NASA Grant NsG-89-60)
(NASA CR-50016, *Its* Repr. 614)

General conclusions concerning the atmosphere of Mars are presented with particular emphasis directed to the water vapor content it is capable of condensing out to form liquid or crystal fogs. It was concluded that the atmosphere of Mars contains two layers of particulate matter, a thick layer of large dust particles near the surface, and a very thin layer of fine particles above the layer of dust. It was implied that this upper layer consists of fine ice crystals. This suggestion is consistent with the association between the thin atmospheric clouds and the underlying polar caps. N.E.A.

N63-17168 Naval Research Lab., Washington, D.C.
MEASUREMENTS OF THE 4.3-MM RADIATION OF VENUS
C. R. Grant, H. H. Corbett, and J. E. Gibson Repr. from Astrophys. J., v. 137, no. 2, Feb. 15, 1963 p 620-627 21 refs

Observations were made of the 4.3-mm radiation from Venus over a period from 40 days before to 54 days after the inferior conjunction of April 11, 1961. The mean brightness temperature at this wavelength was 350° K, with an uncertainty of +50° and −30° probable error. The observations did not indicate a trend toward variation with phase. Author

N63-17176 General Electric Co., Space Sciences Lab., Philadelphia, Pa.
NORMAL SHOCK PARAMETERS FOR THE MARTIAN ATMOSPHERE
F. Bosworth, C. Cook, L. Gilbert, and S. Scala Jan. 30, 1963 47 p 28 refs
(R63SD12)

Normal shock wave and stagnation point solutions are presented for two limiting models of the Martian atmosphere, covering a range of flight speeds from 6,000 to 25,000 feet per second, and a range of altitudes from zero to 500,000 feet. Curves of dimensionless pressure, temperature, and density of the shocked gas are presented as functions of flight speed for constant altitudes. Author

N63-17208 Rensselaer Polytechnic Inst., Troy, N.Y.
PHOTOCHEMICAL PROBLEMS OF THE VENUS ATMOSPHERE
Paul Harteck, Robert R. Reeves, Jr., and Barbara A. Thompson Washington, NASA, June 1963 42 p 46 refs
(NASA Grant NsG-261-62)
(NASA TN D-1984) OTS: $1.25

In an experimental investigation of the possible chemical composition of the atmosphere of Venus, a series of conditions which may exist on Venus have been simulated. Experimental measurements were made of the absorption coefficients of carbon dioxide (CO_2), carbon monoxide (CO), oxygen (O_2), and other gases in the region from 1850 A to longer wavelengths. The behavior of CO_2 under the impact of ionizing radiation from pressures of 1 atmosphere down to a few hundred microns was studied, and extrapolation made to the region of chemosphere. Reaction mechanisms which may occur and be of major importance in the Venus atmosphere are discussed. As an alternate to the currently popular thermal origin of the observed microwave radiation emitted from Venus, a chemical source is suggested. Light-emitting chemical reactions of the type believed to occur on Venus are discussed. Preliminary results show that microwave radiation in the 3-cm wavelength region is emitted from the CO_2 discharge. Author

N63-17311 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY VI: ELECTRON TEMPERATURES IN THE IONOSPHERE
M. B. Mc Elroy, R. J. Moffett (Queen's U.), and A. Dalgarno Nov. 1962 62 p 26 refs
(NASA Contract NASw-395)
(NASA CR-12, GCA-TR-62-11-N) OTS: $6.60 ph, $2.06 mf

Detailed calculations are described of the rate of heating of the ambient electrons arising from solar ultraviolet radiation, and it is shown that the resulting difference between the electron temperature and the gas temperature at noon in a quiet ionosphere may reach a maximum value lying between 800° K and 1500° K at an altitude near 200 km, but the difference vanishes below about 120 km and above about 400 km. Author

N63-17312 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY VII: THE SOLAR FLUX INCIDENT AT THE TOP OF THE ATMOSPHERES OF EARTH AND NEIGHBORING PLANETS FOR THE SPECTRAL REGION 50 A TO 3000 A
E. D. Schultz and A. C. Holland Nov. 1962 36 p 5 refs
(NASA Contract NASw-395)
NASA CR-11) (GCA-TR-62-14-N OTS: $3.60 ph, $1.28 mf

The solar flux incident at the top of the Earth's atmosphere has been compiled for the spectral region 50 A to 3000 A. Between 50 A and 1850 A, the major emission lines were distinguished from the continuum and are presented separately. The continuum and weak lines are lumped together. The pure experimental data are plotted in two clear and unambiguous presentations of the tabulation to provide a convenient comparison of the contribution of major emission lines with the contribution of the continuum and weak lines. To obtain the flux values at the top of the atmospheres of neighboring planets, intensity dilution factors are easily determined using an inverse square relation based on mean radius vector magnitudes. The tabulated data for Earth were used as a base to generate the entire model of the solar photon flux from 50 A to 3000 A for the top of the atmosphere of Venus and Mars. N.E.A.

N63-17313 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY VIII: A CONGERIES OF ABSORPTION CROSS SECTIONS FOR WAVELENGTHS LESS THAN 3000 Å

E. D. Schultz, A. C. Holland, and F. F. Marmo Nov 1962 103 p 106 refs
(NASA Contract NASw-395; Contract AF 33(657)-9199)
(NASA CR-15; GCA-TR-62-15-N) OTS: $9.10 ph, $3.29 mf

Experimental data on the absorption of solar vacuum ultraviolet radiation by atmospheric gases, which is of primary importance in the study of planetary aeronomy, is compiled. Available absorption curves and tabulations, in the spectral region from 100 A to 3000 A, of various authors were collected and identified. Summaries of these authors' studies are included and the respective spectral regions studied are given. An accompanying discussion of the absorption characteristics, together with a historical sketch of each gas considered, is presented. N.E.A.

N63-17314 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY IX: THE DARK SIDE AIRGLOW OF VENUS
Neville Jonathan and George Doherty Feb. 1963 44 p 6 refs
(NASA Contract NASw-395)
(NASA CR-14; GCA-TR-63-1-N) OTS: $4.60 ph, $1.52 mf

The luminescence on the dark side of Venus, strong emissions in the region 4400 A to 4410 A, is analyzed to determine whether it is a product of chemical reactions. The results of several investigations of the chemiluminescence arising from the reaction of carbon monoxide with atomic oxygen are summarized and compared. A mechanism is proposed to explain the airglow which involves two distinct two-body reactions resulting in the formation of both radiative and nonradiative carbon dioxide molecules. A recommendation is made to study the reactions at higher temperatures but it is noted that, at room temperatures, the luminescence is a factor of 2000 less than that caused by the O + NO reaction. D.E.R.

N63-17315 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY X: ATOMIC POLARIZABILITIES AND SHIELDING FACTORS
A. Dalgarno Feb. 1963 87 p 96 refs Submitted for Publication
(NASA Contract NASw-395)
(NASA CR-6; GCA-TR-63-2-N) OTS: $8.10 ph, $2.81 mf

The changes in the charge distribution of an atom interacting with an electric field and the various shielding effects of the inner closed shells of electrons on the distribution of nuclear and electron charge are discussed. The definitions and quantal formulae are explained, the approximations for the perturbation theory are presented, and solutions via variational methods, the Hartree–Fock approximation, expansion methods, and statistical methods are given. Finally, numerical values for dipole and quadrupole polarizabilities and for the quadrupole and higher order shielding factors are presented in tabular form. D.E.R.

N63-17316 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY XI: ABSOLUTE INTENSITY MEASUREMENTS IN THE VACUUM ULTRAVIOLET
J. A. R. Samson Mar. 1963 28 p 6 refs
(NASA Contract NASw-395)
(NASA CR-7; GCA-TR-63-3-N) OTS: $2.60 ph, $1.04 mf

Absolute intensity measurements of vacuum ultraviolet radiation are made using the technique of photoionizing rare gases and assuming that their photoionization yield is unity. It was concluded that the relative photoionization yields of the rare gases with respect to one another is unity. Therefore, absolute intensity measurements will be independent of the rare gas that is used, provided that proper experimental care is observed. N.E.A.

N63-17317 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY XII: THE ROLE OF INTERPLANETARY DEBRIS IN PLANETARY ATMOSPHERES: I. SODIUM IN THE EARTH'S ATMOSPHERE
F. F. Marmo and H. K. Brown Mar. 1963 38 p 19 refs
(NASA Contract NASw-395)
(NASA CR-13; GCA-TR-63-4-N) OTS: $3.60 ph, $1.34 mf

Investigations of planetary atmospheres are conducted to explain the extraterrestrial origin of sodium. First, sodium in the Earth's atmosphere is examined to check the validity of the physical-mathematical model, boundary conditions, and parametric values employed. Second, with identical debris influx rates assumed for both Venus and Mars, the distribution of sodium in their atmospheres is calculated. All computations are presented on a relative scale for ready comparison. Results indicate that there is considerable more free sodium in the atmospheres of Venus and Mars than that which exists in the Earth's atmosphere. This is apparently due to the fact that the total oxygen contents of the atmospheres of Venus and Mars are believed to be about 1 part in 10^5 of that of Earth. I.v.L.

N63-17319 Geophysics Corp. of America, Bedford, Mass.
LABORATORY AND THEORETICAL STUDIES IN THE VACUUM ULTRAVIOLET Final Report, 2 Feb. 1962 through 2 Mar. 1963
F. F. Marmo Apr. 1963 182 p refs
(NASA Contract NASw-395)
(NASA CR-50201; GCA-TR-63-12-N) OTS: $13.00 ph, $5.66 mf

Laboratory and theoretical studies in the ultraviolet covered the following phases of theoretical planetary aeronomy: NO_2 in the Martian atmosphere, atmospheric parameter determination by rocket-borne mass spectrometers, electron temperature in the ionosphere, solar flux incident to planetary atmospheres for the spectral region from 50 A to 3000 A, absorption cross sections for wavelengths less than 3000 A, and atomic polarizabilities and shielding factors; and the following phases of experimental planetary aeronomy: the absorption and photoionization coefficients of propylene and butene-1 in the vacuum ultraviolet, the duoplasmatron as a vacuum ultraviolet light source, and the dark side airglow of Venus. D.E.R.

N63-17320 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY XIV: ULTRAVIOLET ABSORPTION OF SO_2: DISSOCIATION ENERGIES OF SO_2 AND SO
P. Warneck, F. F. Marmo, and J. O. Sullivan May 1963 25 p 17 refs
(NASA Contract NASw-701)
(NASA CR-10; GCA-TR-63-13-N) OTS: $2.60 ph, $0.95 mf

The absorption intensities of SO_2 were measured in the wavelength region 2000 to 3100 A, employing the hydrogen continuum as the source and at selected wavelengths utilizing the mercury line spectrum. The pressure dependence of the absorption intensity was investigated at 1849, 2537, and 3131 Å. The existence of an absorption continuum in the spectral region 1700 to 2300 Å has been established, and attributed to the dissociation of SO_2 forming SO and a ground state oxygen atom. The onset of the continuum provides an upper limit value to the dissociation energy of SO_2. The implications upon the SO_2 and SO dissociation energies are discussed. Author

N63-17664 RAND Corp., Santa Monica, Calif.
RADIATIVE TRANSFER IN A PLANETARY ATMOSPHERE WITH IMPERFECT SCATTERING
Zdenek Sekera June 1963 76 p 15 refs
(AF 49(638)-700; Proj. RAND)
(R-143-PR)

The problem of radiative transfer in a plane-parallel medium that exhibits scattering and absorption is solved. It can be used to compute the intensity and polarization of radiation emerging from an absorbing atmosphere. The solution was obtained for the so-called inhomogeneous case in which the absorption coefficient varies within the medium. Hence, this theoretical model represents an atmosphere in which the absorbing power is changed by temperature dependence or pressure broadening of the absorption lines. The theoretical results can be readily applied to the radiation emerging from a planetary atmosphere, both in the ultraviolet absorption region of ozone and oxygen, and in the near-infrared region where the atmospheric constituents have vibration-rotational absorption bands. Author

N63-18313 National Aeronautics and Space Administration, Washington, D.C.
NASA PROGRAM PLANNING IN SPACE SCIENCES
Dec. 1962 465 p
(NASA TM X-50138) OTS: $23.50 ph, $14.15 mf

The NASA program planning in space sciences is discussed. The following areas are covered: Astronomy, Solar Physics, Planetary Atmospheres, Ionospheres and Radio Physics, Particles and Fields, Planetology, and Biosciences. J.A.J.

N63-18334 RAND Corp., Santa Monica, Calif.
STUDIES OF THE PHYSICAL PROPERTIES OF THE MOON AND PLANETS Quarterly Technical Progress Report (2)
M. H. Davis, comp. and ed. Dec. 31, 1960 66 p 10 refs
(NASA Contract NASw-6; JPL Contract N-33561)
(NASA CR-50576; RM-2711-JPL) OTS: $6.60 ph, $2.18 mf

Among the subjects discussed in this progress report are: the ultraviolet spectrometer for the Mariner A, general circulation of the planetary atmospheres, the interpretation of radiometric measurements of Venus, atmospheric reentry (Mars vs. Venus), density of the very high atmosphere, and orbit determinations from terminator observations. J.A.J.

N63-18384 RAND Corp., Santa Monica, Calif.
FLIGHT REGIMES IN THE ATMOSPHERES OF VENUS AND MARS
Peter P. Wegener July 1963 55 p 41 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3388-PR)

Preliminary estimates of the flight parameters to be encountered on Mars and Venus are desirable. Although considerable qualitative information on the two planets is available, there are few quantitative data that contribute to an understanding of their atmospheres. From the available quantitative data, limiting models of the two atmospheres have been constructed, and from these models it has been possible to estimate the approximate extremes of aerodynamic parameters likely to be encountered. It is seen that the uncertainties in aerodynamic flight conditions encompass orders of magnitude, particularly at high altitudes. Author

N63-18437 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio
STUDY OF INTERPLANETARY GAS
In its Soviet Satellites and Space Ships (Selected Articles) Feb. 23, 1962 p 73-75 (See N63-18430 17-32)

A study is made of interplanetary gas which has great significance in explaining the processes of the exchange of gas between an interplanetary medium and the surface layers of the earth's atmosphere. Also, this study aids in understanding the conditions of propagation of the sun's corpuscular radiation. On the basis of data from observations of polarization of zodiacal light, the study of propagation of the so-called whistling atmospherics can be taken as the most accurate model of an interplanetary medium. For experimental verification concerning interplanetary gas in the region of the earth and far beyond its limits, so-called proton catchers were used on cosmic ray rockets. J.R.C.

N63-19020 General Electric Co. Space Sciences Lab. Philadelphia, Pa.
PERFORMANCE OF SEVERAL ABLATION MATERIALS IN SIMULATED PLANETARY ATMOSPHERES
R. A. Sheridan, N. S. Diaconis, and W. R. Warren Apr. 1963 31 p 9 refs
(Contract JPL-950250)
(R63SD35)

Well-known ablation materials typical of three classes of ablators were tested in the arc-heated gas mixture representative of Martian and Venusian atmospheres. The performance of each material in each gas mixture is evaluated and compared with similar performance in air. The results illustrate the severity of the entry problem for Mars and Venus relative to Earth reentry for high heating rate or primarily steady-state ablation situations. Author

N63-19314 RAND Corp., Santa Monica, Calif.
ENGINEERING MODEL ATMOSPHERE OF MARS
Gerhard F. Schilling Sept. 1962 18 p 8 refs For Presentation at the AFOSR-GE Symp. on Dyn. of Manned Lifting Planetary Entry, Philadelphia Oct. 29–31, 1962
(Contract AF 49(638)-700)
(P-2639)

A theoretical model of the Martian atmosphere is given. This model atmosphere gives extreme upper and lower probable limits of pressure, temperature, and density up to 150-km altitude over middle and low latitudes, independent of time of day or season. In addition, a number of parameters are tabulated which are of concern for the engineering design of entry probes. The mathematical method was based on our present factual knowledge with a minimum of assumptions and has therefore yielded results on a rather high confidence level. This has been achieved in part through an extremely wide spread of values. Nevertheless, a combination of circumstances makes it apparent that the engineering task of atmospheric entry will be easier for the Martian atmosphere than for the atmosphere of any other planet in our solar system. It can safely be concluded that Mars will be the first planet inviting manned exploration from an engineering as well as scientific point of view. Author

N63-19338 RAND Corp., Santa Monica, Calif.
THE ENVIRONMENT OF THE PLANETS

William W. Kellogg Oct. 1962 13 p 5 refs Presented at the Space Exploration lecture series, Calif. U., Oct. 1-4, 1962 and at Moffett Field, Anaheim, Los Angeles, and San Diego (P-2640)

This review discusses the solar system, and the limitation of observations from earth-optical telescopes, radio telescopes, and space probes. Also included are studies of Mars and Venus atmospheres and surfaces and the possibilities of the existence of life forms on these planets. N.E.A.

N63-19478 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

PROCEEDINGS OF THE LUNAR AND PLANETARY EXPLORATION COLLOQUIUM, VOLUME III, NUMBER 2, SANTA MONICA, CALIFORNIA, MAY 23-24, 1962

E. M. Fallone, ed. May 5, 1963 174 p 130 refs (Pub. 513-W-12)

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14. GRAVITY DESIGN REQUIREMENTS FOR SPACE STATIONS C. B. S. Evans (Douglas Aircraft Co., Inc.) and E. B. Konecci (NASA) p 135-140 5 refs (See N63-19492 19-16)

15. OPERATIONAL ASPECTS OF WEIGHTLESSNESS S. J. Gerathewohl (NASA, Ames Res. Center) p 141 145 (See N63-19493 19-16)

16. PLAGIOGEOTROPISM IN XANTHIUM PENNSYLVANICUM Preliminary Report J. C. Finn, Jr. and O. D. Brown p 147-151 5 refs (See N63-19494 19-16)

N63-19479 California U., San Diego

THE POSSIBILITY OF LIFE ON MARS

S. L. Miller *In* North American Aviation, Inc., Downey, Calif. Proc. of the Lunar and Planetary Exploration Colloq., Santa Monica, Calif., May 23-24, 1962 p 1-7 10 refs (See N63-19478 19-16)

The primitive earth is believed to have had a reducing atmosphere which was favorable for the evolution of simple organic life. As Mars was formed from the same cosmic dust cloud as the Earth, similar conditions might be expected to have existed on that planet. Laboratory experiments demonstrate that certain basic organic compounds necessary to produce "living" matter can be formed in such a favorable environment. Although these data and the polarization and infrared measurements of the Martian surface are not conclusive evidence, the existence of life on Mars is highly probable. Author

N63-19862 National Aeronautics and Space Administration, Washington, D.C.

PHYSICAL CONDITIONS ON MARS [FIZICHESKIYE USLOVIYA NA MARSE]

N. P. Barabashov Washington, NASA, Aug. 1963 13 p Transl. into ENGLISH from Vestnik Akad. Nauk SSSR (Moscow), no. 10, 1962 p 18 25

(NASA TT-F-165) OTS: $0.50

A discussion is presented in an effort to clarify what is reliably known about Mars, what is in the realm of more or less probable conjecture, and finally what is still completely unexplainable. Significant areas for future research toward determining the physical aspects of planets are indicated. Author

N63-19949 General Electric Co., Philadelphia, Pa. Space Sciences Lab.

THEORY OF HYPERSONIC LAMINAR STAGNATION REGION HEAT TRANSFER IN DISSOCIATING GASES

S. M. Scala and L. M. Gilbert Apr. 1963 70 p 33 refs

(NASA Contract NAS7-100)

(NASA CR-50882; R63SD40) OTS: $6.60 ph, $2.30 mf

The purpose of the present investigation was to determine the thermochemical effects of foreign planetary atmospheres upon hypersonic stagnation-region laminar heat transfer and skin friction, and to attempt to obtain, if possible, a simple correlation of the results with molecular weight, over a range of free-stream molecular weight from 2 to 44. Author

N63-19961 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

VENUS: A SUMMARY OF PRESENT KNOWLEDGE

Michael H. Briggs and Gregg Mamikunian [1963] 39 p 107 refs

(NASA Contract NAS7-100)

(NASA CR-50873) OTS: $3.60 ph, $1.37 mf

Various characteristics and phenomena of the planet Venus are discussed orbital elements, inferior conjunctions of Venus to 1980, Venus transits, linear diameter, mass, color, depth of atmosphere from occultation, spectral features, gases in the atmosphere, clouds, temperature estimates, and rotation periods C L W

N63-20136 National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

EXPERIMENTAL STUDY OF RADIATIVE TRANSPORT FROM HOT GASES SIMULATING IN COMPOSITION THE ATMOSPHERES OF MARS AND VENUS

Carlton S James N Y Am Inst of Aeron and Astronautics 1963, 7 p 12 refs Presented at the AIAA Conf on Physics of Entry into Planetary Atmospheres MIT, Cambridge, Aug 26-28 1963

(AIAA Paper 63-455) AIAA S0 50 members, $1 00 non-members

Measurements have been made of gross spectral quality and intensity of thermal radiations from the hot-gas cap of small polyethylene models flying through mixtures of CO_2 and N_2 Mixture proportions and ambient pressure were varied from pure N_2 to nearly pure CO_2, and from 0 004 to 0 08 atmosphere, respectively Model flight velocity varied from 5 to 8 km/sec Strong radiation from CN, formed in the shock layer, is observed for a wide range of mixture proportions Variation of the total intensity of gas-cap radiation with ambient pressure, flight velocity, and mixture proportions is defined Radiation from the mixtures is compared with radiation from air The total intensity of gas-cap radiation from the CO_2-N_2 mixtures is found to be several times that from air at the same flight conditions, except when high CO_2 concentrations are combined with low velocities Author

N63-20576 Aerospace Medical Div, Brooks AFB, Tex School of Aerospace Medicine

THE ECOLOGICAL PROFILE OF MARS: BIOASTRONAUTICAL ASPECT

Hubertus Strughold *In its* Lectures in Aerospace Med, 4 8 Feb 1963 p 431-448 30 refs (See N63-20551 20-16)

The ecological profile of Mars shows (1) atmosphere composition to be 93 8% nitrogen, 4% argon, 2 2% carbon dioxide, and traces of water vapor and oxygen, (2) a barometric pressure at ground level of about 65 mm Hg, (3) the shield of the Martian atmosphere should offer adequate protection from meteorites and cosmic rays, (4) gravity on the Martian surface is about 38% of that on Earth, and (5) there is no liquid hydrosphere on the Martian surface P V E

N63-20654 Army Missile Command, Huntsville, Alabama Redstone Scientific Information Center

RECENT INVESTIGATIONS OF THE ATMOSPHERE AND SURFACE OF MARS

N N Sytinskaya Aug 5, 1963 18 p Transl by JPRS into ENGLISH from Priroda (Moscow), v 45, no 6, 1956 p 33-41 (RSIC-44)

Investigations of the atmosphere and surface of Mars are reviewed The review covers: (1) physical and chemical composition of the atmosphere, (2) clouds and fog, (3) temperature of the surface, (4) polar caps, and (5) nature of the surface A G O

N63-20816 General Electric Co, Evendale, Ohio Missile and Space Div

VENUS-MARS CAPSULE STUDY, VOLUME I (REVISED)

Mar 1, 1963 598 p refs

(NASA Contract NAS7-100, Contract JPL-950250)

(NASA CR-50956) OTS $26 00 ph, $18 14 mf

A study was conducted to determine the feasibility of sending capsules on impact trajectories to Venus and have them transmit to the Earth information about the thermodynamic variations of the planet atmosphere, to investigate and establish the primary controlling parameters as they affect the performance and capability of a capsule design, and to relate the capsule requirements and capabilities to future Venus and Mars capsule missions The results of the study indicate that it is feasible to design a capsule that will survive entry and collect and transmit data to the Earth as to the characteristics of the Venusian atmosphere The difference in the design of capsules for Mars and Venus was also discussed It was indicated that the heat shield for the Venus capsule may be twice as heavy as the heat shield for the Mars capsule The Mars capsule will require a parachute retardation system in order to obtain adequate subsonic descent times whereas the Venus capsule obtain roughly the same descent times without the use of a retardation system These differences in the two capsules tend to balance out on a weight basis yielding capsules with roughly the same payload capability for the same total weight C L W

N63-21063 Yale U Observatory, New Haven, Conn.

OBSERVATIONS BEARING ON THE MECHANISM OF JOVIAN DECAMETRIC EMISSION

James N Douglas and Harlan J Smith Repr from Mem Soc Roy Sci, Ser 5, v 7, (1963) p 551-562 8 refs

(NASA Grant NsG 73-60)

The mechanism of Jovian decametric emission is discussed with respect to the following areas rotation period and its constancy, polarization anomalies, and power and energy associated with decameter storms P V E

N63-21075 National Aeronautics and Space Administration, Goddard Inst for Space Studies, New York, N Y

AN ANALYTICAL SOLUTION FOR DENSITY DISTRIBUTION IN A PLANETARY EXOSPHERE

C S Shen Repr from J Atmospheric Sci, v 20, No 2, Mar 1963 p 69-72 2 refs

(NASA RP-15)

An analytical expression is derived for the density distribution in a planetary exosphere 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 Maxwelliam law The physical significance of this difference and its effect on the escape rate are discussed Author

N63-21355 California U, Berkeley

ON THE NATURE OF THE JOVIAN RED SPOT

Carl Sagan [1963] 12 p 13 refs Repr from Memories In-8° De La Soc R Sc De Liege, v 7, ser 5, no 1, 1963 p 506-515

(NASA Grant NsG-126-61)

The Great Red Spot lies in the South Tropical Zone of the atmosphere of Jupiter. For the past 130 years, at least, it has been localized at approximately the same latitude; however, it has shown considerable drift in longitude. Hypotheses have been proposed for explaining this curious discrepancy between the motion in latitude and the motion in longitude. The hypothesis of the floating Red Spot is generally unsatisfactory unless a particularly favorable solid-state phase transition should be operating. The meteorological hypothesis has several satisfactory aspects and is probably preferred at the present time. This hypothesis proposes that a topographical discontinuity in the solid surface of Jupiter, which is only a few kilometers high, but which has a transverse dimension comparable to those of the Red Spot, would suffice to produce a stagnant Taylor column extending to the Jovian cloud level. If the column were fixed to a uniformly rotating solid surface, the drift in longitude cannot be explained—in the last century, there would have been times when the plateau was in one hemisphere and the column in the other. But if the solid surface rotated nonuniformly (only the system solid body plus atmosphere must conserve angular momentum), then the drift in longitude, the absence of a drift in latitude, and several other dynamic features of the Red Spot are readily explained. The meteorological hypothesis may also provide a natural explanation for the color of the Red Spot. I.v.L.

N63-21425 Brown Engineering Co., Inc., Huntsville, Ala. Scientific Research Labs.
CHARACTERISTICS AND ORIGIN OF THE NONTHERMAL RADIO EMISSION FROM JUPITER
N. F. Six, Jr. July 1963 68 p 76 refs
(Tech. Note R-60)

The first part of this document is an up-to-date summary of the experimental data collected by monitoring the nonthermal radiofrequency signals from the planet Jupiter. The latter part contains a discussion of the theories which attempt to explain the origin of the microwave and decameter components of the radiation, in the light of these data. Author

N63-21480 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE ELECTRICAL CHARACTERISTICS OF THE ATMOSPHERE AND SURFACE OF VENUS FROM RADAR OBSERVATIONS
Duane O. Muhleman (Harvard Coll. Obs.) Repr. from Icarus, v. I, no. 5/6, May 1963 p 401–411 26 refs
(NASA Contract NAS7-100)
(JPL-TR-32-423)

Radar observations of Venus were made at wavelengths of 12.5 cm and 68 cm during several months around the 1961 inferior conjunction. These observations have been quantitatively compared for possible dispersion effects caused by the atmosphere of Venus and the interplanetary medium. A possible effect of the plasma has been observed at 68 cm through correlations of the radar echo characteristics with solar activity. On the assumption that this correlation was real, a crude model for the ionosphere of Venus has been developed. The model yields a maximum electron density at Venus of order 10^7 cm^{-3} corresponding to a plasma frequency of about 27 mc. The absence of relative dispersion and absorption effects between the two propagation frequencies is interpreted to indicate that all plasma phenomena were small, however,. In particular, the proposed ionospheric model as the source of the Venusian radio spectrum is shown to be inconsistent with the radar observations. An analysis of the observed echo power indicates the average dielectric constant of the Venusian surface material to be less than 7 but greater than 3 with no large upward variations during the observations. This low value of the dielectric constant and the absence of measurable variations in the echo power (and consequently, in the dielectric constant) is interpreted to indicate that there are no large bodies of water on the Venusian surface. Author

N63-21547 Joint Publications Research Service, Washington, D.C.
EXTRATERRESTRIAL LIFE
A. I. Oparin Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), v. 28, no. 1, 1963 p 3–8 *In its* Soviet Studies in Space Biol. and Med., Apr. 4, 1963 p 1–7 (See N63-21546 22-16)

The possibility of extraterrestrial life on Mars is discussed. This discussion begins with the conjecture that Mars once had a hydrosphere and an atmosphere. Thus, the evolution of organic matter and origin of life on this planet may have occurred in a similar fashion to that on earth. However, the physical conditions on Mars gradually came to differ sharply from those on Earth. The physical conditions now prevailing on Mars suggest that the only living organisms may be anaerobic microorganisms whose metabolism functions in the absence of free oxygen. Water vapor, which is clearly insufficient in the Martian atmosphere, may condense at night into liquid on top of the "Martian soil" and thus create a medium in which primitive organisms can survive. I.v.L.

N63-21997 Armour Research Foundation, Chicago, Ill.
LIFE IN EXTRATERRESTRIAL ENVIRONMENTS Quarterly Status Report, Feb. 15-May 15, 1963
Charles A. Hagen [1963] 15 p 3 refs
(NASA Contract NASr-22)
(NASA CR-50883; ARF 3194-9) OTS: $1.60 ph, $0.80 mf

A micrococcus, nonspore former, isolated from a California desert soil, was placed in a simulated Martian environment and survived with little change in total viable count for at least 28 days. Survival in the Martian environment of this microorganism was enhanced when the Martian soil was replaced with sterile desert soil from which it was isolated. The decrease in total viable count as a result of inoculation procedure and flushing with either Earth or Martian atmosphere was partially overcome by replacing the Martian soil with the desert soil. A partial listing of this microorganism's morphological and biochemical characteristics is given; the moisture, organic, and inorganic composition of the Martian soil and of 5 desert soils are reported, and the moisture uptake of Martian soil and of Martian soil with 1 and 10% dehydrated bacteriological medium is indicated. C.L.W.

N63-22157 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE INFLUENCE OF SHAPE ON AERODYNAMIC DAMPING OF OSCILLATORY MOTION DURING MARS ATMOSPHERE ENTRY AND MEASUREMENT OF PITCH DAMPING AT LARGE OSCILLATION AMPLITUDES
Bain Dayman, Jr., James M. Brayshaw, Jr., Duane A. Nelson, Peter Jaffe, and Terry L. Babineaux Feb. 28, 1963 39 p 17 refs
(NASA Contract NAS7-100)
(NASA CR-51421; JPL-TR-32-380) OTS: $3.60 ph, $1.37 mf

Preliminary mission requirements for first generation vehicles proposed for entry into the atmosphere of Mars indicate the use of a high-drag body of revolution with length about equal to the maximum diameter. Even for the case of initial rearward entry, it is desirable that forward orientation with low amplitudes of oscillation of such vehicles during the heating period (and beyond) be attained passively; that is, without the need of any active control devices. Six-degree-of-freedom atmosphere-entry studies indicate the significant effects of both vehicle shape and pitch damping upon the envelope of the angle-of-attack oscillation at the time of practical parachute deployment. One purpose of this report is to demonstrate the importance of the vehicle shape upon the requirements (accuracy and angle-of-attack amplitude) for measuring pitch damping; the other purpose is to discuss the two wind-tunnel methods being developed to measure small amounts of pitch damping accurately at high amplitudes of oscillation. Author

N63-22371 Douglas Aircraft Co., Inc., Santa Monica, Calif.
PHYSICAL PROPERTIES OF THE PLANET MARS
Aug. 1963 98 p 179 refs
(SM-43634)

Topics of discussion include orbital elements, satellites, mass, diameter, shape, mean density, internal structure, surface gravity, the axis and period of rotation, temperature, climate, atmosphere, surface pressure, circulation, clouds, surface features, polar caps, canals, life, and electromagnetic and particle fields. J.E.T.

N63-22512 Geophysics Corp. of America, Bedford, Mass.
THEORETICAL ESTIMATES OF THE AVERAGE SURFACE TEMPERATURE ON MARS Technical Report No. 1
George Ohring, Wen Wang, and Gloria De Santo Apr. 1962 27 p 10 refs
(NASA Contract NASw-286)
(NASA CR-51990; GCA-TR-62-3-N) OTS: $2.60 ph, $1.01 mf

Estimates of the average surface temperature on Mars are derived from radiative equilibrium considerations. A minimum possible surface temperature is estimated by computing the radiative equilibrium temperature that the Martian surface would have if the planet had no atmosphere. An estimate of the maximum possible value of the average surface temperature is obtained by computing the surface temperature that would result from a maximum greenhouse model. The computations indicate that the average surface temperature is in the range 219° K to 233° K. Comparisons of the theoretical computations with indications of surface temperature obtained from thermal emission observations are found to be in reasonable agreement. Author

N63-22880 RAND Corp., Santa Monica, Calif.
THE PHYSICS OF BALLOONS AND THEIR FEASIBILITY AS EXPLORATION VEHICLES ON MARS
S. M. Greenfield and M. H. Davis Sept. 1963 167 p 68 refs
(NASA Contract NAS7-100; and JPL Contracts N-33561 and N-950505)
(NASA CR-51782; R-421-JPL) OTS: $12.00 ph, $5.21 mf

This report presents a development of balloon theory and an analysis of the performance of balloons as vehicles on Mars. A general theory is developed that describes the behavior of extensible balloons and three classes of nonextensible balloons. With reasonable assumptions concerning the Martian atmosphere and the success of certain research efforts, the theory indicates that the tasks at which balloons can be useful and efficient on Mars are quite varied. Author

N63-22939 Douglas Aircraft Co., Inc., Santa Monica, Calif.
AN AIRBORNE INFRARED RADIOMETER EXPERIMENT TO DETECT WATER VAPOR ON VENUS
D. C. Evans Apr. 1963 69 p 27 refs

Development of a system using the DC-8 as an airborne observatory is discussed. During 1962, attempts were made to observe Venus. The program has been delayed indefinitely because the spectral radiometer that was used proved to be inadequate. Author

N63-23020 National Aeronautics and Space Administration, Washington, D.C.
THE U.S. SPACE PROGRAM PROGRESS REPORT
Hugh L. Dryden [1962] 10 p Presented at Space Sci. Commemorative Dinner, Cleveland, Ohio, Nov. 25, 1962
(NASA TM X-50963) OTS: $1.10 ph, $0.80 mf

NASA accomplishments over the past four years are outlined. Much detailed information of the composition of the Earth's "atmosphere" has been gained. The first layer extends to about 75 miles, and is composed chiefly of oxygen and nitrogen; the second layer extends from about 75 miles to about 620 miles, and is composed essentially of atomic oxygen; the third layer which extends from about 620 miles to 1500 miles is composed chiefly of helium. Above this layer is the hydrogen layer fading out into interplanetary space. The major outline of the density of the atmosphere at various heights and its variation with time of day and with solar activity have been determined. Radio soundings of the ionosphere are being made. Measurements of protons and electrons in the region around the Earth are being made. The main features of the Earth's magnetic field have been determined. The moving Earth produces a magnetic shock wave in the interplanetary field. Behind the shock wave is a region of transition to the Earth's field exhibiting irregular variations in magnitude and direction. The first probe to Venus is on the way, due to reach the neighborhood of the planet in mid-December. Tiros weather satellites are sending meteorological data, and Echo and Telstar are providing transoceanic communications. The development of an advanced Saturn is underway. Project Mercury was successful. Projects Gemini and Apollo are in the development stages. I.v.L.

N63-23185 General Electric Co., Valley Forge, Pa. Space Sciences Lab.
EXPERIMENTAL HEAT TRANSFER STUDIES OF HYPERVELOCITY FLIGHT IN PLANETARY ATMOSPHERES
J. S. Gruszczynski and W. R. Warren, Jr. N.Y., Am. Inst. of Aeron. and Astronautics [1963] 61 p 20 refs Presented at the AIAA Conf. on Phys. of Entry into Planetary Atmospheres, Cambridge, Mass., Aug. 26–28, 1963
(Supported by NASA; JPL Contract 950297)
(AIAA Paper 63-450) AIAA: $0.50 members, $1.00 nonmembers

Characteristics of aerothermodynamic conditions affecting a vehicle entering a planetary atmosphere are explored. Results

of flight simulation study of some of the heat transfer problems associated with the entry of a ballistic vehicle into the atmospheres of near planets are presented. The planetary atmospheres are assumed to be composed primarily of CO_2-N_2, and hypervelocity entry conditions are assumed. The percentage composition of the CO_2-N_2 does not have a large effect on the experimental convective heat transfer rates; and the percentage composition of the test gas is relatively much less important in the hypervelocity regime than in the earth orbital and suborbital velocity regimes. R.T.K.

N63-23454 California U., Berkeley
LIFE BEYOND THE EARTH
Carl Sagan *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 297–310 (See N63-23436 24-01) (Lecture 20)

The interrelated questions of extraterrestrial life and the origin of life on Earth are considered. A theory of the origin of life in the primitive oceans is reviewed, and the laboratory recreation of life is regarded as a likely possibility. The primitive environments of the other planets are expected to have been similar to the primitive environment of the Earth. Information on the present atmospheric and surface conditions of Venus, Mars, the Moon, and the Jovian planets is reviewed and related to the possibility of existence of life based on organic matter. The existence of life based on some other kind of chemistry is beyond comprehension at present. Speculation on extraterrestrial life has been popular over the years, but the prospect of actual experimentation to solve this question belongs to this generation. The importance of sterilizing the interiors of all space probes in order to prevent contamination of extraterrestrial areas with terrestrial microorganisms is stressed. M.P.G.

N63-23806 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MARS ATMOSPHERE ENTRY PARAMETRIC STUDY
J. M. Brayshaw Sept. 15, 1963 109 p refs
(NASA Contract NAS7-100)
(NASA CR-52271; JPL-TR-32-458) OTS: $9.10 ph, $3.47 mf

The expected extreme model atmospheres as well as the anticipated extremes of initial entry velocity, entry angle, and ballistic coefficient were included in the study. As functions of these variables, the following parameters are plotted in graphical form: (1) flight path acceleration vs altitude; (2) mach no. vs altitude; (3) dynamic pressure vs altitude; (4) heating rate vs altitude; (5) flight path angle vs altitude; (6) atmospheric velocity vs altitude; (7) altitude vs time; (8) altitude vs planet centered angle. In addition, summary plots of peak heating rate, peak acceleration, unretarded impact velocity, and altitude for parachute deployment are shown as a function of entry angle for the extremes of ballistic coefficient and model atmosphere. Author

N63-23818 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STUDIES ON ABLATION OF OBJECTS TRAVERSING AN ATMOSPHERE
Ernst W. Adams, John D. Warmbrod, and Benton K. Berry June 19, 1963 42 p refs
(NASA TM X-50999; MTP-AERO-63-47) OTS: $4.60 ph, $1.46 mf

This report reviews theoretical studies performed with regard to the ablation-type heat protection of vehicles traversing an atmosphere. These studies rest on numerical solution methods of the pertinent, partial differential equations representing balances of mass, momentum, and heat. Provided sufficiently small steps are used, the numerical calculation methods yield exact solutions for homogeneous and noncharring materials. Author

1964
STAR ENTRIES

N64-10081* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENTAL STUDIES OF STATIC STABILITY AND RADIATIVE HEATING ASSOCIATED WITH MARS AND VENUS ENTRY
Carlton S. James and Willard G. Smith *In* Am. Inst. of Aeron. and Astronautics Proc. of the Aerospace Forum I Session Jan. 1963 p 16–21 refs (See N64-10080 01-01) AIAA: $4.00 members, $8.00 nonmembers

Preliminary experimental studies concerning two aspects of vehicle entry into the atmosphere of Mars or Venus, those of radiative heating and static stability, are discussed. The radiative heating problem is examined by comparing gas-cap radiation in the simulated planetary atmospheres with that under the same ambient conditions in air. The effects of gas composition on static stability and drag of several different entry-body configurations are compared. Author

N64-10102* General Electric Co., Philadelphia, Pa. Space Sciences Lab.
MEASUREMENTS OF HYPERVELOCITY STAGNATION POINT HEAT TRANSFER IN SIMULATED PLANETARY ATMOSPHERES
J. S. Gruszczynski and W. R. Warren Mar. 1963 69 p refs
(NASA Contract NAS7-100; JPL Contract 950250; AF 49 (638)-931)
(NASA CR-52201; R63SD29) OTS: $6.60 ph, $2.27 mf

The heat transfer to the stagnation region of a hemispherical body at flight velocities up to 40,000 fps in two CO_2-N_2 gas mixtures corresponding to the expected atmosphere of Venus, has been investigated experimentally in the electrically driven hypervelocity shock tube. These results are compared with heat-transfer data in pure CO_2 and pure N_2. Calculations of radiative heat-transfer contribution to the total heating are shown. Also, shock-tube performance in two gas compositions as used in these experiments was computed. An attempt was made to measure radiant heat transfer to the stagnation region using the newly developed cavity gage. Author

N64-10315 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
CONVECTIVE HEATING IN PLANETARY ATMOSPHERES
W. Van Tassell Oct. 18, 1963 40 p refs
(RAD-TM-63-72)

A study of convective heating in mixtures of nitrogen and carbon dioxide is reported. This study for four different mixture

ratios and for a variety of flight conditions has been performed. The results in the form of tables and design graphs are presented. Applications to planetary probe designs are given. A comparison with available experimental data is also made, and very good agreement is indicated. Author

N64-10461* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ULTRAVIOLET SPECTROSCOPY OF PLANETARY ATMOSPHERES
Charles A. Barth Repr. from "Dyn. of Manned Lifting Planetary Entry", July 1963 p 82–94
(NASA Contract NAS7-100)
(NASA CR-52461; TR-32-516)

The ultraviolet spectrum of a planetary atmosphere is produced by charged-particle bombardment and solar radiation. The ultraviolet aurora and dayglow may be observed from a rocket within the atmosphere, from a satellite above the atmosphere, and from a space probe flying by the planet. The spectrum of the ultraviolet dayglow is the result of molecular scattering, abosrption, resonance reradiation, and fluorescence of the incident solar radiation. The composition of the upper atmosphere may be determined from a quantitative analysis of the dayglow spectra. The spectrum of the ultraviolet aurora identifies many of the atoms and molecules that are present in the atmosphere. The geographic distribution of the aurora is believed to be the result of the interaction of the solar plasma with the planet's magnetosphere. The details of the spectrum will provide information on the energy and nature of the bombarding particles. Author

N64-10903* Cutler-Hammer, Deer Park, N.Y.
STUDY OF TOPSIDE SOUNDER FOR MARS AND VENUS IONOSPHERES FROM MARINER SPACECRAFT Final Report
T. Flattau and R. Donegan Oct. 1963 118 p refs
(NASA Contract NASw-513)
(NASA CR-52731; Rept. 1844-1) OTS: $9.60 ph, $3.74 mf

This report analyzes the problems and solutions in sounding the topside of the ionospheres of Mars and Venus from a passing spacecraft. A recommended system configuration is described that uses a set of optimum techniques for performing the soundings requiring peak RF powers that are compatible with solid-state transmitters. Transmission of an interrupted CW (50-percent duty cycle) RF pulse train that is small-angle phase modulated by a 150-cps tone is chosen as the optimum modulation. The distance to the reflecting layer of the ionosphere can then be determined by measuring the phase delay of the detected tone in the received signal. A partial breadboard of the recommended system was constructed during the study to verify the suitability of the various techniques and their compatibility. The design specifications and details of the system components are discussed. Author

N64-10929* Massachusetts Inst. of Tech., Cambridge
RADIOMETRIC MEASUREMENTS IN RADIO ASTRONOMY
Victor K. Chung *In* RAND Corp. The Appl. of Passive Microwave Technol. to Satellite Meteorology: A Symp. Aug. 1963 p 218–219 (See N64-10911 02-01) OTS: $17.00 ph, $8.15 mf

Plans for a program in radio astronomy, which will investigate the Earth's atmosphere and the extraterrestrial sources of radio emission, are summarized as follows: (1) A ground-based radiometer looking skyward at various angles with respect to the zenith will be used for studying the distribution and abundance of water vapor in the atmosphere. The radiometer will track the Sun and the Moon. (2) Radiometric measurements will be taken of several sources, primarily Venus, Jupiter, and some of the other stronger sources. (3) An attempt will be made to take spectra of gases at very high pressures. (4) Measurements of the emissive properties of some common materials will be made at frequencies planned for the radiometers. (5) An attempt will be made to transistorize all equipment so that it can be flown in a balloon and perhaps even in a satellite. I.v.L.

N64-11234* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENTS FROM A SMALL PROBE WHICH ENTERS THE ATMOSPHERE OF MARS
R. A. Hanel, L. E. Richtmyer, R. A. Stampfl, and W. G. Stroud Washington, NASA Dec. 1963 23 p refs
(NASA TN D-1899) OTS: $0.75

This paper addresses itself to the design of a Mars capsule capable of a safe entry and landing on Mars. Quite simple sensors of pressure, temperature, density, molecular weight, and gross composition of the atmosphere can yield significant physical and ecological data. The safe landing will permit the execution of significant biological experiments for the detection of life. Data transmitted at a rate of 1 bit/sec during the capsule descent and following the landing are best handled by a direct planet-to-Earth communication link. The significance of the experiments and the techniques required are discussed. Author

N64-11293* IIT Research Inst., Chicago, Ill.
LIFE IN EXTRATERRESTRIAL ENVIRONMENTS Quarterly Status Report, 15 Sep–15 Nov. 1963
Charles A. Hagen and Regnal Jones [1963] 20 p
(NASA Contract NASr-22; IITRI Proj. C194)
(NASA CR-52841; IITRI-C194-11) OTS: $1.60 ph, $0.80 mf

Bacterial counts are given for soil samples collected at Rocky Mountain National Park, Colorado and White Sand National Monument, New Mexico. Faculative, lecithinase positive microorganisms were isolated from a variety of desert and tundra soil samples. These bacteria were able to survive the simulated Martian environment of the experiment. Fungal components of lichen species were isolated and were able to survive the Martian atmosphere. Apothecia germination, with mycelial growth also occurred in the simulated Martian environment. Some pigmentation of lichenized fungi grown in the Martian atmosphere was noticed. R.T.K.

N64-11650* National Aeronautics and Space Administration, Washington, D.C.
RADIATIVE TRANSFER IN THE ATMOSPHERES OF VENUS AND MARS
R. Jastrow and S. I. Rasool [1962] 14 p refs Presented at the 3rd COSPAR Space Sci. Symp., Wash., D.C. 30 Apr.–9 May 1962

An approximate theory of radiative transfer in planetary atmospheres is developed and applied to atmospheres of Venus and Mars. The results for Venus indicate that the atmosphere of that planet must have an optical thickness of 60 in the infrared, corresponding to a transmission of 10^{-26}, in order to produce the observed surface temperature of 600° K. The surface temperature and tropopause height of Mars are also investigated. Author

N64-11903* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A STUDY OF THE CONVECTIVE AND RADIATIVE HEATING OF SHAPES ENTERING THE ATMOSPHERES OF VENUS AND MARS AT SUPERORBITAL SPEEDS
Fred A. Demele Washington, NASA, Dec. 1963 31 p refs (NASA-TN-D-2064) OTS: $0.75

Analysis indicates that for blunt capsule entries at speeds somewhat greater than the Hohmann-transfer planetary arrival velocities, the predominant heating mode is by radiation in the case of Venus, and by convection in the case of Mars. It is shown that sweepback of the bow shock can reduce the radiative input so drastically that for Venus entry the total combined radiative and convective heat input of a conical shape will be about half that of a blunt capsule. Because convective heating predominates in the Mars entry, little or no reduction in total heat is afforded by conical shapes. However, since the radiation is highly dependent on velocity, conical shapes appear attractive for Mars entry at higher velocities (say 40,000 fps) corresponding to those for shortened interplanetary trip times. There is strong experimental evidence that the intensity of radiation is significantly influenced by gas composition. Author

N64-11942 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
MODEL ATMOSPHERES FOR THE PLANET MARS
D. C. Evans and P. E. Wasko Aug. 1963 61 p refs (SM-44552)

Four model atmospheres for the planet Mars are presented for use in engineering studies. Three are for a molecular weight of 28.0 with surface pressures of 85, 162, and 37 mb. They are representative of mean, maximum, and minimum conditions, respectively. The fourth model is for a molecular weight of 32.8 with a surface pressure of 37 mb, representing extreme minimum conditions. These models indicate the expected numerical range of the thermodynamic variables—pressure, temperature, and density—to be encountered in the Martian atmosphere from 0 to 400 km (1,312,300 ft) during the 11-year solar cycle, 1975 to 1985. The extreme atmospheric models are not artificial envelopes of all possible combinations, but represent physical conditions which may actually exist on Mars. Author

N64-12165 National Bureau of Standards, Boulder, Colo.
BIBLIOGRAPHY ON ATMOSPHERIC ASPECTS OF RADIO ASTRONOMY
Wilhelm Nupen 1 May 1963 453 p 1013 refs Meteorol. and Geoastrophysical abstracts prepared by Am. Meteorol. Soc. (NBS-TN-171) Available from GPO

This annotated bibliography contains references from the literature published between 1900 and 1961, inclusive, but the bulk of the literature follows the discovery by Jansky in 1932 of radiofrequency radiation from the sun, and especially the building of radio telescopes since World War II. The subject matter is confined to: (1) the effects of the earth's atmosphere on radiofrequency radiation from the sun, planets, stars, the galaxies, and intergalactic space; and (2) knowledge of atmospheric or ionospheric structure, composition, or physics. R.T.K.

N64-12274 RAND Corp., Santa Monica, Calif.
PARAMETRIC LIMITS FOR THE UPPER ATMOSPHERE OF MARS
G. F. Schilling Nov. 1963 52 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3885-PR; AD-423922)

Probable upper and lower limits are calculated for the distribution of atmospheric pressure and mass density in the upper atmosphere of Mars. The three self-consistent model atmospheres (Tentative Maximum, Tentative Minimum, and Tentative Standard) should bracket actual conditions in the Martian atmosphere up to 500-km altitude and, above that, plausibly represent the extreme range of probable conditions. At any specific altitude level, the true daily mean values prevailing during any season over middle and low latitudes should fall between these limits. If no specific season, time of day, or latitude is specified, the Tentative Standard Atmosphere will estimate, in orders of magnitude for the whole altitude range, those pressures and densities that will probably occur more often than not. Author

N64-12890 Joint Publications Research Service, Washington, D.C.
EXPLORATIONS OF OUTER SPACE AND THE OUTER LAYERS OF THE ATMOSPHERE
A. A. Blagonravov *In its* Outer Space Explorations 4 Dec. 1963 p 1–22 (See N64-12889 04-01)

The principal results of explorations of outer space were carried out with the aid of: (1) the automatic interplanetary station, "Mars-1;" (2) satellites of the "Kosmos" type intended for study of the outer layer of the atmosphere and the outer space which surrounds the Earth; (3) the launching of exploratory rockets with the purpose of recording the temperature, density, and winds in the upper layers of the atmosphere; and (4) radiolocation of the planets Mercury, Venus, and Mars with the aid of ground-based means. R.T.K.

N64-12950* Geophysics Corp. of America, Bedford, Mass.
A THEORETICAL ESTIMATE OF THE AVERAGE VERTICAL DISTRIBUTION OF TEMPERATURE IN THE MARTIAN ATMOSPHERE Technical Report No. 2
George Ohring Jun. 1962 19 p refs
(NASA Contract NASw-286)
(NASA CR-52414; GCA-TR-62-7-N) OTS: $1.60 ph, $0.80 mf

The average variation of temperature with height in the Martian atmosphere is probably controlled by radiative and convective processes. With the use of a simple theoretical formulation in which it is assumed that convection will extend to that height above which the radiative equilibrium lapse rate is just stable, the average temperature profile is computed. It is assumed that the average surface temperature is 230° K, that there is no absorption of solar radiation in the atmosphere, and that carbon dioxide in an amount equal to 2% by volume is the only important radiating gas. The radiation fluxes are computed with the aid of radiation tables; the radiative equilibrium temperatures are calculated using an iterative procedure. The computed temperature profile is characterized by an adiabatic troposphere extending to about 9 km, above which the temperature continues to decrease with height to an average value of about 90° K for the topmost 5mb layer. Author

N64-13066* Geophysics Corp. of America, Bedford, Mass.
A STUDY OF THE METEOROLOGY OF MARS AND VENUS Quarterly Progress Report No. 3, 6 Jul.-5 Oct. 1963
[1963] 35 p 4 refs
(NASA Contract NASw-704)
(NASA CR-55165) OTS: $3.60 ph, $1.25 mf

Several topics of importance to the meteorology of Mars and Venus were investigated. Atmospheric tides in the Martian

atmosphere were discussed. Techniques for constructing thermodynamic diagrams for the Martian atmosphere were developed, and actual diagrams are under construction. Meteorological studies of Venus focused on two problems, both of which are related to planetary and atmospheric temperatures. The first problem was an estimate of the amount of solar radiation absorbed by carbon dioxide in the atmosphere of Venus. The second problem concerned the temperature variation with altitude in the atmospheric layer between the planet's surface and the base of the cloud layer. Techniques for computing the radiative equilibrium distribution of temperature in this layer were developed. I.v.L.

N64-13272* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

HIGH DISPERSION SPECTRA OF THE OUTER PLANETS: I. JUPITER IN THE VISUAL AND RED

Hyron Spinrad and Laurence M. Trafton Repr. from Icarus, v. 2 Jan. 1963 p 19–28 refs
(NASA Contract NAS7-100)
(NASA CR-53003; JPL-TR-32-437)

High dispersion spectrograms of Jupiter partially resolve the red methane and ammonia bands and show new, weak lines. At times the Jovian ammonia and methane gases do not co-rotate with the cloud layer as evidenced by the anomalous inclination of their absorption lines. The measures are discussed in detail. The Jovian CH_4 lines in the λ6190 band have been compared in detail with their laboratory and Saturnian counterparts. An upper limit to the total pressure above the Jovian cloud layer is estimated; from these data and a new H_2 abundance of about 27 km-atm, a limit to the H/He ratio is deduced. We find the H/C ratio for Jupiter, Saturn, and Uranus to be far below the corresponding ratio in the Sun and other stars. The locations of two new lines tentatively ascribed to Jupiter are given; a search for some other absorbers in this spectral region gave negative results. Author

N64-13273* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

MARS ATMOSPHERE ENTRY PARAMETRIC STUDY

J. M. Brayshaw 31 Oct. 1963 109 p refs (See N63-23806 24-29)
(NASA Contract NAS7-100)
(NASA CR-53020; JPL-TR-32-458, Rev. 1) OTS: $9.10 ph, $3.47 mf

The expected extreme model atmospheres, as well as the anticipated extremes of initial entry velocity, entry angle, and ballistic coefficient were included in the study. As functions of these variables, the following parameters are plotted in graphical form: (1) flight path acceleration vs altitude; (2) Mach no. vs altitude; (3) dynamic pressure vs altitude, (4) heating rate vs altitude; (5) flight path angle vs altitude; (6) atmospheric velocity vs altitude; (7) altitude vs time; and (8) altitude vs planet centered angle. In addition, summary plots of peak heating rate, peak acceleration, unretarded impact velocity, and altitude for parachute deployment are shown as a function of entry angle for the extremes of ballistic coefficient and model atmosphere. Author

N64-13274* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

HIGH DISPERSION SPECTRA OF THE OUTER PLANETS. II. A NEW UPPER LIMIT FOR THE WATER VAPOR CONTENT OF THE MARTIAN ATMOSPHERE

Hyron Spinrad and E. H. Richardson Repr. from Icarus, v. 2, Jun. 1963 p 49–53 refs
(NASA Contract NAS7-100)
(NASA CR-53004; JPL-TR-32-462)

A very high dispersion spectrogram of Mars has been searched unsuccessfully for Martian H_2O lines near λ 7200. The plate was taken on a very dry night when the Doppler shift was sufficient to displace any Mars H_2O lines 0.29 A from their telluric counterparts. From this data, an upper limit has been derived for the integrated Martian water vapor abundance of approximately 3.5×10^{-3} gm/cm^2 (35 μ). The practical limits for detection of Martian water vapor by Earth-bound, balloon, and space probe techniques indicate that spectroscopic observations from the Earth can be refined to a point where they are at least as sensitive as present infrared space experiments. Author

N64-14146 Joint Publications Research Service, Washington, D.C.

PLANET MARS DISCUSSED IN POPULAR SCIENCE ARTICLES

M. G. Mikhaylov, comp. et al 24 Jan. 1964 37 p refs Transl. into ENGLISH of 9 articles from the booklet "Mars", Moscow, Znaniye Publishing House, 1962 p 3–22 and 47–63
(JPRS-22878; OTS-64-21375) OTS: $1.00

Russian popular science articles presented are: (1) Mysteries of the Planet Mars; (2) What We Know about the Planet Mars; (3) Nature on the Mysterious Planet; (4) The Bowels of the Planet Mars; (5) The Assault upon Space; (6) The Most Difficult Thing To Do Is To Forecast; (7) Thoughts about Mars; and (8) Data on Our Neighbor in Space. Also, a bibliography of Russian literature concerning Mars is presented. I.v.L.

N64-14152* California U., La Jolla, Calif.

REMARKS CONCERNING THE CHEMICAL COMPOSITION OF THE ATMOSPHERE OF VENUS

Hans E. Suess Oct. 1963 12 p refs Submitted for Publication
(NASA Grants NsG-322-63 and NsG-317-63)
(NASA CR-55367) OTS: $1.60 ph, $0.80 mf

It is still impossible to decide, on the basis of observational facts, whether the atmosphere of Venus is oxidizing, or reducing. Also, cosmochemical considerations do not lead to a conclusive answer to this important question. The atmosphere of Venus appears to be much more dense than that of the Earth. For several reasons, it seems probable that the main constituent of the dense atmosphere is neon. Author

N64-14270* National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.

A THEORETICAL STUDY OF THE MARTIAN IONOSPHERE

R. B. Norton [1963] 16 p refs Presented at the Am. Astronautical Soc. Symp. on the Exploration of Mars
(NASA Order R-65)
(NASA CR-55362) OTS: $1.60 ph, $0.80 mf

A theoretical study, based on a neutral atmosphere composed of 2% carbon dioxide and 98% molecular nitrogen, indicates that the Martian ionosphere would occur higher above the planet's surface than does the terrestrial ionosphere, but at about the same total pressure. The maximum electron density for overhead sun is about 2×10^5 cm^3 as compared to about 10^6 cm^3 on earth. On Mars there may be layers that absorb radio waves more strongly than the normal terrestrial D region. Author

N64-14285* Arizona U., Tucson Engineering Research Labs.
DETECTION TECHNIQUES FOR TENUOUS PLANETARY ATMOSPHERES First Semiannual Report, 1 Jun. 1963-1 Jan. 1964
Stuart A. Hoenig and Melvin M. Eisenstadt [1964] 13 p refs
(NASA Grant NsG-458)
(NASA CR-55379) OTS: $1.60 ph, $0.80 mf

Developments in the following areas of investigation are discussed: chemisorption detector for oxygen, thoriated tungsten filament for oxygen detection, chemisorption detector for hydrogen, molecular-beam systems, and molecular-beam detectors. P.V.E.

N64-14515 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena Space Sci. Div
THE ANOMALOUS INCLINATION OF THE JOVIAN AMMONIA LINES
Hyron Spinrad Repr. from the Astrophys. J., v. 136, no. 1, Jul. 1962 p 311 refs

The NH_3 lines in the λ 6460 band are well resolved on four Mount Wilson and Palomar coudè spectrograms of Jupiter. Two of these (Ce 817 by Dunham in 1934 and Pa 6055 by Munch in 1961) were taken with the slit along the Jovian equator. These plates clearly show the Fraunhofer lines tilted with respect to the comparison lines and the nearby H_2O lines. However, the inclination of the ammonia lines is strikingly different from the reflected solar lines; the inclination of the NH_3 lines was about 22 percent of the Fraunhofer line inclination on Ce 817 and about 30 percent on Pa 6055. The errors of measurements are about 5 percent—far too small to permit the expected result of 50 percent of the solar-line inclination. A satisfactory explanation for the anomalous ammonia-line tilt has not yet been proposed. Author

N64-14972 Pennsylvania State U., University Park
IONOSPHERIC RESEARCH Final Report, 1 Oct. 1958-31 Oct. 1963
A. H. Waynick 30 Nov. 1963 52 p refs
(Contract AF 19(604)-4563)
(AFCRL-63-931; AD-428804)

The statement of work for the research to be performed under this contract called for theoretical and experimental investigations on the physics, dynamics, and aeronomic properties of the earth's and other planetary atmospheres. Also involved were theoretical and experimental studies of various relevant atomic and molecular rate coefficients. These broad objectives, along with certain related efforts underway in the laboratory, comprised the basis for the studies outlined in this report. An outline of each investigation undertaken is given. A listing of the reports issued and in preparation is presented. Author

N64-15781* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ON THE PRESENCE OF OXYGEN IN THE ATMOSPHERE OF VENUS
V. K. Prokofyev and N. N. Petrova 15 Jan. 1964 21 p refs
Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 29, 1963 p 3-14
(NASA Contract NAS7-100)
(NASA CR-53061; JPLAI/Trans.-33) OTS: $2.60 ph, $0.83 mf

Spectra of reflected solar light from Venus in the region of the telluric oxygen α-band at a dispersion of 1A/mm were obtained with an echelle spectrograph (grating spectrograph) attached to the solar tower telescope. The photometric reduction of the plates showed an asymmetry in the lines of the telluric oxygen α-band. This asymmetry may be due to a faint oxygen-absorption band formed in the region above the cloud layer of the atmosphere of Venus. R.T.K.

N64-16362 Air Force Systems Command, Wright-Patterson AFB, Ohio
VOLCANOES ON VENUS
N. A. Kozyrev 29 Mar. 1963 4 p Transl. into ENGLISH from Zarya Vostoka (USSR), 18 Dec. 1962 p 4
(FTD-TT-63-305/1+4; AD-402594)

Photographs of the absorption spectra of the smoke flames from certain active volcanoes of the Klyuchevskiy group at Kamchatka were obtained. These photographs revealed the presence of two absorption bands in the visible region of the spectrum. Bands of this same type had been previously observed in the spectrum of Venus. Thus, the existence of such bands in the spectra of volcanic fumes provides a basis for assuming that there is strongly developed volcanic activity on Venus. These bands are entirely absent in the Martian atmosphere; therefore, there is a basis for assuming that volcanic activity on this planet, if it does exist, is significantly weaker than that on Venus and Earth. I.v.L.

N64-16675* Princeton U. Observatory, N.J.
THE FIRST FLIGHT OF STRATOSCOPE II
Robert E. Danielson Repr. from Am. Scientist., v. 51, no. 4, Dec. 1963 p 375-399 refs
(Sponsored by NASA, NSF, and ONR; Proj. Stratoscope)

A description is presented of the stratoscope II telescope system and of the launching and operation procedures. During the first flight, Mars was scanned for approximately one-half hour. From the data obtained (only infrared emission was recorded), it appeared that the carbon dioxide abundance on Mars is about 6,000 cm-atm. The data also indicated a water-vapor content of 10μ in the Martian atmosphere. P.V.E.

N64-16678* Princeton U. Observatory, N.J.
MARS OBSERVATIONS FROM STRATOSCOPE II
R. E. Danielson, J. E. Gaustad, M. Schwarzschild, H. F. Weaver, and N. J. Woolf (Calif. U.) Repr. from Symp. on Instrumental Astronomy, Ariz. U., 1964 refs
(Sponsored by NASA, NSF, and ONR; Proj. Stratoscope)

On March 1, 1963, Stratoscope II, a balloon-borne telescope, was flown for the first time with the aim of investigating the infrared spectrum of Mars. A series of technical difficulties arose during the flight and severely restricted the number and quality of the spectrometer scans that were obtained. Nevertheless, the following results could be deduced from these scans: (1) It is improbable that the water vapor content of Mars is greater than 40 microns. (2) If the total pressure at the surface of Mars is assumed to be 87 mb, the amount of CO_2 in the atmosphere of Mars amounts to about 6,000 cm-atm, rather than 3,000 cm-atm, as previously estimated. Author

N64-16745* IIT Research Inst., Chicago, Ill.
LIFE IN EXTRATERRESTRIAL ENVIRONMENTS Quarterly Status Report, 15 Nov. 1963-15 Feb. 1964
Charles A. Hagen and Regnel Jones [1964] 16 p refs
(NASA Contract NASr-22 IITRI Proj. C 194)
(NASA CR-53106; IITRI C194-12) OTS: $1.60 ph, $0.80 mf

Incorporation of 4.9% or 21.7% moisture into the dry simulated Martian soil modified by the addition of 1% organic medium increased the number of *B. subtilis* surviving the inoculating and flushing procedures. Lower moisture concentrations, 2.0% and 0.25%, did not have this effect. However, the death rate was greater in the tubes with 4.9 and 21.7% moisture. Thus, after 56 days of exposure there was no significant difference between the groups. Less than 0.02% of *Ps. aeruginosa* cells survived a 1-week exposure to Martian environment modified by 10% organic medium and 10% moisture. *B. cereus* spores survived the simulated Martian environment modified by 10% organic medium plus 20% moisture, but there was no apparent germination. Author

N64-17575* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
HYPERSONIC BALLISTIC RANGE RESULTS OF TWO PLANETARY ENTRY CONFIGURATIONS IN AIR AND CARBON DIOXIDE/NITROGEN MIXTURES
Peter Jaffe 31 Jan. 1964 12 p refs
(NASA Contract NAS7-100)
(NASA CR-53232; JPL-TR-32-543) OTS: $1.60 ph, $0.80 mf

Tests were performed at velocities of 15,500 fps in the Ballistic Range of the Naval Ordnance Laboratory (NOL) in order to determine the effects of carbon dioxide on aerodynamic characteristics. Two configurations were tested; both were spherically blunted cones with flat bases. The resultant aerodynamic data indicate no appreciable effect on drag and stability due to carbon dioxide. They correlated well with existing information obtained at lower Mach numbers and show a slight decrease in stability with increasing Mach number.
Author

N64-17592* Stanford U., Calif. Radioscience Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semi-Annual Status Report No. 2, 1 Jul.-31 Dec. 1963
V. R. Eshleman Feb. 1964 9 p
(NASA Grant NsG-377)
(NASA CR-53205) OTS: $1.10 ph, $0.80 mf

Research conducted includes theoretical and experimental radio and radar studies of lunar and planetary ionospheres, atmospheres, and surfaces, and radar studies of the sun and interplanetary medium.
R.T.K.

N64-17593* Geophysics Corp. of America, Bedford, Mass.
A STUDY OF THE METEOROLOGY OF MARS AND VENUS Quarterly Progress Report No. 4, 6 Oct. 1963-5 Feb. 1964
[1964] 25 p refs
(NASA Contract NASw-704)
(NASA CR-53285) OTS: $2.60 ph, $0.95 mf

Computations of the radiative equilibrium distribution of temperature between the cloud-base and the surface of Venus were completed, and the results are presented. To the extent that this region of the Venus atmosphere is in radiative equilibrium, and to the extent that the computed temperature distribution is thermally stable, the results provide estimates of the actual temperature versus altitude distribution below the clouds. Work has continued on the construction of a model radiation budget for the planet Mars. A preliminary version of the average annual radiation budget at the top of the Martian atmosphere is presented.
Author

N64-17795* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIATIVE EQUILIBRIUM IN PLANETARY ATMOSPHERES: I. APPLICATION OF STRONG LINE ABSORPTION LAW TO THE ATMOSPHERE OF VENUS
R. A. Hanel and F. Bartko Jan. 1964 48 p refs
(NASA TM X-51525) OTS: $4.60 ph, $1.64 mf

The temperatures, the net fluxes, and the specific intensities were calculated for a CO_2-N_2 atmosphere in radiative equilibrium. The wavelength, temperature, and pressure dependence of the CO_2 absorption, including the excited bands, was considered. Solar radiation absorbed in the clear atmosphere influences the temperature profile distinctly. The effects of various CO_2 concentrations, cloud top pressure levels, and cloud reflectivities on the equilibrium temperatures are also discussed.
Author

N64-17818* Rensselaer Polytechnic Inst., Troy, N.Y.
CHEMISTRY OF THE ATMOSPHERE OF THE PLANET VENUS Technical Status Report No. 3, 1 Aug. 1963-31 Jan. 1964
P. Harteck, R. R. Reeves, Jr., and Barbara A. Thompson 1964 4 p
(NASA Grant NsG-261-62)
(NASA CR-53365) OTS: $1.10 ph, $0.80 mf

In an experiment designed to detect microwave emission from chemical reactions, signals of about 25 db were obtained for a discharge through SO_2, about 10 to 15 db for a discharge through CO_2, and 0.5 to 1 db through air or argon. Whether microwave emission also is generated by the chemical reactions alone (outside of a discharge tube) was not determined. Photochemical studies, using an iodine lamp, are outlined.
R.T.K.

N64-17877* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
RADIO ASTRONOMY
A. H. Barrett, J. W. Graham, R. P. Rafuse, W. C. Schwab, R. J. Allen et al. *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 25-30 refs (See N64-17876 10-01)
(NASA Grant NsG-250-62; NASA Grant NsG-419; Contract Nonr-3963(02); Contract AF 19(628)-500)

Work has progressed in the following areas: (1) development of techniques for radiometry at millimeter wavelengths; (2) observation of extraterrestrial radio sources, principally, but not exclusively, at short centimeter and millimeter wavelengths; (3) microwave studies of the terrestrial atmosphere and surface with application to meteorological satellites; and (4) a study of wide base-line interferometry at millimeter wavelengths.
R.T.K.

N64-18165* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE THERMAL ENVIRONMENT OF THE TERRESTRIAL PLANETS (SUPPLEMENT 3)
Klaus Schocken 2 Mar. 1964 34 p refs
(NASA TM X-53016) OTS: $3.60 ph

As determined by the microwave radiometer, the surface temperature of Venus averages approximately 427° C on both light and dark sides of the planet. The surface pressure is estimated as equal to about 20 bars. A new density model of the upper atmosphere of the Earth from 200 to 800 km is presented. Some physical parameters of the Moon, which are generally those of average silicate rock, are summarized. If it is assumed that the solar wind has remained unchanged over the period of the Moon's existence, then the Moon has lost a layer approximately 17 cm thick in $4.5 \cdot 10^9$ years. A series of model atmospheres for Mars has been developed in order to derive upper and lower probable limits for the variation of pressure and density in the upper atmosphere. On the assumption that ordinary meteoritic densities are of the order of 5 g cm^{-3}, mean space densities of meteoritic material at the Earth's distance from the Sun are found to be of the order of 10^{-21} to 10^{-23} g cm^{-3}
Author

N64-18306* Geophysics Corp. of America, Bedford, Mass.
EXPERIMENTAL AND THEORETICAL STUDIES IN PLANETARY AERONOMY Final Report, 2 Apr. 1963-2 Oct. 1963
F. F. Marmo Oct. 1963 186 p refs
(NASA Contract NASw-701)
(NASA CR-53559; GCA-TR-63-30-N) OTS: $13.00 ph

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1. PLANETARY AERONOMY XI: ABSOLUTE INTENSITY

MEASUREMENTS IN THE VACUUM ULTRAVIOLET J. Samson 36 p refs (See N63-17316 15-07)

2 PLANETARY AERONOMY XII: THE ROLE OF INTERPLANETARY DEBRIS IN PLANETARY ATMOSPHERES I SODIUM IN THE EARTH'S ATMOSPHERE F. Marmo and H. Brown 36 p refs (See N63-17317 15-12)

3 PLANETARY AERONOMY XIII: ELECTRON AND ION TEMPERATURES IN THE IONOSPHERE A. Dalgarno 31 p refs (See N63-17318 15-12)

4 PLANETARY AERONOMY XIV: ULTRAVIOLET ABSORPTION OF SO_2 DISSOCIATION ENERGIES OF SO_2 AND SO P. Warneck and F. Marmo 22 p refs (See N63-17320 15-07)

5 PLANETARY AERONOMY XV: TRANSPORT PROPERTIES AND SCATTERING IN MOLECULAR GASES A. Dalgarno and R. Henry 14 p refs (See N64-11295 02-23)

6 PLANETARY AERONOMY XVI: CORPUSCULAR RADIATION IN THE UPPER ATMOSPHERE A. Dalgarno 31 p refs (See N64-12097 03-28)

N64-18453* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

SPECTROSCOPIC RESEARCH ON THE MAJOR PLANETS

Hyron Spinrad Repr. from Applied Optics, v. 3, Feb. 1964 p 181-186 refs

(NASA Contract NAS7-100)

(NASA CR-53574; JPL-TR-32-550)

Recent results in planetary spectroscopy of Jupiter, Saturn, Uranus, and Neptune are summarized. Some methods of analysis for atmospheric composition and thermal and kinematic characteristics are described. Author

N64-18454* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

AN ANALYSIS OF THE SPECTRUM OF MARS

Lewis D. Kaplan, Guido Münch, and Hyron Spinrad Repr. from Astrophys. J., v. 139, no. 1, 1 Jan. 1964 p 1-15 refs

(NASA Contract NAS7-100)

(NASA CR-53573; JPL-TR-32-554)

On a high-dispersion spectrogram of Mars rotational lines of H_2O near λ 8300 and CO_2 near λ 8700 have been detected. Recent laboratory measurements of line strengths have been used to determine the amounts of H_2O and CO_2 in the atmosphere of Mars: 14 ± 7μ precipitable water and 55 ± 20 m atm CO_2. From the absence of O_2 in the Martian spectra, an upper limit of 70 cm atm for the O_2 content has been set. By suitably combining the CO_2 amount with observations by Kuiper and Sinton of the strongly saturated bands in the 2μ region, a surface pressure of 25 ± 15 mb has been derived. The implications of the results on the composition of the Martian atmosphere are discussed. Author

N64-18788 RAND Corp., Santa Monica, Calif.

A WATER-CLOUD INTERPRETATION OF VENUS MICROWAVE CONTINUUM

D. Deirmendjian Apr. 1964 37 p refs

(Contract AF 49(638)-700)

(RM-4060-PR; AD-434501)

The most recent microwave brightness determinations of Venus are analyzed in the light of new theoretical results concerning the equivalent scattering and absorption properties of typical terrestrial clouds and precipitation. Based on the argument that the analysis of existing data does not conclusively demonstrate the absence of large amounts of water in the lower Venusian atmosphere, it is shown that a 600° K surface temperature and a planet-wide continuous and thick water-cloud veil are consistent with the observed microwave brightness distribution in the millimeter and centimeter range. The total water content of this veil is estimated at 10 gm cm^{-2}. The surface pressure of the sustaining atmosphere may be as low as 3 atm. Author

N64-19258* National Aeronautics and Space Administration, Washington, D.C.

NASA PROGRAM PLANNING IN SPACE SCIENCES

Sep. 1963 718 p

(NASA TM X-51603) OTS: $31.00 ph

Detailed information is given on NASA-approved experiments and supporting research in the disciplines of astronomy, solar physics, planetary atmospheres, ionospheres and radio physics, particles and fields, planetology, and biosciences. R.L.K.

N64-19356 Kyoto U. (Japan)

METEOROLOGICAL OBSERVATIONS OF MARS DURING THE 1962-63 OPPOSITION

S. Miyamoto *In its* Contrib. from the Inst. of Astrophys. and Kwasan Obs. 1963 p 1-80 refs (See N64-19355 12-29) (*Its* Contrib. 124)

In Martian spring, the Propontis-Cerberus and Nilokeras-Lacus vapor courses were well developed and very dark, whereas the Utopia-Nodus Laocoontis course was somewhat fainter than in the 1960 opposition. Compared with the 1960 opposition, the polar cap in 1963 was larger, and in late spring, the retreat of the cap stopped and even increased its dimension for a while. The Casius-Neith yellow cloud appeared at the same season as in the last opposition, and in summer, an outburst of the Noachis white cloud was observed across the equator. The doldrum was conspicuous in spring. It followed the subsolar point and faded in summer. Author

N64-19357 Kyoto U. (Japan)

OBSERVATIONAL STUDY ON THE GENERAL CIRCULATION OF MARS

S. Miyamoto *In its* Contrib. from the Inst. of Astrophys. and Kwasan Obs. 1963 p 81-88 refs (See N64-19355 12-29) (*Its* Contrib. 125)

In the Martian atmosphere, contrary to Earth, meridional circulation is more important than lateral mixing. Energy flows from pole to equator in summer. The prevailing winds over the middle latitude turns into easterlies during this season. An attempt is made to prove these particular circulation regimes with the observational data available. It is pointed out that local topographic circulations make important contributions to the general circulation. The topographical difference of northern and southern hemispheres should be taken into account in establishing the actual circulation pattern. Author

N64-19567* IIT Research Inst., Chicago, Ill. Astro Sciences Center

THE SCIENTIFIC OBJECTIVES OF DEEP SPACE INVESTIGATIONS: JUPITER

D. L. Roberts 9 Mar. 1964 21 p refs

(NASA Contract NASr-65(06))

(NASA CR-53735; P-1; Formerly part of Rept. 1.4P2 No. 2, Sep. 1963) OTS: $2.60 ph

The theories of origin of Jupiter are discussed and are followed by a summary of the physical properties of Jupiter. The measurements that are proposed are (1) spectrometry and polarimetry of the Jovian atmosphere and, if possible, of the surface; (2) photography of the complex atmospheric appearance of Jupiter, including observations through holes in the cloud cover either at the poles or over the Red Spot; (3) magnetic field measurements throughout the mission and in the supposedly high-intensity field of Jupiter, which may extend

to 1 au from the surface, (4) temperature measurement using microwave techniques to measure temperatures under the cloud layer, (5) detection of plasma and particles in space and in the proposed intense radiation belts, and (6) measurement of interplanetary dust and, in particular, any dust cloud associated with Jupiter. Author

N64-19804* Maryland U., College Park
JUPITER
E. J. Öpik. Repr. from Irish Astron. J. (Armagh), v. 6, no. 4, Dec. 1963 p 135-149 refs
(NASA Grant NsG-58-60)
(*Its* Leaflet 58)

This report proves that the theory of the hydrogen-snowball process of accretion concerning the planet Jupiter can give qualitatively, as well as quantitatively, an adequate account of the difference in composition between the planet's atmosphere and its main body—a mainly hydrogenic interior comprising the bulk of Jupiter's mass and a predominantly helium atmosphere. A.W.

N64-19954* Columbia U., New York, N.Y.
[THEORETICAL AND ANALYTICAL STUDIES OF PLANETARY AND STELLAR STRUCTURES, EVOLUTION AND DYNAMICAL PROCESSES; AND THE APPLICABILITY OF GEOPHYSICAL METHODS TO SUCH STUDIES] Status Report, Apr. 1, 1963-Sep. 30, 1963
[1963] 3 p
(NASA Grant NsG-445)
(NASA CR-53869) OTS: $1.10 ph

This program of research stresses the following areas: radiative and convective transfer in planetary atmospheres, physics of the upper atmosphere, applications of plasma physics to geophysical and astrophysical problems, stellar structure and evolution, and stellar and galactic dynamics. C.L.W.

N64-20166 RAND Corp., Santa Monica, Calif.
FORBIDDEN REGIONS FOR THE FORMATION OF CLOUDS IN A PLANETARY ATMOSPHERE
G. F. Schilling. Apr. 1964 18 p refs
(Contract AF 49(638)-700. Proj. RAND)
(RM-4084-PR; AD-438216)

Every model planetary atmosphere implicitly establishes unique altitude distributions for the saturation vapor pressures of its minor constituents solely by relating ambient atmospheric pressures and temperatures to altitude. It is therefore possible to determine for any model atmosphere those altitude regions where cloud formation due to condensation or sublimation of minor constituents is permitted or forbidden by basic thermodynamic laws, regardless of the amounts of the minor constituents present. As an example, this exclusion principle is applied to the formation of H_2O clouds in the earth's upper atmosphere for conditions given by supplemental model atmospheres for latitudes 15° to 75°. The specific results presented permit inferences with regard to the expected seasonal distribution of noctilucent clouds and serve generally to illustrate the application of a basic principle of thermodynamics to the study of planetary atmospheres. Author

N64-20315 RAND Corp., Santa Monica, Calif.
HABITABLE PLANETS FOR MAN
Stephen Dole. Mar. 1964 170 p refs
(Contract AF 49(638)-700; Proj. RAND)
(R-414-PR; AD-437264)

Discussed are man's nonterrestrial destinations rather than methods of propulsion or other technical problems of space travel. Habitable planets are studied in terms of human requirements of temperature, light, gravity, atmosphere, water, and food. The solar system and beyond are surveyed as possible candidates. Impelling reasons are given for human emigration to other planets. R.T.K.

N64-20358 RAND Corp., Santa Monica, Calif.
SOLAR SYSTEM SCIENCE BIBLIOGRAPHIES
Edna O'Connell. Jan. 1964 52 p refs
(P-2859; AD-429110)

This paper is an annotated bibliography of bibliographies of scientific disciplines related to the solar system covering the period from 1961 to 1963. The subjects included are: atmospheric physics, interplanetary physics, the moon, the planets, and bibliographies related to solar system science in general. R.T.K.

N64-20643* IIT Research Inst., Chicago, Ill. Astro Sciences Center
SURVEY OF A JOVIAN MISSION Report No. M-1
W. O. Davies, F. Narin, D. L. Roberts, L. A. Schmidt, L. C. Scholz et al. Mar. 1964 90 p refs
(NASA Contract NASr-65(06))
(NASA CR-53987; M1) OTS: $8.10 ph

A survey of the requirements for Jovian missions was made. Scientific questions concerning Jupiter were used to select minimum experimental payloads to increase knowledge of the planet. Approximate payload weights were derived from instrumentation estimates, data handling and transmission requirements, electrical power demands, guidance and control requirements, spacecraft structure, shielding, and terminal maneuver energy needed. Three launch vehicles were postulated with performance sufficient to cover the range expected in the next decade. The requirements for additional propulsion, and the launch restrictions associated with Jovian missions were assessed on the basis of these three vehicles. The addition of a final stage for injection to transfer orbit is necessary to achieve most missions. The characteristics of a hypothetical high-performance stage were derived for several combinations of mission parameters. Author

N64-20724* New York U., N.Y. Geophysical Sciences Lab.
PROJECT HIAM [A THEORETICAL INVESTIGATION OF THE PROPERTIES OF PLANETARY ATMOSPHERES] Progress Report, 1 Jul.-31 Dec. 1963
James E. Miller. 15 Jan. 1964 9 p refs
(NASA Grant NsG-499)
(NASA CR-56134) OTS: $1.10 ph

Progress reported includes the following: (1) A model for studying breaking atmospheric waves was developed. It consists of a two-layer fluid resting on a solid, nonrotating parabolic surface. Thereby, the model can approximate a wave propagating over a mountain. The computations to determine the initial breaking point of an internal gravity wave initiated in such a model are being carried out on an IBM-7094 computer. (2) A literature search was conducted on the size distribution, height distribution, and composition of the atmospheric aerosol particles. Junge found that, in the range of the optically significant particles, the size distribution of particles followed a simple inverse power law. His chemical analysis of the aerosol showed the NH_4 and SO_4 radicals to be the most common. Fenn found that the aerosol does not follow a continuous distribution, as Junge found, but occurs in discrete size ranges. The magnitude of these discrete distributions depends on time and locality. However, the peaks of the discrete concentrations were found to lie along the line of the profile as found by Junge. I.v.L.

N64-20743* General Electric Co., Philadelphia, Pa. Re-entry Systems Dept.

SELECTION OF A TEMPERATURE CONTROL SYSTEM FOR A MARS PROBE

Clark V. Dohner 10 Jan. 1963 26 p refs
(NASA Contract NAS7-100; JPL-950226)
(NASA CR-56178) OTS: $2.60 ph

This report presents the thermal design study for a Mars-probe entry vehicle. Four types of temperature control systems are considered: (1) α/ϵ coating with solar cells (α is the solar absorptivity of the exterior of the vehicle; ϵ is the emissivity of the exterior of the vehicle); (2) α/ϵ control; (3) superinsulation with solar cells; and (4) radioisotope heat generation. The α/ϵ coating system is a temperature control system that makes use of coatings on the shield and capsule to limit the change in temperature of the capsule as the solar flux varies during the journey from Earth to Mars. The α/ϵ control system would require the placement of a magnesium "clamshell" around the outside of the vehicle. Copper tubing filled with a liquid Freon or propane then would be wound around the outside of this clamshell and in intimate thermal contact with it. Contraction or expansion of the liquid due to temperature changes would actuate open-closed type shutters to increase or decrease the α/ϵ value so that an average vehicle temperature of approximately 80° F would be maintained. The superinsulation system consists of superinsulation wrapped around the outside of the vehicle with solar cells affixed to it. The radioisotope heat generation system controls the capsule temperature through the use of a radioisotope thermoelectric generator (RTG) unit. Based on a preliminary investigation the RTG type of system appears to be quite desirable. I.v.L.

N64-20899* New Mexico State U., University Park

OBSERVATIONS OF THE OPTICALLY THIN SCATTERING LAYER IN THE ATMOSPHERE OF VENUS

Bradford A. Smith and Walter E. Bains Repr. from Astron. J., v. 69, no. 2, Mar. 1964 1 p refs
(Grant NsG-142-61)

Photographic observations were made during the inferior conjunctions of 1959, 1961, and 1962. In addition to confirming the existence of an optically thin scattering layer overlying an opaque surface on Venus, established through observations of cusp extensions near the inferior conjunction, and establishing that the extension angles of the two cusps are usually asymmetric, the photographs indicate the probable existence of very weak scattering at heights as great as 30 to 40 km above the opaque surface. A composite of heights published by Edson and those obtained by the authors (at elongation angles less than 10°) suggests a symmetry about an axis nearly perpendicular to the orbital plane. Symmetry about any axis other than the orbital radius vector can be produced only by rotation. These observations tend to conflict with the current concept of synchronous rotation of Venus. I.v.L.

N64-22076* Geophysics Corp. of America Bedford, Mass.

A THEORETICAL ESTIMATE OF THE AVERAGE VERTICAL DISTRIBUTION OF TEMPERATURE IN THE MARTIAN ATMOSPHERE

George Ohring Rep. from Icarus, v. 1, no. 4, Jan. 1963 p 328-333 refs
(Contract NASw-704)
(GCA-TR-62-7-N)

The average variation of temperature with height in the Martian atmosphere is probably controlled by radiative and convective processes. With the use of a simple theoretical formulation in which it is assumed that convection will extend to that height above which the radiative equilibrium lapse rate is just stable, the average temperature profile is computed. It is assumed that the average surface temperature is 230° K, that there is no absorption of solar radiation in the atmosphere, and that carbon dioxide in an amount equal to 2% by volume is the only important radiating gas. The radiation fluxes are computed with the aid of radiation tables; the radiative equilibrium temperatures are calculated using an iterative procedure. The computed temperature profile is characterized by an adiabatic troposphere extending to about 9 km, above which the temperature continues to decrease with height to an average value of about 90° K for the topmost 5-mb layer. Author

N64-22413* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL STUDY OF RADIATIVE TRANSPORT FROM HOT GASES SIMULATING IN COMPOSITION THE ATMOSPHERES OF MARS AND VENUS

Carlton S. James Repr. from the AIAA J., v. 2, no. 3, Mar. 1964 p 470-475 Presented at the AIAA Conf. on Phys. of Entry into Planetary Atmospheres, Cambridge, Mass., 26-28 Aug. 1963 Previously Issued as AIAA Paper 63-455; see N63-20136 20-28
(NASA-RP-174)

Measurements have been made of gross spectral quality and intensity of thermal radiation from the hot gas cap of small polyethylene models flying through mixtures of CO_2 and N_2. Mixture proportions and ambient pressure were varied from pure N_2 to nearly pure CO_2 and from 0.004 to 0.08 atm, respectively. Model flight velocity varied from 5 to 8 km/sec. Strong radiation from CN, formed in the shock layer, is observed for a wide range of mixture proportions. Variation of the total intensity of gas-cap radiation with ambient pressure, flight velocity, and mixture proportions is defined. Radiation from the mixtures is compared with radiation from air. The total intensity of gas-cap radiation from the CO_2-N_2 mixtures is found to be several times that from air at the same flight conditions, except when high CO_2 concentrations are combined with low velocities. Comparison of the measurements with available equilibrium calculations indicates agreement within factors of two or three over the test range. Author

N64-22770* California U., Berkeley

THE REFLECTION AND EMISSION OF ELECTROMAGNETIC RADIATION BY PLANETARY SURFACES AND CLOUDS

D. G. Rea and W. J. Welch 26 Jul. 1963 90 p refs
(Grants NsG-101-61; NSF G-16741)
(NASA-CR-52222) OTS: $8.10 ph

A review of data dealing with the reflection and emission of electromagnetic radiation by planetary surfaces and clouds is presented. Only quantitative observations possessing a certain amount of spectral resolution are considered. Theoretical considerations are developed for reflection and emission by plane surfaces, layered surfaces, rough surfaces, and clouds. The radiometric determination of planetary temperatures is also discussed. Reflection and emission observations of the following planetary bodies are considered: (1) Moon—visible region, radar reflections, infrared region, and microwave region; (2) Mercury—infrared, radio waves, and radar; (3) Venus—visible and near infrared, infrared, passive microwave, and radar; (4) Mars—visible region, infrared region, and microwave; and (5) major planets (Jupiter and Saturn)—radio waves. P.V.E.

N64-22779* New Mexico State U., University Park Research Center

PHOTOGRAPHIC OBSERVATIONS OF MARS AT NEW MEXICO STATE UNIVERSITY IN 1960-61

J. C. Robinson 9 Aug. 1963 19 p refs
(Grant NsG-142-61)
(NASA-CR-51173; TN-557-64-3) OTS: $1.60 ph

Photographic observations of Mars were made on a regular basis during the fall, winter, and spring, including the Martian vernal equinox. All the observations were made at the 20.12 Cassegrain focus of the University's 30-cm reflector. The photographic methods used are described. Among the phenomena observed and described are the following: Margaritifer Sinus, Cerberus I canal, Blue clouds and blue clearings, atmospheric belts, activity in the Tharsis-Amazonis region. Photographs and charts are included. E.K.R.

N64-22787* Florida State U., Tallahassee Inst. for Space Biosciences

EMERGENT ORGANIC CHEMISTRY UNDER VARIOUS PLANETARY CONDITIONS AND EXTRATERRESTRIAL MATRICES AND ENVIRONMENTS First Annual Report [1 Oct. 1961–30 Sep. 1962]

Sidney W. Fox, Seymour L. Hess, and Charles B. Metz 1 Nov. 1962 52 p refs

(Grant NsG-173-62)

(NASA-CR-56526) OTS: $5.60 ph

The organic chemistry that can emerge under a variety of planetary conditions is being investigated. Studies that are summarized and relate to this emergence are: abiogenesis, planetary atmospheres, the genetic mechanisms of plant tissue cultures and the evolutionary divergence of chromosomes, and fertilization physiology. A.R.B.

N64-22788* Florida State U., Tallahassee Inst. for Space Biosciences

STUDY OF ORGANISMS UNDER TERRESTRIAL AND EXTRATERRESTRIAL CONDITIONS First Semi-Annual Report

Sidney W. Fox, S. L. Hess, and C. B. Metz 15 Mar. 1962 12 p refs

(Grant NsG-173-62)

(NASA-CR-56527) OTS: $1.60 ph

An investigation is made of processes involved in the origin, evolution, and development of organisms under terrestrial and extraterrestrial conditions. The study includes work on the following: proteinoids, microspheres, the vertical structure of the atmosphere of Venus, immunochemical studies, research on antiradiation extracts, and observations of Jupiter. J.R.C.

N64-23124* National Aeronautics and Space Administration, Washington, D.C.

LIGHT SCATTERING IN THE SPHERICAL ATMOSPHERE. II [RASSEYANIYE SVETA V SFERICHESKOY ATMOSFERE. II]

I. N. Minin and V. V. Sobolev Feb. 1964 14 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 1, no. 2, 1963 p 227–234

(NASA-TT-F-8814)

An investigation into light scattering in the planetary atmosphere, with allowance for atmospheric-layer curvature, is continued. The case is considered in which the atmospheric coefficient of absorption is constant. An analytical solution for the fundamental equation determining J is obtained. Taken into account was the reflection of light from the planet's surface. Formulas are given for the intensity of the radiation leaving the atmosphere. The solution can be applied to the case of illumination of a homogeneous sphere. Considered in detail was the formula determining the intensity of radiation leaving a homogeneous sphere after single scattering. From this formula, asymptotic formulas were obtained for large-sphere optical radii. N.E.A.

N64-23128* National Aeronautics and Space Administration, Washington, D.C.

WATER DETECTION IN THE VENUS ATMOSPHERE [K VOPROSU OB OBNARUZHENII VODY V ATMOSFERE VENERY]

A. Ye. Salomonovich May 1964 15 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 7, no. 1, 1964 p 51–58 Presented at the All-Union Conf. on Radio Astronomy, Gor'kiy, USSR, 28 Feb. 1963

(NASA-TT-F-8875)

The question of the nature of the cloud layer of Venus and the possibility of detecting water vapor in its atmosphere are discussed in the light of new data on the radio emission spectrum of the dark side of the planet. Author

N64-23863 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

RADIO ASTRONOMY RESEARCH AND CURRENT CONCEPTS ABOUT THE ATMOSPHERE OF VENUS

A. D. Danilov *In its* Cosmic Res. 27 Apr. 1964 p 188–215 refs (See N64-23852 16-29)

Research on the physical characteristics of the surface and atmosphere of Venus has recently aroused much interest. Radio astronomy data have brought about concepts of the atmospheric conditions of the planet that differ sharply from those earlier proposed on the basis of optical data. There are currently two hypotheses in serious contention for explaining data on the characteristic radio-wave emission of Venus, the greenhouse effect and the ionosphere. According to the greenhouse-effect hypothesis, in the atmosphere of Venus there must be a large quantity of water that so far was not successfully recorded. The difficulty with the ionosphere hypothesis is that it requires that a high electron concentration on the order of $10^9 cm^{-3}$ exist in the Venus ionosphere. The agreement between observed radio-wave emission spectra and radar data can be obtained if it is assumed that the Venus ionosphere has a porous character. Also, if the ionosphere is assumed to be porous, difficulties do not arise in explaining the absence of solar limb brightening that was found experimentally on waves of 1.6 and 3 cm. The correlation of the magnitude of the astronomical unit with solar activity shows the presence of a powerful ionosphere about Venus. Further research regarding the possibilities for both hypotheses is needed for a final decision to the question about the origin of radio-wave emission from Venus and the characteristics of its atmosphere. Author

N64-23895* Geophysics Corp. of America, Bedford, Mass.

THE EFFECT OF CLOUDINESS ON A GREENHOUSE MODEL OF THE VENUS ATMOSPHERE

George Ohring and Joseph Mariano Repr. from J. of Geophys. Res., v. 69, no. 1, 1 Jan. 1964 12 p refs

(Contract NASw-704)

In previous models of the greenhouse effect in the Venus atmosphere, it was assumed that infrared-absorbing atmospheric gases provide the sole contribution to the infrared opacity of the Venus atmosphere. In the present study, the influence of an extensive cloud cover, opaque to infrared radiation, is also included in the greenhouse model. The magnitude of the greenhouse effect, which is defined here as the ratio of the surface temperature produced by the greenhouse to the surface temperature of an atmosphereless Venus, is computed as a function of infrared opacity of the atmosphere, and amount and height (actually ratio of cloud-top pressure to surface pressure) of clouds. It is assumed that the Venus atmosphere is gray, that the absorbing gas has a constant mixing ratio, and that the temperature variation with altitude in linear. Calculations are made for two temperature lapse

rates: the adiabatic lapse rate and nine-tenths of the adiabatic lapse rate. The adiabatic lapse rate maximizes the greenhouse effect; for this case estimates of the minimum infrared opacity required to maintain the observed surface temperature can be determined. For a surface temperature of 700° K, 99% cloudiness, and cloud-top temperature of 240° K, the minimum required infrared opacity is 6. Uncertainties and questionable side effects of the model are discussed. The model is quite general and can be applied to other planetary atmospheres; sample calculations are shown for the Earth and Mars. Author

N64-24039* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
AN EVALUATION OF THE COMMUNICATION BLACKOUT FROBLEM FOR A BLUNT MARS-ENTRY CAPSULE AND A POTENTIAL METHOD FOR THE ELIMINATION OF BLACKOUT
Dwain F. Spencer 15 Apr. 1964 27 p refs
(Contract NAS7-100)
(NASA-CR-56459; JPL-TR-32-594) OTS: $2.60 ph

Unless preventive methods are used, it appears that the communications link from a blunt body entering the Martian atmosphere will be blacked out during entry because of the free electron concentration in the wake of the capsule. Estimates of the free electron concentration in the wake indicate peak values of approximately 3×10^{12} electrons/cm^3, whereas the critical electron concentration for S-band transmission at 2,295 mc is 10^{11} electrons/cm^3. The injection of a high-electron-affinity fluid such as carbon tetrachloride may reduce the free electron concentration below this critical value. The amount of fluid required is estimated to be 1 to 10 lb. The latter statement must be experimentally confirmed, however, before the use of an auxiliary fluid-injection system can be fully evaluated. Author

N64-24042* Meteorology Research, Inc., Altadena, Calif.
A MOISTURE ANALYZER FOR MARTIAN ATMOSPHERE Final Report
Paul B. Mac Cready, Jr. 10 Sep. 1962 81 p
(Contract NAS7-100; JPL-950207)
(NASA-CR-56454; MRI62-FR-48) OTS: $8.10 ph

A 4-month study and experimental program was undertaken to determine if the phosphorous pentoxide type of moisture meter could be used to measure the expected water vapor in the Martian atmosphere while being lowered to the surface in an instrument package ejected from a space vehicle near this planet. An operating breadboard model of the proposed system met or exceeded most of the criteria set forth for this project. For the system designed, temperature and sterilization requirements do not appear to impose any severe problems. The space and weight requirement of 1lb and 500 cc were surpassed, the model weighing approximately 11 ounces, with a volume of approximately 450 cc. The overall maximum power requirement of 500 mw can be met, but there would be some advantages if more power were available. The present moisture sensor and system is believed to be capable of operation down to levels of 0.5 ppm. Author

N64-24043* Honeywell, Seattle, Wash. Aeronautical Div.
ATMOSPHERIC COMPOSITION INSTRUMENTATION Final Report
J. E. Crowley, J. G. Ballinger, and H. M. Hoeksema 30 Nov. 1962 42 p refs
(Contract NAS7-100; JPL-950285)
(NASA-CR-56453; Rept.-2928-TRI) OTS: $4.60 ph

A study is carried out to define the upper and lower bounds of frost point and atmospheric temperature in the atmosphere of Mars to establish the dynamic range requirements for instrumentation. The temperature and frost point of the atmosphere of Mars indicate that a maximum temperature differential between the thermocooler hot and cold junctions of 91° C permits measurements of frost point at all extremes predicted for Mars. The developed instrument is capable of achieving a temperature differential of 90° C. J.R.C.

N64-24075* National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif.
THEORY OF TUMBLING BODIES ENTERING PLANETARY ATMOSPHERES WITH APPLICATION TO PROBE VEHICLES AND THE AUSTRALIAN TEKTITES
Murray Tobak and Victor L. Peterson Washington, NASA Jul. 1964 39 p refs
(NASA-TR-R-203) OTS: $1.00

The tumbling motion of aerodynamically stable bodies entering planetary atmospheres is analyzed considering that the tumbling, its arrest, and the subsequent oscillatory motion are governed by the equation for the fifth Painlevé transcendent. Results based on the asymptotic behavior of the transcendent are applied to study the oscillatory behavior of planetary probe vehicles in relation to aerodynamic heating and loads and the dynamic behavior of the Australian tektites on entering the earth's atmosphere, under the hypothesis that their origin was the moon. Author

N64-24106* IIT Research Inst., Chicago, Ill.
RADIATIVE ENERGY TRANSFER ON ENTRY INTO MARS AND VENUS Quarterly Report No. 6
William O. Davies Oct. 1963 28 p refs
(Contract NASr-65(01))
(NASA-CR-56554; IITRI-T200-6) OTS: $2.60 ph

The dissociation rate of carbon dioxide has been determined for temperatures from 3,500° to 6,000° K. The rate of disappearance of carbon dioxide behind shock waves in CO_2-N_2 and CO_2-Ar gas mixtures was monitored by observing the radiation from the CO_2 4.3μ fundamental vibration band. The dissociation rates obtained for 1% CO_2 in both argon and nitrogen were fit to the classical collision theory for diatomic molecules, yielding the rate constants. Author

N64-24169* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
DEVELOPMENTS IN ENTRY VEHICLE TECHNOLOGY
Alvin Seiff [1964] 12 p refs Presented at the 1st AIAA Ann. Meeting, Washington, 29 Jun.-2 Jul. 1964
(AIAA Paper-64-528) AIAA: $0.50 members, $1.00 nonmembers

Discussed are entry-vehicle problems related to Mars entry of an unmanned probe and to Earth entry well above the escape speed. Some recent laboratory research findings related to high-speed entry problems are summarized. Design for steep entry into some of the proposed Mars atmospheres appears to be unfeasible because of the extremely low m/C_DA

required for soft landing. Hence, missions to search for life on Mars and to make physical measurements of the Martian surface cannot be confidently undertaken until the questions about the atmosphere are resolved. For entry into planetary atmospheres at speeds much greater than 40,000 fps, use of entry vehicles with all surfaces swept back relative to the stream (such as cones) is indicated to prevent radiative heat transfer from becoming castastrophically large. Items selected from recent research are related to cone radiative heating at high speeds, combustion of ablation shields, ablation products radiation, injected gas interaction with the external flow, and atmospheric gas radiation of nitrogen-carbon-dioxide mixtures.
Author

N64-24774 Joint Publications Research Service, Washington, D.C.
BEHAVIOR OF THE HYDROSPHERE UNDER MARTIAN CONDITIONS AND ITS OBSERVED MANIFESTATIONS
V. D. Davydov *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 146-166 refs (See N64-24759 17-29) OTS: $5.00

The propriety of comparing water resources on Earth to those on Mars is confirmed, even though the spectral method could not be used to detect water vapors in the Martian atmosphere. Oceanographic techniques are employed instead. G.D.B.

N64-24812* North American Aviation, Inc., Downey, Calif.
THE FEASIBILITY OF SPACECRAFT DECELERATION BY AERODYNAMIC BRAKING AT THE PLANET MARS
Gerald M. Hanley and Frank J. Lyon N.Y., AIAA [1964] 16 p refs Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.-2 Jul. 1964
(Contract NAS9-1748)
(AIAA Paper-64-479) AIAA: $0.50 members, $1.00 nonmembers

The feasibility of decelerating a spacecraft by aerodynamic braking to establish an orbit about the planet Mars is determined. The effect of vehicle shape on heat protection weight at a nominal entry velocity of 27,600 ft/sec and the effect of initial entry velocity on heat shielding of a selected configuration for entry velocities between 27,600 and 39,000 ft/sec are studied. Because of the wide spread in current estimates of the constituents and density of the Martian atmosphere, their effect on the maximum deviations of heat protection weight and entry corridor depth is presented. The study results indicate that gas radiation is a major source of gasdynamic heating during atmospheric braking, even for entry at 27,600 ft/sec. Consequently, blunt shapes such as the Apollo configuration have higher heat protection weight requirements than finer shapes such as the M-2 and high L/D delta wing shapes. A modified conical vehicle having a half-cone angle of 18° and an $(L/D)_{max} = 1.16$ was studied to determine the effect of initial entry velocity on vehicle heat protection weight. Heat protection weight increases rapidly with velocity as radiant heating becomes a more dominant factor. Aerodynamic maneuvering during braking in the Mars atmosphere is also discussed to illustrate the effect of L/D on braking corridor depth and on the ability to change orbital planes. Mars aerodynamic deceleration appears technically feasible and highly attractive when compared to the use of retrothrust for orbiting Mars. Author

N64-24816* National Bureau of Standards, Washington, D.C.
A THEORETICAL STUDY OF THE MARTIAN AND CYTHEREAN IONOSPHERES
R. B. Norton Washington, NASA, Jul. 1964 58 p refs
(NASA Order R-65)
(NASA-TN-D-2333) OTS: $1.50

The approach to the theory of planetary ionospheres is made by reviewing the theory of the terrestrial ionosphere regions and applying this theory, with necessary modifications, to the planets Venus and Mars. Among the important procedures considered are the production of electrons, the exchange and recombination reactions, and finally, the diffusion of an electron-ion gas through the neutral gas. Author

N64-24975 General Electric Co., Philadelphia, Pa. Missiles and Space Div.
MOLECULAR OPTICAL THICKNESS OF LOW-DENSITY MODELS OF THE ATMOSPHERE OF MARS
E. L. Gray and K. L. Coulson Mar. 1964 31 p refs
(R645021; AD-437226)

Values of volume scattering coefficient and normal optical thickness for the revised estimates of the Martian atmosphere are given, as a function of altitude above the planetary surface, for eight selected wavelengths from 2500 to 10,000 A. Four models of the Martian atmosphere, as given by the Jet Propulsion Laboratory, are used, the surface pressure for the models being 11 mb (2 models), 15 mb, and 30 mb. Comparisons with the previous higher-density atmospheric models for Mars, and with the U.S. Standard Atmosphere, are shown, and the values of optical thickness are used to compute the energy directed outward from the top of a Rayleigh atmosphere on Mars. The computations show that the normal optical thickness is lower for the new models than for the previous models by approximately the ratio of the surface pressures. Author

N64-25075* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPLORATION OF THE ATMOSPHERE OF VENUS BY A SIMPLE CAPSULE
Rudolf A. Hanel Washington, NASA, Jul. 1964 24 p refs
(NASA-TN-D-1909) OTS: $0.75

The exploration of Venus by probes that penetrate the atmosphere will allow direct measurements of important physical parameters. Early probes must be restricted to a few simple instruments, but if carefully chosen, they will yield a great increase of knowledge. These results will then pave the way for more sophisticated instruments, to be considered as second and third generation. The main target of the early experiments should be the structure and composition of the atmosphere. Accordingly, pressure, temperature, and density will be measured as well as the nitrogen, carbon dioxide, argon, water vapor, and cloud content. Simple methods to determine these parameters are discussed. Author

N64-25370 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A SEARCH FOR WATER VAPOR AND TRACE CONSTITUENTS IN THE VENUS ATMOSPHERE
Hyron Spinrad Repr. from Icarus, v. 1, no. 3, Oct. 1962 p 266-700 refs

An unsuccessful spectroscopic search for water vapor and other gases in the Venus atmosphere is described. The resulting upper limit on the Cytherean water vapor-atmosphere mixing ratio down to a level of high temperature and pressure is about 10^{-5}. Author

N64-25690* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
PLANETARY ENTRY SIMULATION BY MEANS OF COMBUSTION

Richard D. Wood and R. Liaugminas (Ill. U., Urbana) Repr. from Am. Inst. of Aeron. and Astronautics, v. (CP7), Aerodynamic Testing, Mar. 1964 28 p refs Previously published as N64-17018 09-10
(Contract NAS7-100)
(NASA-CR-56461; JPL-TR-32-614)

Present-day knowledge of the atmospheres of Venus and Mars are reviewed, and the simulation of conditions by combustion-heated hypervelocity wind tunnels for the purpose of studying planetary entry are discussed. Using typical entry trajectories, expected flight conditions and aerodynamic regimes are considered, and the flow parameter requirements for ground simulation are estimated. The regions of application of the methods developed are discussed. IAA

N64-25709* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GODDARD SPACE FLIGHT CENTER CONTRIBUTIONS TO THE COSPAR MEETING
Washington, NASA Jun. 1964 95 p refs
(NASA-TN-D-2303)

The general properties of the atmospheres of Mars, Venus, and Jupiter are reviewed. The evolutionary processes of planetary atmospheres are outlined as an introduction to a detailed discussion of the structure of the atmospheres of other planets. The most recent observational results indicate that the surface pressure on Mars may be about 20 mb, and the abundance of CO_2 in the atmosphere of Mars about 25% by volume. For Venus there are indications that the surface pressure is about 100 atm, with the atmosphere mainly composed of N_2. In the case of Jupiter, recent theoretical investigations of the atmosphere below the clouds suggest that there may be regions in the atmosphere of very high density and pressure but at relatively low temperature, creating conditions possibly favorable to the occurrence of complex organic reactions. Author

N64-25775* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
CONVECTIVE HEAT TRANSFER IN PLANETARY ATMOSPHERES
Daniel J. Collins 1 Jul. 1964 12 p refs
(Contract NAS7-100)
(NASA-CR-56972; JPL-TR-32-629) OTS: $1.60 ph

Convective heat transfer rates for three model planetary atmospheres have been obtained. These atmospheres are characteristic of those about the planets Mars and Venus. Atmospheres consisting of nitrogen and carbon dioxide gave heat-transfer rates similar to that of air. The presence of argon materially increased the heat-transfer rate. The effects of different gage materials on the convective heat transfer were also measured. No major differences were found for the experimental conditions studied. Author

N64-26310* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MARTIAN AIRGLOW
Edward C. Y. Inn Repr. from J. Atmospheric Sci., v. 21, no. 2, Mar. 1964 p 220-221 refs
(NASA-RP-250)

A mechanism of blue Martian airglow, which can be expected to occur on Mars as well as on Venus, is discussed. It is assumed that the Martian atmosphere is composed of 2% CO_2 and the remainder is N_2, the surface pressure being about 100 mb. The density disbribution of these constituents, with altitude, should be somewhat similar to that of the Earth. Thus, at some altitude corresponding to unit optical depth for solar radiation short of 1700A where CO_2 absorbs, the following photodissociation process can be expected: $CO_2 + h\nu \rightarrow CO + O$. If it is assumed that some sort of photochemical equilibrium exists at these altitudes, then one of the important reactions that follows the photodissociation is $CO + O + M \rightarrow CO_2 + M$, where M refers to any other atom or molecule, principally, however, to N_2. This is in essence a chemiluminescent recombination reaction with a characteristic complex banded spectrum due to CO_2 between about 5,000A to 3,000A, the maximum intensity being at about 4,000A. Although there appears to be some question as to the kinetics and mechanism of this recombination, it is clear that the emission is due to electronically excited CO_2. I.v.L.

N64-26314* National Aeronautics and Space Administration. Goddard Inst. For Space Studies, New York N.Y.
RADIATIVE TRANSFER IN THE ATMOSPHERES OF VENUS AND MARS
R. Jastrow and S. I. Rasool [1962] 6 p refs Reprinted Previously Published as N64-11650 03-29
(NASA-RP-251)

An approximate theory of radiative transfer in planetary atmospheres is developed and applied to atmospheres of Venus and Mars. The results for Venus indicate that the atmosphere of that planet must have an optical thickness of 60 in the infrared, corresponding to a transmission of 10^{-26}, to produce the observed surface temperature of 600 K. The surface temperature and tropopause height of Mars are also investigated. Author

N64-26370* Aerojet-General Corp., Azusa, Calif. Production Projects Div.
ENGINE OPERATING PROBLEMS IN SPACE. VOLUME I: THE SPACE ENVIRONMENT Final Report, 15 Feb. 1962–14 Mar. 1964
W. W. Howard and U. A. Coty Apr. 1964 223 p refs
(Contract NAS7-98)
(NASA-CR-58136; Rept.-2824; Vol. 1) OTS: $15.00 ph

This volume presents a comprehensive definition of the space environment as it is presently known. For the purposes of this program, this environment consists of the solar system, excluding the earth and its inner atmosphere. Special emphasis is given to data on electromagnetic and particulate radiation, meteoroid flux, and the structure and composition of the planetary atmospheres. A list of 405 references is included; many of these are annotated. Author

N64-26419* National Aeronautics and Space Administration, Washington, D.C.
STUDY OF THE PLANETS BY MEANS OF THE POLARIZATION OF THEIR LIGHT [ETUDE DES PLANETES PAR LA POLARISATION DE LEUR LUMIERE]
Audouin Dollfus (ph.D. Thesis--Paris U., 1955) Jul. 1964 137 p refs Transl. into ENGLISH
(NASA-TT-F-188) OTS: $2.75

The instruments developed permit the measurement of the ratio of polarized light and the direction of the favored vibration in small regions of the surface of the disks of planets, and within limited spectral regions. Measurements performed from 1948 to 1954 on Mercury, Venus, Mars, Jupiter, and lunar earthshine were compared with the determinations made on terrestrial samples. The natures of their soils and clouds and the densities of their atmospheres could thus be specified. Author

N64-26597* IIT Research Inst., Chicago, Ill. Astro Sciences Center
SUMMARY OF FLIGHT MISSIONS TO JUPITER Digest Report
1 Jul. 1964 29 p
(Contract NASr-65(06))
(NASA-CR-58120, M-4) OTS: $2.40 ph

The feasibility of an unmanned scientific mission to Jupiter to obtain astrophysical information concerning the planet and its environment was studied. The report deals primarily with an overall assessment of the problem areas that must be considered in successfully completing a Jovian mission, as well as attempts to establish the feasibility of achieving such a mission using present state-of-the-art vehicle technology, and the scientific payload. The results of the study indicate that a useful scientific mission to Jupiter is feasible with presently available chemical propulsion techniques, sensors, power supplies, telemetry links, and boosters. The development of a high-performance final-stage rocket compatible with the vehicles considered was found to be desirable for either a flyby or orbiter mission. R.T.K.

N64-27068* National Aeronautics and Space Administration, Washington, D.C.
RESEARCH ON THE POLARIZATION OF LIGHT FROM PLANETS AND FROM SOME TERRESTRIAL SUBSTANCES [RECHERCHES SUR LA POLARISATION DE LA LUMIERE DES PLANETES ET DE QUELQUES SUBSTANCES TERRESTRES]
B. Lyot Jul. 1964 155 p refs Transl. into ENGLISH from Ann. de l'Observatoire de Paris, Section de Meudon, v. VIII, no. 1, 1929
(NASA-TT-F-187) OTS: $3.00

A study of the planets and of light scattered by various terrestrial substances are presented according to observations made prior to 1929 and includes a description of the instruments, experimental methods, and results obtained. The results obtained from the planets are compared with those obtained from earth substances. Author

N64-27154 Joint Publications Research Service, Washington, D.C.
CONCERNING THE DETECTION OF WATER IN THE ATMOSPHERE OF VENUS
I. Ye. Salomonovich *In its* Izv. VUZov: Radiophys., No. 1, 1964 19 Jun. 1964 p 73-85 refs (See N64-27151 19-08) OTS: $4.00

In light of new data on the spectrum of the radio emission of the unilluminated side of Venus, the question is considered of the nature of the cloud layer of the planet and the possibility of observing water vapor in the atmosphere. Author

N64-27302* IIT Research Inst., Chicago, Ill.
RADIATIVE ENERGY TRANSFER ON ENTRY INTO MARS AND VENUS Quarterly Report No. 7
William O. Davies Jun. 1964 32 p refs
(Contract NASr-65(01))
(NASA-CR-56537; IITRI-T200-7) OTS: $3.60 ph

The dissociation rate of CO_2 was measured for temperatures of 6,000° to 11,000° K. The rate of disappearance of CO_2 behind shock waves in a CO_2-Ar gas mixture was monitored by observing the infrared radiation from the CO_2 2.7μ combination bands. The dissociation rates were expressed in the classical collision theory and an Arrhenius equation (in cm^3/particles-sec). A rate constant was also determined from observations of emission at 3,500 A, which is proportional to the product of the CO and O concentrations. The rates determined from these measurements are about a factor of three lower than those obtained from the infrared measurements, and the process has an activation energy of 3.68 ev as compared to the 2.96 ev for the infrared measurements. These results suggest that two different reactions are being observed; it is suggested that the infrared observations are a measure of CO_2 dissociation, while the UV emission is controlled by the recombination of CO and O into an excited state of CO_2, and the radiative lifetime of this CO_2 level. The results obtained by both methods over a temperature range of 2,600° to 10,000° K are summarized. Author

N64-27739* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
RADIATIVE EQUILIBRIUM IN PLANETARY ATMOSPHERES. I: APPLICATION OF THE STRONG LINE ABSORPTION LAW TO THE ATMOSPHERE OF VENUS
Rudolf A. Hanel and Frank Bartko Washington, NASA, Aug. 1964 30 p refs
(NASA-TN-D-2397) OTS: $0.75

The interpretation of the data obtained for Venus in the 8μ to 12μ atmospheric window clearly requires some knowledge of the temperature distribution in the planet's upper atmosphere. For this purpose temperatures, net fluxes, and specific intensities were calculated for a CO_2-N_2 atmosphere in radiative equilibrium. The wavelength, temperature, and pressure dependence of the CO_2 absorption, including the excited bands, was considered. Solar radiation absorbed in the clear atmosphere influences the temperature profile distinctly. The effects of various CO_2 concentrations, cloud-top pressure levels, and cloud reflectivities on the equilibrium temperatures are also discussed. Author

N64-28316* Geophysics Corp. of America, Bedford, Mass.
TIDES IN THE ATMOSPHERES OF EARTH AND MARS
Richard A. Craig Washington, NASA, Sep 1964 50 p refs
(Contract NASw-704)
(NASA-CR-97)

The theory of atmospheric tides, as developed for Earth's atmosphere, is applied to the Martian atmosphere. For corresponding modes of oscillation, equivalent depths are less in the Martian atmosphere than in Earth's atmosphere. On the other hand, the eigenvalue corresponding to the presumed Martian temperature distribution in the troposphere and stratosphere is about 20 km, about twice the corresponding value on Earth. These differences arise mainly from the different radii and masses of the planets. Unless the temperature distribution at high levels on Mars has a rather special form so that a second eigenvalue appears, no resonance magnification is to be expected. Tides in the Martian atmosphere might arise from periodic temperature oscillations, induced either by surface heating, or by radiative heating through deep layers of the atmosphere. Author

N64-28625 American Meteorological Society, Boston, Mass.
CONCERNING N. A. KOZYREV'S ARTICLE "EXPLANATION OF THE COLOR OF MARS BY THE SPECTRAL PROPERTIES OF ITS ATMOSPHERE" [PO POVODU STAT'I N. A. KOZYREVA "OB IASNENIE TSVETA MARSA SPEKTRAL'NYMI SVOISTVAMI EGO ATMOSFERY"]

G. A. Tikhov Bedford, Mass., AFCRL, Mar. 1964 7 p ref Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), no. 16, 1956 p 159-161
(Contract AF 19(628)-3880)
(T-R-423+; AD-602202)

In this paper, the author substantiates his reasons for believing that Kozyrev's conclusion that the red color of Mars is determined solely by the properties of its atmosphere is incorrect. R.T.K.

N64-28762* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
THE UPPER ATMOSPHERE OF JUPITER
S. H. Gross (Airborne Instr. Labs.) and S. I. Rascool Jun. 1964 40 p refs Submitted for Publication
(NASA-TM-X-51917) OTS: $3.60 ph

The properties of the upper atmosphere of Jupiter were theoretically investigated. The vertical temperature profile in the atmosphere above the clouds and the structure of the ionosphere were computed for two different model atmospheres: Model I corresponds to a H/He mixing ratio of 20:1 by volume, and Model II has a H/He ratio as low as 0.03:1. Assuming that the atmosphere of Jupiter above the clouds is in radiative equilibrium, the temperature distribution in the upper atmosphere of Jupiter was computed. With a cloud top temperature of 153° K and the total optical thickness of the atmosphere in the far infrared of 0.66, the radiation emitted by the planet is 3.1×10^4 ergs cm^{-3} sec^{-1}. This value of radiation flux is ~ 4 times higher than the solar flux received by Jupiter. The equilibrium distribution of electron densities in the ionosphere of Jupiter was also calculated. The maximum electron densities of ~ 10^6 electrons/cc occurred at the altitudes of 220 km and 110 km above the cloud top for the two model atmospheres. Author

N64-28862 Kitt Peak National Observatory, Tucson, Ariz.
MONTHLY REPORT: KITT PEAK, MAY 1964; CERRO TOLOLO, FEBRUARY, MARCH, APRIL, MAY 1964
1964 30 p refs
(Sponsored by NSF)

News notes from Kitt Peak National Observatory, Tucson, Arizona, and Cerro Tololo Inter-American Observatory, La Serena, Chile, include meetings with various corporations; settlement of claim regarding extra cost of 84-inch telescope; payrolls and personnel; instrument notes; libraries and their publications; Stellar Division, Solar Division, and Space Division reports; and the general progress at Cerro Tololo in construction and location of facilities. A.W.

N64-28868 American Meteorological Society, Boston, Mass.
RESULTS OF OBSERVATIONS OF MARS [REZUL'TATY NABLIUDENII MARSA]
Iu. N. Lipskii [1957] 8 p Transl. into ENGLISH from Priroda (Moscow), v. 46, no. 4, 1957 p 105-106
(Contract AF 19(628)-3880)
(T-R-427; AD-602180)

Preliminary results of observations made during the opposition of Mars in September 1956 are discussed. Included in these observations are the following: (1) an investigation of the optical properties of the vegetation of the various climatic zones; (2) brightness; (3) the polar cap; (4) the seas; (5) a comparison between the color of the seas and that of the continents; (6) water in the atmosphere and on the surface; and (7) the polarization of light reflected by various portions of the surface. I.v.L.

N64-29559* IIT Research Inst., Chicago, Ill. Life Sciences Div.
SURVIVAL OF MICROORGANISMS IN A SIMULATED MARTIAN ENVIRONMENT. I: *BACILLUS SUBTILIS* VAR. *GLOBIGII*
C. A. Hagen, E. J. Hawrylewicz, and R. Ehrlich Repr. from Appl. Microbiol., v. 12, no. 3, May 1964 p 215-218 refs
(Contract NASr-22)

Survival of *Bacillus subtilis* var. *globigii* in a simulated Martian environment was demonstrated. Previous contact with the simulated Martian soil or atmosphere reduced germination or outgrowth of unheated spores, or both. Inoculation into simulated Martian soil and then flushing with a simulated Martian atmosphere were lethal to both vegetative cells and spores. After one diurnal temperature cycle (26° to −60° C), the majority of cells present were spores. No further effect of the diurnal cycle on survival was noted in any of the experimental samples Author

N64-29597 American Meteorological Society, Boston, Mass.
PRELIMINARY RESULTS OF OBSERVATIONS OF MARS [PREDVARITEL'NYE REZUL'TATY NABLIUDENII MARSA]
N. P. Barabashov Bedford, Mass., AFCRL, Feb. 1964 9 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 5, 1957 p 34-36
(Contract AF 19(628)-3880)
(T-R-426; AD-602193)

Coordinated observations of Mars were conducted by various observatories throughout the U.S.S.R. for 5 months during the 1956 opposition. All observers noted that the Mars atmosphere was not transparent but was filled with a fog, which interfered with the study of surface features. Considerable changes from past observations were noted, however, in the contrast between the seas and the continents, the appearance and brightness of the southern polar cap and the polar fringe, and the brightness variations of the same land areas with time. The observational data acquired are being processed more fully to get a more accurate picture of the physical conditions on Mars. M.P.G.

N64-30339* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
DISCOVERIES FROM SPACE EXPLORATION
Robert Jastrow *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 109-121 (See N64-30326 22-01) GPO: $1.50

Some contributions of space science in astrophysics, geodesy, geology, meteorology, and astronomy are reviewed in considerable detail. R.L.K.

N64-31091 General Electric Co., Philadelphia, Pa. Reentry Systems Dept.
A SIMPLE ENTRY SYSTEM EXPERIMENT FOR MARTIAN ATMOSPHERIC MEASUREMENTS
F. G. Beuf [1964] 14 p refs

This paper discusses the results of a complementary study aimed at the development of a simple, light, sterilizable entry vehicle experiment, designed to gather the necessary information when launched into the Martian atmosphere from a flyby Bus. A low-ballistic-coefficient, minimum-weight vehicle design was generated. In its basic form the system is designed to telemeter vehicle acceleration, base pressure, and atmospheric constituent measurements during entry into the Martian atmosphere. A particular feature of the design is the use of

a spherical entry configuration, the symmetrical aerodynamics of which permit the use of a simple, low-data-rate communications system for transmission of vehicle motion data. The vehicle is designed to survive entry and to decelerate to subsonic velocity before impact in any of the presently proposed Martian atmospheres (surface pressures from 11 to 135 mb). Author

N64-32156 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Astro and Geophysics Section
PARTICLES AND RADIATION IN THE MARTIAN ATMOSPHERE
T. Fink and N. Milford Sep. 1963 21 p refs
(RM-222; AD-421540)

When galactic cosmic rays and high-energy solar particles impinge on the atmosphere of Mars, the primary particles, secondary particles, and radiation penetrate to various levels of the atmosphere. The approximate intensities of protons, electrons, neutrons, and muons at several levels in the Martian atmosphere are calculated. The corresponding radiation dosages are derived. It is found that the probable radiation dosages at the surface of Mars are about as large as the tolerable human dosage. Author

N64-32435* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANGLE-OF-ATTACK CONVERGENCE OF SPINNING BODIES ENTERING PLANETARY ATMOSPHERES AT LARGE INCLINATIONS TO THE FLIGHT PATH
Murray Tobak and Victor L. Peterson Washington, NASA, Oct. 1964 21 p refs
(NASA-TR-R-210) OTS: $0.50

An analysis is made of the angle-of-attack history of a spinning body entering a planetary atmosphere at an arbitrarily large inclination to the flight path. An asymptotic solution for the resultant angle-of-attack is derived, applicable to any axially symmetric body having an aerodynamic restoring-moment coefficient proportional to the sine of the resultant angle-of-attack. The solution yields results in satisfactory agreement with results obtained from numerical integrations of the exact equations of motion. Author

N64-32492* Georgetown U., Washington, D.C.
SPECTROSCOPIC STUDY OF SOLAR AND PLANETARY ATMOSPHERES Semi-Annual Status Report No. 2, 1 Aug. 1963–1 Feb. 1964
Francis J. Heyden [1964] 15 p
(Grant NsG-362)
(NASA-CR-59060) OTS: $1.00 fs; $0.50 mf

The method of observation was refined, and data were analyzed. Areas of research comprise the preparation of the simulated Martian atmosphere, the study of the spectrum of Jupiter from high dispersion plates taken on the Georgetown spectrograph, and the observation of planets at every available opportunity, along with spectrum analysis. Spectrographs are included for Mars, the Moon, nitrogen dioxide absorption, and the Sun. D.E.W.

N64-33000* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
DETERMINATION OF SOME PHYSICAL PROPERTIES OF THE ATMOSPHERE OF MARS FROM CHANGES IN THE DOPPLER SIGNAL OF A SPACECRAFT ON AN EARTH OCCULTATION TRAJECTORY
Arvydas Kliore, Dan L. Cain, and T. W. Hamilton 15 Oct. 1964 42 p refs
(Contract NAS7-100)
(NASA-CR-59161; JPL-TR-32-674) OTS: $2.00 fs; $0.50 mf

The expressions describing the effects of refraction in the atmosphere are derived and used to compute expected doppler changes for several isothermal model atmospheres of Mars, using typical 1964 and 1966–1967 Earth-occulting Mars flyby trajectories. Based on these computed results, and on the expected data accuracy, it is estimated that the scale height and surface density of the atmosphere of Mars can be determined with an accuracy of better than 10% by means of the experiment. In addition, several limitations of the experiment are described, and their effects on the results are discussed. Author

N64-33094* Stanford Research Inst., Menlo Park, Calif.
STUDY OF THE BREAKDOWN CHARACTERISTICS OF ANTENNAS IN THE ATMOSPHERES OF MARS AND VENUS Final Report
J. A. Martin and J. Chown Feb. 1963 30 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950380)
(NASA-CR-59111) OTS: $2.00 fs; $0.50 mf

The objective of this study was to determine the power-handling capability and breakdown-power level of several typical linear and circularly polarized antennas in the simulated atmospheres of Mars and Venus. For the N_2, CO_2, and Ar concentrations forming the simulated atmospheres employed here, the breakdown power level of the antennas was not significantly different from that experienced in air. Measured power required to initiate breakdown of 0.26 λ cylindrical monopole antennas is presented for Ω = 13.8, 12.0, 10.6, 10.1, 9.2, 7.8, 6.0, and 5.0 [Ω = 2 ln (4 length/diam) of antenna]. Measured breakdown power as a function of pressure is presented also for a cylindrical dipole antenna. The antenna scaling principle was verified at frequencies of 250 Mc (CW), 1197 Mc (pulse), and 3000 Mc (pulse), using monopole antennas of different thickness ratio, Ω. Author

N64-33165* Geophysics Corp. of America, Bedford, Mass.
PLANETARY METEOROLOGY Quarterly Progress Report No. 1, 20 Apr.–19 Jul. 1964
[1964] 38 p refs
(Contract NASw-975)
(NASA-CR-58848) OTS: $2.00 fs; $0.50 mf

Subjects covered include radiative equilibrium temperature distribution in the Venus atmosphere, atmospheric circulation on Venus, Martian surface pressure, carbon dioxide, and water-vapor amounts, atmospheric circulation on Mars, and the vertical variation of temperature above clouds of Jupiter. D.E.W.

N64-33173* Georgetown U., Washington, D.C. Georgetown College Observatory
SPECTROSCOPIC STUDY OF SOLAR AND PLANETARY ATMOSPHERES Semi-Annual Status Report, 1 Feb.–1 Aug. 1964
Francis J. Heyden and Carl C. Kiess [1964] 17 p
(Grant NsG-362)
(NASA-CR-58772) OTS: $1.00 fs; $0.50 mf

The absorption bands of nitrogen peroxide were mapped with high dispersion through the region from 3300 Å to 6600 Å. Experimental conditions and procedures are described. During the report period, Jupiter and Mars were unobservable. Observations of Venus were attempted, two for rotational velocity determination and one for the violet "fall off." The methods

and results of reductions of spectral observations are presented. The photoelectric spectrum scanner was put in operation, and the instrument is described in detail. D.E.W.

N64-33190* Rensselaer Polytechnic Inst., Troy, N.Y.
CHEMISTRY OF THE ATMOSPHERE OF THE PLANET VENUS Technical Status Report No. 4, 1 Feb.–31 Jul. 1964
P. Harteck, R. R. Reeves, Jr., and Barbara A. Thompson [1964] 6 p ref
(Grant NsG-261-62)
(NASA-CR-59112) OTS: $1.00 fs; $0.50 mf

Three different experimental arrangements were used for the investigation of the emission of microwave radiation by chemical reactions. The first is an ordinary X-band waveguide noise generator with the argon discharge tube replaced by a 6-mm Pyrex tube connected to a vacuum rack. Observed CO_2 and SO_2 intensities were too unreasonably high to be attributed solely to electron temperature. In order to test whether the origin of the emission may be the continua associated with the chemiluminescent reactions occurring in the discharges, a method was developed to see whether such emission could be observed from the reactions alone. This test could not be carried out using the noise generator because the oxygen atoms recombine on the walls of the 6-mm tubing before any glow reaches the detection area. Two alternate systems were set up and are being studied. The results obtained to date indicate that the microwave radiation emitted from Venus may originate in part from a nonthermal source, and thus the surface temperature may be lower than previously reported. Photochemistry experiments using iodine and bromine lamps are also reported. R.L.K.

N64-33336* Arizona U., Tucson Field Emission and Space Systems Lab.
DETECTION TECHNIQUES FOR TENUOUS PLANETARY ATMOSPHERES Second Semiannual Report, Jan. 1–Jun. 1, 1964
Stuart A. Hoenig and Melvin M. Eisenstadt [1964] 13 p refs
(Grant NsG-458)
(NASA-CR-59285) OTS: $1.00 fs; $0.50 mf

A chemisorption detector for hydrogen has been developed. This device operates over the pressure range from 10^{-5} to 10^{-8} torr and has a large and repeatable response to hydrogen. The detector makes use of the effect of hydrogen chemisorption on the work function of a palladium filament. This system is reasonably specific for hydrogen, and the effect of oxygen and nitrogen has been investigated. Oxygen has a substantial effect, but nitrogen does not. A similar detector for water vapor, using a barium-coated tungsten filament, has been tested and is undergoing further development. The large (18-in.-diam) uhv molecular beam system has been finished and leak checked. Author

N64-33371* National Aeronautics and Space Administration, Washington, D.C.
AMERICAN PROGRESS AND GOALS IN SPACE News Release
James E. Webb Available from the Scientific and Technical Information Division [1964] 18 p Presented at the Inventors' Congr. and Space Symp., Little Rock, Ark., 30 Oct. 1964

Major achievements and plans of the NASA space program are briefly discussed by James E. Webb. New scientific knowledge with wide application is stated to be produced rapidly, and technological advances are said to be tremendous in all areas as a result of the space program. The key roles of inventors and inventions in this program are emphasized, and the regional economic impact of the program is reviewed. D.E.W.

N64-33686* Stanford U., Calif. Radioscience Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semi-Annual Report No. 3, 1 Jan.–30 Jun. 1964
V. R. Eshleman Jul. 1964 9 p refs
(Grant NsG-377)
(NASA-CR-59325) OTS: $1.00 fs; $0.50 mf

This research program on radio and radar studies of the lunar and planetary ionospheres, atmospheres, and surfaces, and radar studies of the sun and interplanetary medium contains the following articles: "Planetary Research"—correlation characteristics of the radio-noise storm from Jupiter and from the Sun; "Propagation Characteristics through the Solar Corona"—a doppler shift observation in a radio wave sent from the earth to a solar probe; "Magnetohydrodynamic waves in Interplanetary Space"—the use of radar astronomy techniques for MHD waves in the interplanetary medium; "Solar Radar Program"—a conclusion that no solar echoes were present in the 1963 solar data; and "Cislunar Gas Studies"—automatic data-processing techniques development to edit and to store lunar data, a study of several methods to measure cislunar gas density, and development of a method to measure the total daily electron content in the ionosphere as a function of time and rate of change in electron content over the entire earth–moon path. G.G.

N64-33811* General Electric Co., Philadelphia, Pa. Missile and Space Div.
FUEL-CELL OXYGEN ANALYZER Preliminary Design Study
Robert G. Newland Dec. 1962 98 p refs
(Contract JPL-950286)
(NASA-CR-59363; PIR-7530-1419) OTS: $3.00 fs, $0.75 mf

Adaption of a fuel-cell-type oxygen analyzer design to the special requirements of determining the atmospheric oxygen response level on the planet Mars is discussed. As a result of the study, a fuel-cell oxygen analyzer assembly was fabricated that provided a voltage output change of 0.52 volts for an oxygen partial-pressure change from 0- to 10-mm Hg. A rapid and reproducible response was demonstrated by the assembly when it was subjected to a series of tests simulating descent trajectories through the Mars atmosphere. A sample gas-flow rate of 25 cc/min at 113-mm Hg total pressure has been found to provide adequate sample gas for the oxygen analyzer. The analyzer assembly was fabricated from nonferrous materials to provide a nonoperating permanent magnetic field less than 1 gamma at 3 1/2 feet. P.V.E.

1965
STAR ENTRIES

N65-10076# Joint Publications Research Service, Washington, D.C.
IZVESTIYA VUZov: RADIOPHYSICS, NO. 2, 1964

19 Oct. 1964 283 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 7, no. 2, Mar.-Apr. 1964 p 193-388
(JPRS-26953, TT-64-51209) OTS: $6.00

CONTENTS:

N65-10182# Paris Observatory, Meudon (France)

MEASUREMENT OF WATER VAPOR IN THE ATMOSPHERE OF MARS AND VENUS [MESURE DE LA VAPEUR D'EAU DANS LES ATMOSPHERES DE MARS ET DE VENUS]

A. Dollfus In Liège U. Infrared Spectra of Astron. Bodies 1964 p 392-395 *In* FRENCH (See N65-10155 01-29)

Attempts to measure the water vapor on Mars and Venus using photometric equipment for the 1.4μ radiation of the H_2O molecule are described. The data presented were obtained using this equipment both in balloons and on high mountains. Comparisons of Mars and lunar observations gave a different signal that, when corrected for brightness inequalities and instrumental effects, indicate that water vapor exists in the Mars atmosphere at a concentration of 2.6×10^{-2} g/cm^2. In the case of Venus, the water-vapor band was found to be juxtaposed with strong carbonic gas bands. Appropriate filtering out of the CO_2 bands confirmed the estimate of water vapor in the upper layers of the Venus atmosphere as the value 1.15×10^{-2} g/cm^2, assuming that the atmosphere is saturated to the level of the clouds. M.P.G.

N65-10183# RAND Corp., Santa Monica, Calif.

THE WATER CONTENT OF VENUS INFERRED FROM HER MICROWAVE BRIGHTNESS

D. Deirmendjian *In* Liège U. Infrared Spectra of Astron. Bodies 1964 p 397-405 refs (See N65-10155 01-29)

A recent theoretical evaluation of the microwave attenuation, albedo of single scattering, angular distribution, and polarization properties of terrestrial water clouds and precipitation is discussed with respect to its implication for the problem of Venus. On the basis of the preliminary analysis presented, the following conjectures for the nature of the Venusian atmosphere are presented. (1) The invisible surface of Venus radiates as a blackbody with a 600° to 800° K temperature, the source of the energy being at the surface or the planetary interior. (2) The planet is covered by a continuous and optically deep cloud layer of ice crystals and water droplets that can reach the size of raindrops. The cover allows very little of the surface radiation to escape to space and, conversely, a negligible amount of solar energy reaches the surface. P.V.E.

N65-10552# American Meteorological Society, Boston, Mass.
SOME PROPERTIES OF THE MARTIAN ATMOSPHERE INDICATED BY SPECTROPHOTOMETRIC OBSERVATIONS OF 1956 [O NEKOTORYKH SVOISTVAKH ATMOSFERY MARSA po SPEKTROFOTOMETRICHESKIN NABLIUDENIIAM 1956 GODA]
N. A. Kozyrev Bedford, Mass., AFCRL, Mar. 1964 9 p ref Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), no. 18, 1958 p 61-65
(Contract AF 19(628)-3880)
(T-R-429; AD-602183) OTS. $1.00

In 1956, the contrast of the surface details of Mars decreased sharply, while the general color of the planet changed but little. It is concluded that the atmosphere became turbid only in the lowest layers, and that no essential changes took place in the general optical properties of the atmosphere itself. Spectrograms of the polar cap, made in the second half of September and early October, showed it to be an atmospheric formation resulting from the condensation of the particles that cause normal scattering in the upper layers of the Martian atmosphere. Author

N65-10860*# National Aeronautics and Space Administration, Washington, D.C.
THE ENHANCEMENT OF HUMAN EXPLORATION BY MEANS OF SPACE FLIGHT An Address
Edgar M. Cortright [1964] 74 p Presented before the Norweg. Geograph. Soc., 27 Sep. 1964

This paper gives an overall survey of the exploration of space. Mr. Edgar M. Cortright describes the various satellites and their objectives. Terrestrial and lunar photographs that were taken from spaceships are presented and discussed. The missions of future manned and unmanned space flights are observed. G.G.

N65-10955*# National Aeronautics and Space Administration, Washington, D.C.
NASA ENGINEERING MODELS OF THE MARS ATMOSPHERE FOR ENTRY VEHICLE DESIGN
George M. Levin, Dallas E. Evans, and Victor Stevens, ed. Nov. 1964 51 p refs
(NASA-TN-D-2525) OTS Prices: HC $1.50/MF $0.50

In an effort to standardize atmosphere models used in Mars mission analyses and thus facilitate interpretation of such analyses, tentative engineering models for the Mars atmosphere are proposed. The emphasis is on the entry aspect of the mission. Three models having pressures at the planet's surface of 10, 25, and 40 mb are presented in both tabular and graphic form. An atmosphere model for use in terminal descent calculations is also presented. The atmosphere models are presented in both English and metric units in terms of eight variables as a function of altitude. These model atmospheres are based, insofar as possible, on experimentally obtained data and are not envelopes drawn around existing models of the Mars atmosphere. Author

N65-11443*# Consultants and Designers, Inc., Arlington, Va.
ON THE PRESENCE OF OXYGEN IN THE ATMOSPHERE OF VENUS [O NALICHII KISLORODA v ATMOSFERE VENERY]
V. K. Prokof'yev 17 Nov. 1964 8 p ref Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 31, 1964 p 276-280
(Contract NAS5-3760)
(NASA-TT-F-8992; ST-LPS-10242) OTS Prices: HC $1.00/MF $0.50

Spectra of solar light reflected by Venus at 1Å/mm dispersion in the 6300 Å region (α—oxygen band) have been obtained during the period May–July 1962. With the approach of Venus to the Earth a weak absorption band was detected on the short-wave side of the telluric oxygen band. This band may be due to the presence of a negligible amount of oxygen in the upper atmosphere layers of Venus. Author

N65-11445*# Consultants and Designers, Inc., Arlington, Va.
OPTICAL PROPERTIES OF THE ATMOSPHERE OF PLANET MARS IN THE ULTRAVIOLET SPECTRUM REGION [OB OPTICHESKIKH SVOYSTVAKH ATMOSFERY MARSA V UL'TRAFIOLETOVOM UCHASTKE SPEKTRA]
V. I. Garazha and E. G. Yanovitskiy 19 Nov. 1964 14 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 41, no. 5, 1964 p 942-950
(Contract NAS5-3760)
(NASA-TT-F-8994; ST-LPS-10244) OTS Prices: HC $1.00/MF $0.50

It is shown that during the 1956 opposition, the optical thickness of the atmosphere of Mars in the spectral region $\bar{\lambda}$ = 360mμ was considerably greater than the unity. It is assumed that the ultraviolet layer of the atmosphere of Mars consists of a mixture of gas with aerosol particles. It was found that at this mixture's single scattering, the albedo of particles is 0.50. Using the Rocard theory for the interpretation of atmosphere indicatrices, the scattering indicatrix was obtained in the indicated spectral region, and the mean radius of the aerosol particle was found to be $0.9 \cdot 10^{-5}$ cm. It was found that aerosol particles have an albedo of single scattering equal to 0.38 and that the concentration of these particles in the ultraviolet layer is rather high. Author

N65-12615*# Melpar, Inc., Falls Church, Va.
GAS CHROMATOGRAPHIC INSTRUMENTATION FOR GAS ANALYSIS OF THE MARTIAN ATMOSPHERE. VOLUME I: THIRD MONTHLY LETTER TECHNICAL REPORT Final Report
J. H. Chaudet 25 Sep. 1962 34 p
(JPL-950326)
(NASA-CR-59769) OTS Prices: HC $2.00/MF $0.50

Successful efforts to integrate all components into a working laboratory model of a gas chromatograph instrument for analysis of the Martian atmosphere are reported. Mechanical developments discussed include the following: (1) the construction and evaluation of an optimum sample injection value; (2) a carrier-gas control system; (3) instrument sealing; (4) loop switching; (5) Martian atmospheric Venturi gas pump; (6) construction of a Martian atmosphere simulator; (7) construction aspects of the laboratory model; and (8) design considerations for the breadboard model. M.P.G.

N65-12616*# Melpar, Inc., Falls Church, Va.
GAS CHROMATOGRAPHIC INSTRUMENTATION FOR GAS ANALYSIS OF THE MARTIAN ATMOSPHERE. VOLUME II: OVERALL PROGRAM SUMMARY Final Report
J. H. Chaudet 25 Sep. 1962 162 p
(JPL-950326)
(NASA-CR-59773) OTS Prices: HC $5.00/MF $1.00

A laboratory model of a gas chromatographic instrument to analyze 12 components that may be present in the Martian atmosphere is described. The NH_3, CO_2, H_2O, H_2, N_2, O_2, A, CH_4, and CO can be quantitatively measured and N_2O, C_2H_6, and Kr can be detected, all at a level of 10 ppm, with the

exception of ammonia. The system consists of a series arrangement of four major columns and two delay columns, four cross-section ionization detectors paired in sequence, and electrometers to analyze the outputs of each pair of detectors. The discussion includes the following: (1) configuration; (2) performance data; (3) detailed consideration of the various components; and (4) design drawings. Significant engineering research and development aspects are emphasized. M.P.G.

N65-12617*# Melpar, Inc., Falls Church, Va.
GAS CHROMATOGRAPHIC INSTRUMENTATION FOR GAS ANALYSIS OF THE MARTIAN ATMOSPHERE. VOLUME III: POST DESIGN CRITERIA AND SUMMARY Final Report
J. H. Chaudet 25 Sep. 1962 100 p
(JPL-950326)
(NASA-CR-59772) OTS Prices: HC $3.00/MF $0.75

Post design criteria related to the breadboard and prototype gas chromatography units are considered. Components were selected, and a package configuration is presented. Environmental constraints were considered in the package design. Recommendations are included on the injector valve, columns, detectors, sample pumping, etc. Numerous tradeoffs that were available for increasing the versatility or the reliability of the instrument are also discussed. D.E.W.

N65-12728*# Geophysics Corp. of America, Bedford, Mass.
PLANETARY METEOROLOGY Quarterly Progress Report No. 2, 20 Jul.–19 Oct. 1964
[1964] 34 p refs
(Contract NASw-975)
(NASA-CR-59695) OTS Prices: HC $2.00/MF $0.50

A model was developed for computing the radiative equilibrium temperature distribution of the entire atmosphere of a planet, such as Venus, that is completely covered by clouds. Two theories for estimating the circulation characteristics of Venus are presented: a model for estimating the average horizontal velocity in the Venusian atmosphere and for computing the mean wind velocity, and a model for determining the circulation pattern of the Venusian atmosphere. Also described are the development of a nongrey radiative transfer model to compute the radiative equilibrium temperature distribution of the Jupiter atmosphere, and the problem of estimating the maximum wind velocity near the Martian surface. G.G.

N65-13197*# National Aeronautics and Space Administration. Washington, D.C.
PROBLEMS OF SOLAR ACTIVITY
B. M. Rubashev Dec. 1964 397 p refs Transl. into ENGLISH of the book "Problemy Solnechnoy Aktivnosti" Moscow, "Nauka" Publishing House, 1964
(NASA-TT-F-244) OTS Prices: HC $7.00/MF $2.00

This study concerning the nature of solar activity was directed toward raising the qualitative level of solar activity forecasting by a change from the empirical–statistical methods to the more promising physicomathematical methods. The material is presented under the following chapter headings: (1) "Cyclic Character of Solar Activity"; (2) "Structure and Dynamics of the Subphotospheric Layers of the Sun"; (3) "Energy Sources of Solar Activity"; (4) "Certain Manifestations of Solar Activity in the Upper Layers of the Earth's Atmosphere"; (5) "Manifestations of Solar Activity in the Lower Layers of the Earth's Atmosphere"; (6) "Manifestations of Solar Activity in the Brightness of Comets and in Planetary Atmospheres." D.S.G.

1963
IAA ENTRIES

A63-10220
A SEARCH FOR WATER VAPOR AND TRACE CONSTITUENTS IN THE VENUS ATMOSPHERE.
Hyron Spinrad (California Institute of Technology, Jet Propulsion Laboratory, Div. of the Space Sciences, Pasadena, Calif.)
Icarus, vol. 1, Oct. 1962, p. 266-270. 12 refs.

A description of an unsuccessful spectroscopic search for water vapor and other gases in the Venus atmosphere. The resulting upper limit on the Cytherean water-vapor/atmosphere mixing ratio down to a level of high temperature and pressure is about 10^{-5}.

A63-10587
THE MISSION OF MARINER II: PRELIMINARY OBSERVATIONS THE IOWA RADIATION EXPERIMENT.
James A. Van Allen and Louis A. Frank (University of Iowa, Dept. of Physics and Astronomy, Iowa City, Iowa).
Science, vol. 138, Dec. 7, 1962, p. 1097, 1098.

Discussion of the primary purposes and a description of the equipment of the Iowa experiment carried by Mariner II (1962 Alpha Rho 1). The detector is an Anton type-213 Geiger-Mueller tube, which is a miniature tube having a 1.2 mg/cm^2 mica window about 0.3 cm in diameter. A schematic diagram of it, and a table of its properties are included. Data recorded by the detector in September and October 1962 are plotted.

A63-10743
THEORETICAL ESTIMATES OF THE AVERAGE SURFACE TEMPERATURE ON MARS.
George Ohring, Wen Tang, and Gloria DeSanto (Geophysics Corp. of America, Bedford, Mass.)
Journal of the Atmospheric Sciences, vol. 19, Nov. 1962, p. 444-449. 11 refs.
Contract No. NASw-286.

Estimation of the average surface temperature on Mars from radiative-equilibrium considerations. A minimum possible surface temperature is estimated by computing the radiative-equilibrium temperature that the Martian surface would have if the planet had no atmosphere. An estimate of the maximum possible value of the average surface temperature is obtained by computing the surface temperature that would result from a maximum greenhouse model. The computations indicate that the average surface temperature is in the range 219°K to 233°K. Comparisons of the theoretical computations with indications of surface temperature obtained from thermal-emission observations are found to be in reasonable agreement.

A63-10756
MARINER II INSTRUMENTATION: WHAT WILL IT SEE ON VENUS?
S. Chase, Jr. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) and F. Schwarz (Barnes Engineering Co., Stamford, Conn.)
Electronics, vol. 35, Dec. 14, 1962, p. 42-45.

Discussion of the Mariner II (1962 Alpha Rho 1) microwave- and IR-radiation detectors, designed to investigate the cloud cover and surface radiation of Venus. By mapping the temperature pattern of the Venus cloud tops, and measuring the extent of cloud breaks, the IR radiometer will help to establish a correct model for the planet's atmosphere. It is shown how, by receiving radiation alternately through two lenses that view regions 45° apart, the thermistor detector will measure the absolute radiation from the planet, from which its temperature can be determined. A low-frequency preamplifier with a high input-impedance, and a logarithmic amplifier are described, as is the synchronous rectification used to improve the SNR.

A63-10769
FIZICHESKIE USLOVIIA NA MARSE [PHYSICAL CONDITIONS ON MARS].
N. P. Barabashov (Akademiia Nauk, Ukrainian SSR).
Akademiia Nauk, SSSR, Vestnik, vol. 32, Oct. 1962, p. 18-25. In Russian.

An analysis of results obtained by several observers on the various characteristics of the physical nature of Mars. Discussed are the formation of the atmosphere, the composition of soil, polar caps, temperature, seasonal changes, and the possibility of life on the planet.

A63-11146
MOLECULAR SPECTROSCOPY OF PLANETARY ATMOSPHERES.
D. G. Rea (University of California, Space Sciences Laboratory, Berkeley, Calif.)
Space Science Reviews, vol. 1, Oct. 1962, p. 159-196. 79 refs.
Grant No. NsG-101-61.

Critical review of the various studies concerning the computation of planetary atmospheres undertaken with dispersing devices, summarizing only briefly topics which have been adequately covered in the papers that are cited. The field is further restricted to gaseous components, generally neglecting the cloud cover. All the planets, except Earth and Mercury are considered. It is shown that spectroscopy has provided considerable insight into the nature of the planetary atmospheres. Several molecular constituents are positively identified and upper limits are placed on the abundances of others which are of particular significance in devising planetary models. But, equally clearly, the inadequacy of the spectral data, due to low spectral and/or spatial resolution renders deductions of abundances, temperatures, and pressures very uncertain. With the sole exception of the Martian CO_2 abundance, knowledge of the concentrations of planetary atmospheric constituents is unsatisfactory, and all numbers given must be regarded as only crude estimates.

A63-11343
DYNAMICAL AND OTHER ASPECTS OF COSMIC GASES OF LOW DENSITY.
Sydney Chapman (University of Alaska, Geophysical Institute, College, Alas., and University of Colorado, High Altitude Observatory, Climax, Colo.)
(International Symposium on Rarefied Gas Dynamics, 2nd, Proceedings, Berkeley, Calif., Aug. 3-6, 1960.)
IN: Rarefied Gas Dynamics. New York, Academic Press, Inc., 1961, p. 669-690. 23 refs.
USAF-NBS-sponsored research.

Discussion of low-density gases in the ambium, which is the independent, outer distribution of gas that surrounds an atmosphere. The ambium has a low density but great extent. Hence, its mass may far exceed that of the atmosphere it surrounds. Where atmosphere and ambium merge, the conditions may be determined more by the ambium than by the central body. The ambium may be free or almost free from any influence of the star or planet, but still determines the limiting value to which the atmospheric pressure can fall. Thus, it partly governs the extent of the atmosphere - the lower the ambient pressure, the greater the extension of the atmosphere. Some simple fundamental considerations, based on kinetic theory and statistical mechanisms, are presented on the state and extent of the Earth's outermost atmosphere. Specific problems of the atmospheres of the Earth and the Sun are treated. Interplanetary gas is considered on the basis of two alternatively supposed distributions of electron density.

A63-11897
STRUCTURE OF PLANETARY ATMOSPHERES.
S. I. Rasool (NASA, Institute for Space Studies, New York, N. Y.)
AIAA Journal, vol. 1, Jan. 1963, p. 6-19. 81 refs.

Review of the properties of the atmospheres of Mars, Venus, and Jupiter in the light of the most recent observational data. Surface features of Mars and the blue haze layer covering that planet are studied. The greenhouse, the aelosphere, and the ionosphere models for the atmosphere of Venus are presented. Observed radio brightness temperatures of Jupiter are tabulated, and the significance of the great red spot present in the atmosphere of that planet is discussed.

A63-12834
A THEORETICAL ESTIMATE OF THE AVERAGE VERTICAL DISTRIBUTION OF TEMPERATURE IN THE MARTIAN ATMOSPHERE.
George Ohring (Geophysics Corporation of America, Bedford, Mass.)
Icarus, vol. 1, Jan. 1963, p. 328-333. 10 refs.
Contract No. NASw-286.

Computation of the average temperature profile of the Martian atmosphere, using a simple theoretical formulation in which it is assumed that convection will extend to that height above which the radiative equilibrium lapse rate is just stable. It is assumed that the average surface temperature is 230°K, there is no absorption of solar radiation in the atmosphere, and carbon dioxide in an amount equal to 2% by volume is the only important radiating gas. The radiation fluxes are computed with the aid of radiation tables; the radiative equilibrium temperatures are calculated using an iterative procedure. The computed temperature profile is characterized by an adiabatic troposphere extending to about 9 km, above which the temperature continues to decrease with height to an average value of about 90°K for the topmost 5-mb layer.

A63-13109
VENUS.
Carl Sagan.
International Science and Technology, Mar. 1963, p. 86-92, 94.

Discussion of the nature of the Venus surface based on observations of the Venus microwave spectrum, cloud-top temperatures, radar reflectivity, and interpretation of the Venus IR spectrum. It is noted that, from these observations, four models of the planet's surface may be defended: a desert with calm, clear, ovenlike temperature, below ice clouds; a swamp with fernlike plants, below a dense cover of water clouds; an ocean of carbonate water; and an ocean of oil. Similarly, at least three model atmospheres are tenable: the so-called greenhouse, aelosphere, and ionospheric models. It is shown, however, that Earth-based observations of the variation in microwave intensity are limited to the planet's dark hemisphere. The possibility of using the Mariner II (1962 Alpha Rho 1) results, once they have been evaluated, in support of one of the conflicting models is examined. The problem of determining the surface temperature of Venus is discussed in some detail.

A63-13754
ELECTRICAL PROPERTIES OF SHOCK WAVES ON MARS.
William O. Davies (Illinois Institute of Technology, Armour Research Foundation, Chicago, Ill.)
AIAA Journal, vol. 1, Feb. 1963, p. 464-466.

Calculation of the electrical properties of the Martian atmosphere at temperatures and densities expected to occur in shock layers for probes circling the planet, and the reflection and attenuation by the shock layer of electromagnetic waves having radio and radar frequencies. The flight conditions considered are for a probe circling Mars at an altitude of 2×10^5 ft, with constant velocities of 7,200, 10,000, and 15,000 fps. Kopal's model atmosphere for Mars is used in the calculations.

A63-13792
OB ISSLEDOVANII ATMOSFERY VENERY OPTICHESKIMI METODAMI [THE ATMOSPHERE OF VENUS AS INVESTIGATED BY OPTICAL METHODS].
G. V. Rozenberg (Akademiia Nauk, Institut Fiziki Atmosfery, Moscow, USSR).
Akademiia Nauk (USSR), Doklady, vol. 148, Jan. 11, 1963, p. 300-302. In Russian.

Presentation of data on the atmosphere of Venus obtained by optical methods. It is concluded that (1) the atmosphere of Venus is very nubilous indicating that its optical thickness is, at least, of several units of measurement; and (2) the brightness coefficient influences not only the light absorption in the region above the clouds but also the absorption within the cloud region. In addition, it is suggested that the acquisition of data on the atmosphere of Venus by optical methods is possible only in the case in which the effects of multiple light scattering are taken into account.

A63-14376
SOUNDING ROCKET TECHNIQUES EXTRAPOLATED TO PLANETS.
Herbert Friedman (U.S. Naval Research Laboratory, Washington, D.C.)
(International Astronomical Union-Douglas Aircraft Co., Inc., International Symposium on Space Age Astronomy, Pasadena, Calif., Aug. 7-9, 1961.)
IN: Space Age Astronomy. New York, Academic Press, Inc., 1962, p. 414-424.

Discussion of sounding-rocket techniques for the determination of the structure of a planetary atmosphere by measuring the optical thickness at various wavelengths. Measurements in the UV and the far UV should permit analysis of planetary hydrogen corona and planetary albedo. Measurements in the visible spectrum should provide information on airglow and aurora.

A63-14377
THE ATMOSPHERE OF MARS.
W. W. Kellogg (RAND Corp., Santa Monica, Calif.)
(International Astronomical Union-Douglas Aircraft Co., Inc., International Symposium on Space Age Astronomy, Pasadena, Calif., Aug. 7-9, 1961.)
IN: Space Age Astronomy. New York, Academic Press, Inc., 1962, p. 425-429; Discussion, p. 429.

Summary of the known and deduced composition and characteristics of the atmosphere of Mars. The general circulation of the Martian atmosphere is briefly considered, as is the albedo of the planet.

A63-14378
THE PHYSICAL ENVIRONMENT OF VENUS: MODELS AND PROSPECTS.
Carl Sagan (University of California, Berkeley, Calif.)
(International Astronomical Union-Douglas Aircraft Co., Inc., International Symposium on Space Age Astronomy, Pasadena, Calif., Aug. 7-9, 1961.)
IN: Space Age Astronomy. New York, Academic Press, Inc., 1962, p. 430-442; Discussion, p. 442, 443.

A description of three models for the atmosphere of Venus: the greenhouse, the aeolosphere, and the ionospheric models. The evidence in favor of each of these three mutually exclusive models is outlined, and the difficulties each presents are discussed. Six areas of investigation that could be performed by space vehicles, which might prove the validity of one of the models, are discussed.

A63-14521
CARBON DIOXIDE ABSORPTION FOR PATH LENGTHS APPLICABLE TO THE ATMOSPHERE OF VENUS.
Gilbert N. Plass and V. Robert Stull (Ford Motor Co., Aeronutronic Div., Newport Beach, Calif.)
Journal of Geophysical Research, vol. 68, Mar. 1, 1963, p. 1355-1363. 16 refs.

Extension of calculations of the spectral transmittance of CO_2 from 500 to 9,500 cm^{-1} to cover pressures of 31 atm and CO_2 amounts of 2.34×10^7 atm cm. From the tables and figures given it is possible to obtain the transmittance of the atmosphere of Venus for a wide range of assumed conditions.

A63-14791
EXPERIMENTAL STUDIES OF STATIC STABILITY AND RADIATIVE HEATING ASSOCIATED WITH MARS AND VENUS ENTRY.
Carlton S. James and Willard G. Smith (NASA, Ames Research Center, Moffett Field, Calif.)
(Institute of the Aerospace Sciences, Annual Meeting, 31st, New York, N.Y., Jan. 21-23, 1963.)
IN: Aerospace Forum, 1st Session, Proceedings. New York, Institute of the Aerospace Sciences, SMF Fund Paper FF-34, 1963, p. 16-21.

Preliminary experimental investigation of two aspects - radiative heating and static stability - of vehicle entry into the atmosphere of Mars or Venus. The radiative heating problem is examined by comparing gas-cap radiation in the simulated planetary atmospheres with that under the same ambient conditions in air.

The effects of gas composition on static stability and drag of several different entry-body configurations are compared. It is concluded that the problems of static stability and drag of a low-fineness-ratio capsule for entry into the Mars or Venus atmospheres will not be significantly different from those for entry into air, at least in the lower portions of the trajectory. The radiation measurements indicate that radiative heating rates during Martian entry may be four or five times more severe than for an entry into air.

A63-14848

STRATOSCOPE 2 AIMS FOR SPECTRAL ANALYSES OF PLANETS' ATMOSPHERES.

Aviation Week and Space Technology, vol. 78, Apr. 1, 1963, p. 74, 75, 78.

Discussion of planetary studies by means of stratoscope balloon systems. Following a brief review of the successful flight of Stratoscope 1, the objectives are outlined for the flight of Stratoscope 2. The latter carries a 6,300-lb payload consisting of instrumentation of improved optics; specifically described is the Perkin-Elmer telescope system which will perform an IR spectral analysis of the atmospheres of Venus, Jupiter, and Saturn.

A63-14865

VERTICAL DISTRIBUTION OF NEUTRAL GASES ON VENUS.

Mikio Shimizu (University of London, University College, Physics Dept., London, England).

Planetary and Space Science, vol. 11, Mar. 1963, p. 269-273. 25 refs.

Calculation of the vertical distribution of neutral CO_2, O_2, CO, and O gases on Venus, assuming photochemical equilibrium. Kaplan's model of the atmospheric structure is adopted; and the solar UV radiation in the wavelengths from 1,250 to 1,950 Å is assumed to be that of a 5,000°K blackbody. It is found that the radiation is absorbed mainly by O_2 molecules produced by three-body recombination between O atoms. Consequently, the altitude of the dissociation layer on Venus is higher than was derived earlier by taking into account the dissociation of CO_2 molecules only. The calculated amounts of CO, O, and O_2 on Venus are ~4, 4, and 0.1 cm STP, respectively.

A63-16203

AN ANALYTIC SOLUTION FOR DENSITY DISTRIBUTION IN A PLANETARY EXOSPHERE.

C. S. Shen (Institute for Space Studies, New York, N. Y.)

Journal of the Atmospheric Sciences, vol. 20, Mar. 1963, p. 69-72.

Derivation of an analytical expression for the ballistic density distribution in a planetary exosphere. It is shown that in 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 according to a Maxwellian law. The physical significance of this difference and its effect on the escape rate are discussed.

A63-16365

THE RADIO EMISSIONS FROM JUPITER AND THE DENSITY OF JOVIAN EXOSPHERE.

G. R. A. Ellis (University of Tasmania, Physics Dept., Hobart, Tasmania, Australia).

Australian Journal of Physics, vol. 16, Mar. 1963, p. 74-81.

Discussion of the properties of cyclotron radiation from bunches of electrons trapped in a Jovian exosphere. It is shown that, if the polar magnetic field intensity is 15 gauss and the magnetic axis is inclined 10° to the rotation axis, the calculated properties agree with those observed for the decametric radiation, providing Jupiter is surrounded by an extensive exosphere. The electron density of the exosphere varies mainly as the magnetic-field intensity.

A63-16650

THE WATER VAPOR CONTENT OF THE MARTIAN ATMOSPHERE AS A PROBLEM OF CHEMICAL EQUILIBRIUM.

Joe A. Adamcik (Texas Technological College, Dept. of Chemistry, Lubbock, Tex.)

Planetary and Space Science, vol. 11, Apr. 1963, p. 355-359. 16 refs.

Calculations, from the thermodynamic point of view, of the expected water vapor content of the Martian atmosphere, on the assumption that it is determined by the equilibrium dissociation pressure of ferric-oxide hydrate. The pressure so calculated is seen to agree well with estimates of the atmospheric water content derived from data of other kinds, thus lending support to the hypothesis that ferric-oxide hydrate forms a significant fraction of the Martian surface. It is shown that the presence of such a hydrate would significantly extend the time scale for any evolution of the planet due to loss of water.

A63-17235

ATMOSPHERE AND SURFACE PROPERTIES OF MARS AND VENUS.

Ernst J. Öpik (University of Maryland, Dept. of Physics, College Park, Md.)

IN: Progress in the Astronautical Sciences. Vol. I. Amsterdam, North-Holland Publishing Co., 1962, p. 261-342. 97 refs.

Grant No. NsG 58-60.

Critical review of some partly controversial general properties of the surface and atmosphere of Mars and Venus. Two major types of permanent or semipermanent surface formations on Mars are observed: the bright orange-red continents, and the dark grayish maria whose average coloration on an absolute scale is slightly brown or yellow, but by contrast may sometimes give the impression of green or blue. The bright polar caps, regularly varying with the season, are undoubtedly composed of a thin layer of water, hoarfrost or snow. The darkness and coloration of the maria also show regular seasonal variation, in addition to sporadic changes of a more persistent, nonseasonal character. The maria are commonly interpreted as vegetation consisting of primitive plants not containing chlorophyll. The failure to observe topographic irregularities near the Martian terminator is interpreted as indicating the absence of mountain chains or peaks; the upper limit of altitude is set for mountains at 2-3 km (Lowell) and for mountain ranges at 0.8 km (Russell). The Martian atmosphere is much thinner than the terrestrial, with carbon dioxide the only constituent which has been definitely observed spectroscopically. The bulk of the atmosphere may consist of nitrogen and argon. Oxygen is practically absent. The presence of water vapor is indirectly inferred from the polar caps, but its amount is small. Liquid water surfaces are definitely absent, except perhaps temporarily near the poles. The optical properties of the surface of Venus are consistent with a relatively thin-scattering gaseous atmosphere, overlying a continuous layer of clouds. The effective thickness of the gaseous layer appears to decrease with decreasing wavelength. The reflectivity of the clouds rapidly decreases toward the violet. The yellow color of the clouds is their intrinsic property, and is not caused by absorption in the atmosphere. The observed amount of water vapor is too small to be condensable. Water in liquid or solid form cannot exist on Venus. The clouds of Venus cannot consist of water; most probably they represent solid dust, possibly containing carbonates, blown up from the surface. Circumstantial evidence points to 10-13 days as the probable period of rotation of Venus. Kuiper's explanation of the bands in the upper haze level as corresponding to climatic zones, as well as their visibility in the ultraviolet and invisibility in longer wavelengths, is in excellent agreement with the general optical properties of the planet. Hydrocarbons cannot be present on Venus in large quantities, as indicated by the nonobservability of the spectral bands of the lighter compounds. A model of the vertical distribution of temperature and structure of the atmosphere of Venus is proposed.

A63-17247

DECAMETRIC RADIO EMISSIONS OF JUPITER.

G. R. A. Ellis and P. M. McCulloch (University of Tasmania, Dept. of Physics, Hobart, Tasmania, Australia).

Nature, vol. 198, Apr. 20, 1963, p. 275.

Comparison of observations of Jupiter at 4.8 and 19 Mc during 1961 and 1962 to test the theory that decametric wavelength radiation from Jupiter results from cyclotron emission by bunches of electrons traveling through the exosphere. It is seen that at 19 Mc the pronounced peak in the vicinity of 270° longitude system III is due largely to the greater number of occurrences. When this is taken into account, three almost equal maxima appear, two of which agree with those at 4.8 Mc. These two maxima are consistent with the

cyclotron hypothesis, as is the greater depth of the minimum of the received power at 19 Mc compared with 4.8 Mc for longitudes near 90^0.

A63-17408
MESURE DE LA QUANTITE DE VAPEUR D'EAU CONTENUE DANS L'ATMOSPHERE DE LA PLANETE MARS [MEASUREMENT OF THE WATER-VAPOR CONTENT IN THE MARTIAN ATMOSPHERE].
Audouin Dollfus (Observatoire de Paris, Meudon, Seine-et-Oise, France).
Académie des Sciences (Paris), Comptes Rendus, vol. 256, no. 14, Apr. 1, 1963, p. 3009-3011. 15 refs. In French.

Photometric comparison of the intensity of the 1.4μ band for water vapor, from Mars, the Moon, and various stars, in order to determine the water-vapor content in the Martian atmosphere. The measurements were made in winter at high altitudes (from Jungfraujoch observatory) when the declination of Mars was +19°. The vapor content is found to be 0.02 gm/cm^2.

A63-17570
SPACECRAFT ENTRY AND LANDING IN PLANETARY ATMOSPHERES.
Maurice Tucker (Lockheed Aircraft Corp., Lockheed Missiles and Space Co., Palo Alto, Calif.)
IN: Advances in Space Science and Technology, Vol. IV. New York, Academic Press, Inc., 1962, p. 139-201. 64 refs.

Discussion of the problems of bringing spacecraft safely through planetary atmospheres and onto the surface. The entry equations are reviewed, attention being focused on aerodynamic loading and heating problems in various planetary atmospheres, atmospheric braking, and entry techniques (ballistic and controlled). Various configurations for entry vehicles are described. The use of parachute recovery techniques is assumed. It is concluded that problems of entering the atmospheres of Earth and Venus are about equal with respect to deceleration levels, guidance accuracy, and convective heating. Convective heating problems for entry into the Jovian atmosphere appear to be unrealizable within the present state of space technology, whereas no particular difficulties are anticipated for Mars entry.

A63-18588
SEEING PLANETS FROM SPACE.
Oskar L. Ritter and Hubertus Strughold (U.S. Air Force University, School of Aviation Medicine, Randolph AFB, Tex.).
Astronautics and Aerospace Engineering, vol. 1, July 1963, p. 82-87. 10 refs.

Presentation of some quantitative data on the surface regions which can be seen on celestial bodies by an observer in space near these bodies. The various optical, atmospheric, and physiological conditions which influence visibility are discussed. The question of how much of a planetary atmosphere can be seen from low- and medium-range satellites is examined from the standpoint of physical optics, and the matter of what details on a planetary surface can be perceived and discerned from space with the naked eye is examined from the standpoint of physiological optics.

A63-18902
THE INFRARED SPECTRUM OF VENUS (1-2.5 μ).
V. I. Moroz (Shternberg State Astronomical Institute, Moscow, USSR).
(Astronomicheskii Zhurnal, vol. 40, Jan.-Feb. 1963, p. 144-153.)
Soviet Astronomy, vol. 7, July-Aug. 1963, p. 109-115. 25 refs. Translation.

Study of the near-IR spectrum of Venus, using a spectrometer with diffraction grating. To exclude errors and identifications confused with telluric bands, spectra of the Sun and Moon are recorded under similar conditions. The observational material is listed, and tables showing both new and unidentified features are presented. Estimates on the abundance and upper limits of numerous compounds are given, and information on the chemical composition of the Venus atmosphere is summarized.

A63-18924
THE DESIGN OF MARTIAN BIOLOGICAL EXPERIMENTS.
N. H. Horowitz (California Institute of Technology, Pasadena, Calif.).
COSPAR, International Space Science Symposium, 4th, Warsaw, Poland, June 3-11, 1963, Paper. 5 p. 14 refs.

Consideration of the biochemical characteristics of the life that would be found on Mars, in order to develop correct criteria in planning Martian biological experiments. It is assumed by the Gulliver and similar experiments designed to detect metabolism on Mars that, if life exists there, it is carbonaceous. This assumption is analyzed in terms of the uniqueness of the carbon atom, the uniformity of chemical composition in terrestrial life forms, and the mechanism of protein synthesis. The hypothesis that life in the universe has a common origin is briefly discussed. It is concluded that Martian life is likely to be similar, but not necessarily identical, to terrestrial life in chemical composition. This follows from the assumption that the primitive Martian atmosphere resembled that of the primitive Earth, that similar chemical reactions occurred in it, and that Martian life, like terrestrial life, was formed from the compounds available.

A63-18937
INVESTIGATIONS OF THE ATMOSPHERE OF THE PLANET VENUS BY OPTICAL METHODS.
G. V. Rozenberg (Institute of Physics of the Atmosphere, Moscow, USSR).
(Akademiia Nauk (USSR), Doklady, vol. 148, Jan. 1963, p. 300-302.)
Soviet Physics - Doklady, vol. 8, July 1963, p. 1, 2. Translation.
[For abstract see Accession no. A63-13792 08-05]

A63-19698
OBSERVATION OF WATER VAPOR ON VENUS [OBSERVATION DE LA VAPEUR D'EAU SUR LA PLANETE VENUS].
Audouin Dollfus (Observatoire de Paris, Meudon, Seine-et-Oise, France).
Académie des Sciences (Paris), Comptes Rendus, vol. 256, no. 15, Apr. 8, 1963, p. 3250-3253. 12 refs. In French.

Study of the photometric comparisons of the 1.4-μ band of water vapor on Venus and on the Moon, from a high mountain in the winter. It shows the existence of at least 10^{-2} gm/cm^2 of water vapor above the high cloud layer of Venus. It is, therefore, concluded that the clouds may be composed of either ice or water.

A63-19734
INTERACTION OF COSMIC AND SOLAR FLARE RADIATIONS WITH THE MARTIAN ATMOSPHERE AND THEIR BIOLOGICAL IMPLICATIONS.
Herman Yagoda (USAF, Cambridge Research Laboratories, Bedford, Mass.).
COSPAR, International Space Science Symposium, 4th, Warsaw, Poland, June 3-11, 1963, Paper. 4 p.

Brief review of studies of the intensity of the radiation falling on the Martian surface. Outlined are investigations concerning neutron production, capture of slow neutrons, particle star production, and galactic cosmic-ray intensities in terms of solar flares. A table shows the comparative surface radiation levels for Earth and Mars. It is noted that Mars, with its marginal environment for sustaining primitive life forms, is subjected periodically to comparatively intense radiation levels which may have profound effects on the mutation and evolution of Martian plant and animal life.

A63-19917
GEOMAGNETIC PHENOMENA AT CONJUGATE POINTS.
S.-I. Akasofu (Geophysical Institute, College, Alaska).
(American Geophysical Union, Western National Meeting, 2nd, Stanford, Calif., Dec. 27-29, 1962.)
American Geophysical Union, Transactions, vol. 44, Mar. 1963, p. 137, 138.

Summary review of recent experimental and theoretical investigations in the space sciences. Outlined are studies concerning (1) geomagnetic phenomena at conjugate points; (2) airglow and auroral phenomena, including measurements of the UV day glow in the upper atmosphere of the Earth, and observations of time variations in the intensity of solar X-rays; (3) conditions near the interface between

the magnetosphere and the interplanetary plasma, emphasizing the results reported from the three-axis fluxgate magnetometer and low-energy particle detectors in Explorer 12 (1961 Upsilon 1); (4) the Moon and planets, including results on hypervelocity impact phenomena and meteorites; (5) planetary atmospheres; (6) results of the Mariner 2 (1962 Alpha Rho 1) space mission, including Doppler tracking data and telemetry data; and (7) the steel fragment found in Manitowoc, Wis., and identified as a piece of Sputnik 4 (1960 Epsilon 1).

A63-19958

PLANETARY ATMOSPHERES.

Yale Mintz (University of California, Los Angeles, Calif.).

(International Union of Geodesy and Geophysics, Thirteenth General Assembly, United States National Report, 1960-1963.)
American Geophysical Union, Transactions, vol. 44, June 1963, p. 400-403. 34 refs.

Brief summary of recent experimental and theoretical treatments of planetary atmospheres, emphasizing the thermal structure of Venus. Recent radiation temperature measurements from Venus are outlined, and theories suggesting a thermal or a nonthermal origin for the observed microwave radiation factors are noted. Outlined is the effect of the rotation rate of a planet on its thermal structure.

A63-19976

RADIO OBSERVATIONS OF THE MOON AND PLANETS.

Cornell H. Mayer (U.S. Naval Research Laboratory, Radio Astronomy Branch, Washington, D.C.).

(International Union of Geodesy and Geophysics, Thirteenth General Assembly, United States National Report, 1960-1963.)
American Geophysical Union, Transactions, vol. 44, June 1963, p. 457-461. 59 refs.

Présis of some significant results of observational and theoretical studies of the radio emission of the Moon, Mercury, Venus, Jupiter, and Saturn. Noted are studies aimed at the verification, extension, and explanation of Mayer's observations of Venus, as are investigations concerning three types of Jovian radiation, the generation of nonthermal decimeter radiation as synchrotron radiation, and Jovian radiation belts. Recent quantitative measurements of Saturnian radio emission are briefly summarized.

A63-20010

CIRCUMPLANETARY EXPLORATION OF THE ATMOSPHERES [EXPLORATION CIRCUMPLANETAIRE DES ATMOSPHERES].

F. Link (Academy of Sciences, Institute of Astronomy, Prague, Czechoslovakia).

IN: Space Research III; Proceedings of the Third International Space Science Symposium. Washington, D.C., May 2-8, 1962. Committee on Space Research — COSPAR and the U.S. National Academy of Sciences. Edited by Wolfgang Priester. Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers Division, John Wiley and Sons, Inc., 1963, p. 1022-1025. In French.

Brief theoretical consideration of the photometric observation of stars when they are occulted by the planets during a close passage of a spacecraft. From these observations, information about the planetary atmospheres is obtained without landing or penetrating into the dense parts of the atmosphere. Two examples are briefly considered concerning the atmospheres of Venus and Mars.

A63-20011

MODELS FOR THE IONOSPHERE OF VENUS AND MARS.

A. D. Danilov (Institute of Applied Geophysics, Moscow, USSR).

IN: Space Research III; Proceedings of the Third International Space Science Symposium. Washington, D.C., May 2-8, 1962. Committee on Space Research — COSPAR and the U.S. National Academy of Sciences. Edited by Wolfgang Priester. Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers Division, John Wiley and Sons, Inc., 1963, p. 1026-1035. 20 refs.

Construction of models of the ionospheres of Venus and Mars, based on an analysis of photochemical reactions occurring in the Earth's atmosphere. The Venus ionosphere is assumed to be composed mainly of carbon dioxide and the Mars ionosphere of molecular nitrogen. CO_2^+, CO^+, and O^+ ions are found in the Venus ionosphere, and an electron concentration maximum on the order of 10^6 electrons/cm^3 at an altitude of about 100 km. In the Mars ionosphere, N_2^+ and N^+ ions are found, and the maximum of the electron concentration is of the order of 10^5 electrons/cm^3 at about 300 km.

A63-20012

RADIATIVE TRANSFER IN THE ATMOSPHERES OF VENUS AND MARS.

R. Jastrow and S. I. Rasool (NASA, Goddard Space Flight Center, Institute for Space Studies, New York, N.Y.).

IN: Space Research III; Proceedings of the Third International Space Science Symposium. Washington, D.C., May 2-8, 1962. Committee on Space Research — COSPAR and the U.S. National Academy of Sciences. Edited by Wolfgang Priester. Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers Division, John Wiley and Sons, Inc., 1963, p. 1036-1041. 11 refs.

An approximate theory of radiative transfer in planetary atmospheres is developed and applied to atmospheres of Venus and Mars. The results for Venus indicate that the atmosphere of that planet must have an optical thickness of 60 in the IR, corresponding to a transmission of 10^{-26}, in order to produce the observed surface temperature of 600°K. The surface temperature and tropopause height of Mars are also investigated.

A63-20397

NO_2 IN THE MARTIAN ATMOSPHERE.

P. Warneck and F. F. Marmo (Geophysics Corporation of America, Bedford, Mass.).

Journal of the Atmospheric Sciences, vol. 20, May 1963, p. 236-240. 11 refs.

The transmission curve of the Martian atmosphere derived by Öpik is compared with transmission curves derived by applying the absorption data of Dixon (1940) and of Hall and Blacet (1952) to an atmosphere containing various amounts of nitrogen dioxide. The importance is shown for the presence of NO_2 in the Martian atmosphere, in varying amounts for various Martian surface temperatures. It is conjectured that the blue clearings on Mars may be associated with NO_2 depletion due to temperature decrease. Experiments are suggested to test this hypothesis.

A63-20649

EXPERIMENTAL STUDY OF RADIATIVE TRANSPORT FROM HOT GASES SIMULATING IN COMPOSITION THE ATMOSPHERES OF MARS AND VENUS.

Carlton S. James (NASA, Ames Research Center, Moffett Field, Calif.).

American Institute of Aeronautics and Astronautics, Conference on Physics of Entry into Planetary Atmospheres, Cambridge, Mass., Aug. 26-28, 1963, Paper 63-455. 7 p. 12 refs.
Members, $0.50; nonmembers, $1.00.

Description of measurements made of gross spectral quality and intensity of thermal radiation from the hot gas cap of small polyethylene models flying through mixtures of CO_2 and N_2. Mixture proportions and ambient pressure were varied from pure N_2 to nearly pure CO_2, and from 0.004 to 0.08 atm., respectively. Model flight velocity varied from 5 to 8 km/sec. Strong radiation from CN, formed in the shock layer, is observed for a wide range of mixture proportions. Variation of the total intensity of gas-cap radiation with ambient pressure, flight velocity, and mixture proportions is defined. Radiation from the mixtures is compared with radiation from air. The total intensity of gas-cap radiation from the CO_2-N_2 mixtures is found to be several times that from air at the same flight conditions except when high CO_2 concentrations are combined with low velocities.

A63-21194

A POSSIBLE JOVIAN ANALOGY TO THE TERRESTRIAL EQUATORIAL STRATOSPHERIC WIND REVERSAL.

T. C. Owen and D. O. Staley (University of Arizona, Tucson, Ariz.).

Journal of the Atmospheric Sciences, vol. 20, July 1963, p. 347-350. 11 refs.
Contract Nos. Nonr G-00050-62 and Nonr 7173(02).

Consideration of a rotation anomaly recently discovered by Spinrad in the spectrum of the planet Jupiter, which may originate from causes related to those responsible for similar terrestrial phenomena. The periods of rotation of markings and the inclinations of ammonia lines on all spectrograms obtained from Jupiter to date were

converted into zonal wind speeds. All ammonia lines are straight, which shows that the zonal winds are constant across the disc, and presumably extend around complete latitude circles. These results are analogized to the 26-month oscillation on Earth.

A63-21286
INVESTIGATION OF INTERPLANETARY PLASMA AND PLANETARY IONOSPHERES BY MEANS OF CHARGED PARTICLE TRAPS ON SPACE ROCKETS.
K. I. Gringauz (Academy of Sciences, Institute of Radio Engineering, Moscow, USSR).
IN: 12th INTERNATIONAL ASTRONAUTICAL CONGRESS, PROCEEDINGS, vol. 2. Washington, D.C., Oct. 1-7, 1961. New York and London, Academic Press, Inc., 1963, p. 702-713. 22 refs.

Brief review of Soviet investigations of the interplanetary plasma by means of charged-particle traps installed on satellites and space probes. The three-electrode traps on Lunik III (1959 Theta 1) are briefly described and diagramed, and typical data obtained are shown graphically. Also described are the instrumentation and experiments in the Venus Probe (1961 Gamma 1). The theoretical interpretations of the data are briefly reviewed.

A63-21293
ATMOSPHERIC SAMPLING INSTRUMENTATION.
Nelson W. Spencer (NASA, Goddard Space Flight Center, Greenbelt, Md.).
IN: 12th INTERNATIONAL ASTRONAUTICAL CONGRESS, PROCEEDINGS, vol. 2. Washington, D.C., Oct. 1-7, 1961. New York and London, Academic Press, Inc., 1963, p. 807-812.

Brief consideration of techniques which appear to offer the greatest promise of obtaining direct, quantitative measurements of properties of planetary atmospheres. Described is a representative capsule. A diagram shows its proposed heat shield and the basic instrument package. Outlined are the measurements to be made and the instruments considered appropriate for these, including atmospheric temperature and pressure, the mean molecular density divided by the ratio of specific heats, "air" density, and chemical composition.

A63-21417
A NOTE ON THE UPPER ATMOSPHERE OF MARS.
Gerhard F. Schilling (RAND Corp., Santa Monica, Calif.).
Journal of Geophysical Research, vol. 68, Aug. 15, 1963, p. 4875, 4876.
Contract No. AF 49(638)-700.

Results are presented of an extension of previously developed model atmospheres of Mars, which led to the derivation of upper and lower probable limits for the variation in temperature, pressure, and density. Parametric limits are now extended to altitudes in excess of 2,000 km. Two model atmospheres are presented, a tentative maximum and a tentative minimum. A table summarizes representative values for the permissible extreme ranges of both pressure and density.

A63-21574
THE SPECTRUM OF SHOCK-HEATED GASES SIMULATING THE VENUS ATMOSPHERE.
A. Fairbairn (Avco Corp., Avco-Everett Research Laboratory, Everett, Mass.).
American Institute of Aeronautics and Astronautics, Physics of Entry into Planetary Atmospheres, Conference, Cambridge, Mass., Aug. 26-28, 1963, Paper 63-454. 13 p. 17 refs.
Members, $0.50; nonmembers, $1.00.
Contract Nos. NASw-748 and NAS 9-858.

Mixtures of 90% N_2 plus 10% CO_2, and 80% N_2 plus 20% CO_2, have been heated by reflected shock waves to temperatures of about 8,000°K and normal density, in order to study the radiation which might be expected from the Venusian atmosphere. Photographic and photoelectric measurements have been made of the emitted radiation in the region of 0.23 to 1.2 μ. The CN radical is the most prominent radiator in these experiments, and the intensity of the emission has been used to derive transition probabilities for the violet and red systems of bands.

A63-21609
HIGH DISPERSION SPECTRA OF THE OUTER PLANETS. I - JUPITER IN THE VISUAL AND RED.
Hyron Spinrad and Laurence M. Trafton (California Institute of Technology, Jet Propulsion Laboratory, Division of the Space Sciences, Pasadena, Calif.).
Icarus, vol. 2, June 1963, p. 19-28. 19 refs.
Contract No. NAS 7-100.

Study of the chemical compositions, pressures, temperatures, and velocities in the atmospheres of the outer planets by detailed examination of high dispersion spectrograms of Jupiter. These spectrograms partially resolve the red methane and ammonia bands and show new, weak lines. It is found that at times the Jovian ammonia and methane gases do not corotate with the cloud layer, as evidenced by the anomalous inclination of their absorption lines. The Jovian CH_4 lines in the λ 6190 band are compared in detail with their laboratory and Saturnian counterparts. An upper limit to the total pressure above the Jovian cloud layer is estimated. From these data and a new H_2 abundance of about 27 km-atm, a limit to the H/He ratio is deduced. It is found that the H/C ratio for Jupiter, Saturn, and Uranus is far below the corresponding ratio in the Sun and in other stars. The locations of two new lines tentatively ascribed to Jupiter are given.

A63-21612
HIGH DISPERSION SPECTRA OF THE OUTER PLANETS. II - A NEW UPPER LIMIT FOR THE WATER VAPOR CONTENT OF THE MARTIAN ATMOSPHERE.
Hyron Spinrad and E. H. Richardson (California Institute of Technology, Jet Propulsion Laboratory, Division of the Space Sciences, Pasadena, Calif. and Dominion Astrophysical Observatory Victoria, British Columbia, Canada).
Icarus, vol. 2, June 1963, p. 49-53.
Contract No. NAS 7-100.

Derivation, based on dispersion spectrograms of Mars, of an upper limit for the integrated Martian water-vapor abundance of approximately 3.5×10^{-3} gm/cm^2 (35 μ). The practical limits for detection of Martian water vapor by Earth-bound, balloon, and space-probe techniques indicate that spectroscopic observations from the Earth can be refined to a point where they are at least as sensitive as present IR space experiments.

A63-22405
ON THE THEORY OF LIGHT SCATTERING IN PLANETARY ATMOSPHERES [K TEORII RASSEIANIIA SVETA V PLANETNYKH ATMOSFERAKH].
I. N. Minin and V. V. Sobloev (Leningrad State University, Astronomical Observatory, Leningrad, USSR).
Astronomicheskii Zhurnal, vol. 40, May-June 1963, p. 496-503. In Russian.

Study of the problem on light scattering in a spherical atmosphere. The solution of this problem is necessary for the study of the radiation of a planet near the terminator and for the construction of the theory of twilight phenomena. The integral equation for the source function is found, assuming isotropic light scattering. In order to simplify the equation it is assumed that the atmosphere consists of plane-parallel layers. It is also assumed that a layer at each point is illuminated by the Sun in a spherical atmosphere. Light reflection from the surface of the planet is taken into account. If the atmospheric layers at each point are illuminated by parallel solar rays, the equation obtained transforms to the well-known equation of diffusion of radiation in planetary atmospheres.

A63-23639
MOVEMENT IN THE ATMOSPHERE OF SATURN IN 1960 [MOUVEMENTS DANS L'ATMOSPHERE DE SATURNE EN 1960].
Audouin Dollfus (Observatoire de Paris, Meudon, Seine-et-Oise, France).
Icarus, vol. 2, Aug. 1963, p. 109-114. 12 refs. In French, with summary in English.

Description of observations of the tropical zone of Saturn, north of latitude +57°, which revealed small, brilliant, persistent, white, patches. In a few days these were observed to open and align themselves longitudinally in the brilliant zone. This zone grew, and, in several months, the clear patches were climbing toward the North Pole.

A63-23648
ENGINEERING MODEL ATMOSPHERE OF MARS.
Gerhard F. Schilling (Rand Corp., Santa Monica, Calif.).
(USAF, Office of Scientific Research and General Electric Co., Space Sciences Laboratory, Dynamics of Manned Lifting Planetary Entry, Symposium, 3rd, Proceedings, Philadelphia, Pa., Oct. 1962.)
IN: DYNAMICS OF MANNED LIFTING PLANETARY ENTRY.
Edited by Sinclaire M. Scala, Abner C. Harrison, and Milton Rogers. New York, John Wiley and Sons, Inc., 1963, p. 68-81.
10 refs.
Contract No. AF 49(638)-700.

Presentation of a model of the Martian atmosphere, in order to determine the limiting conditions to be encountered in the exploration of Mars by space vehicles. The model gives extreme upper and lower probable limits of pressure, temperature, and density, up to 150 km altitude over middle and low latitudes, independent of time of day or season. A number of parameters are tabulated for the engineering design of entry probes.

A63-23649
ULTRAVIOLET SPECTROSCOPY OF PLANETARY ATMOSPHERES.
Charles A. Barth (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).
(USAF, Office of Scientific Research and General Electric Co., Space Sciences Laboratory, Dynamics of Manned Lifting Planetary Entry, Symposium, 3rd, Proceedings, Philadelphia, Pa., Oct. 1962.)
IN: DYNAMICS OF MANNED LIFTING PLANETARY ENTRY.
Edited by Sinclaire M. Scala, Abner C. Harrison, and Milton Rogers. New York, John Wiley and Sons, Inc., 1963, p. 82-94.
10 refs.
Contract No. NAS 7-100.

Discussion of methods for observing and analyzing the UV spectra of planetary atmospheres. The spectrum of UV dayglow is the result of molecular scattering, absorption, resonance reradiation, and fluorescence of the incident solar radiation; the composition of the upper atmosphere may be determined from a quantitative analysis of these spectra. The spectrum of UV aurora identifies many of the atoms and molecules that are present in the atmosphere.

A63-23650
EFFECT OF A THERMOSPHERE ON THE MARTIAN ATMOSPHERIC DENSITY AT HIGH ALTITUDES.
Donald N. Vachon (General Electric Co., Advanced Space Projects Dept., Valley Forge, Pa.).
(USAF, Office of Scientific Research and General Electric Co., Space Sciences Laboratory, Dynamics of Manned Lifting Planetary Entry, Symposium, 3rd, Proceedings, Philadelphia, Pa., Oct. 1962.)
IN: DYNAMICS OF MANNED LIFTING PLANETARY ENTRY.
Edited by Sinclaire M. Scala, Abner C. Harrison, and Milton Rogers. New York, John Wiley and Sons, Inc., 1963, p. 130-141.
11 refs.

Discussion of the effect of a possible region of increasing temperature with altitude, on the Martian atmospheric density; this effect is compared with the influence of the lower troposphere. The results are compared qualitatively to the Earth's atmosphere, and lead to the conclusion that isothermal model approximations will grossly underestimate the mass density at high altitudes.

A63-23652
CHEMICAL KINETICS OF PLANETARY ENTRY.
M. H. Bortner (General Electric Co., Missile and Space Division, Space Sciences Laboratory, Valley Forge, Pa.).
(USAF, Office of Scientific Research and General Electric Co., Space Sciences Laboratory, Dynamics of Manned Lifting Planetary Entry, Symposium, 3rd, Proceedings, Philadelphia, Pa., Oct. 1962.)
IN: DYNAMICS OF MANNED LIFTING PLANETARY ENTRY.
Edited by Sinclaire M. Scala, Abner C. Harrison, and Milton Rogers. New York, John Wiley and Sons, Inc., 1963, p. 172-184.

Description of a method for the determination of the chemical kinetics of the gases in the shock layer of a vehicle entering an atmosphere composed mainly of nitrogen and carbon dioxide, such as that of Venus or Mars. To predict the change in chemical composition, including electron density, a limited system of 15 reversible reactions is developed. The rate constants for these reactions are not accurately known. Estimates are made on the basis of published and current experimental data, theoretical estimates, or analogy to other reactions. Calculations made using this system show fairly rapid increase of electron density, but times of more than a millisecond are required to approach equilibrium at high altitudes.

A63-23656
RADIANT EMISSION IN THE ATMOSPHERES OF THE TERRESTRIAL PLANETS.
R. G. Breene, Jr. and M. C. Nardone (General Electric Co., Missile and Space Division, Space Sciences Laboratory, Valley Forge, Pa.).
(USAF, Office of Scientific Research and General Electric Co., Space Sciences Laboratory, Dynamics of Manned Lifting Planetary Entry, Symposium, 3rd, Proceedings, Philadelphia, Pa., Oct. 1962.)
IN: DYNAMICS OF MANNED LIFTING PLANETARY ENTRY.
Edited by Sinclaire M. Scala, Abner C. Harrison, and Milton Rogers. New York, John Wiley and Sons, Inc., 1963, p. 331-348.
31 refs.
USAF-JPL-supported research.

Analysis of the radiative processes that are likely to be brought into play by a vehicle disturbing the Martian or Venusian atmosphere. Discussed are the primary sources of radiation that are to be expected; methods are given that can be used to calculate the absorption coefficients necessary to estimate the radiative transfer.

A63-23666
MARTIAN ENTRY CAPSULE: DESIGN CONSIDERATIONS FOR TERMINAL DECELERATION.
J. C. McMullen and A. M. Smith (General Electric Co., Missile and Space Division, Advance Space Projects Dept., Philadelphia, Pa.).
(USAF, Office of Scientific Research, and General Electric Co., Space Sciences Laboratory, Dynamics of Manned Lifting Planetary Entry, Symposium, 3rd, Proceedings, Philadelphia, Pa., Oct. 1962.)
IN: DYNAMICS OF MANNED LIFTING PLANETARY ENTRY.
Edited by Sinclaire M. Scala, Abner C. Harrison, and Milton Rogers. New York, John Wiley and Sons, Inc., 1963, p. 647-667.
JPL Contract No. 950226.

Discussion of the design of a retardation system for a capsule that is to enter the Martian atmosphere. Emphasis is placed on designing the system so that reliable operation can be assured for a range of "best estimates" of the Martian environment. Pertinent design areas discussed are the trade-offs relating a given capsule ballistic parameter and retardation state-of-the-art, the design of the retardation system, and the selection of a deployment sensing system.

A63-23725
PLANETARY CORONAE AND ATMOSPHERIC EVAPORATION.
Joseph W. Chamberlain (Kitt Peak National Observatory, Tucson, Ariz.).
Planetary and Space Science, vol. 11, Aug. 1963, p. 901-960. 96 refs.
NSF-supported research.

Development of a comprehensive theory for the region of a planetary atmosphere where collisions are rare and where the controlling factors are gravitational attraction and thermal energy conducted from below. The theory is first developed on the classic assumption of a sharply defined critical level above which the atmosphere is completely free of collisions. The different types of particle orbits are treated separately; coronal particles are either ballistic captive particles whose orbits intersect the critical level, satellite (captive particles orbiting above the critical level), or escaping. Liouville's equation leads to exact expressions for the density distributions and escape flux. The latter is a simple analytic expression, but the density integrals are more complex, and numerical evaluations are provided in tables. Examined are a variety of problems dealing with production and loss mechanisms. Some orbital properties and flight times are investigated.

A63-23870
TERRAIN AND SOIL OF MARS.
Rodney W. Johnson (General Electric Co., Missile and Space Division, Valley Forge, Pa.).
(American Astronautical Society, Annual Meeting, 9th, Los Angeles, Calif., Jan. 15-17, 1963.)
IN: ADVANCES IN THE ASTRONAUTICAL SCIENCES. VOL. 13.

Edited by Eric Burgess. North Hollywood, Calif., Western Periodicals Co., 1963, p. 406-435. 25 refs.

Brief summary of the physical properties of Mars, especially the atmospheric and crystal composition and structure. On the basis of these data, hydrographic and physiographic features are discussed. A model of the Martian terrain is developed from soil-forming processes based upon processes active in an Earth environment. The surface features of the polar caps and so-called canals are included briefly, particularly from the standpoint of their existence and their effect on terrain configuration and soils. The nature and composition of the crust of Mars are discussed in terms of origin and in comparison with meteoritic composition. Possible relationships between meteorites and cosmic-dust contribution to the surface soils are introduced. The possible effects of the presence of organic life on the character of the surface soil are briefly discussed.

A63-24269

EXPERIMENTAL HEAT TRANSFER STUDIES OF HYPERVELOCITY FLIGHT IN PLANETARY ATMOSPHERES.

J. S. Gruszczynski and W. R. Warren, Jr. (General Electric Co., Space Sciences Laboratory, Philadelphia, Pa.).

American Institute of Aeronautics and Astronautics, Physics of Entry into Planetary Atmospheres Conference, Cambridge, Mass., Aug. 26-28, 1963, Paper 63-450. 61 p. 20 refs.

Members, $0.50; nonmembers, $1.00.

JPL Contract No. 950297.

Presentation of the results of an experimental study of some of the heat-transfer problems associated with the entry of a ballistic vehicle into the atmospheres of the near planets, assuming the atmospheres to be composed primarily of CO_2-N_2 mixtures and assuming hypervelocity entry conditions. The latter assumption emphasizes the Venus entry problem. The stagnation-region convective and equilibrium radiative heat-transfer problems are investigated, and the results are related to entry vehicle conditions. Two general conclusions are derived: (1) the percentage composition of the CO_2-N_2 does not have an unusually large effect on the experimental convective heat-transfer rates, and (2) the percentage composition of the test gas is relatively less important in the hypervelocity regime than in the Earth orbital and suborbital velocity regimes.

A63-24921

MOLECULAR SCATTERING OF SOLAR RADIATION IN THE ATMOSPHERE OF MARS.

K. L. Coulson and M. Lotman (General Electric Co., Philadelphia, Pa.).

Journal of Geophysical Research, vol. 68, Oct. 15, 1963, p. 5681-5688.

Application of the exact theory of radiative transfer in a Rayleigh atmosphere to compute the molecular optical thickness of the Martia atmosphere as a function of altitude above the planetary surface, for 16 different wavelengths in five atmospheric models. Surface values vary by a factor of about 3 among the different models, and by a factor of approximately 300 between wavelengths of 2500 Å and 10000 Å for a given model. Although the optical thickness of the total Martian atmosphere is up to nearly an order of magnitude less than that of the Earth's atmosphere, the less rapid decrease of optical thickness with height for Mars results in a generally greater optical thickness above 10-20 km for Mars than for the Earth.

A63-25202

THE DECAMETRIC RADIO EMISSIONS OF JUPITER.

G. R. A. Ellis and P. M. McCulloch (Tasmania, University, Dept. of Physics, Hobart, Tasmania, Australia).

Australian Journal of Physics, vol. 16, Sept. 1963, p. 380-397. 10 refs.

Discussion of the cyclotron theory of the decametric radiations of Jupiter. Providing Jupiter is surrounded by an extensive ionized exosphere, it is shown that the theory accounts for the observed variation in the number of radiation bursts with planetary rotation, their polarization, and their spectra. It is found also that the average power of the bursts and their polarization are functions of the number of bursts. The configuration of the Jupiter magnetic field is discussed. It is suggested that this deviates from that of a dipole with a maximum deviation in dip angle of 13° between longitudes 200° and 260° below a height of about 35,000 km.

A63-25334

JUPITER: CHEMICAL COMPOSITION, STRUCTURE, AND ORIGIN OF A GIANT PLANET.

E. J. Öpik (Armagh Observatory, Armagh, Ireland, and Maryland, University, Dept. of Physics and Astronomy, College Park, Md.).

IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 47-50.

Grant No. NsG-58-60.

[For abstract see Accession no. A63-10218 01-05]

A63-25337

GENERAL REPORT ON RADIATION TRANSFER IN PLANETS: SCATTERING IN MODEL PLANETARY ATMOSPHERES.

H. C. van de Hulst and W. M. Irvine (The Observatory, Leyden, Netherlands).

IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 78-98. 30 refs.

Review of simple models describing scattering in planetary atmospheres. Considered are (1) isotropic and Rayleigh scattering, (2) the approximation of scattering diagrams for a cloud droplet or aerosol particle, (3) the method of successive scattering for determining the intensity of radiation in a plane-parallel, homogeneous layer, (4) factors affecting the atmospheric absorption of light, and (5) the effects which must be considered in nonsimple models.

A63-25339

SPECTRAL ENERGY DISTRIBUTIONS OF THE MAJOR PLANETS.

Robert L. Younkin (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) and Guido Münch (California Institute of Technology, Pasadena, Calif.).

IN: PHYSICS OF PLANETS; Proceedings of the Eleventh International Astrophysical Symposium, Liège, Belgium, July 9-12, 1962. (Mémoires de la Société Royale des Sciences de Liège, Cinquième Série, Tome VII).

Université de Liège and USAF.

Cointe-Sclessin, Institut d'Astrophysique, 1963, p. 125-136.

Contract No. NAS 7-100.

Consideration of preliminary results of color photometry measurements of the major planets, made to determine, in a general way, the nature of the energy distribution curves of the planets. The procedure for obtaining and recording the spectral scans is presented, and the instrumentation is shown in a block diagram. Data reduction procedures are outlined, and spectral energy distribution plots are presented and analyzed for Jupiter, Saturn, Uranus, and Neptune. In general, the curves reduced are seen to repeat quite well.

A63-25340

HYDROGEN AND HELIUM RESONANCE RADIATION FROM THE PLANETS.

John C. Brandt (California, University, Dept. of Astronomy, Berkeley, Calif.).

IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 137-142. 19 refs.

Consideration of the possibility of hydrogen and helium emissions from the planets. It appears that Lyman-α radiation can be observed with present-day techniques from Venus, Mars, Jupiter, and Saturn if the intensities are near the estimates given, and that valuable information concerning the particular atmospheres would be obtainable. Observations of the Raman band (Q-branch) near 1280 Å due to Lyman-α may also be of value in the study of the atmospheres of Jupiter and Saturn.

A63-25341

NUMERICAL SOLUTIONS OF THE AUXILIARY EQUATION FOR AN INHOMOGENEOUS PLANETARY ATMOSPHERE.

J. S. Goldstein (Brandeis University, Waltham, Mass., and Baird Atomic, Inc., Cambridge, Mass.).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 143-168.
Contract No. AF 19(604)-7283.

Solution of the equation for an atmosphere in which the ratio of the local mass-scattering coefficient to the local mass-extinction coefficient may vary. An approximate method is derived for the calculation of the reflectivity of a planetary atmosphere for the case of an albedo varying with optical depth. The method is restricted by the condition that $\omega(\tau)/\omega(\tau)$ not be too large, but in other respects seems relatively unrestricted. The method can, in principle, be used whenever the scattering phase function can be expanded in a finite series of Legendre polynomials. Numerical results have thus far been obtained only for isotropic scattering. The case of Rayleigh scattering is presently being calculated. The results for isotropic scattering indicate a marked insensitivity to atmospheric structure. In order to test whether this insensitivity also characterizes a more physical case, the following problems are investigated: the case of Rayleigh scattering, and the case in which not only ω, but also γ, is a function of τ. The method can be extended to cover this case, although the approximations will have to be somewhat different.

A63-25344
MICROWAVE SPECTRAL LINES AS PROBES OF PLANETARY ATMOSPHERES.
Alan H. Barrett (Massachusetts Institute of Technology, Research Laboratory of Electronics, Cambridge, Mass.).
IN: Société Royale des Sciences de Liège, Memoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 197-219. 29 refs.
Army-Navy-USAF-supported research; Contract No. NASr-101 and Grant No. NsG-250-62.

Discussion of the possibility of detecting atomic and molecular spectral lines by radio techniques in planetary atmospheres. Tables present the atoms and molecules that have been identified in planetary atmospheres, including the Earth's, together with other possible molecular constituents. The molecules are separated into those that do not have microwave spectra, and those that do, and only the latter group is considered. Discussed is the dependence of microwave properties on planetary environment and their importance in dictating equipment design, planning an observing program, or interpreting the observations. A microwave experiment is outlined for the determination of atmospheric properties.

A63-25345
NON-THERMAL NOISE MEASUREMENTS NEAR PLANETS.
R. F. Mlodnosky, D. L. Carpenter, and R. A. Helliwell (Stanford University, Radioscience Laboratory, Stanford, Calif.).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 220-223.
Grant No. NsG-174-61.

Proposed study of planetary ionization and magnetic fields through measurements of nonthermal radio noise made near planets. Outlined are procedures for the measurements which require the determination of cutoff frequencies and time delays or echoing intervals. The accuracy with which the various parameters may be determined depends upon resolution in time and frequency. For deep space probes, the instrumentation would consist of many fixed-frequency receivers whose outputs would be digitally sampled. The number of receivers and the sampling rate would be limited primarily by the telemetry system's data-transmission rate. Specific instrumentation could be designed to investigate some of the outstanding questions of particular planets. Noise measurements would increase the probability of overall success of a planetary probe without resorting to redundant instrumentation. It is therefore felt that nonthermal measurements should be included among the experiments to be performed on the first probes designed to study planetary atmospheres.

A63-25348
PARTICULATE MATTER IN THE ATMOSPHERES OF THE TERRESTRIAL PLANETS.
Michael H. Briggs (Victoria University, Dept. of Geology, Wellington, New Zealand).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 251-260. 35 refs.

Discussion of the evidence for the composition of the hazes of each of the inner planets. The Earth possesses a wide variety of chemically different atmospheric particulate materials: water and ice, biogenic hydrocarbons, free metals, nitrogen dioxide, and the products of silicate weathering. On the whole, the hazes of Mercury are likely to be fluorescent-free radicals or volcanic sulphur. For Venus, however, it is possible to construct only a hypothetical model system because of the uncertain chemical composition of the two hazes present in the atmosphere. The hazes of the Mars atmosphere are of three types: one due to dust storms, another to ice crystals, while the third one (the so-called "blue haze" or "violet layer") has an undefined chemical composition.

A63-25349
INTERACTIONS OF THE PLANET MERCURY WITH INTERPLANETARY MATERIAL.
Paul Hodge (California, University, Dept. of Astronomy, Berkeley, Calif.).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 261-268. 24 refs.

Evaluation of the rate of erosion of Mercury's surface due to meteoritic encounters, assuming that Mercury has no appreciable atmosphere. There is some evidence that a small atmosphere on the bright side is detected by polarization measures. The erosion rate on this side would be unaffected by an atmosphere of less than about 0.1-mb pressure, which is approximately the pressure at the level at which meteoroids are decelerated by the Earth's atmosphere. An atmosphere of 10^{-4} times the Earth's is the maximum allowable if Mercury's sunward surface is extensively eroded meteoritically. Dollfus' value of 3×10^{-3} Earth atmospheres is so great that most meteoroids would never reach Mercury's sunward surface.

A63-25352
ON THE QUESTION OF THE PRESENCE OF OXYGEN IN THE ATMOSPHERE OF VENUS.
V. K. Prokofjev and N. N. Petrova (Crimean Astrophysical Observatory, Partizanskoe Simeiz, USSR).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium, Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 311-321.

Consideration of the question of spectroscopic discovery of Venus oxygen. Tabulated are the conditions of photography, spectral width of the slit of the spectrograph, and the value of the Doppler shift calculated from change of the heliocentric distance and measured on the spectra. Also tabulated is a complete list of the solar and atmospheric lines which are near the oxygen lines. Qualitative confirmation is obtained for the presence of weak oxygen absorption in the Venus spectrum.

A63-25353
PHYSICAL CONDITIONS IN THE VENUS ATMOSPHERE [LES CONDITIONS PHYSIQUES DANS L'ATMOSPHERE DE VENUS].
D. Ia. Martynov (Moscow State University, Shternberg Astronomical Institute, Moscow, USSR).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium, Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 325-327. In French.

Discussion of physical conditions in the atmosphere of Venus. The presence of water vapor, observed with some uncertainty by Strong, is confirmed by the polarization image of the cloud layer of

Venus. The presence of water vapor in the atmosphere exerts a strong influence on its thermal regimen. The very high temperatures of Venus inferred from radiometric observations cause large accidental errors and it is impossible, as yet, to be certain of the absence of the effects of nonthermal radiation from the planet.

A63-25354
ON THE ATMOSPHERE AND CLOUDS OF VENUS.
Carl Sagan (California, University, Institute for Basic Research in Science, Space Sciences Laboratory, and Dept. of Astronomy, Berkeley, Calif.).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium, Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 328-330.

Considerations of atmospheric and cloud conditions on Venus. The surface pressures and phase effect lead to a sidereal period of rotation which exceeds 170 days and possibly equals the period of revolution. For nonsynchronous rotation, the specific heat capacity of the atmosphere controls the nocturnal cooling. There is a smaller contribution from subsurface conduction. For synchronous rotation, the atmospheric circulation must supply the radiation emitted to space from the dark hemisphere. The effect of Rayleigh scattering on a cloudless day on Venus is to yellow the sky and redden the Sun. The radiation scattered back to space will also have a yellow cast, and may explain the apparent color of Venus.

A63-25359
THE NATURE OF THE MARS SURFACE AND ATMOSPHERE ACCORDING TO PHOTOMETRIC AND COLORIMETRIC DATA [LA NATURE DE LA SURFACE ET DE L'ATMOSPHERE DE LA PLANETE MARS D'APRES LES DONNEES PHOTOMETRIQUES ET COLORIMETRIQUES].
V. V. Sharonov (Leningrad State University, Observatory, Leningrad, USSR).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 386-392. 12 refs. In French.

Conclusions on the nature of the surface and atmosphere of Mars derived from visual and photographic observations. The data on the albedo and color of objects on the Earth and on Mars are tabulated. The photometric observations show that the light reflection from the soil of bright regions occurs in accordance with the Lambert law. The simplest explanation is that the external layer of the Mars surface consists of powder or powders colored orange by limonite.

A63-25360
ON THE APPLICATION OF PHOTOMETRY TO THE STUDY OF THE NATURE OF MARS [SUR L'APPLICATION DE LA PHOTOMETRIE DANS LES RECHERCHES DE LA NATURE DE MARS].
N. N. Sytinskaia (Leningrad State University, Observatory, Leningrad, USSR).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 394-401. 10 refs. In French.

Description of photometric methods for the measurement of brightness distribution on the disk of Mars for different spectral regions. It is noted that when photographic photometry is used, the photographic irradiation becomes a dangerous source of error. The brightness of an element of the Mars disk contains light reflected from the planet's surface and light diffused in the atmosphere. When interpreting the results of photometric observations, it is necessary to separate these two components. The spectral brightness results obtained are tabulated.

A63-25361
CONTINUOUS SPECTROPHOTOMETRY (BETWEEN 6100 AND 3200 Å) OF A BRIGHT REGION OF MARS AT OPPOSITION, AND THE NATURE OF THE VIOLET LAYER [SPECTROPHOTOMETRIE CONTINUE (ENTRE 6100 ET 3200 Å) D'UNE REGION CLAIRE DE MARS A L'OPPOSITION, ET NATURE DE LA COUCHE VIOLETTE].
Pierre Guerin (Institut d'Astrophysique, Paris, France).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 402-410. In French.

Spectrophotometric determination of the curve of the UV reflecting power of the Mars region viewed. The complete curve of the reflectivity of the center of the Mars disk at opposition is shown. Continuous spectrophotometry is the only method capable of showing slight undulations between 4600 and 5200 Å. In the UV regime, the total absence of diffused absorption bands or of luminescent bands from Mars permits refutation of various explanations of the violet layer based on the existence of such bands.

A63-25362
THE ATMOSPHERE OF MARS.
D. H. Menzel (Harvard University, Observatory, Cambridge, Mass.).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 411-414.
Grant No. NsG-89-60.

General conclusions on the lower atmosphere of Mars. The redness of Mars, its low albedo, and the visibility of surface markings in the red and yellow indicate that the total amount of atmosphere is small. The Martian atmosphere contains two layers of particulate matter: a thick layer of large dust particles near the surface, and a very thin layer of fine particles above the layer of dust. It is implied that the upper layer consists of fine ice crystals.

A63-25363
ATMOSPHERIC EDGE OF MARS [BORD ATMOSPHERIQUE DE MARS].
F. Link (Academy of Sciences, Astronomical Institute, Prague-Ondřejov, Czechoslovakia).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 417-424. In French.

Calculation of the brightness of the edge of Martian atmosphere when the planet is at opposition. Curves show the brightness of the atmospheric edge as a function of altitude. It is concluded that, if the measurements of the brightness distribution on the disk seem to prove the existence of contaminated atmosphere on Mars, the enlargement of the optical edge does not necessarily require that this contamination be localized in the higher layers.

A63-25364
THEORETICAL ESTIMATES OF THE AVERAGE SURFACE AND ATMOSPHERIC TEMPERATURES ON MARS. I - AVERAGE SURFACE TEMPERATURE.
George Ohring (Geophysics Corporation of America, Bedford, Mass.).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 425-447. 13 refs.

Derivation of estimates, based upon radiative equilibrium considerations, of the possible minimum and maximum values of the average temperature of the Martian surface. The estimating theory is explained, together with the greenhouse model adopted, and the computational techniques followed. The average surface temperature of Mars is found to be in the 219°-233°K range. The computations also indicate that the maximum greenhouse effect on Mars is about 40% of the average greenhouse effect in the Earth's atmosphere, and that CO_2 is the most important contributor to the Martian greenhouse. The major characteristics of the computed vertical distribution of temperature in the Martian atmosphere are an adiabatic troposphere extending to 9 km, a stratosphere that is stable, and a temperature still decreasing with height.

A63-25365
ON THE PROBLEMS OF A MARTIAN OZONOSPHERE.
H. K. Paetzold (Cologne, University, Institute of Geophysics and Meteorology, Cologne, Germany).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 452-459.

Discussion of ozonospheric problems on Mars. Since ozone formation depends not on the absolute intensity of the solar UV-radiation, but on the temperature, more ozone is found on Mars than on Earth for the same oxygen concentration because of the lower air temperature on Mars. A diagram shows the total thickness of the ozone layer on Mars for different oxygen concentrations. It is concluded that the ozone content can be used as a sensitive indicator for the oxygen concentration in a planetary atmosphere. The exospheric temperature may be estimated at 1,300°K on Mars. An explanation is found for the lack of water and oxygen on Mars.

A63-25366
A SEARCH FOR PERIODICITY IN THE THICKNESS OF JUPITER'S N. E. B.
Ronaldo Rogério de Freitas Mourão (National Observatory, Rio de Janeiro, Brazil).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 463-467. 16 refs.

Analysis of periodicity occurring in the North Equatorial Belt (N. E. B.) of Jupiter. A table presents values obtained for the northern and southern parts of the N. E. B. and their difference, or thickness of belt; bibliographical references are included. Periodograms suggesting the existence of a period of 4.5 yr are shown. A graphic representation is provided of the N. E. B. thickness variation for a period of 4.5 yr, with mean values.

A63-25369
ON THE HYDRODYNAMICS OF JUPITER'S ATMOSPHERE.
R. Hide (Massachusetts Institute of Technology, Cambridge, Mass.).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, 481-505. 30 refs.
Contract No. AF 61(052)-216 and NSF Grant No. G-22390.

Brief description of the theory of the Great Red Spot, as a clue to the hydrodynamics of Jupiter's atmosphere. The principal properties of the Great Red Spot are summarized. Considered are previous theories of the Great Red Spot, Jupiter's internal structure and rotation, the "Taylor columns," the flow around the Great Red Spot, the critique of the simplest model, and the dynamical effects of compressibility in a highly rotating fluid.

A63-25370
ON THE NATURE OF THE JOVIAN RED SPOT.
Carl Sagan (California, University, Institute for Basic Research in Science, Space Sciences Laboratory, Dept. of Astronomy, Berkeley, Calif.).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 506-515. 13 refs.
Grant No. NsG-126-61.

Discussion of various hypotheses on the nature of the Great Red Spot in the South Tropical Zone of Jupiter's atmosphere. It is concluded that the hypothesis of a Floating Red Spot is generally unsatisfactory, unless a favorable solid-state phase transition should be operating. With a wobbly Jovian solid body, the meteorological hypothesis has several satisfactory aspects and is probably to be preferred at the present time.

A63-25373
PRELIMINARY RESULTS CONCERNING THE ATMOSPHERIC ACTIVITY OF JUPITER AND SATURN.
J. H. Focas (Athens Observatory, Athens, Greece).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 535-540.

Considerations on the development of Jovian atmospheric phenomena. The appearance of brilliantly white and dark matter on Jupiter is the major sign of atmospheric activity. The minimum total activity for the entire planet is produced according to a 20-22-yr cycle. By starting cycle, the activity apparently propagates from the higher latitudes toward the equator and changes direction during the 20-22-yr cycle. In the case of Saturn, the activity shows propagation from 45°-50° latitude toward the poles. The total intensity of the activity seems to be slightly higher in the southern hemisphere of Jupiter.

A63-25374
RESULTS OF RECENT DECAMETER-WAVELENGTH OBSERVATIONS OF JUPITER.
Alex G. Smith, T. D. Carr, and N. F. Six (Florida, University, Dept. of Physics and Astronomy, Gainesville, Fla., and Chile, University, Maipú Radioastronomical Observatory, Santiago, Chile).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 543-550.
Army-Navy-NSF-supported research.

Discussion of the application of mechanisms for the generation of planetary radio noise to the generation of decameter radio noise in the vicinity of Jupiter. Shown graphically are a smoothed probability profile for Jovian sources at 18 Mc, and the orbital position of Jupiter relative to the inclination of the Sun's axis of rotation. It is noted that the radio observations now span a complete orbit of the planet. The buildup and decay of a normal pulse over a period of about 4 sec are illustrated. The rather smooth envelope of this pulse is typical of many that have been recorded.

A63-25379
SOME DATA ON THE INTENSITY OF METHANE ABSORPTION IN THE ATMOSPHERE OF JUPITER.
V. G. Teifel (Kazakh Academy of Sciences, Astrophysical Institute, Alma-Ata, USSR).
IN: Société Royale des Sciences de Liège, Mémoires, Cinquième Série, Tome 7, 1963; Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liège, Belgium, July 9-12, 1962. University of Liège and USAF. Institut d'Astrophysique, Liège, Belgium, 1963, p. 589-592.

Study of the possible intensity changes of the absorption band CH_4 6190 Å as a function of time and position on the planet disk. It is indicated that the intensity of the methane absorption band remains constant in any regions of the planet disk. The tabulated observations confirm the constancy of the methane absorption band intensity in different points of Jupiter's disk. The observations carried out in 1959 and 1960 show that the intensity of the CH_4 band is changing somewhat from night to night.

A63-25997
RADIO ASTRONOMICAL TECHNIQUES FOR THE STUDY OF PLANETARY ATMOSPHERES.
James W. Warwick (High Altitude Observatory, Boulder, Colo.). (Advanced Study Institute of Corfu, Conference on Radio Astronomical and Satellite Studies of the Atmosphere, Corfu, Greece, June 1962.)
IN: RADIO ASTRONOMICAL AND SATELLITE STUDIES OF THE ATMOSPHERE.
Edited by Jules Aarons.
Conference sponsored by NATO.
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers Div., John Wiley and Sons, Inc., 1963, p. 400-429.
74 refs.
USAF-supported research.

Discussion of radio observations of Mercury, Venus, the Earth, the Moon, Mars, Jupiter, and Saturn. All emit appreciable

thermal radiation in centimetric and millimetric wavelengths, which permits investigation of thermodynamic properties of the planetary ionospheres, atmospheres, and surfaces. The Earth is, in addition a nonthermal source in decametric, metric, and decimetric wavelengths, while Jupiter is nonthermal in the decametric and the decimetric regions. The nonthermal emission of the Earth and Jupiter permits study of the origin, time variations, and precipitation of fast trapped particles from magnetic radiation belts.

A63-26009
THE RED BANDS OF CH_2 AND THEIR POSSIBLE IMPORTANCE IN THE SPECTRA OF THE MAJOR PLANETS.
G. Herzberg and J. W. C. Johns (National Research Council, Div. of Pure Physics, Ottawa, Ontario, Canada).
IN: PHYSICS OF PLANETS; Proceedings of the Eleventh International Astrophysical Symposium, Liège, Belgium, July 9-12, 1962. (Mémoires de la Société Royale des Sciences de Liège, Cinquième Série, Tome VII).
Université de Liège and USAF.
Cointe-Sclessin, Institut d'Astrophysique, 1963, p. 117-124. 10 refs.

Consideration of the possibility that CH_2 singlet absorption could be observed in the major planets when sufficiently high resolution is applied. Detailed tables show the wavelengths of all the stronger lines measured in the region 5300-8700 Å. The majority of the lines have been identified. It is shown that, in the interstellar medium, CH_2 is only detectable by the strong absorption at 1415 Å, which will become accessible when satellite observatories start operation.

1964
IAA ENTRIES

A64-10026
THE MARINER 2 INFRARED RADIOMETER EXPERIMENT.
S. C. Chase, G. Neugebauer (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), and L. D. Kaplan (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif., and Nevada, University, Reno, Nev.).
Journal of Geophysical Research, vol. 68, Nov. 15, 1963, p. 6157-6169. 12 refs.

Measurements of the 8.4- and 10.4-μ radiation temperature of small regions of Venus, using an infrared radiometer on Mariner 2 (1962 Alpha Rho 1). The radiation temperatures agree with broad-band (8- to 13-μ) Earth-based measurements, the light- and dark-side temperatures are equal, and there is definite limb darkening. The data are consistent with equal radiation temperatures at 8.4 μ and 10.4 μ, which is interpreted as indicating that the emission is from cloud structure. No breaks in the clouds were observed. A description of the radiometer instrumentation and operation is given.

A64-10101
THE ECOLOGICAL PROFILE OF MARS: BIOASTRONAUTICAL ASPECT.
Hubertus Strughold (USAF, Aerospace Medical Div., Brooks AFB, Tex.).
IN: EXPLORATION OF MARS; Proceedings of the American Astronautical Society Symposium on the Exploration of Mars, Denver, Colo., June 6, 7, 1963. (Advances in the Astronautical Sciences, Vol. 15.)
Edited by George W. Morgenthaler.
North Hollywood, Western Periodicals Co., 1963, p. 30-44. 36 refs.

Review of the environmental and operational background information necessary for the success of a Mars manned planetary flight. The factors discussed include the Martian gravitational, magnetic, radiational, atmospheric, hydrospheric, lithospheric, and biotic environments.

A64-10108
VEHICLE DESIGN FOR MARS LANDING AND RETURN TO MARS ORBIT.
David M. Hammock and Bruce G. Jackson (NASA, Manned Spacecraft Technology Div., Houston, Tex.).
IN: EXPLORATION OF MARS; Proceedings of the American Astronautical Society Symposium on the Exploration of Mars, Denver, Colo., June 6, 7, 1963. (Advances in the Astronautical Sciences, Vol. 15.)
Edited by George W. Morgenthaler.
North Hollywood, Western Periodicals Co., 1963, p. 174-192.

Description of three modes for accomplishing a Mars landing mission: a propulsion braking mode, an atmospheric braking mode, and a flyby rendezvous mode. The modes are compared on a gross basis to indicate their probable order of merit, and to identify design requirements placed on the Mars Excursion Module (MEM) by the choice of mode. Parametric studies of the Mars atmosphere entry problem were conducted for two vehicles typifying a ballistic-type and a lifting-body type, in order to identify the problems associated with design of a MEM that must be able to withstand the extremes of Mars atmospheric density presently predicted. This study indicates that: (1) the presently predicted density extremes of the Mars atmosphere present no serious design problems for a MEM which can operate across the band of predicted densities; (2) details of operational requirements and mission objectives will control the choice of configuration rather than entry requirements; and (3) the ballistic-type MEM is lighter and simpler, but has less operational flexibility than a high L/D MEM. The results of these studies are discussed.

A64-10109
RESEARCH IN THE ENTRY PROBLEMS OF INTERPLANETARY EXPLORATION.
Peter H. Rose (Avco Corp., Avco-Everett Research Laboratory, Everett, Mass.).
IN: EXPLORATION OF MARS; Proceedings of the American Astronautical Society Symposium on the Exploration of Mars, Denver, Colo., June 6, 7, 1963. (Advances in the Astronautical Sciences, Vol. 15.)
Edited by George W. Morgenthaler.
North Hollywood, Western Periodicals Co., 1963, p. 195-216. 38 refs.

Brief discussion of the entry problems peculiar to interplanetary travel. The desirability of high velocity entry into planetary atmospheres is noted. Aspects of entry contributing to the severity of the heating problem are discussed, and recent investigations into the convective and radiative energy transport in ionized gases are discussed. Convective heating has been measured up to velocities of 55,000 ft/sec and the radiative properties of air are known up to about 10,000°K. The present uncertainties in this knowledge are discussed. Among the problems treated are those due to the coupling of the radiative energy transfer and the other aspects of the flow problem - i.e., the energy loss in the shock layer, absorption in the inviscid flow, the boundary layer, the ablated material and even in the free stream. The conditions under which these problems become significant are estimated.

A64-10124
OPTICAL STUDIES OF THE SURFACE AND ATMOSPHERE OF MARS.
G. de Vaucouleurs (Texas, University, Dallas, Tex.).
IN: EXPLORATION OF MARS; Proceedings of the American Astronautical Society Symposium on the Exploration of Mars, Denver, Colo., June 6, 7, 1963. (Advances in the Astronautical Sciences, Vol. 15.)
Edited by George W. Morgenthaler.
North Hollywood, Western Periodicals Co., 1963, p. 519-532. 30 refs.

Discussion of telescopic studies of Mars during the past 20 yr, which have confirmed and slowly added to our general knowledge of the planet. The fine structure of the surface, the so-called "canals," and the seasonal and irregular variations are described. The latest data on atmospheric composition and pressure are reviewed.

A64-10125
A THEORETICAL STUDY OF THE MARTIAN IONOSPHERE.
R. B. Norton (National Bureau of Standards, Central Radio Propagation Laboratory, Boulder, Colo.).
IN: EXPLORATION OF MARS; Proceedings of the American Astronautical Society Symposium on the Exploration of Mars, Denver, Colo., June 6, 7, 1963. (Advances in the Astronautical Sciences, Vol. 15.)
Edited by George W. Morgenthaler.
North Hollywood, Western Periodicals Co., 1963, p. 533-542.
12 refs.
NASA-supported research.

Presentation of a theoretical study, based on a neutral atmosphere composed of 2% carbon dioxide and 98% molecular nitrogen, which indicates that the Martian ionosphere would occur at a greater height above the planet's surface than does the terrestrial ionosphere, but at about the same total pressure. The maximum electron density for overhead Sun is about $2 \times 10^5/cm^3$, as compared to about $10^6/cm^3$ on Earth. On Mars there may be layers that absorb radio waves more strongly than the normal terrestrial D region.

A64-10130
REMARKS ON THE METEOROLOGY OF MARS.
Seymour L. Hess (Florida State University, Dept. of Meteorology, Tallahassee, Fla.).
IN: EXPLORATION OF MARS; Proceedings of the American Astronautical Society Symposium on the Exploration of Mars, Denver, Colo., June 6, 7, 1963. (Advances in the Astronautical Sciences, Vol. 15.)
Edited by George W. Morgenthaler.
North Hollywood, Western Periodicals Co., 1963, p. 596-598.

Discussion of Mars circulation problems. It is stated that theory, suggests that, in the summer hemisphere, the north-south temperature gradient on Mars is sufficiently weak that we would have a kind of symmetrical circulation in a meridional plane similar to that in the vicinity of our tropics on Earth. On the other hand, the winter hemisphere has such a strong north-south temperature gradient that the prevailing westerly winds, which certainly exist there, must be unstable in the same sense that middle latitude flow is unstable on Earth.

A64-10492
THE THEORY OF RADIATION SCATTERING IN PLANETARY ATMOSPHERES.
I. N. Minin and V. V. Sobolev (Leningrad State University, Astronomical Observatory, Leningrad, USSR).
(Astronomicheskii Zhurnal, vol. 40, May-June 1963, p. 496-503.)
Soviet Astronomy, vol. 7, Nov.-Dec. 1963, p. 379-383. Translation.

A64-10798
RADIATIVE VS. CONVECTIVE HEAT FLUXES FOR MARTIAN ENTRY.
M. G. Boobar (North American Aviation, Inc., Space and Information Systems Div., Downey, Calif.) and R. M. Foster (Philco Corp., Aeronutronic Div., Newport Beach, Calif.).
Astronautics and Aerospace Engineering, vol. 1, Dec. 1963, p. 30-35. 17 refs.

Parametric study of factors affecting the design of a heat protection system for a Mars entry vehicle. Considered are the effects of entry angle and velocity, density and density gradient of the atmosphere as functions of altitude, and the composition of the atmosphere. Among the data considered is a Mollier diagram for the Martian atmosphere. The effects of the formation of CN behind the shock for an entry vehicle are considered, as are the expected radiative and convective heating. The effects of uncertainties in the available data are discussed.

A64-12277
INVESTIGATIONS OF INTERPLANETARY SPACE AND UPPER LAYERS OF THE ATMOSPHERE [ISSLEDOVANIIA KOSMICHESKOGO PROSTRANSTVA I VERKHNIKH SLOEV ATMOSFERY].
A. A. Blagonravov.
Akademiia Nauk SSSR, Vestnik, vol. 33, Sept. 1963, p. 9-16.
In Russian.

General survey of the basic results obtained by means of the "Mars 1" interplanetary probe, the satellites of the "Cosmos" series, geophysical and meteorological rockets, and radar probing of the planets Mercury, Venus, and Mars. The equipment and procedures used are noted.

A64-12564
ON THE POSSIBILITY OF STUDYING PLANETARY ATMOSPHERES BY OBSERVING STELLAR OCCULTATIONS FROM A FLYBY SPACE PROBE OR PLANETARY ORBITER.
Howard Weisberg (RAND Corp., Santa Monica, Calif.).
Icarus, vol. 2, Oct. 1963, p. 226, 227. 10 refs.

Brief discussion of the possibility of stellar occultation observations from space probes in order to obtain information that complements that obtained from other proposed types of photometry. It is noted that in a program of planetary photometry from flyby and orbiting space probes such observations are feasible. Studies, from artificial satellites, of occultations by Earth's atmosphere are also recommended.

A64-12565
8.35 MM RADIO EMISSION FROM JUPITER.
D. D. Thornton and W. J. Welch (California, University, Space Sciences Laboratory and Dept. of Electrical Engineering, Berkeley, Calif.).
Icarus, vol. 2, Oct. 1963, p. 228-232. 10 refs.
Contract No. Nonr 222(54); NSF Grant No. G-16741.

Presentation of the results of a number of observations of the 8.35-mm radio emission from Jupiter made following the planet's opposition at the end of August, 1962. A disk temperature of 144 ± 23^0 is found. It is shown that the 8-mm brightness temperature of Jupiter should correspond closely to the temperature at the level of the visible cloud cover. The results are compared with the emission temperature predicted by a model atmosphere proposed by Kuiper.

A64-12567
THE ORIGIN OF THE ATMOSPHERES OF VENUS AND THE EARTH.
A. G. W. Cameron (NASA, Goddard Space Flight Center, Goddard Institute for Space Studies, New York, N.Y.).
Icarus, vol. 2, Oct. 1963, p. 249-257. 36 refs.

Discussion of the evidence regarding the difference between the compositions of the atmospheres of Venus and the Earth. It is concluded that there are no detectable traces of the primitive solar nebula surviving in the Earth's atmosphere, and that the Venus atmosphere probably contains of the order of 100 times the amount of nitrogen in the Earth's atmosphere and negligible amounts of water vapor. The difficulty in determining how the two atmospheres can have had a common origin is pointed out, and it is proposed that the bulk of the Venus atmosphere is a remnant of the primitive solar nebula. In order to account for the absence of primitive gases from the Earth's atmosphere, a modified form of the Darwin-Wise hypothesis is proposed, according to which the Moon is formed as a result of the Earth's rotational instability induced by formation of the iron core. During such rotational instability the primitive gases would be entirely lost. A discussion is given of the circumstances surrounding the period of rotational instability.

A64-12686
THE TEMPERATURE DEPENDENCE OF THE UREY EQUILIBRIUM AND THE PROBLEM OF THE CARBON DIOXIDE CONTENT OF THE ATMOSPHERE OF VENUS.
Joe A. Adamcik and Arthur L. Draper (Texas Technological College, Dept. of Chemistry, Lubbock, Tex.).
Planetary and Space Science, vol. 11, Nov. 1963, p. 1303-1307.

Development, by means of standard thermochemical equations, and application to the atmosphere of Venus, of the general relationship between temperature and the equilibrium pressure of carbon dioxide in the Urey equilibrium. Equations are developed from the relevant thermodynamic data for the temperature dependence of the equilibrium constants of representative reactions of the Urey equilibrium. The values of the carbon dioxide pressure computed by means of these equations for 700°K are greater than any reasonable estimate of its partial pressure at the base of the Cytherean atmosphere. It is concluded that there is no failure of the Urey equilibrium due to a lack of water, as has been supposed, but rather that the oxidized carbon abundance on the planet is insufficient to maintain the equilibrium pressure at the temperature of the planetary surface. Consequently, carbonates would be unstable on the Cytherean surface, and all oxidized carbon would be expected to be in the atmosphere.

A64-12916
TARGET ORBIT SELECTION FOR MARS MISSIONS USING AERODYNAMIC MANEUVERING.
Arthur L. Napolin and Joseph C. Mendez (North American Aviation, Inc., Space and Information Systems Div., Flight Sciences Dept., Downey, Calif.).
American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, New York, N.Y., Jan. 20-22, 1964, Preprint 64-14. 12 p.
Members, $0.50; nonmembers, $1.00.

Parametric analysis of the feasibility of Mars Aerodynamic Braking for reducing the Manned Mars (Orbiting or Landing) Mission energy requirement. Lateral plane changes executed during aerodynamic braking are studied to provide an insight into the operational flexibility that such maneuvers might provide. It is concluded that: (1) from a flight mechanics standpoint, Mars entry and aerodynamic braking are both attractive and feasible; (2) the minimum trans-Earth injection velocity required to circularize a given parking orbit after skip-out is essentially independent of all aerodynamic parameters for a gravity turn pull-up; (3) optimal "arrival" orbital inclinations may be chosen to best provide an immediate Earth return capability throughout the Mars orbital stay period; and (4) plane changes executed during the braking maneuver permit additional operational flexibility by modifying the orbital elements of the approach conic.

A64-12923
THE REQUIREMENTS FOR EFFICIENT MARS LAUNCH TRAJECTORIES.
Lars F. Helgostam (Lockheed Aircraft Corp., Lockheed Missiles and Space Co., Palo Alto, Calif.).
American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, New York, N.Y., Jan. 20-22, 1964, Preprint 64-15. 9 p.
Members, $0.50; nonmembers, $1.00.

Preliminary study of the efficiency of launch trajectories from Mars and of the vehicle and flight mechanics parameters, such as number of stages and thrust level, that determine this efficiency. Described are the approach to the problem and the assumptions for the calculations, together with the lifetimes and the required altitudes for parking orbits, as determined by the atmospheric models used. The results for single burn and dual burn ascents and staging are presented, together with an application of the results to mission planning. It is noted that dual burn ascents with a coast above the atmosphere have a much higher efficiency than the continuous burn ascents. A two-stage vehicle offers a significant improvement in performance efficiency, compared to a one-stage dual burn vehicle. The efficiency of the continuous burn ascent is sensitive to the required parking orbit altitude, which, in turn, is determined by the atmosphere. The launch efficiency for Mars is much lower than that for the Moon and comparable to that for the Earth.

A64-12924
A QUANTITATIVE GREENHOUSE MODEL OF THE VENUS ATMOSPHERE.
Jean I. F. King (Geophysics Corporation of America, Bedford, Mass.).
American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, New York, N. Y., Jan. 20-22, 1964, Preprint 64-68. 4 p.
Members, $0.50; nonmembers, $1.00.

Investigation of the plausibility of the greenhouse effect as an explanation of the high surface temperature of Venus, where the contrasting atmospheric opacity in the visible and far-infrared spectrum traps the absorbed sunlight and raises the surface temperature. A quantitative model of the greenhouse model is developed from first principles. The model, under the limitations set forth, is applied to the atmosphere of Venus. It is noted that it is apparent that the greenhouse heating is dependent on the valving action of the atmosphere - i.e., on contrasting opacities at the visible and far-infrared spectral regions. Thus, the absorbed sunlight constitutes an imbedded source to which the temperature profile, according to radiative transfer laws, must adjust.

A64-12926
MODEL ATMOSPHERES FOR THE PLANET MARS.
D. C. Evans and P. E. Wasko (Douglas Aircraft Co., Inc., Santa Monica, Calif.).
American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, New York, N. Y., Jan. 20-22, 1964, Preprint 64-67. 11 p. 20 refs.
Members, $0.50; nonmembers, $1.00.

Presentation of model atmospheres of the planet Mars for the use of design, test, and reliability engineers. The four model atmospheres shown in detail in tables are: (1) Mars equator, the mean model; (2) Mars equator, the maximum model; (3) Mars South Pole, the minimum model; and (4) Mars South Pole, minimum-high molecular weight. Graphical illustrations of the model atmospheres are provided. It is noted that the models represent possible real conditions. They are internally consistent, rather than statistically synthetic or physically extreme. The best available data and information were used in their construction. Nevertheless, it is emphasized that the models must be used with discretion, as they may be changed with the advent of new information. Serious performance problems have arisen in the past because designs were based on a single mean-model atmosphere. The development of the model atmospheres presented is the culmination of a detailed survey of the literature on the planet Mars.

A64-13811
THE EFFECT OF CLOUDINESS ON A GREENHOUSE MODEL OF THE VENUS ATMOSPHERE.
George Ohring and Joseph Mariano (Geophysics Corporation of America, Bedford, Mass.).
(American Geophysical Union, Meeting, Washington, D.C., Apr. 1963.)
Journal of Geophysical Research, vol. 69, Jan. 1, 1964, p. 165-175. 13 refs.
Contracts No. NASw-286; No. NASw-704.

Investigation of the effect of a cloud cover, opaque to infrared radiation, on a greenhouse model of the Venus atmosphere. The magnitude of the greenhouse effect is computed as a function of infrared opacity of the atmosphere and of the amount and height of clouds. It is assumed that the Venus atmosphere is gray, that the absorbing gas has a constant mixing ratio, and that the temperature variation with altitude is linear. Calculations are made for two temperature lapse rates: the adiabatic lapse rate is shown to maximize the greenhouse effect; for this case, estimates of the minimum infrared opacity required to maintain the observed surface temperature are determined. For a surface temperature of 700°K, 99% cloudiness, and cloud-top temperature of 240°K, the minimum required infrared opacity is 6. Uncertainties and questionable side effects of the model are discussed.

A64-13871
THE PROBLEM OF THE MARTIAN YELLOW CLOUDS.
F. A. Gifford, Jr. (U. S. Weather Bureau, Research Station, Oak Ridge, Tenn.).
Monthly Weather Review, vol. 91, Oct.-Dec. 1963, p. 610-612

Observations on the problem of the yellow clouds of Mars - the usually isolated and more or less clearly delimited obscurations of comparatively small areas of the Martian disk which can be detected visually or in photographs with yellow or red filters. It is noted that, in view of the known dryness of the Martian atmosphere, the desert location of most of the yellow clouds shown in a table, and their

occurrence in regions of comparatively high surface temperature, certainly tend to confirm the hypothesis that they are dust clouds, probably initiated by thermal convection. Their generally equatorward drift seems to imply that they are low-level phenomena, possibly steered by the tropical portion of a symmetric circulation cell. Considered as peturbations on some steady-state circulation regime, the dust storms appear to be damped out fairly rapidly. Moreover, they are fairly small, of the order of several hundred to 1,000 km in horizontal extent.

A64-14172
MOLECULAR ABSORPTION IN PLANETARY ATMOSPHERES.
A. E. S. Green, C. S. Lindenmeyer, and M. Griggs (General Dynamics Corp., General Dynamics/Astronautics, Space Science Laboratory, San Diego, Calif.).
Journal of Geophysical Research, vol. 69, Feb. 1, 1964, p. 493-504. 17 refs.

Application of laboratory data on infrared absorption in the range of 1 to 10 μ, at moderate resolution, to obtain a simple analytical model for transmission through planetary atmospheres. This model takes into account the variation of the spectral line strength with temperature, which has been neglected in previous atmospheric transmission models. The analysis leads to a transmission equation involving parameters characterizing the atmospheric distribution of absorbing species and two parameters dependent on wavelength. The problem, including the distribution of the absorbing species, has been fully treated for the atmosphere of the Earth. For other planets, since the type and distribution of absorbing species are not fully known, they are not treated completely. However, the form of the transmission equation is such that it should be useful in inferring the distribution of absorbing species from measurements by planetary probes.

A64-14249
OPTICS AND THE ATMOSPHERES OF THE PLANETS.
William M. Sinton (Lowell Observatory, Flagstaff, Ariz.).
Applied Optics, vol. 3, Feb. 1964, p. 175-180. 45 refs.

General discussion of some of the experiments that have been performed in the observation of atmospheres of planets using the light waves emanating from the planets and collected by the telescopes. The methods are examined for determining the nature of an atmosphere containing particles from the wavelength dependence of scattered intensity when combined with the wavelength dependence of the polarization properties of the atmosphere. Some results of measurements of planetary temperatures are discussed, together with those of spectrographic observations. A table containing gases found spectrographically on the planets is included.

A64-14250
SPECTROSCOPIC RESEARCH ON THE MAJOR PLANETS.
Hyron Spinrad (California Institute of Technology, Jet Propulsion Laboratory, Space Sciences Div., Pasadena, Calif.).
Applied Optics, vol. 3, Feb. 1964, p. 181-186. 14 refs.

Review of spectroscopic research on the compositions, velocity fields, and thermal structures of the major planets as known in mid-1963. Some methods of spectroscopic observation using radiation from reflected sunlight in the visible and near-infrared portions of the spectrum are described. The atmospheres of Jupiter, Saturn, Uranus, and Neptune are studied, and their spectra are presented.

A64-14398
MARS NONSTOP ROUND-TRIP TRAJECTORIES.
Roger W. Luidens (NASA, Mission Analysis Branch, Flight Systems Section, Lewis Research Center, Cleveland, Ohio).
AIAA Journal, vol. 2, Feb. 1964, p. 368-370.

Analysis of the trajectories resulting from the following two Mars trajectory modifications in order to achieve an Earth return: (1) modification by gravity supplemented by propulsion and (2) modification by gravity supplemented by aerodynamic forces. Three kinds of nonstop round-trip trajectories in the years 1971 and 1980 are compared on the basis of mission time and the required propulsive velocity increment. The following conclusions are drawn from the study of Mars round-trip trajectories using gravity, propulsive-gravity, and atmospheric turns at Mars: (a) when compared with gravity turns, the use of small amounts of propulsion near Mars markedly expands the range of possible trip times and in some cases reduces the required propulsive velocity increment; (b) the use of an atmospheric turn at Mars can reduce the required propulsive velocity increment to a value approaching that for a one-way transfer to Mars, depending on the feasible vehicle lift-drag ratios; (c) in general, greater propulsive velocity increments are required in 1980 than in 1971; and (d) the propulsive-gravity and the atmospheric-turn trajectories appear to offer the potential of fast, lightweight nonstop round trips to Mars.

A64-14464
DIFFERENTIAL REFRACTION IN PLANETARY ATMOSPHERES WITH LINEAR SCALE HEIGHT GRADIENTS.
Donald W. Goldsmith (Harvard College Observatory, Cambridge, Mass.).
Icarus, vol. 2, Nov. 1963, p. 341-349. 10 refs.

Discussion of the theory of differential refraction in an isothermal atmosphere, extended to the case of an atmosphere with a linear gradient of scale height caused solely by temperature changes. The atmospheric refraction with its approximations is presented. Detailed results differing from the Euler-Lagrange differential formulation for stellar occultation are obtained. Corrections to the derived pressure and reduced thickness are also given, and application to the occultation of σ Arietis by Jupiter and of Regulus by Venus are briefly discussed.

A64-14534
PLANETARY ENTRY SIMULATION BY MEANS OF COMBUSTION.
Richard D. Wood (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) and R. Liaugminas (Illinois, University, Urbana, Ill.).
IN: AIAA AERODYNAMIC TESTING CONFERENCE, WASHINGTON, D.C., MARCH 9, 10, 1964, PROCEEDINGS.
New York, American Institute of Aeronautics and Astronautics, 1964, p. 135-160. 55 refs.
Contract No. NAS 7-100.

Review of present-day knowledge of the atmospheres of Venus and Mars, and discussion of the simulation of conditions by combustion-heated hypervelocity wind tunnels for the purpose of studying planetary entry. Using typical entry trajectories, expected flight conditions and aerodynamic regimes are considered, and the flow parameter requirements for ground simulation are estimated. The regions of application of the methods developed are discussed.

A64-15023
DIFFUSE REFLECTION OF RADIATION BY A PLANETARY ATMOSPHERE. I.
Sueo Ueno (Kyoto University, Faculty of Science, Kyoto, Japan).
IN: INTERNATIONAL SYMPOSIUM ON SPACE TECHNOLOGY AND SCIENCE, TOKYO, JAPAN, AUGUST 27-31, 1962, 4th, PROCEEDINGS.
Edited by Tamiya Nomura.
Tokyo, Japan and Rutland, Vt., Japan Publications Trading Co., 1963, p. 451-458. 16 refs.

Exact treatment of the diffuse reflection problem of parallel rays by a finite, plane-parallel, inhomogeneous, non-emitting, and isotropically scattering atmosphere, whose bottom surface reflects the radiation according to Lambert's law with a constant albedo. Using the scattering and transmission functions given by the author's probabilistic method, and following an idea of van de Hulst for the planet problem, the angular distribution of emergent radiation from the upper surface is rigorously obtained. It is noted that, when the optical properties of the medium are constant throughout the atmosphere, the result reduces to that provided by van de Hulst and Sobolev, respectively. It is mentioned that, when the albedo varies with the horizontal coordinate - i.e., the reflecting bottom surface is not horizontally uniform, the solution cannot be reduced to the solution of the standard problem alone, because the diffuse reflection and transmission problem by the two-dimensional flat layer should be considered.

A64-15103
PHOTOMETRIC STUDY OF THE ATMOSPHERIC ACTIVITY ON THE PLANET JUPITER AND PECULIAR ACTIVITY IN ITS EQUATORIAL AREA.
J. H. Focas and C. J. Banos (Athens, National Observatory, Athens, Greece).
Annales d'Astrophysique, vol. 27, Jan.-Feb. 1964, p. 36-45. 6 refs.

Description of a program for studying the evolution of the activity in the atmosphere of Jupiter, and development of a photometric method for determining a coefficient of its intensity. Data covering the variation of the intensity of the total activity on the planet in the period 1952-1963 and the peculiar activity in the equatorial area in the period 1957-1963 are given.

A64-15143
EXPERIMENTAL STUDY OF RADIATIVE TRANSPORT FROM HOT GASES SIMULATING IN COMPOSITION THE ATMOSPHERES OF MARS AND VENUS.
Carlton S. James (NASA, Hypersonic Free-Flight Branch, Flow Fields and Stability Section, Ames Research Center, Moffett Field, Calif.).
(American Institute of Aeronautics and Astronautics, Conference on Entry into Planetary Atmospheres, Cambridge, Mass., Aug. 26-28, 1963, Preprint 63-455.)
AIAA Journal, vol. 2, Mar. 1964, p. 470-475. 20 refs.

A64-15346
ON A CRITERION GOVERNING THE MODE OF CLOUD FORMATION IN PLANETARY ATMOSPHERES.
J. E. McDonald (Arizona, University, Institute of Atmospheric Physics, Tucson, Ariz.).
Journal of the Atmospheric Sciences, vol. 21, Jan. 1964, p. 76-82. 7 refs.
Navy-supported research.

Condensation in vertically moving planetary atmospheric gases containing small quantities of any condensable vapor will occur in updrafts only if the latent heat of the vapor is sufficiently large; otherwise the condensation will require adiabatic compression and will occur only in downdrafts, as first noted by Brunt. Several methods are presented for viewing and deriving a quantitative criterion for the intermediate case in which the vapor behaves in neutral fashion in either ascending or descending currents. Put in its most general form, relating the molar entropy of vaporization S of the condensable vapor and the molar specific heat C_p of the carrier gas, the null criterion requires $S = C_p$. The peculiar nature of meteorological processes in a planetary atmosphere in which latent heat considerations imply downdraft condensation is examined in some detail, and some implications of the null condensation criterion for studies of planetary atmospheres and their evolution are discussed.

A64-15535
AN ANALYSIS OF THE SPECTRUM OF MARS.
Lewis D. Kaplan, Guido Münch, and Hyron Spinrad (Carnegie Institution of Washington and California Institute of Technology, Mount Wilson and Palomar Observatories; California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).
Astrophysical Journal, vol. 139, Jan. 1, 1964, p. 1-15. 27 refs.

On a high-dispersion spectrogram of Mars taken at Mount Wilson rotational lines of H_2O near λ 8300 and CO_2 near λ 8700 have been detected. Recent laboratory measurements of line strengths by D. Rank have been used to determine the amounts of H_2O and CO_2 in the atmosphere of Mars: $14 \pm 7\ \mu$ precipitate water and 55 ± 20 m atm CO_2. From the absence of O_2 in the Martian spectra, an upper limit of 70 cm atm for the O_2 content was set. By suitably combining the CO_2 amount with observations by Kuiper and Sinton of the strongly saturated bands in the 2-μ region, a surface pressure of 25 ± 15 mb has been derived. The implications of the results on the composition of the Martian atmosphere are discussed.

A64-15573
REMARKS CONCERNING THE CHEMICAL COMPOSITION OF THE ATMOSPHERE OF VENUS.
Hans E. Suess (California, University, San Diego, Calif.).
Zeitschrift für Naturforschung, vol. 19a, Jan. 1964, p. 84-87. 31 refs.
Grant No. NsG-322.

Survey of our present knowledge of the Venus atmosphere. Examined are several models proposed for the strong microwave emission of the Earth's twin planet, and for a corresponding structure of its atmosphere. It is shown that none of them, nor the recent data on the temperature, pressure, and period of rotation of Venus provide an answer as to whether the atmosphere of Venus is oxidizing or reducing. Cosmochemical considerations also fail to provide a conclusive answer. The atmosphere of Venus is seen to be much more dense than that of the Earth. Some observations are noted which indicate that the main constituent of this dense atmosphere may be neon.

A64-15584
PETROLOGY OF VENUS - FURTHER DEDUCTIONS.
Louis S. Walter (NASA, Goddard Space Flight Center, Theoretical Div., Greenbelt, Md.).
Science, vol. 143, Mar. 13, 1964, p. 1161. 7 refs.

Brief summary of recent investigations of Venusian petrology. The possible existence of pools of carbonate lava on the surface of Venus is discussed, based on the physicochemical condition assumed by Mueller. It is noted that the carbon dioxide pressure of the atmosphere of Venus may be controlled by one or more of several decarbonation reactions. One of these is the formation of carbonate-rich liquids. The pressure-temperature equilibrium conditions of these reactions are in the range of those proposed for the Venusian surface. Also considered is the existence of carbonate melts on the surface.

A64-16842
RADIO ASTRONOMICAL INVESTIGATIONS AND MODERN CONCEPTS OF THE VENUS ATMOSPHERE [RADIOASTRONOMICHESKIE ISSLEDOVANIIA I SOVREMENNYE PREDSTAVLENIIA OB ATMOSFERE VENERY].
A. D. Danilov.
Kosmicheskie Issledovaniia, vol. 2, Jan.-Feb. 1964, p. 121-135. 76 refs. In Russian.

Re-evaluation of the green-house and the ionospheric models for the structure of the Venus atmosphere, on the basis of observational and theoretical data compiled during the last two and a half years. A discussion of a number of controversial problems points out the difficulties that arise in explaining the observed high surface temperatures on the basis of the green-house model. It is shown that Spinrad's data, which indicate a temperature increase toward the lower atmospheres, cannot explain the existence of a high temperature gradient, and contradict the existence of pressures of the order of 50 to 100 atm necessary to create the green-house effect. On the other hand, the model of a semitransparent ionosphere covering the entire disk of the planet can be correlated with radio data and with the high brightness temperatures observed at wavelengths of 10 cm, requires, however, the concept of a porous ionosphere to correlate with the brightness-temperature spectrum in the 0.4 to 40 cm range. The absence of a distinct limb brightness observed at wavelengths of 1.6 and 3.02 cm cannot be considered as an argument against a model based on a porous ionosphere, since such a model would require a decrease in limb brightness of the planet disk. The state-of-the-art is found to neither completely support nor disprove either model, nor to furnish a satisfactory explanation of the nature of the high temperatures indicated by the microwave radiation of Venus. Further extensive studies of the possibilities of the two models are required.

A64-17024
THE IONOSPHERIC INTERPRETATION OF THE RESULTS OF RADAR OBSERVATIONS OF VENUS. II.
A. D. Danilov and S. P. Iatsenko (Academy of Sciences, Institute of Applied Geophysics, Moscow, USSR).
(Geomagnetizm i Aeronomiia, vol. 3, no. 4, 1963, p. 594.)
Geomagnetism and Aeronomy, vol. 3, no. 4, 1963, p. 481-483. 5 refs. Translation.

Discussion of the interpretation of data on the natural radio emission of Venus in the centimeter wavelength region from the point of view of the hypothesis that Venus has an ionosphere. It is shown that in the case of an optically dense ionosphere having certain window effects, the difficulties with respect to the explanation of radar observation data can be eliminated, and a radiation spectrum can be obtained for Venus which coincides with experimental observations. Comment is made that the explanations given are based on assumptions, and further investigation is required to confirm or refute them.

A64-17257
HABITABLE PLANETS FOR MAN.
Stephen H. Dole (RAND Corp., Human Engineering Group, Santa Monica, Calif.).

New York, Blaisdell Publishing Co., 1964. 160 p.
$5.75.

The conditions necessary for planets to support human life, and the essential properties required of the stars that provide heat and light to such planets are studied in detail. The environmental needs of man are considered, including temperature, light, gravity, atmospheric composition and pressure, and water. The natural environments provided by other planets are considered, and hypothetical planets that could exist in orbits around other stars are discussed. The various classes of possible planets are analyzed, and a class of planets is described that would provide human beings with suitable environmental conditions. The probability of occurrence of habitable planets is analytically considered. In an appendix, data on the 25 principal bodies of the solar system of mass greater than 10^{23} gm are tabulated. A bibliography and subject index are also included. The book was prepared as part of the continuing program of research undertaken by the RAND Corporation for the U.S. Air Force.

A64-17350
ADVANCES IN ASTRONOMY AND ASTROPHYSICS. VOLUME 2.
Edited by Zdeněk Kopal (Manchester, University, Dept. of Astronomy, Manchester, England).
New York, Academic Press, 1963. 314 p.
$11.50.

Studies dealing with recent theoretical and experimental investigations in astronomy and astrophysics are collected. The papers include: the twilight zone of Venus; eclipse phenomena; and the stray bodies in the solar system, emphasizing the survival of cometary nuclei and the asteroids. The papers are individually abstracted and indexed in this issue.

A64-17351
THE TWILIGHT ZONE OF VENUS.
J. B. Edson (NASA, Washington, D.C.).
IN: ADVANCES IN ASTRONOMY AND ASTROPHYSICS. VOLUME 2.
Edited by Zdeněk Kopal.
New York, Academic Press, 1963, p. 1-42. 47 refs.

Review of observational and theoretical examinations of the twilight zone of Venus. Included in the review are presentations and/or analyses of: (1) the results of observations of the twilight extensions of the Venus cusps; (2) color in the twilight cusp extensions; (3) an interpretation of the brightness distribution along the cusp extension; (4) horizontal refraction across the twilight zone at solar transit; (5) twilight phenomena and the general circulation of the Venus atmosphere; (6) the relation of the Venus UV clouds to the twilight phenomena; and (7) the discrepancy between the observed and theoretical times of dichotomy. It is noted that observations of the twilight cusp extensions are particularly propitious during inferior conjunction, because such work requires no large or elaborate instruments.

A64-17618
MARTIAN AIRGLOW.
Edward C. Y. Inn (NASA, Ames Research Center, Moffett Field, Calif.).
Journal of the Atmospheric Sciences, vol. 21, Mar. 1964, p. 220, 221. 7 refs.

Discussion of the problem of whether an observable airglow from other planets, such as Mars and Venus, could be expected to occur, taking our present knowledge of the composition of these planetary atmospheres as a basis. An airglow mechanism that may be expected to take place on Mars or Venus is proposed, and its implications are discussed for the Martian atmosphere.

A64-17829
HYPERSONIC FLOW FIELD AROUND A HEMISPHERE IN A CO_2-N_2-A GAS MIXTURE.
Jerold H. Klaimon (Boeing Co., Aero-Space Div., Flight Technology Dept., Seattle, Wash.).
AIAA Journal, vol. 2, May 1964, p. 953, 954. 7 refs.

Presentation of sample solutions of the subsonic-transonic flow region around a hemispherical cap moving at hypersonic speeds through atmospheres consisting of carbon dioxide, nitrogen, and argon. These data are preliminary results of a systematic effort to develop equilibrium solutions for blunted axially symmetric or two-dimensional bodies at supersonic speeds in any arbitrarily specified mixture of CO_2-N_2-A. The assumed atmosphere contains $0.5CO_2$-$0.25N_2$-0.25A, which is considered representative of those atmospheres now being considered for Mars. Constant temperature, pressure, and radiation intensity lines are mapped in the shock layer for a typical case; shock-shape and surface-pressure distribution correlations are presented, and shock standoff distance is compared with available hypersonic approximations.

A64-17876
STUDY OF THE VENUS ATMOSPHERE. I [ISSLEDOVANIE ATMOSFERY VENERY. I].
V. V. Sobolev (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR).
Astronomicheskii Zhurnal, vol. 41, Jan.-Feb. 1964, p. 97-103. 10 refs. In Russian.

Derivation of expressions describing the relationship between the magnitude of the planet Venus and the phase angle. On the basis of a comparison of the theory with the results of observations, the indicatrix of light scattering is determined, together with the ratio of scattering coefficient to the absorption coefficient.

A64-17915
ON EXOSPHERIC DRAG AS THE CAUSE OF THE SUPPOSED SECULAR ACCELERATIONS OF PHOBOS.
G. F. Schilling (RAND Corp., Santa Monica, Calif.).
Journal of Geophysical Research, vol. 69, May 1, 1964, p. 1825-1829. 18 refs.
Contract No. AF 49(638)-700.

A recent theory by Shklovskii explained the supposed orbital accelerations of Phobos by suggesting that it is an artificial satellite of Mars. Reasonable assumptions about the physical state of the equatorial exosphere of Mars, however, lead to values of atmospheric density that could exert observable drag effects on Phobos without its being a hollow sphere. It is further shown that a required correlation may exist between solar activity and reported values of the accelerations over a period of some 60 years. As long as reliable observational evidence remains scarce, the actual existence of orbital accelerations remains in doubt. Yet, because of the potential importance of the phenomenon to the study of planetary exospheres, future observations and analyses are stated to be emphatically necessary.

A64-18258
BACTERIA UNDER SIMULATED MARTIAN CONDITIONS.
Richard S. Young (NASA, Ames Research Center, Biochemical Evolution Branch, Moffett Field, Calif.).
Space World, vol. A-2, Nov.-Dec. 1963, p. 36-39.

Discussion of a new technique for the simulation of known parameters of the Martian environment, along with possible biological implications. The response of bacteria to such simulation is demonstrated in terms of survival and growth, showing that certain bacteria will not only survive, but grow during simulated Martian freeze-thaw cycling if water is present. How water could be present on Mars although not detectable with current technology is demonstrated, and plans for future experimentation are discussed.

A64-18733
WATER VAPOR IN THE ATMOSPHERE OF VENUS.
Murk Bottema, William Plummer, and John Strong (Johns Hopkins University, Laboratory of Astrophysics and Physical Meteorology, Baltimore, Md.).
Astrophysical Journal, vol. 139, Apr. 1, 1964, p. 1021, 1022.
USAF-supported research.

Determination of the amount of water vapor present above the reflective cloud layer on the planet Venus, using an automatic daytime telescope of 30-cm aperture carried by balloon to 26.5 km. From 120 records it was determined that the modulation produced by the water absorption, when the line groups were scanned, was (10.5 ± 0.5) percent. By calibration, this modulation is the same as that produced by 9.8×10^{-3} gm/cm^2 of water vapor at atmospheric pressure. Possible influence of water vapor in the Earth's atmosphere above the balloon was assessed. The influence of the Doppler shift on the recorded data was also determined.

A64-18766
UNITED STATES SPACE SCIENCE PROGRAM.
COSPAR, Meeting, 7th, and International Space Science Symposium, 5th, Florence, Italy, May 8-20, 1964, Paper. 353 p.

A condensed compilation of reports is presented, covering the period from the time of the last report through 1963 and, in some cases, into the first months of 1964. Thirteen sections cover astronomy; solar physics; energetic particles and fields; ionospheric physics; planetary atmospheres and meteorology; planetology; exobiology; the effect of the space environment on man and other terrestrial organisms; celestial mechanics, trajectory studies, geodesy, and gravity; laboratory astrophysics and other supporting studies; communications satellites; international activities; and NASA tracking and data acquisition system, new developments. Five appendices provide: (1) A summary of launchings for 1963 including rockets, satellites and balloons, (2) select lists of sources of support for work reports in text, (3) IGY rocket and satellite report series, (4) journals in which US space science research reports are normally published, and (5) bibliography.

A64-18768
SPACE RESEARCH IN THE UNITED STATES, 1963.
Richard W. Porter (National Academy of Sciences, National Research Council, Washington, D.C.).
COSPAR, Meeting, 7th, and International Space Science Symposium, 5th, Florence, Italy, May 8-20, 1964, Paper. 15 p.

Summary description of the space research activities conducted in the U.S. during 1963, covering such areas as: X-rays and gamma rays, interaction of the solar wind with the Earth's magnetic field, structure of the upper atmosphere and ionosphere, cloud photographs from satellites, new data on the Martian atmosphere, biogenesis experiments in the laboratory, manned spaceflight, improved data on the Earth's gravitational field, and communication satellites. In addition, reference is made to cooperative rocket and satellite projects of various kinds and to U.S. participation in IQSY, and other COSPAR-sponsored programs.

A64-18801
ON CREATION OF ARTIFICIAL CONDITIONS OF MARS FOR MICROBIOLOGICAL INVESTIGATIONS.
A. I. Zhukova and I. I. Kondratiev (Academy of Sciences, Moscow, USSR).
COSPAR, Meeting, 7th, and International Space Science Symposium, 5th, Florence, Italy, May 8-20, 1964, Paper. 9 p.

Approach to the solution of problems regarding the character of life on Mars, by simulating Martian conditions by means of data obtained from astrophysics. Experiments are described in which pure cultures of fungi and bacteria have been used, as listed in a table. Short-time exposure has enabled conclusions on the viability of 22 strains of microorganisms under chamber conditions when the insolation source is switched on. It is concluded that: (1) spores of mold fungi are more stable than spores of bacterial cells, and (2) not all tested forms of microorganisms are capable of retaining viability under conditions imitated in the installation.

A64-18826
THE NATIONAL COMMITTEE FOR SPACE RESEARCH OF THE ISRAEL ACADEMY OF SCIENCES AND HUMANITIES REPORT ON SPACE ACTIVITIES 1963-64.
COSPAR, Meeting, 7th, and International Space Science Symposium, 5th, Florence, Italy, May 8-20, 1964, Paper. 11 p.

Review, in the form of an annual report, of space research activities which have been conducted and scheduled by various organizations in Israel for the period of 1963-1964. Individual programs of each of the organizations are outlined, covering such areas as planetary atmospheres, spectroscopy, plasma physics, selective surfaces, stability of the atmosphere of Venus, solar research, cell biology, and aerodynamics.

A64-19089
SPECTRUM OF SHOCK-HEATED GASES SIMULATING THE VENUS ATMOSPHERE.
A. R. Fairbairn (Avco Corp., Avco-Everett Research Laboratory, Everett, Mass.).
(American Institute of Aeronautics and Astronautics, Conference on Physics of Entry into Planetary Atmospheres, Cambridge, Mass., Aug. 26-28, 1963, Paper 63-454.)
AIAA Journal, vol. 2, June 1964, p. 1004-1007. 19 refs.
Contracts No. NASw-748; No. NAS 9-858.

A64-19195
THE HISTORY OF OXYGENIC CONCENTRATION IN THE EARTH'S ATMOSPHERE.
L. V. Berkner and L. C. Marshall (Southwest Center for Advanced Studies, Dallas, Tex.).
Faraday Society, General Discussion on Chemical Reactions in the Atmosphere, Edinburgh, Scotland, Apr. 2, 3, 1964, Paper 3429. 22 p. 64 refs.

Discussion of a subject which is stated to be classifiable under the general heading of Paleo-atmospheres or Fossil Atmospheres, comprising a critical quantitative study of the history of planetary atmospheres. Attention is directed only to the history of the growth of oxygen in the atmosphere of the planet Earth. Only the principal methods and conclusions of a more extended study from which a preliminary model has been formulated are outlined. A model is presented which is stated to suggest that the Cambrian was not preceded by a long period of evolution of advanced organisms which have not been preserved in the fossil record. It is noted that the analysis of oxygen balance during the several eras also poses the problem of the present stability of the oxygenic level.

A64-19823
THE ATMOSPHERE OF MERCURY.
Nikolai A. Kozyrev (Pulkovo Observatory, Pulkovo, USSR).
Sky and Telescope, vol. 27, June 1964, p. 339-341.

Discussion of spectrographic studies of Mercury made with a fast prism spectrograph and a 50-in. reflecting telescope. Spectrograms of Mercury's immediate vicinity were obtained at various position angles and distances from the planet's limb. They showed no traces of emission lines or bands, thus eliminating the possibility of an appreciable extended atmosphere. However, a comparison of the Fraunhofer lines in the spectra of Mercury and the Sun does indicate the existence of atomic hydrogen on that planet. Other theoretical and experimental evidence supporting the possibility that there is hydrogen in Mercury's atmosphere is discussed.

A64-19892
DEVELOPMENTS IN ENTRY VEHICLE TECHNOLOGY.
Alvin Seiff (NASA, Ames Research Center, Vehicle Environment Div., Moffett Field, Calif.).
American Institute of Aeronautics and Astronautics, Annual Meeting, 1st, Washington, D.C., June 29-July 2, 1964, Paper 64-528. 12 p. 18 refs.
Members, $0.50; nonmembers, $1.00.

Discussion of entry-vehicle problems related to Mars entry of an unmanned probe and Earth entry well above the escape speed, and summary of some recent laboratory research findings related to high-speed entry problems. It is stated that design for steep entry into some of the proposed Mars atmospheres appears to be unfeasible because of the extremely low m/C_DA required for soft landing. Hence, missions to search for life on Mars and to make physical measurements of the Martian surface cannot be confidently undertaken until the questions about the atmosphere are resolved. For entry into planetary atmospheres at speeds much greater than 40,000 fps, use of entry vehicles with all surfaces swept back relative to the stream (such as cones) is indicated to prevent radiative heat transfer from becoming castastrophically large. Items selected from recent research are related to cone radiative heating at high speeds, combustion of ablation shields, ablation products radiation, injected gas interaction with the external flow, and atmospheric gas radiation of nitrogen, carbon-dioxide mixtures.

A64-19913
THE FEASIBILITY OF SPACECRAFT DECELERATION BY AERODYNAMIC BRAKING AT THE PLANET MARS.
Gerald M. Hanley and Frank J. Lyon (North American Aviation, Inc., Space and Information Systems Div., Flight Sciences Dept., Downey, Calif.).
American Institute of Aeronautics and Astronautics, Annual Meeting, 1st, Washington, D.C., June 29-July 2, 1964, Paper 64-479. 16 p. 16 refs.
Members, $0.50; nonmembers, $1.00.

Determination of the feasibility of decelerating a spacecraft by aerodynamic braking to establish an orbit about the planet Mars.

The effect of vehicle shape on heat-protection weight at a nominal entry velocity of 27,600 fps, and the effect of initial entry velocity on heat shielding of a selected configuration for entry velocities between 27,600 and 39,000 fps are studied. It is stated that, because of the wide spread in current estimates of the constituents and density of the Martian atmosphere, their effect on the maximum heat-protection weight and entry corridor depth is presented. The study results are said to indicate that gas radiation is a major source of gasdynamic heating during atmospheric braking, even for entry at 27,600 fps. Consequently, blunt shapes, such as the Apollo configuration, have higher heat-protection weight requirements than finer shapes such as the M-2 and high L/D delta wing shapes. As a consequence of these initial study results, a modified conical vehicle having a half-cone angle of 18° and an $(L/D)_{max} = 1.16$ was studied to determine the effect of initial entry velocity on vehicle heat-protection weight. The indications suggested by the results of this analysis are provided.

A64-19932

AERODYNAMIC BRAKING TRAJECTORIES FOR PLANETARY ORBIT ATTAINMENT.

Thomas W. Finch (Douglas Aircraft Co., Inc., Missile and Space Systems Div., Santa Monica, Calif.).

American Institute of Aeronautics and Astronautics, Annual Meeting, 1st, Washington, D.C., June 29-July 2, 1964, Paper 64-478. 7 p. Members, $0.50; nonmembers, $1.00.

Examination of the problems associated with aerodynamic braking into a Martian orbit from the standpoint of vehicle and trajectory capability. Mars entry corridors for lifting vehicles are presented. Trajectories are developed which minimize the propulsive orbit injection velocity increment. The magnitude of the propulsive velocity increment is examined for these trajectories as a function of orbit altitude, vehicle lift/drag ratio, and lift parameter, and entry velocity and peak load factor. It is stated that, since the minimum propulsive velocity trajectories are found to be impractical due to extreme sensitivity and lack of control capability, a class of trajectories is proposed which minimizes these difficulties. These alternate trajectories are found to require larger propulsive velocities for orbit injection. Propulsive velocity increments are again examined as functions of orbit altitude, vehicle lift/drag ratio and lift parameter, and entry velocity and peak load factor. It is noted that, since the alternate trajectories provide orbital plane rotation capability, the magnitude of the orbital plane rotation possible through aerodynamic maneuvering is examined as a function of the vehicle lift/drag ratio.

A64-20138

A SIMPLE ENTRY SYSTEM EXPERIMENT FOR MARTIAN ATMOSPHERIC MEASUREMENTS.

F. G. Beuf (General Electric Co., Re-entry Systems Dept., Martian Entry Experiment Study, Philadelphia, Pa.).

American Institute of Aeronautics and Astronautics, Annual Meeting, 1st, Washington, D.C., June 29-July 2, 1964, Paper 64-292. 15 p. 10 refs.
Members, $0.50; nonmembers, $1.00.

Description of a simple, light, sterilizable entry-vehicle experiment designed to gather information when launched into the Martian atmosphere from a fly-by bus. The low-ballistic-coefficient, minimum-weight vehicle will telemeter vehicle acceleration, base pressure, and atmospheric constituent measurements. The vehicle design employs a spherical entry configuration, the symmetrical aerodynamics of which permit the use of a simple, low-data-rate communications system for the transmission of vehicle motion data. The telemetered data will be sufficient to obtain a good estimate of the atmospheric pressure at the Martian surface, the scale height, the atmospheric composition, and an altitude-density profile.

A64-21019

A NEW AMMONIA BAND IN THE JOVIAN SPECTRUM.

Tobias Owen (Arizona, University, Lunar and Planetary Laboratory, Tucson, Ariz.), E. H. Richardson (Dominion Astrophysical Observatory, Ottawa, Canada), and Hyron Spinrad (California Institute of Technology, Jet Propulsion Laboratory, Div. of the Space Sciences, Pasadena, Calif.).

Astrophysical Journal, vol. 139, May 15, 1964, p. 1374-1377. Contract No. Nonr G-00050-62.

Investigation of high-dispersion spectrograms of Jupiter taken at the Victoria and McDonald Observatories which show many weak planetary lines near the telluric A-band at λ 7600. These absorption lines are identified as a new band of ammonia observed in the laboratory with a multiple-path absorption tube.

A64-21021

RESOLVING POWER OF THE 100-INCH COUDE SPECTROGRAPH IN THE INFRARED.

Roger Griffin (Cambridge, University, University Observatories, Cambridge, England).

Astrophysical Journal, vol. 139, May 15, 1964, p. 1387, 1388.

Discussion and criticism of the procedure used by Kaplan, Münch, and Spinard in their investigation of the atmosphere of Mars. The above mentioned authors claimed to have achieved an instrument resolving power in excess of 10^5. The likelihood of this value is disputed and reasons for the criticism are given. Using the published results, the resolving power is estimated at 41,000.

A64-22306

ANOMALY IN THE BEHAVIOR OF THE NH_3 BAND IN THE SPECTRUM OF THE PLANET JUPITER [SUR UNE ANOMALIE DU COMPORTEMENT DES BANDES DE NH_3 DANS LE SPECTRE DE LA PLANETE JUPITER].

Charles Fehrenbach and Pierre Guérin.

Académie des Sciences (Paris), Comptes Rendus, vol. 258, no. 5, Feb. 3, 1964, p. 1403-1405. 5 refs. In French.

Remeasurement of the inclinations of ammonia lines (6450 Å) from Jupiter and radiation from the Sun on a plate where terrestrial oxygen and water vapor lines are parallel to the slit image. The ratio of the two slants is found to be 0.492 ± 0.01, in close agreement with the theoretically predicted 0.500. Thus, the values obtained by Spinrad (0.23 and 0.34 in 1934 and 1961, respectively) are not confirmed, and further research is urged.

A64-22734

EQUILIBRIUM ELECTRON DENSITY ON MARS.

Edward D. Shane (Avco Corp., Research and Advanced Development Div., Wilmington, Mass.).

AIAA Journal, vol. 2, Aug. 1964, p. 1497-1499. 6 refs.

Presentation of thermochemical equilibrium values of electron concentration as a function of temperature and density corresponding to five models of the Martian atmosphere. The models consist of different percentages of carbon dioxide, argon, and nitrogen. It is shown that at a given temperature and density the electron concentration on Mars will be less than that on Earth and that this is most evident at low temperatures and high densities.

A64-22783

EFFECT OF ARGON ADDITION ON SHOCK-LAYER RADIANCE OF CO_2-N_2 GAS MIXTURES.

F. Wolf and T. Horton (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).

AIAA Journal, vol. 2, Aug. 1964, p. 1472-1474. 10 refs.

Determination of the equilibrium radiative heat transfer to blunt entry bodies for unmanned planetary missions. It is felt that the possibility of relatively large amounts of argon in the Mars atmosphere requires a reappraisal of the equilibrium radiative heat transfer. A thermochemistry and real-gas normal shock computer program, used previously to give solutions to the equilibrium gas radiance of a CO_2-N_2 mixture, has been extended to cases of high argon content. The program used existing emissivity data to compute the radiance. The effect of the argon addition to the CO_2-N_2 mixture on the radiance is graphically displayed, and the application of this result to space-vehicle design is outlined.

A64-22997
ATMOSPHERIC RADIATION. VOLUME 1 - THEORETICAL BASIS.
R. M. Goody (Harvard University, Blue Hill Meteorological Observatory, Cambridge, Mass.).
Oxford, Clarendon Press, 1964. 436 p.
$8.

Quantitative treatment of the fundamental processes involved when electromagnetic energy from the Sun comes in contact with a planetary atmosphere. Not being limited to terrestrial meteorology, the theories advanced are seen to be applicable to studies of Mars and Venus and to have some relevance to studies of the outer planets. The theory of radiative transfer is presented along with the corresponding numerical and approximate methods. Rotational, vibrational, and electronic bands are discussed in the theory of gaseous absorption, and the problems encountered in measuring the widths, and shapes of spectral lines in the infrared and microwave regions are examined. Band models presented include those attributed to Elsasser, Schnaidt, and Curtis. Computations of fluxes and heating rates are illustrated using, among others, the Mügge-Möller, Kew, and Yamamoto charts. The appendix includes tables of the refractive index of air for various wavelengths and temperatures, model atmospheres, the Planck function, the optical properties of liquid water and ice, and tables representing the physical state of the quiet and disturbed Sun.

A64-23030
STABILITY OF HYDROGEN COMPOUNDS ON VENUS.
Robert F. Mueller (Chicago, University, Dept. of the Geophysical Sciences, Chicago, Ill.).
Nature, vol. 203, Aug. 8, 1964, p. 625, 626. 12 refs.

Discussion of the possibility of evaluating the stabilities of many hydrogen compounds on Venus. The compounds examined are methane, the higher polymers of the paraffin series, and the various hydrocarbon series. It is stated that the benzene series of hydrocarbons is somewhat more stable than the paraffin series for corresponding polymers under standard conditions. However, the lowest benzene polymer is C_6H_6, and this will be far less abundant than methane. It is noted that it seems unlikely that any significant quantities of hydrocarbons could occur on the surface or in the lower atmosphere, and this seems also to preclude their occurrence in the higher atmospheric levels.

A64-23658
SCATTERING OF LIGHT IN A SPHERICAL ATMOSPHERE. II [RASSEIANIE SVETA V SFERICHESKOI ATMOSFERE. II].
I. N. Minin and V. V. Sobolev.
Kosmicheskie Issledovaniia, vol. 1, Sept.-Oct. 1963, p. 227-234. In Russian.

Discussion of the scattering of light in a planetary atmosphere with constant absorption factor. An analytical solution of the basic equation defining the quantity J (a Bessel function describing the mean intensity of the diffusive radiation in a given region of the atmosphere) is obtained, taking into account the reflection of light from the surface of the planet. Formulas are derived for the intensity of the outgoing radiation. The solution obtained is applied to the luminescence of a homogeneous sphere. The expression for the intensity of the radiation emitted by the homogeneous sphere is analyzed in some detail. This analysis leads to asymptotic formulas for large values of the optical radius of the sphere.

A64-23742
A DETECTOR FOR THE ARGON ABUNDANCE IN THE MARTIAN ATMOSPHERE.
F. B. Harrison and W. Bernstein (Space Technology Laboratories, Inc., Redondo Beach, Calif.).
Planetary and Space Science, vol. 12, July 1964, p. 726, 727. 5 refs.

Description of a simple instrument of low weight and small power consumption, suitable for inclusion in a "first generation" instrument package placed in the Mars atmosphere, for the determination of argon abundance, provided the total atmospheric density is independently measured. The instrument is a cylindrical ionization chamber 5-cm long and 10-cm in diam., which is open to the atmosphere; the ionization produced by a low-energy X-ray source is measured. The walls of the chamber are made of Z-material, such as beryllium or aquadag-coated magnesium to reduce the contribution of electrons generated by X-rays interactions with the walls to a negligible amount. It is stated that, since the mass absorption coefficient for 4- to 10-kev X-rays for argon is much greater than for the low-Z gases, the ionization current will depend sensitively on the argon concentration. On the other hand, the absorption coefficients for the high-Z gases such as Xe and Kr are not much greater than that for argon; thus, trace amounts of these gases will not distort significantly the argon determination. The currents calculated for a 30-Mc Fe^{55} source for various total atmospheric densities and argon concentrations are shown.

A64-24547
INTENSE 584-Å LIGHT FROM A SIMPLE CONTINUOUS HELIUM PLASMA.
C. A. Jensen and W. F. Libby (California, University, Dept. of Chemistry and Institute of Geophysics, Los Angeles, Calif.).
Physical Review, 2nd Series, vol. 135, Aug. 31, 1964, p. A1247-A1252. 21 refs.
Grant No. AF AFOSR 245-64.

Description of a simple helium source for the production of continuous cold plasmas and intense line spectra. The device acts as an intense source of ionizing ultraviolet radiation and can be used to study the chemical effect of the solar ionizing ultraviolet on planetary atmospheres and surfaces. The intensity of the radiation is measured by simple photocells. 10^{16} 584-Å photons per second are emitted by a 30-watt source. The mechanism is via the electron-ion recombination from 1660°K plasma with a density of about 10^{13} ions/cm^3.

A64-24638
THE STRUCTURE AND COMPOSITION OF JUPITER AND SATURN.
P. J. E. Peebles (Princeton University, Palmer Physical Laboratory, Princeton, N.J.).
Astrophysical Journal, vol. 140, July 1, 1964, p. 328-347. 28 refs.
NSF Grant No. GP-579.

Analysis, using a computer, of model-planet calculations for Jupiter and Saturn. The general model used consists of a high-density core, surrounded by a uniform mixture of helium and hydrogen. The mass of the core necessary to yield the correct total mass, and the first two nonzero gravitational multipole moments, are calculated for various helium abundances. Different assumptions about the depth of the atmosphere below the cloud layer are examined. The results of the model planet calculations are compared with observations of Jupiter and Saturn. Implications of the results, particularly the very high hydrogen abundance found for Jupiter, for theories of planetary origin, and for cosmology, are considered.

A64-24640
INTENSITY MEASUREMENTS ON SPECTRA OF GASES OF PLANETARY INTEREST - H_2, H_2O, AND CO_2.
D. R. Rank, U. Fink, J. V. Foltz, and T. A. Wiggins (Pennsylvania State University, Physics Dept., University Park, Pa.).
Astrophysical Journal, vol. 140, July 1, 1964, p. 366-373. 9 refs.
NSF-supported research.

Study, using a multiple-reflection absorption tube of the "white" type, of the spectra of H_2, H_2O vapor, and CO_2, to furnish a calibration for astronomically obtained data. Data are presented on the relative intensities of the H_2 quadrupole bands, lines in the H_2O vapor band at 8200 Å, the $5\nu_3$ band of CO_2 (head wavelength 8690 Å), and N_2-broadened CO_2 lines.

A64-24800
EVIDENCE FOR ASYMMETRY OF JUPITER'S VAN ALLEN BELT.
J. A. Roberts and M. M. Komesaroff (Commonwealth Scientific and Industrial Research Organization, Div. of Radiophysics, Sydney, Australia).
Nature, vol. 203, Aug. 22, 1964, p. 827-830. 17 refs.

Discussion of features which suggest that the belt is not symmetrically disposed about the planet. The results of investigations

are mentioned in which the beaming of radiation, which manifests itself as a variation of the total intensity as the planet rotates, is considered. An attempt is made to relate observed beaming to the distribution of the pitch angle of the electrons in the belt. In addition, evidence for asymmetry is provided by the variation of the direction of polarization with longitude. It is assumed that the asymmetry reflects some permanent departure of the magnetic field from a centered dipole configuration.

A64-24809

RECENT SPACE PROBE AND EARTH-BASED STUDIES OF MARS AND VENUS.

P. Thaddeus (NASA, Goddard Space Flight Center, Goddard Institute for Space Studies, New York, N.Y.).

(British Interplanetary Society, Symposium on Meteorology from Space, London, England, Sept. 19, 1963.)
British Interplanetary Society, Journal, vol. 19, May-June 1964, p. 419-428; Discussion, p. 428. 21 refs.

Review of information obtained. Knowledge of the Venusian atmosphere as of 1961 is reviewed. The results of measurements made up to that time are presented and several models are proposed to account for the observations. Among those mentioned are the greenhouse, ionosphere, and aeolosphere models. The experiments designed for the Mariner 2 (1962 Alpha Rho 1) spacecraft are considered. The launch vehicle and the spacecraft are discussed along with the problems that arose before the flight. A description of the flight and steps taken to obtain the desired distance of approach are given. Satellite observations as well as Earth-based ones are considered. The Martian atmosphere is discussed, along with plans to send a Mariner space vehicle for further studies.

A64-24942

THE ATMOSPHERES OF MARS, VENUS AND JUPITER.

S. I. Rasool and R. Jastrow (NASA, Goddard Space Flight Center, Goddard Institute for Space Studies, New York, N.Y.).

IN: LIFE SCIENCES AND SPACE RESEARCH II; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 4TH, WARSAW, POLAND, JUNE 3-12, 1963.
Sponsored by the Committee on Space Research (COSPAR).
Edited by M. Florkin and A. Dollfus.
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964, p. 3-24. 40 refs.

Review of the general properties of the atmospheres of Mars, Venus, and Jupiter. The most recent observational results are said to indicate that the surface pressure on Mars could be as low as 20 mb, and that the amount of CO_2 may have a mixing ratio as high as 25% by volume. For Venus, the Mariner 2 (1962 Alpha Rho 1) results suggest that the surface temperature may actually be of the order of 600°K. Also there are indications that the surface pressure on Venus could be ~100 atm, with the atmosphere mainly composed of N_2. In the case of Jupiter, recent theoretical investigations of the atmosphere below the clouds suggest that there may be regions in the atmosphere of very high density and pressure, but at relatively low temperature, creating conditions possibly favorable to the occurrence of complex organic reactions.

A64-24947

INTERACTION OF COSMIC AND SOLAR FLARE RADIATIONS WITH THE MARTIAN ATMOSPHERE AND THEIR BIOLOGICAL IMPLICATIONS.

Y. Yagoda (USAF, Office of Aerospace Research, Cambridge Research Laboratories, Hanscom Field, Bedford, Mass.).

IN: LIFE SCIENCES AND SPACE RESEARCH II; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 4TH, WARSAW, POLAND, JUNE 3-12, 1963.
Sponsored by the Committee on Space Research (COSPAR).
Edited by M. Florkin and A. Dollfus.
(COSPAR, International Space Science Symposium, 4th, Warsaw, Poland, June 3-12, 1963, Paper.)
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964, p. 101-104.
[For abstract see Accession no. A63-19734 18-28]

A64-24951

THE DESIGN OF MARTIAN BIOLOGICAL EXPERIMENTS.

N. H. Horowitz (California Institute of Technology, Pasadena, Calif.).

IN: LIFE SCIENCES AND SPACE RESEARCH II; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 4TH, WARSAW, POLAND, JUNE 3-12, 1963.
Sponsored by the Committee on Space Research (COSPAR).
Edited by M. Florkin and A. Dollfus.
(COSPAR, International Space Science Symposium, 4th, Warsaw, Poland, June 3-12, 1963, Paper.)
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964, p. 133-138. 14 refs.
[For abstract see Accession no. A63-18924 17-16]

A64-24961

ON THE PROBLEM OF DETECTION OF WATER IN THE ATMOSPHERE OF VENUS.

A. E. Salomonovich (Academy of Sciences, Physical Institute, Moscow, USSR).

IN: LIFE SCIENCES AND SPACE RESEARCH II; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 4TH, WARSAW, POLAND, JUNE 3-12, 1963.
Sponsored by the Committee on Space Research (COSPAR).
Edited by M. Florkin and A. Dollfus.
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964, p. 200-210. 24 refs.

Consideration of the possibility of the existence of water vapor in the Venus atmosphere, from data obtained on the spectrum of radio emission of an illuminated side of Venus. It is shown that the observed dependence of Venus brightness temperature averaged over the disk in the mm-waveband cannot be accounted for by partial absorption of the emission of the planet's surface only in carbon dioxide of its atmosphere. It is stated that a water cloud layer with the mean temperature of about 235°K, which contributes to additional absorption, cannot explain with sufficient accuracy the entire spectrum observed in the range 0.4-10 cm. A better agreement can be obtained if one takes the temperature of a cloud layer equal to 350°K which, however, leads to an increase of pressure at a level of this layer up to about 1 atmosphere. It is noted that the detection of spectral lines of absorption and small quantities of water vapor, as well as vapors of other compounds, which probably form a cloud layer, require the use of precision methods of spectral radio astronomy.

A64-24962

ON THE IONOSPHERIC MODEL OF VENUS.

A. D. Kuzmin (Academy of Sciences, Physical Institute, Moscow, USSR).

IN: LIFE SCIENCES AND SPACE RESEARCH II; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 4TH, WARSAW, POLAND, JUNE 3-12, 1963.
Sponsored by the Committee on Space Research (COSPAR).
Edited by M. Florkin and A. Dollfus.
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964, p. 211-221. 26 refs.

Discussion of the model of Venus with a hole or semitransparent ionized layer responsible for the increased radio emission of the planet in the cm and dm wavelength ranges. The generalized parameters of the layer, and the surface of the planet are determined at which the calculated radio emission spectrum corresponds to experimental data. With the use of data from radar measurements, the electron temperature T_e is calculated in the layer, together with the temperature T_s and the dielectric constant of the material of the surface, depending on the area of the holes and the optical thickness of semitransparent layers. It is shown that relatively low (about 400°K) temperatures of the surface are not necessary for the ionospheric model. At great ε, the observed spectrum of radio emission of Venus can be obtained at temperatures of the surface commensurable with and even higher than the electron temperature in the layer. It is noted that, for a numerical estimate of T_e, T_s, and ε, radar measurements of the reflective properties of Venus at wavelengths shorter than 1 cm are necessary.

A64-24964
RECENT OBSERVATIONS OF THE INFRARED SPECTRA OF MARS AND VENUS IN CONNECTION WITH THE SPACE INVESTIGATIONS PROBLEM.
V. I. Moroz (Moscow State University, State Astronomical Institute, Moscow, USSR).
IN: LIFE SCIENCES AND SPACE RESEARCH II; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 4TH, WARSAW, POLAND, JUNE 3-12, 1963.
Sponsored by the Committee on Space Research (COSPAR).
Edited by M. Florkin and A. Dollfus.
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964, p. 230-237. 12 refs.

Discussion of the CO absorption band at 2.35 μ (equivalent laboratory absorption approximately 4 cm) and of several unidentified absorption features which were found in the IR spectrum of Venus during observations made in 1963. A theoretical model of the Venusian atmosphere in the region of the CO_2 photo-dissociation was calculated. It is stated that the observed CO absorption is in rough accordance with that model. Venusian albedo decreases by a factor of 20 from 2.5 to 2.9 μ. The absorption observed at $\lambda > 3$ μ seems to create the significant greenhouse effect, which heats the planetary surface. The constituent which produced this absorption is still unidentified (not H_2O), but the existence of this strong IR absorption is established with certainty. New CO_2 bands were also found; the "ice" origin of polar caps and the presence of Sinton's "bands of life," were confirmed on the basis of the IR spectral investigation of Mars. It is noted that the observed equivalent widths of Martian CO_2 bands are narrower than those published earlier by Kuiper. Two bands (3.53 and 3.56 μ) were detected, instead of the single Sinton's 3.56-μ band.

A64-24965
OBSERVATIONAL STUDY OF THE GENERAL CIRCULATION OF MARTIAN ATMOSPHERE - CLOUD OBSERVATIONS DURING THE 1963 OPPOSITION.
S. Miyamoto (Kyoto University, Kwasan Observatory, Kyoto, Japan).
IN: LIFE SCIENCES AND SPACE RESEARCH II; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 4TH, WARSAW, POLAND, JUNE 3-12, 1963.
Sponsored by the Committee on Space Research (COSPAR).
Edited by M. Florkin and A. Dollfus.
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964, p. 238-245.

Interpretation of observational data on the regime of general circulation of the Martian atmosphere. It is stated that the season on Mars at the time of the 1963 opposition was from Spring to Summer of the Martian Northern Hemisphere. Both for the surface markings and for cloud distributions, the progress of the seasons was quite regular. It is noted that, aside from the regular progress of meteorological phenomena, this opposition was characterized by an atmospheric disturbance of global scale, which was first discovered on the evening of Jan. 29, 1963. The white cloud mass hanging over Noachis suddenly burst into the Northern Hemisphere across the equator, and since then the disturbance propagated throughout the globe. It is stated that it is now clear that the regime of general circulation of the Martian atmosphere is quite different from that of the Earth. By construction of the radiation budget, it is predicted that the zonal winds are the easterlies in the solstice season of the Summer Hemisphere. According to Mintz, the circulation regime of the Martian atmosphere is symmetric, except in the Winter Hemisphere. The observational data seem to favor the symmetric regime, rather than the wave regime of the Earth.

A64-24967
POLARIMETRIC INVESTIGATIONS OF MARS AT THE MAIN ASTRONOMICAL OBSERVATORY OF THE UKRAINIAN ACADEMY OF SCIENCES.
A. V. Morozhenko.
IN: LIFE SCIENCES AND SPACE RESEARCH II; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 4TH, WARSAW, POLAND, JUNE 3-12, 1963.
Sponsored by the Committee on Space Research (COSPAR).
Edited by M. Florkin and A. Dollfus.
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964, p. 251-254.

Presentation of results of a polarimetric investigation, during the 1962-1963 opposition of Mars, of the relationship between polarization and phase angle for the entire disk, as well as for some parts of it in 8 spectral intervals (350-600 mμ). The results are as follows: (1) for the phase angle 39° the spectral polarization curve is: 355 mμ-9.10%, 390 mμ-4.80%, 420 mμ-3.10%, 450 mμ-2.70%, 475 mμ-2.40%, 510 mμ-2.00%, 560 mμ-1.60%, 600 mμ-1.40%; (2) during two months, a considerable variation of the degree of polarization was observed while the phase angle remained almost unchanged (37.40-39.20°). Two groups (each including two periods of observations) with different polarization may be distinguished. The ratio of upward polarization of the second group to the first is: 355 mμ-1.01, 390 mμ-1.14, 420 mμ-1.32, 450 mμ-1.31, 475 mμ-1.37, 510 mμ-1.50, 560 mμ-1.71, 600 mμ-2.32. It is noted that the possible explanation of this phenomenon is the variation of dust in the Martian atmosphere.

A64-25013
SPACE RESEARCH IV; INTERNATIONAL SPACE SCIENCE SYMPOSIUM, 4TH, WARSAW, POLAND, JUNE 4-10, 1963, PROCEEDINGS.
Organized by the Committee on Space Research (COSPAR) and the Polish Academy of Sciences.
Edited by P. Muller (Service d'Aeronomie et de Physique Cosmique, Observatoire de Meudon, Meudon, Seine-et-Oise, France).
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964. 997 p.
$37.

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GALACTIC X-RAY EMISSION DUE TO SUPRATHERMAL PARTICLES. Satio Hayakawa and Masaru Matsuoka (Nagoya University, Nagoya, Japan), p. 960-965. 9 refs. [See A64-25093 21-28]

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SPECTRUM OF HEAVY NUCLEI IN THE PRIMARY COSMIC RADIATION.
M. A. Pomerantz, S. P. Duggal (Franklin Institute, Swarthmore, Pa.), and L. Witten (Martin Marietta Corp., Baltimore, Md.), p. 972-988. 18 refs. [See A64-25095 21-28]

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A64-25205

RADIO EMISSION FROM JUPITER.
James W. Warwick (Colorado, University, Dept. of Astrophysics and Atmospheric Physics; High Altitude Observatory, Boulder, Colo.).
IN: ANNUAL REVIEW OF ASTRONOMY AND ASTROPHYSICS. VOLUME 2.
Edited by Leo Goldberg, Armin J. Deutsch, and David Layzer. Palo Alto, Annual Reviews, Inc., 1964, p. 1-22. 69 refs.

Review of work since 1961 concerning the origin and nature of Jupiter's nonthermal emission. Longitude histograms of the decametric emission at 22.2 Mc are presented. The morphology of the decimetric emission is discussed. Questions of the supply of energy and the acceleration of electrons in Jupiter's magnetosphere are covered. A summary is given of the observed properties of Jupiter's nonthermal radio emission.

A64-25264

RADIO OBSERVATIONS OF VENUS AND THE INTERPRETATIONS.
A. H. Barrett and D. H. Staelin (Massachusetts Institute of Technology, Research Laboratory of Electronics, Cambridge, Mass.).
Space Science Reviews, vol. 3, July 1964, p. 109-135. 61 refs.
Contract DA-36-039-AMC-03200(E); Grants No. NsG 250-62; No. NsG 419.

Comparison of radio observations of Venus with theoretical microwave spectra computed for various models of the Venusian atmosphere. Radio observations at frequencies from 750 Mc to 75 Gc are reviewed. The atmospheric models considered are: (1) a CO_2-N_2 atmosphere with several values of surface pressure and temperature lapse rates, (2) an atmosphere of dust in which particles of different sizes have various microwave properties, and (3) a cloud model with various loss mechanisms in the cloud. The same planetary surface is assumed for each model, and the effects of polarization on the surface emissivity are included. It is found that to match approximately the observed radio spectra with most models requires extreme conditions on Venus, such as surface pressures of more than 100 atmospheres, or dust densities of at least 10 gm/m^2 composed of large particles at the surface.

A64-25331

EXPERIMENTAL HEAT-TRANSFER STUDIES OF HYPERVELOCITY FLIGHT IN PLANETARY ATMOSPHERES.
J. S. Gruszczynski and W. R. Warren, Jr. (General Electric Co., Missile and Space Div., Space Sciences Laboratory, Valley Forge, Pa.).
AIAA Journal, vol. 2, Sept. 1964, p. 1542-1549. 8 refs.
Jet Propulsion Laboratory Contract No. 950297.

Results of an experimental study of blunt-body heat-transfer problems during entry into planetary atmospheres. Equilibrium gas radiance and convective heat-transfer rates were measured in several CO_2-N_2 gas mixtures over a simulated flight velocity range of 30,000-45,000 ft/sec (approximately). An electrically driven shock tube was used to provide the simulated hypervelocity flight conditions. An unresolved problem concerning the apparent influence of gage surface material on measured convective heat-transfer rates is identified and discussed. The properties and performance of a total radiation cavity gage, used to obtain the gas radiance data, are described. It is shown that species concentrations in a CO_2-N_2 mixture have only a small effect on convective heating rates. A similar conclusion for gas radiance is inferred at flight velocities above 32,000 ft/sec. The experimental results are compared with appropriate theoretical predictions and other experimental data and are used to predict stagnation-point radiative and convective heating for Venus entry trajectories.

A64-25500

AN UPPER LIMIT TO A RAYLEIGH SCATTERING ATMOSPHERE ON MARS.
Steven Musman (Princeton University, Observatory, Princeton, N.J.).
Planetary and Space Science, vol. 12, Aug. 1964, p. 799, 800. 11 refs.

Report of the use of Bellman's computations of the amount of light scattered from the top of a plane parallel layer of Rayleigh scatterers to construct models of spherical planets with completely absorbing surfaces and Rayleigh-scattering atmospheres. The model with optical depth of 0.058 is said to match Mars' dimensionless reflectivity of $\rho\Phi(21^{\circ}) = 0.032$. This value of the optical depth is said to represent a rather high upper limit to the optical thickness of the atmosphere at 3300 Å. The Martian surface pressure for a nitrogen atmosphere is computed to be 27 mb, which is thought to be consistent with the 25 ± 15-mb pressure obtained by Kaplan, Münch, and Spinrad. The effects of non-Rayleigh scatterers are discussed and Dollfus' use of the polarization properties of Rayleigh scattering are commented on.

A64-25623

INVESTIGATION OF THE VENUSIAN ATMOSPHERE. I.
V. V. Sobolev (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR).
(Astronomicheskii Zhurnal, vol. 41, Jan.-Feb. 1964, p. 97-103.)
Soviet Astronomy, vol. 8, July-Aug. 1964, p. 71-75. 10 refs.
Translation.
[For abstract see Accession no. A64-17876 12-05]

A64-25748
RADIO WAVES FROM JUPITER.
K. L. Franklin.
Scientific American, vol. 211, July 1964, p. 35-42.

General review of knowledge of Jupiter, with description of the radio phenomena identified in 1955, and examination of theories to account for their origin. It has been determined that there are at least four points of origin of the waves, probably associated with what is presumed as the solid part of the planet, since they now rotate with a period of about 9 hr 55 min, but were not actually generated in their present locations. A circular polarization of the Jovian radio waves has been observed, which implies the existence of a special circumstance either in the source mechanism itself, or along the path traveled by the waves. Low-megacycle emissions have also been observed, and have been used as an index for estimating the temperature of the planet, assuming it to radiate like a black body. Because of apparent very high temperatures observed, speculation is made that their source is in belts of charged particles around Jupiter, analogous to the Van Allen belts, and the existence of such belts has been confirmed. The long-wave radiation is also considered to be connected in some way with the belts, and may be affected by an eccentric arrangement of Jupiter's magnetic field.

A64-25904
NONTHERMAL RADIATION FROM JUPITER IN THE DECAMETER WAVELENGTH RANGE.
A. G. Smith, T. D. Carr, and N. F. Six (Florida, University, Dept. of Physics and Astronomy, Gainesville, Fla.; Chile, University, Maipú Radioastronomical Observatory, Santiago, Chile).
IN: ENGINEERING ASPECTS OF MAGNETOHYDRODYNAMICS, SYMPOSIUM, 3RD, ROCHESTER, N.Y., MAR. 28, 29, 1962, PROCEEDINGS.
Symposium sponsored by the American Institute of Electrical Engineers, the Institute of Astronautical Sciences, the Institute of Radio Engineers, and the University of Rochester.
Edited by Norman W. Mather and George W. Sutton.
New York, Gordon and Breach Science Publishers, Inc., 1964, p. 25-36. 16 refs.
Navy-Army-NSF-supported research.

Discussion of the properties, methods of detection, and interpretations of the decameter wavelength (5-41 Mc) radiation from Jupiter. This radiation occurs in bursts with bandwidths of the order of 1 Mc and is of such intensity as to be clearly nonthermal in origin. Recent studies suggest that this radiation is correlated with solar and geophysical events and that the bursts are strongly modulated by the terrestrial ionosphere. Polarization measurements indicate that the signals originate in a magnetoionic medium, and cyclotron energy radiation from solar electrons trapped in the Jovian magnetic field appears to be a promising mechanism to account for the required energy. Alternative mechanisms include plasma oscillations and MHD waves generated by the impact of solar plasma clouds. Nonthermal microwave radiation from Jupiter is also briefly considered.

A64-26021
PHYSICS OF THE PLANETS.
A. G. W. Cameron (NASA, Goddard Space Flight Center, Goddard Institute for Space Studies, New York, N.Y.).
IN: SPACE PHYSICS.
Edited by Donald P. Le Galley and Alan Rosen.
New York, John Wiley and Sons, Inc., 1964, p. 127-165. 131 refs.

Attempt at the construction of a general framework of physical interpretations of the properties of the planets and presentation of pertinent observational evidence. The subjects considered are the origin of the planetary atmospheres, the atmospheres of the Earth, Mercury, Venus and Mars, the atmospheres of the giant planets, the surface of the Moon, and planetary interiors. It is shown that many crucial observations are needed before such a framework of physical interpretations of planetary properties can become sufficiently concrete to allow many predictions to be made about such properties.

A64-26027
THE SOLAR PLASMA - ITS DETECTION MEASUREMENT AND SIGNIFICANCE.
William Bernstein (Space Technology Laboratories, Inc., Redondo Beach, Calif.).
IN: SPACE PHYSICS.
Edited by Donald P. Le Galley and Alan Rosen.
New York, John Wiley and Sons, Inc., 1964, p. 397-436. 57 refs.

Presentation of direct and indirect experimental observations on solar plasma. The subjects discussed include the results of in situ spacecraft experiments, the experimental techniques employed, and the limitations to the generalization of the experimental results imposed by the location, duration, and instrumental problems associated with each technique. Experiments that may yield further information about the plasma properties and the solar-wind acceleration processes are described. A brief outline is provided of the contribution to knowledge of nucleosynthesis, stellar evolution, and the history of planetary atmospheres which can be derived from a mass analysis of the solar wind.

A64-26096 •
NOTES ON THE MARTIAN YELLOW CLOUDS.
J. A. Ryan (Douglas Aircraft Co., Inc., Missile and Space Systems Div., Santa Monica, Calif.).
Journal of Geophysical Research, vol. 69, Sept. 15, 1964, p. 3759-3770. 27 refs.
Research supported by the Douglas Independent Research and Development Program.

Consideration of questions associated with the clouds. Those of interest are: (1) the surface winds required to initiate grain motion, (2) the particle grain size which may be primarily responsible for the surface obscuration, and (3) the effects such material movement may have on the surface. The Martian and terrestrial atmospheres are compared as to the ease with which particles can be maintained aloft. The conditions under which material may be transported into the Martian atmosphere is considered. Saltation, compatibility between calculated and observed wind velocities, and the material constituting the yellow clouds are discussed. Conclusions indicate that the Martian dust storm is more violent than terrestrial ones.

A64-26272 •
TRANSLATIONAL AND ROTATIONAL MOTION OF A BODY ENTERING THE MARTIAN ATMOSPHERE [TRANSLATIONS - UND ROTATIONSBEWEGUNG EINES IN DIE MARSATMOSPHÄRE EINTAUCHENDEN KÖRPERS].
Peter Hans Feitis (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).
Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, and Deutsche Gesellschaft für Raketentechnik und Raumfahrtforschung, Jahrestagung, Berlin, West Germany, Sept. 14-18, 1964, Paper. 45 p. In German.

Derivation of the atmospheric parameters and the density distribution within the Martian atmosphere as a function of altitude, assuming that the perfect-gas law holds. The equations of motion of simple bodies are established and solved. The solution consists of equations for the velocity, acceleration, and time as explicit functions of altitude. The case of oblique entry into the atmosphere is also treated. It is shown how the altitudes at which acceleration and heating have their maximum can be calculated. A sphere entering the Martian atmosphere is considered, assuming that the center of gravity of the sphere does not coincide with its geometric center. The diameter containing the sphere's center of gravity is called its axis. First, the rotational motion of the sphere is considered, assuming that its axis is initially inclined with respect to the trajectory. The axis oscillates in a plane with an amplitude which first decreases and then increases after maximum acceleration is reached. When the sphere is spinning it performs a complicated precessional motion around the velocity vector. The precession angle first converges and then diverges.

A64-26398

AERODYNAMIC PROBLEMS OF SPACE-PROBE HYPERSONIC FLIGHT THROUGH PLANETARY ATMOSPHERES [DIE AERODYNAMISCHEN PROBLEME DES HYPERSONISCHEN FLUGES VON RAUMSONDEN DURCH PLANETARISCHE ATMOSPHÄREN].

E. Adams (Deutsche Versuchsanstalt für Luft- und Raumfahrt, Institut für angewandte Mathematik und Mechanik, Freiburg im Breisgau, West Germany).

Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, and Deutsche Gesellschaft für Raketentechnik und Raumfahrtforschung, Jahrestagung, Berlin, West Germany, Sept. 14-18, 1964, Paper. 34 p. 36 refs. In German.

Discussion of the flight mechanics of a hypersonic probe, on the basis of two-body problems in celestial mechanics. The thermochemical and rarefaction effects in the region between the shock-wave front and the surface of the probe are examined, and methods for calculating the pressure distribution over the probe surface are reviewed. The nature of aerodynamic heating is analyzed, and its order of magnitude is determined. A discussion of convective and radiation heating leads to numerical values of the corresponding thermal effects. The principles of transpiration cooling and of heat shielding by ablation are examined.

A64-26583

REQUIREMENTS FOR EFFICIENT MARS LAUNCH TRAJECTORIES.

Lars F. Helgoståm (Lockheed Aircraft Corp., Lockheed Missiles and Space Co., Palo Alto, Calif.).

(American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, New York, N.Y., Jan. 20-22, 1964, Preprint 64-15.)
Journal of Spacecraft and Rockets, vol. 1, Sept.-Oct. 1964, p. 539-544. 6 refs.

[For abstract see Accession no. A64-12923 05-29]

A64-26652

ENTRY VEHICLES FOR UNMANNED PLANETARY EXPLORATION.

G. D. Katz and J. C. McMullen (General Electric Co., Missile and Space Div., Re-Entry Systems Dept., Philadelphia, Pa.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, ENTRY TECHNOLOGY CONFERENCE, WILLIAMSBURG AND HAMPTON, VA., OCTOBER 12-14, 1964, TECHNICAL PAPERS (AIAA PUBLICATION CP-9).
New York, American Institute of Aeronautics and Astronautics, 1964, p. 1-12. 10 refs.

Evaluation of optimum configurations of planetary entry vehicles for model atmospheres of Mars and Venus developed from parametric trajectory analyses. The configurations are evaluated for missions ranging from a simple atmospheric probe to impact-survival life-detection laboratories. The configuration analysis is approached from a parametric point of view with respect to class of configuration, geometric variables, total weight, ballistic parameter, initial entry conditions, and atmospheric models. Detailed subsystem tradeoffs in the areas of heat shield, structure, and retardation are presented. It is found that the near-optimum Martian entry-vehicle configuration is a blunt sphere-cone with a bluntness ratio of ~0.6 and a half-cone angle of ~50°. Optimization of the vehicle configuration, heat shield, structure, and retardation subsystem (20% of vehicle weight) indicates a gross payload of ~50% of the total vehicle weight. V. P.

A64-26653

OPTIMIZATION ANALYSIS OF HEATING OF CONICAL BODIES MAKING LIFTING HYPERBOLIC ENTRIES INTO THE ATMOSPHERES OF EARTH AND MARS.

Michael E. Tauber and Alvin Seiff (NASA, Ames Research Center, Vehicle Environment Div., Moffett Field, Calif.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, ENTRY TECHNOLOGY CONFERENCE, WILLIAMSBURG AND HAMPTON, VA., OCTOBER 12-14, 1964, TECHNICAL PAPERS (AIAA PUBLICATION CP-9).
New York, American Institute of Aeronautics and Astronautics, 1964, p. 13-21. 13 refs.

Analysis of shallow-angle (grazing) re-entries into the Earth's atmosphere from a Mars mission at speeds in the order of 20 km/sec, and entries into the Martian atmosphere at speeds from 6 to 8 km/sec. The heating problems and optimum cone angles of a vehicle at these speeds are discussed, and the merits of conical vehicles for Mars entry are examined. The analysis indicates that with cones of optimum angle, manned Earth entries at speeds of ~20 km/sec should be possible with acceptable mass losses, provided that laminar flow can be maintained at Reynolds numbers of 5 million, that the vehicle has a base radius of not less than 3 m, and a L/D ratio of 0.75, and that high-specific-heat ablation materials, such as quartz, are used to shield the vehicle and preserve an effectively sharp apex. Manned Mars entries at speeds up to 8.5 km/sec are possible at moderate mass losses if optimum cone angles are used to reduce shock-layer radiation, and laminar flow can be maintained. However, while an L/D of less than 0.2 is sufficient for capture at 8.5 km/sec, much higher values are required for capture at sufficiently high altitudes to ensure laminar flow. V. P.

A64-26654

TRAJECTORY CONTROL PROBLEMS IN THE PLANETARY ENTRY OF MANNED VEHICLES.

Rodney C. Wingrove (NASA, Ames Research Center, Moffett Field, Calif.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, ENTRY TECHNOLOGY CONFERENCE, WILLIAMSBURG AND HAMPTON, VA., OCTOBER 12-14, 1964, TECHNICAL PAPERS (AIAA PUBLICATION CP-9).
New York, American Institute of Aeronautics and Astronautics, 1964, p. 22-33. 38 refs.

Discussion of some problems associated with controlling the trajectory of a space vehicle entering the atmospheres of the Earth or Mars. Specifically examined are: the capture maneuvers for Earth-entry velocities of up to 70,000 ft/sec, the capture maneuvers for Mars-entry velocities of 40,000 ft/sec, and the skip-out control to a parking orbit at Mars. Flight-simulator results are obtained for both automatic and piloted guidance systems, using roll-modulation, pitch-modulation, and area-modulation control techniques. An analysis of the heating problem yields typical minimum total heating paths. Results for the capture problem are presented in the form of usable entry-corridor depths, as a function of the entry velocity, vehicle acceleration limit, vehicle L/D ratio, and the control technique employed. The analysis indicates that, for re-entry speeds of 70,000 ft/sec, there is approximately a one-second interval within which a roll maneuver must be initiated in order to ensure capture without exceeding a 10-g acceleration limit. For a vehicle with a maximum roll rate capability of more than 15°/sec, the capture maneuver can be accomplished by means of an automatic control system. For piloted back-up systems, due to the critical timing involved, successful capture is limited to entry velocities of less than 65,000 ft/sec. For Mars entries, the capture maneuver is shown to be less critical, nor do the uncertainties of the Martian atmosphere degrade the ability of a guidance system to perform skip-out control to a parking orbit. V. P.

A64-26665

EXPERIMENTAL MEASUREMENTS OF NONEQUILIBRIUM AND EQUILIBRIUM RADIATION FROM PLANETARY ATMOSPHERES.

George M. Thomas and Wesley A. Menard (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).

IN: AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, ENTRY TECHNOLOGY CONFERENCE, WILLIAMSBURG AND HAMPTON, VA., OCTOBER 12-14, 1964, TECHNICAL PAPERS (AIAA PUBLICATION CP-9).
New York, American Institute of Aeronautics and Astronautics, 1964, p. 170-185. 27 refs.

Investigation of the effect of composition upon the radiation from the shock-heated mixtures: 9% CO_2/90% N_2/1% A, 30% CO_2/70% N_2, and 100% CO_2. An electric arc-driven shock tube was used. The mixtures simulate the atmospheres of Mars and Venus. Measurements of the shock-layer radiance at the stagnation point of a flat-faced cylinder in the 0.3- to 2.7-μ region, using a carbon-coated thin-film gage for flight velocities from 20,000 to 46,000

ft/sec and initial pressures from 0.25 to 2.0 mm Hg are described. Shock stand-off distances are measured by photographic techniques, the intensity behind the incident shock in the 0.3- to 1.0-μ region is measured by photometric techniques, and the nonequilibrium intensity in the far UV region is measured with a tungsten photoelectric gage. Shock-front-integrated nonequilibrium and equilibrium intensities, nonequilibrium relaxation distances, and time-to-peak intensity are determined. The stagnation-point radiance results are found to be higher than some current estimates, indirectly giving support to the CN radical heat of formation values obtained by Knight and Rink. The integrated nonequilibrium intensity for 9% CO_2 mixtures obtained is 55 w/cm^2-2 π ster at 25,000 ft/sec. The major radiating species are found to be the CN radical for CO_2-N_2 mixtures and the CO^+ ion for 100% CO_2. Oscillator strengths for the CN red and violet systems are deduced from the measurements. V. P.

A64-26807

LIGHT SCATTERING IN A SPHERICAL ATMOSPHERE. III [RASSEIANIE SVETA V SFERICHESKOI ATMOSFERE. III].

I. N. Minin and V. V. Sobolev.

Kosmicheskie Issledovaniia, vol. 2, July-Aug. 1964, p. 610-618. 8 refs. In Russian.

Extension of previous papers on the light scattering in a planet's atmosphere, taking into account the curvature of the atmospheric strata and assuming that the coefficient of absorption diminishes exponentially with height. Expressions for optical distances in the atmosphere are derived. An approximate solution is found for the problem of the light scattering in an atmosphere bounded by a reflecting surface. The brightness of the planet near a terminator and the brightness of the zenith for different zenith distances of the Sun observed from the Earth are deduced from the solution. V. Z.

A64-26890

THE FORMATION OF ABSORPTION BANDS AND THE DISTRIBUTION OF PHOTON OPTICAL PATHS IN A SCATTERING ATMOSPHERE.

William M. Irvine (Harvard University, Harvard College Observatory; Smithsonian Institution, Smithsonian Astrophysical Observatory, Cambridge, Mass.).

Astronomical Institutes of the Netherlands, Bulletin, vol. 17, no. 4, 1964, p. 266-279. 12 refs.

Review of the calculation of $I = \Sigma I_n$ for a general scattering law, where I_n is the n-times scattered component of the specific intensity in a homogeneous, plane-parallel, conservative atmosphere. Designating $p_n(\lambda)$ as the probability that a photon contributing to I_n has traveled an optical path λ, the intensity within an absorption band formed in a scattering atmosphere is expressed in terms of I_n, p_n and the transmittance relative to the continuum ψ. The mean geometric path traveled by observed radiation is also expressible in terms of p_n and I_n. A method for calculating p_n for finite atmospheres is given, and p_1 and (under certain conditions) p_2 are obtained. A general expression for p_n in terms of an inverse Laplace transform is found which reduces to a very simple result for arbitrary n for reflection from a semi-infinite atmosphere. The first moments $\langle\lambda_n\rangle$ of the p_n may be obtained from I_n and $\partial I_n/\partial\tau$ without an explicit knowledge of p_n. These quantities provide an estimate of the absorption suffered by n-times scattered radiation. (Author) W. M. R.

A64-26944

ENTRY INTO PLANETARY ATMOSPHERES.

Leonard Roberts (NASA, Langley Research Center, Mathematical Physics Branch, Hampton, Va.).

Astronautics and Aeronautics, vol. 2, Oct. 1964, p. 22-29. 7 refs.

Discussion of research and development problems arising in the design of unmanned and manned planetary entry vehicles, with emphasis on unmanned Mars vehicles. An illustration shows an Apollo of elliptical cross section matched to a conical forebody that provides lift and reduces radiative heating and a lifting body having aerodynamic control surfaces. It is stated that either of these configurations, and any other that could be suggested now, would require substantial research and development for use at entry speeds of 45,000 fps or more, although they are probably within the state of the art for entry up to 30,000 fps. It is noted that manned planetary missions will require entry vehicles entirely different from the existing pattern set by Mercury, Gemini, and Apollo, whose origins lie in the ballistic-missile technology. The future manned entry vehicles are more likely to evolve from the swept-back lifting-body concepts that have reflected from the very beginning the particular needs and the particular advantages of man in the system. M. M.

A64-27072

STUDIES OF THE MOON AND PLANETS IN KAZAKHSTAN [ISSLEDOVANIIA LUNY I PLANET V KAZAKHSTANE].

V. G. Teifel'.

Akademiia Nauk Kazakhskoi SSR, Vestnik, vol. 20, Aug. 1964, p. 9-17. In Russian.

Review of the physical studies of the planets and satellites of the solar system conducted since 1956 at the Astrophysical Institute and the Department of Astrobotany of the Academy of Sciences of the Kazakh SSR. The studies include spectrophotometric and spectrocolorimetric investigations of the lunar surface, photometric and spectral observations of Mars and Venus, spectral measurements of molecular light absorption in the atmospheres of Jupiter, Saturn, and Uranus, and the optical properties of the Red Spot, an elliptical configuration in the cloud layer of Jupiter. Future studies are outlined. V. Z.

A64-27455

NEW OBSERVATIONS OF THE INFRARED SPECTRUM OF VENUS (λ1.2-3.8 μ) [NOVYE NABLIUDENIIA INFRAKRASNOGO SPEKTRA VENERY (λ1.2-3.8 μ)].

V. I. Moroz (Gosudarstvennyi Astronomicheskii Institut, Moscow, USSR).

Astronomicheskii Zhurnal, vol. 41, July-Aug. 1964, p. 711-719. 24 refs. In Russian.

Discussion of some of the results of observations of the infrared spectrum of Venus conducted in the wavelength regions of λ1.2-2.5 and 2.8-3.8 μ, using two spectrometers with cooled lead-sulphide photocells attached to a 125-cm reflector. Both wavelengths and equivalent widths of the planetary absorption bands are measured. It is found that some weak absorption bands could not be identified. The intensities of "hot" CO_2 bands show that the temperature in the region of their formation is less than the laboratory temperature. Estimates are made of the CO_2 abundance, total pressure above the cloud layer, the coefficient of volume scattering in the cloud layer, and concentration of scattering particles. The presence of a band at about 2.35 μ, apparently due to CO, is confirmed. The albedo of Venus at 3.3 μ comprises about 1%. Absorption observed in the region $\lambda > 3\ \mu$ is probably responsible for a strong greenhouse effect which heats the planetary surface. J. R.

A64-28015

A WATER CLOUD INTERPRETATION OF VENUS' MICROWAVE CONTINUUM.

D. Deirmendjian (RAND Corp., Santa Monica, Calif.).

Icarus, vol. 3, July 1964, p. 109-120. 36 refs.

Contract No. AF 49(638)-700.

Report of analysis of recent microwave brightness determinations of Venus in the light of new theoretical results concerning the scattering and absorption properties of typical terrestrial clouds and precipitation. Based on the argument that the analysis of existing data does not conclusively demonstrate the absence of large amounts of water in the lower Venusian atmosphere, it is shown that a 600°K surface temperature and a planet-wide continuous and thick water-cloud veil are consistent with the observed microwave brightness distribution in the millimeter and centimeter range. The total water content of this veil is estimated at 10 gm cm^{-2}. The surface pressure of the sustaining atmosphere may be as low as 3 atm. (Author) F. R. L.

A64-28022
SOLAR SYSTEM SCIENCE - 1963 LITERATURE SURVEY. I.
Edna O'Connell (RAND Corp., Santa Monica, Calif.).
Icarus, vol. 3, July 1964, p. 172-186.

Presentation of a list of 336 references in the categories of atmospheric physics, cosmogony, interplanetary physics, planetary biology, planetary geodesy, planetary geology, planetary physics, solar physics, solar-system dynamics, and solar-terrestrial relations. F. R. L.

A64-28067
RE-ENTRY.
William A. Page (NASA, Ames Research Center, Hypersonic Freeflight Branch, Moffett Field, Calif.).
Space/Acronautics, vol. 42, Sept. 1964, p. 13-16.

Discussion of problems of re-entry at and above Earth-escape speed. It is stated that the optimum vehicle should be properly shaped to minimize the re-entry heating environment, should have reasonable lifting capabilities for trajectory control, and should fly a trajectory compatible with laminar boundary-layer flow. The convective transfer of energy to vehicle surfaces basically depends on the temperature gradient in the boundary layer and the total thermal conductivity of the gas at the wall. Real-gas effects complicate this process. The ablation process is stated to be the most efficient heat-protection method for re-entry velocities. Radiative emission from the hot air in the vehicle shock layer becomes the dominant surface heating mechanism as re-entry speeds exceed Earth-escape velocity. The important radiators are band systems of the N_2 molecule and ion as well as the NO molecule formed in the shock layer. Cone-shaped bodies are proposed for hyperbolic velocities. Entry problems into the Venusian and Martian atmospheres are also discussed. T. V. Y.

A64-28375
MICROWAVE ABSORPTION IN THE MARTIAN ATMOSPHERE.
S. N. Ghosh and V. Malaviya (Allahabad, University, J.K. Institute of Applied Physics, Allahabad, India).
Zeitschrift für Astrophysik, vol. 60, no. 2, 1964, p. 87-93. 8 refs.

Calculation of the microwave absorption γ for the Martian atmosphere. The peak absorption at the resonance frequency and the linewidths of the absorption lines are calculated using the temperature variation and the distribution of constituent gases of the Martian atmosphere as given by Urey, and Ghosh and Sharma. It is shown that γ_0 has a very large value in the Martian atmosphere. For example, at 90 km its value is 2.5 times the corresponding value in the terrestrial atmosphere. This large value of γ_0 is attributed to the low temperature (130°K) at 90 km. Furthermore, because of the low gravity of Mars, the rate at which the density decreases with altitude is much less, and hence the values of ν for different gases are larger than those in the Earth's atmosphere. The total absorption for the frequency range 55 to 65 Gc is plotted, and it is shown that the effective frequency range for absorption is smaller than that for the terrestrial atmosphere. J. R.

A64-28380
A STUDY OF MARTIAN YELLOW CLOUDS THAT DISPLAY MOVEMENT.
F. A. Gifford, Jr. (U.S. Weather Bureau, Research Station, Oak Ridge, Tenn.).
Monthly Weather Review, vol. 92, Oct. 1964, p. 435-440. 24 refs.
NASA-supported research.

Report of an attempt to cull from the published literature all reported instances of Martian yellow-cloud motions, together with an analysis of their probable nature and properties. They seem to be initiated by wind-driven sand and tend to form in low latitudes. The limb and terminator projections seem to be quite different in nature, probably in part aqueous condensations which occur primarily in middle latitudes. F. R. L

A64-28431
INTERNATIONAL ASTRONAUTICAL CONGRESS, 13TH, VARNA, BULGARIA, SEPTEMBER 1962, PROCEEDINGS. VOLUME I.
Edited by Nicolas Boneff (Académie Bulgare des Sciences, Section d'Astronomie; Sofia, Université, Sofia, Bulgaria) and Irwin Hersey.
Vienna, Springer-Verlag, 1964. 482 p.
Members, $20.00; nonmembers, $25.00.

CONTENTS:

EXPERIMENT. Kurt H. Debus (NASA, Kennedy Space Center, Fla.), William G. Johnson, Ray V. Hembree, and Charles A. Lundquist (NASA, Marshall Space Flight Center, Ala.), p. 182-196. 13 refs. [See A64-28448 24-12]

SOME PROBLEMS OF THE UPPER ATMOSPHERE. D. R. Bates (Queen's University, Belfast, Northern Ireland), p. 197-204. 25 refs. [See A64-28449 24-12]

THE PERSPECTIVE OF CLOUDS AS SEEN FROM SPACE VEHICLES. Feliks Burdecki (Weather Bureau, Pretoria, Republic of South Africa), p. 205-227. 5 refs. [See A64-28450 24-21]

INTENSITY OF THE X-RAY RADIATION OF THE SUN NEAR THE SHORT-WAVE LIMIT OF THE SPECTRUM. S. Mandel'shtam, I. Tindo, Iu. Voron'ko, B. Vasil'ev, A. Shurygin, and E. Fetisov (Academy of Sciences, Moscow, USSR), p. 228-232. 6 refs. [See A64-28451 24-28]

THE BOUNDARY REGION OF THE GEOMAGNETIC FIELD. Paul J. Coleman, Jr. (NASA, Headquarters, Washington, D.C.), p. 233-254. 28 refs. [See A64-28452 24-12]

CLOUD FORMATION OVER THE SAHARA FROM TIROS DATA [LES FORMATIONS NUAGEUSES AU-DESSUS SU SAHARA D'APRES LES RENSEIGNEMENTS DU TIROS]. A. Villevieille and R. Jalu (Météorologie Nationale Française, Paris, France), p. 255-264. [See A64-28453 24-21]

ON ONE POSSIBLE MECHANISM OF THE TRAPPING OF CHARGED PARTICLES IN A GEOMAGNETIC FIELD. V. M. Vakhnin and G. A. Skuridin (Academy of Sciences, Moscow, USSR), p. 265-270. [See A64-28454 24-12]

III - BIOASTRONAUTICS.

THE PROBLEM OF IONIZING RADIATIONS IN SPACE FLIGHT Antonio Pasinetti and Laura E. Pasinetti (Milano, Università; Consiglio Nazionale delle Ricerche, Milan, Italy), p. 271-291. 40 refs. [See A64-28455 24-16]

STERILIZATION OF LUNAR AND PLANETARY SPACE VEHICLES - A REVIEW. Carl-Johan Clemedson (Göteborg, University, Göteborg, Sweden), p. 292-313. 87 refs. [See A64-28456 24-16]

STUDIES CONCERNING ADAPTATION OF THE CARDIO-VASCULAR SYSTEM OF PILOTS, AT VARIOUS GROUND AND LOW-PRESSURE CONDITIONS, WITH AND WITHOUT PRESSURE SUIT [ETUDE CONCERNANT L'ADAPTATION DE L'APPAREIL CARDIOVASCULAIRE CHEZ LES AVIATEURS EN DIFFERENTES CONDITIONS DE SOL ET D'HYPOBARISME, AVEC ET SANS COSTUME DE COMPENSATION]. G. Arsenescu, S. Schiau, and A. Ionascu (Académie de la République Populaire Roumaine, Bucharest, Rumania), p. 314-342. 23 refs. [See A64-28457 24-16]

SOME PROBLEMS OF EXPERIMENTAL SPACE PHYSIOLOGY - ON THE PROBLEM OF TRANSVERSE ACCELERATIONS. P. V. Vasil'ev, A. D. Voskresenskii, and O. G. Gazenko (Academy of Sciences, Moscow, USSR), p. 343-352. 14 refs. [See A64-28458 24-16]

SOME MEDICAL AND BIOLOGICAL PROBLEMS OF MANNED SPACE FLIGHT. V. I. Iazdovskii and S. A. Gozulov (Academy of Medical Sciences, Moscow, USSR), p. 353-361. 17 refs. [See A64-28459 24-16]

IV - CELESTIAL MECHANICS.

GENERAL REVIEW OF WORK IN CELESTIAL MECHANICS AT MOSCOW UNIVERSITY. G. N. Duboshin (Moscow State University, Moscow, USSR), p. 362-378. 13 refs. [See A64-28460 24-05]

THEORETICAL CONSIDERATIONS ON THE TRANSLATIONAL-ROTATIONAL MOTION OF TWO ATTRACTING SPHEROIDAL BODIES. Paolo Lanzano (North American Aviation, Inc., Downey, Calif.), p. 379-410. 9 refs. [See A64-28461 24-05]

DETERMINATION OF THE GEOCENTRIC COORDINATES OF SATELLITES AND OBSERVATION STATIONS [LA DETERMINATION DES COORDONNEES GEOCENTRIQUES DES SATELLITES ET DES STATIONS D'OBSERVATION]. Călin Popovici (Bucarest, Observatoire, Bucharest, Rumania), p. 411-419. 5 refs. [See A64-28462 24-29]

APPLICATION OF OBSERVATIONS OF ARTIFICIAL GEODETIC EARTH SATELLITES TO THE DEDUCTION OF THE GEOGRAPHIC COORDINATES OF THE REFERENCE ELLIPSOID [BENUTZUNG DER BEOBACHTUNGEN DER KÜNSTLICHEN GEODÄTISCHEN ERDSATELLITEN ZUR ABLEITUNG ELLIPSOIDISCHER GEOGRAPHISCHER KOORDINATEN AUF DEM REFERENZELLIPSOID]. Vladimir K. Khristov (Bulgarische Akademie der Wissenschaften, Sofia, Bulgaria), p. 420-431. [See A64-28463 24-29]

THE SUN'S PERTURBING EFFECT ON MOTION NEAR A TRIANGULAR LAGRANGE POINT. J. P. de Vries (General Electric Co., Philadelphia, Pa.), p. 432-450. [See A64-28464 24-29]

PRECESSION RATES FOR AN ARTIFICIAL SATELLITE. Jack Lorell and John Anderson (California Institute of Technology, Pasadena, Calif.), p. 451-461. 7 refs. [See A64-28465 24-29]

THERMODYNAMICAL CONSIDERATIONS CONCERNING ASTRONAUTICS [QUELQUES CONSIDERATIONS THERMODYNAMIQUES CONCERNANT L'ASTRONAUTIQUE]. Kiril Popov (Académie Bulgare des Sciences, Sofia, Bulgaria), p. 462-471. 5 refs. [See A64-28466 24-13]

NEW FORMS OF THE DIFFERENTIAL EQUATIONS OF MOTION OF HOLONOMIC AND NONHOLONOMIC MATERIAL SYSTEMS [NOUVELLES FORMES DES EQUATIONS DIFFERENTIELLES DU MOUVEMENT DES SYSTEMES MATERIELS HOLONOMES ET NON HOLONOMES]. I. Tsenov (Académie Bulgare des Sciences, Sofia, Bulgaria), p. 472-476. 9 refs. [See A64-28467 24-29]

DETERMINATION OF TIME FROM OBSERVATIONS PERFORMED UPON THE MOON [DETERMINATION DU TEMPS PAR OBSERVATIONS EFFECTUEES SUR LA LUNE]. N. Boneff (Académie Bulgare des Sciences; Sofia, Université, Sofia, Bulgaria), p. 477-482. [See A64-28468 24-29]

A64-28441

ON THE PRESENCE OF OXYGEN IN THE ATMOSPHERE OF VENUS.

V. K. Prokofiev and M. N. Petrova (Crimean Astrophysical Observatory, Poselok Nauchny, Ukrainian SSR).

IN: INTERNATIONAL ASTRONAUTICAL CONGRESS, 13TH, VARNA, BULGARIA, SEPTEMBER 1962, PROCEEDINGS. VOLUME I.

Edited by Nicolas Boneff and Irwin Hersey.

Vienna, Springer-Verlag, 1964, p. 78-81. 6 refs.

Investigation of spectra of reflected solar light from Venus, with a dispersion of 1 Å per mm, obtained in the region of the α-band of telluric oxygen. Weak absorption lines, revealed by thorough photometric analysis, are attributed to the presence of oxygen in the upper layer of the Venus atmosphere. V. P.

A64-28442

INFRARED SPECTRA AND THE PROBLEM OF PHYSICAL CONDITIONS ON THE SURFACE OF VENUS.

V. I. Moroz (Moscow State University, Astronomical Institute, Moscow, USSR).

IN: INTERNATIONAL ASTRONAUTICAL CONGRESS, 13TH, VARNA, BULGARIA, SEPTEMBER 1962, PROCEEDINGS. VOLUME I.

Edited by Nicolas Boneff and Irwin Hersey.

Vienna, Springer-Verlag, 1964, p. 82-87. 15 refs.

Discussion of data obtained primarily by infrared spectroscopy techniques, the use of which enables a better insight into the physical conditions at the Venus surface. The data include: (1) estimates of the pressure and rotational temperature; (2) infrared spectroscopy of Venus in the 8- to 12-μ, 1- to 2.5-μ, and 1- to 3.5-μ regions; and (3) the phase variation of radio emission. An analysis of these data indicates that: (a) the cloud layer enveloping Venus consists of dust particles; (b) in the far infrared (possibly at 3 μ), radiation is intensely absorbed by some unknown substance, which conceals the CO_2 bands above the cloud cover and produces a strong greenhouse effect below the cover; and (c) this greenhouse effect creates a high temperature on the planet's surface, and leads to a large depth of the lower atmosphere, and relatively high pressures at the surface. V. P.

A64-28490

THE EFFECT OF VARIABLE CORIOLIS PARAMETER IN A PLANETARY CIRCULATION GENERATED BY A TWO-PARAMETER QUASIGEOSTROPHIC MODEL.

Abraham Huss (Hebrew University, Jerusalem, Israel).
Journal of the Atmospheric Sciences, vol. 21, Sept. 1964, p. 507-512. 9 refs.
Contract No. AF 19(604)-4963; NSF Grant No. G-14698.

Experimental investigation of the role of the "β-term," which represents the effect of the spherical shape of the Earth, in the generation of general circulation patterns in a planetary atmosphere. The governing equations of a two-level quasi-geostrophic model were integrated twice for periods of about 10 days, once including variation of the Coriolis parameter (the β term) and once excluding it. It is stated that, as expected, the exclusion of the β-term resulted in a quicker rate of development. The evolving perturbation had almost the same pattern in the two cases, but the final distribution of the mean zonal winds was different. In the $\beta = 0$ case, the zonal velocities in the central region tended towards a barotropic pattern, while a baroclinic jet was formed in the case where $\beta = 0$. The numerical integration is compared with linear theory.
(Author) M. M.

A64-28497 •
THE STRATOSPHERIC ROTATION OF JUPITER IN NOVEMBER 1963.
Minoru Nishida (Kyoto University, Dept. of Nuclear Science, Kyoto, Japan) and Jun Jugaku (Tokyo, University, Tokyo Astronomical Observatory, Tokyo, Japan).
Journal of the Atmospheric Sciences, vol. 21, Sept. 1964, p. 568, 569. 8 refs.

Confirmation of the occurrence in November 1963 of the anomaly predicted by Owen and Staley in the inclination of the Jovian lines relative to the rotation of the planet. It is stated that, if the measurement is correct and substantiated by other observations, the inclination anomaly must have occurred between Aug. and Nov. Caution is necessary in interpreting this anomaly as being due to the Doppler shifts only and as shear velocities between upper and lower atmospheres of Jupiter. It is noted that the lines in the spectrum obtained do not show the curvature within the accuracy of measurement and that, hence, Öpik's original interpretation of the 1961 anomaly is not valid for the present observation. A conclusion is reached on the straightness of planetary lines which is stated to be in agreement with Giver (1964). M. M.

A64-28596
THE POSSIBILITY OF OBSERVING THE POLARIZATION OF THERMAL RADIO EMISSION OF PLANETS.
N. S. Soboleva and Iu. N. Pariiskii (Akademiia Nauk SSSR, Glavnaia Astronomicheskaia Observatoriia, Pulkovo, USSR).
(Astronomicheskii Zhurnal, vol. 41, Mar.-Apr. 1964, p. 362-365.)
Soviet Astronomy, vol. 8, Sept.-Oct. 1964, p. 282-284. 10 refs.
Translation.

1965
IAA ENTRIES

A65-10072
THE BIG PLANETS.
P. J. E. Peebles (Princeton University, Princeton, N. J.).
International Science and Technology, Nov. 1964, p. 32-38.

General description of Jupiter and Saturn. The two largest and most massive planets are the lowest in density and, like the Sun, consist mostly of hydrogen. They are not energy sources like the Sun, however, because their masses are too low to create temperatures high enough, even at their centers, to initiate the energy-generating nuclear transformation of hydrogen into helium. Their high masses and gravitation can, however, create pressures well above 10^6 atm at moderate depths, and this pressure can convert ordinary hydrogen into its theoretically possible metallic form. Such a phase change, by providing a large core of material with high electrical conductivity, would help account for Jupiter's intense magnetic field and Van Allen belt, both inferred to explain recently discovered features of Jupiter's complex spectrum of radio noise. Saturn's radio spectrum is less clearly indicative of a radiation belt, and it is considered possible that its rings of ice-covered dust, ammonia, and methane prevent one from forming. Ammonia, methane, water, helium, and neon are present in both planets' atmospheres, where the temperature at the base may be 2000°K. The top of the ammonia cloud layer forming the visible surface on both planets is believed to be 150°K. (Author) F. R. L.

A65-10241 #
OPTICAL PROPERTIES OF THE ATMOSPHERE OF MARS IN THE UV REGION OF THE SPECTRUM [OB OPTICHESKIKH SVOISTVAKH ATMOSFERY MARSA V UL'TRAFIOLETOVOM UCHASTKE SPEKTRA].
V. I. Garazha and E. G. Ianovitskii (Khar'kovskaia Astronomicheskaia Observatoriia, Kharkov; Akademiia Nauk Ukrainskoi SSR, Glavnaia Astronomicheskaia Observatoriia, Kiev, Ukrainian, SSR).
Astronomicheskii Zhurnal, vol. 41, Sept.-Oct. 1964, p. 942-950. 21 refs. In Russian.

Proof that the optical thickness of the atmosphere of Mars in the $\tilde{\lambda} = 360$ mμ region of the spectrum was appreciably greater than unity during the great 1956 opposition. Suggestion is made that the "UV layer" of the atmosphere of Mars consists of a gas-aerosol mixture. The particle albedo of the mixture is 0.50 in the event of single scattering. The indicatrix of light scattering for the spectrum region and the mean aerosol particle radius are determined using the Rocard theory to interpret atmospheric indicatrices. The concentration of aerosol particles in the UV layer is found to be very high. V. Z.

A65-10333 #
STUDIES OF PLANETARY ATMOSPHERES. I - THE DISTRIBUTION OF ELECTRONS AND IONS IN THE EARTH'S EXOSPHERE.
J. J. Angerami and J. O. Thomas (Stanford University, Radioscience Laboratory, Stanford, Calif.).
Journal of Geophysical Research, vol. 69, Nov. 1, 1964, p. 4537-4560. 37 refs.
Grants No. NsG 30-60; No. AF AFOSR 62-370.

Analysis of factors governing the distribution of electrons and ions in a planet's exosphere under diffusive equilibrium. The theory takes into account the effect of the electric field that arises from charge separation, the centrifugal force arising from the rotation of the planet, and the effect of the planet's gravitational field. It is assumed that the charged particles are constrained to move only along the direction of the planet's magnetic lines of force. The modifications that result in the electron and ion distributions when a temperature variation is assumed along a line of force are also considered. The results predicted by the theory are compared with actual experimental observations of the electron-density distribution in the Earth's exospheric plasma which have been obtained in recent years from whistler data and from topside ionograms made by the Alouette satellite. (Author) W. M. R.

A65-11015 #
THE UTILIZATION OF THE PLANETARY ATMOSPHERES AS CHEMICAL ENERGY SOURCES.
R. A. Rhein (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).
Combustion Institute, Western States Section, Fall Meeting, Salt Lake City, Utah, Oct. 26, 27, 1964, Paper 64-25. 12 p.

Search for appropriate chemicals for burning in the atmospheres of Mars and Venus as a means of propulsion. The guiding criterion was the heat evolution per unit mass of propellant. The ignition temperatures of metal powders (Li, Be, Mg, Ca, B, Al, Ce, mischmetall, Ti, Zr, Th, U, Cr, and Mn) in pure nitrogen and pure carbon dioxide were measured in a reaction tube fitted with a chromel-alumel thermocouple. Ultrafine powdered beryllium proved most promising, while lithium, aluminum, and magnesium showed great potential. However, the high toxicity of Be and the corrosiveness of Li are seen to be deterrents to the development of propulsive devices using these fuels. W. M. R.

A65-11491 #
MARTIAN ENTRY CAPSULE.
F. G. Beuf (General Electric Co., Missile and Space Div., Reentry Systems Dept., Advanced Requirements Section, Philadelphia, Pa.).
Astronautics and Aeronautics, vol. 2, Dec. 1964, p. 30-37. 15 refs

Description of a method for determining the nature of the Martian atmosphere. It is indicated that such determinations are necessary if successful soft landings are to be accomplished on the Martian surface. It is concluded that measurements of Martian atmospheric surface pressure, scale height, altitude-density profile, and gaseous constituents appear to be possible through use of a simple, lightweight, entry-system experiment. It is indicated that a spherical entry vehicle would permit derivations of the atmospheric density-time relationship even though angle of attack is unknown. A relay communications link (experiment, flyby bus, Earth) is said to look attractive from the standpoints of power, data rate, state-of-the-art hardware, and operational flexibility. There is considered to be a high degree of probability that the described experiment can be built from components and materials whose present state of development is compatible with the thermal sterilization requirement. D.H.

A65-11605 #
EXPERIMENTAL CONVECTIVE HEAT-TRANSFER MEASUREMENTS.
D. J. Collins and T. E. Horton (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).
AIAA Journal, vol. 2, Nov. 1964, p. 2046, 2047. 9 refs.

Experimental investigation of stagnation-point heat transfer to determine the range of uncertainties in convective heat transfer due to limited knowledge of the atmosphere of the near planets. Three atmospheric models were investigated: 9% CO_2, 90% N_2, 1% A; 100% CO_2; and 65% CO_2, 35% A. The first model is thought to be the most likely composition of the Venus atmosphere, and the other two are possible Martian atmospheres. All measurements were made in the JPL hypervelocity shock tube. Experimental results are presented graphically. It was found that the carbon-dioxide and nitrogen atmospheres have convective heat-transfer rates similar to that for air. The presence of argon in the atmosphere increases the convective heat transfer by about a factor of 2 for the model atmosphere investigated. F.R.L.

A65-11857
THE THERMAL OPACITY IN THE MAJOR PLANETS.
Laurence M. Trafton (Carnegie Institution of Washington and California Institute of Technology, Mount Wilson and Palomar Observatories, Pasadena, Calif.).
Astrophysical Journal, vol. 140, Oct. 1, 1964, p. 1340, 1341. 10 refs.

Calculation of monochromatic absorption coefficients of H_2 as a function of temperature, following the principles outlined by Poll and Kranendonk (1961) and the measurements of Kiss and Welsh (1959), as a basis for the future construction of model atmospheres for the major planets, in an investigation of possible sources of their opacity. As a preliminary analysis of the problem, a gray model in hydrostatic equilibrium has been constructed for Jupiter, using a Planck mean of the H_2 dipole absorption for an adopted effective temperature of 110°K and taking into consideration only the ρ-dependence of the absorption coefficient. The results are given in a table. It is stated that, on the basis of the preliminary results, it would appear that it is possible to construct a model in hydrostatic equilibrium for the atmosphere of Jupiter with no other source of energy than solar radiation. M.M.

A65-13155
A CHEMICAL MODEL FOR THE LOWER ATMOSPHERE OF VENUS.
Robert F. Mueller (Chicago, University, Dept. of Geophysical Sciences, Chicago, Ill.).
Icarus, vol. 3, Nov. 1964, p. 285-298. 44 refs.

Discussion of the chemistry of the postulated interaction of the atmosphere and lithosphere of Venus, and presentation of a zonal model capable of explaining some of the observed atmospheric characteristics. It is demonstrated that the upper limits in the quantities P_{CO}/P_{CO_2}, P_{H_2O}, and P_{H_2} and the absolute values of T, P_{CO_2}, and P(total) can be used to give a self-consistent picture of the atmosphere if hydrogen is assumed largely lost. The inferred surface values of T ~ 700°K, $P_{CO}/P_{CO_2} \leq 10^{-3}$, and $P_{H_2O} \leq 10^{-3}$ atm lead to the result that $P_{H_2} \leq 10^{-5.05}$ atm and indicate that metallic iron, free carbon, and hydrocarbons are not stable on the surface or in the lower atmosphere. The upper limit in P_{CO}/P_{CO_2} corresponds to the lower limit $P_{O_2} \geq 10^{-27.1}$ atm at 700°K, which is in the center of the magnetic field. The magnesium carbonate magnesite and the calcium-magnesium carbonate dolomite are found to be unstable in the presence of free silica at P_{CO_2} (surface) ~ 10 atm. Calcite may be stable in the presence of free silica, and there is a chance that the atmosphere may be approximately buffered by the wallastonite reaction in the range P_{CO_2} ~ 1-50 atm at the surface. These results are said to agree with the previous conclusions of the writer and generally with those of Adamcik and Draper regarding magnesite and calcite.
(Author) M.M.

A65-13156
EVIDENCE FOR AN ATMOSPHERE ON IO.
Alan B. Binder and Dale P. Cruikshank (Arizona, University, Dept. of Geology, and Lunar and Planetary Laboratory, Tucson, Ariz.).
Icarus, vol. 3, Nov. 1964, p. 299-305. 8 refs.

Photometric observations of eclipse reappearances of Jupiter I and II made in 1962-64 to search for a possible anomalous brightening of the satellite after eclipse. It is stated that a brightening, if present, would suggest a frost or snow deposit or a haze layer by a surface temperature drop during eclipse. In each of four cases of JI eclipse reappearances, a brightness anomaly was observed which had an average value of 0.09 stellar magnitudes. The anomaly decayed in about 15 minutes. A single observation of JII showed no anomaly. (Author) M.M.

A65-13158
THE UPPER ATMOSPHERE OF JUPITER.
S. H. Gross (Cutler-Hammer, Inc., Airborne Instruments Laboratory, Deer Park, N.Y.) and S. I. Rasool (NASA, Goddard Space Flight Center, Goddard Institute for Space Studies, New York; New York University, Dept. of Meteorology, New York, N.Y.).
Icarus, vol. 3, Nov. 1964, p. 311-322. 24 refs.

Theoretical investigation of the properties of the upper atmosphere of Jupiter. The vertical temperature profile in the atmosphere above the clouds and the structure of the ionosphere have been computed for two different model atmospheres: Model I corresponds to a H/He mixing ratio of 20:1 by volume (Urey, 1959), and Model II has a H/He ratio as low as 0.03:1 (Öpik, 1962). Assuming that the atmosphere of Jupiter above the clouds is in radiative equilibrium, the temperature distribution in the upper atmosphere of Jupiter has been computed. With a cloudtop temperature of 153°K and a total optical thickness of the atmosphere in the far infrared of 0.66, the radiation emitted by the planet is 3.1×10^4 ergs cm^{-3} sec^{-1}. This value of radiation flux is about four times higher than the solar flux received by Jupiter. The equilibrium distribution of electron densities in the ionosphere of Jupiter has also been calculated. The maximum electron densities of ~ $10^{6.6}$ electrons/cm^3 are found to occur at the altitudes of 220 km and 110 km above the cloudtop for the two model atmospheres. (Author) M.M.

A65-13160
ON THE INFRARED OPACITY OF JUPITER'S OUTER ATMOSPHERE.

Robert L. Wildey (California Institute of Technology, Div. of Geological Sciences; Carnegie Institution of Washington and California Institute of Technology, Mount Wilson and Palomar Observatories, Pasadena, Calif.).
Icarus, vol. 3, Nov. 1964, p. 332-335. 8 refs.
Grant No. NsG 56-60.

Determination of the dependence of the source function on optical depth in Jupiter's atmosphere, using limb-darkening measurements of Jupiter in the 8-14 micron wavelength band. It is stated that, assuming that the enhancement of emission from the shadows of satellites is derived from the propagation downward into the atmosphere of complete transparency at the loss of energy no longer maintained by the Sun, it is possible to derive, from the observed degree of enhancement and the time in which it is reached, the ratio of the 8 to 14 micron absorption coefficient per gram to the specific latent energy of the atmosphere. The assumptions are such that a lower bound to the opacity is produced. Ammonia appears to be ruled out as the responsible agent, and other compounds of known presence seem less likely. (Author) M.M.

A65-13684
THE REACTION PRODUCTS OF SOLAR HYDROGEN AND COMPONENTS OF THE HIGH ATMOSPHERE OF VENUS - A POSSIBLE SOURCE OF THE VENUSIAN CLOUDS.
R. C. Robbins (Stanford Research Institute, Menlo Park, Calif.).
Planetary and Space Science, vol. 12, Dec. 1964, p. 1143-1146. 16 refs.

Theory on the origin and composition of the Venusian clouds. Hydrogen from the solar wind reacts with components of the upper atmosphere, principally CO and N_2. The initial reaction products are protected upon entering the dark hemisphere of Venus, and the long night (~1400 hr) provides ample time for polymerization, condensation, and subsidence to lower levels of the atmosphere. A continuous source from above, coupled with regenerative processes from the hot regions below, fulfills the requirements for maintaining a perpetual cloud layer. (Author) M.M.

A65-13765
SINTON BANDS - EVIDENCE FOR DEUTERATED WATER ON MARS.
James S. Shirk, William A. Haseltine, and George C. Pimentel (California, University, Dept. of Chemistry, Berkeley, Calif.).
Science, vol. 147, Jan. 1, 1965, p. 48, 49. 8 refs.
NASA-NSF-supported research.

Analysis of IR spectra of the atmosphere of Mars in the region from 1 to 4.2 μ. The IR absorption bands observed by Sinton at 2710, 2793, and 2898 cm^{-1} (3.69, 3.58, and 3.45 μ respectively), in the spectrum of Mars, may be due to gaseous D_2O and HDO in the Martian atmosphere. The implication would be that the deuterium/hydrogen ratio exceeds that on Earth, presumably because of escape of the lighter gases from Mars, with accompanying gravitational fractionation of the hydrogen isotopes. (Author) D.H.

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