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Volume 4 of 4

SPACE COMMUNICATIONS THEORY AND APPLICATIONS

A BIBLIOGRAPHY

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Volume 4: Satellite and Deep Space Applications

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Volume 4 of 4

SPACE COMMUNICATIONS: THEORY AND APPLICATIONS

A BIBLIOGRAPHY

Volume 4: Satellite and Deep Space Applications

An extensive collection of annotated references to reports, journal articles, and books published during the period 1958–1963.

Compiled by
Dr. Richard F. Filipowsky and
Louise C. Bickford
of the Federal Systems
Division, IBM.

Scientific and Technical Information Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington, D.C.
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INTRODUCTION

Space Communications: Theory and Applications is a four-volume bibliography compiled by the Federal Systems Division, IBM under contract to the National Aeronautics and Space Administration. It contains an extensive listing of references to reports, articles, and books on several subjects directly pertinent to the field of space communications. The compilers have endeavored to provide maximum coverage of the literature for the period 1958 through 1963. However, references to publications of unusual significance that appeared before 1958, as well as a limited number of 1964 references, have also been included. The bibliography has been prepared primarily for use by communications specialists engaged in technical activities related to the aerospace program. Each of the four volumes is complete in its coverage of specific subjects and is being published separately.

Volumes 1, 2, and 3 are devoted primarily to a theoretical consideration of their subject matter but, when appropriate, references pertaining to applications are also included. Volume 4 contains references to four important and timely applications of space communications. The NASA Special Publication numbers and the particular subjects of each volume are as follows:

NASA SP-7022(01)	Volume 1	Modulation and Channels
NASA SP-7022(02)	Volume 2	Coding and Detection Theory
NASA SP-7022(03)	Volume 3A	Information Processing
	3B	Advanced Techniques
NASA SP-7022(04)	Volume 4A	Communications Satellites
	4B	Instrumented Satellites
	4C	Deep Space Applications
	4D	Manned Space Flight Applications

Each volume contains a Table of Contents for that particular volume and a separate Table of Contents for the complete set of four. For additional reference aid, a subject index is included in each volume. A listing of abbreviations (established by Science Abstracts, Section B, Electrical Engineering Abstracts, London) of widely used journals and periodicals is included in each volume, for the purpose of identifying source documents.

Arrangement of references in the bibliographic listing is based on subjects in accordance with the Table of Contents. Under each specific topic, references are divided into "Principal Publications" and "Related Publications." Within each of these categories, references are listed in chronological order and, when further separation is necessary, by individual author. Each citation to a reference is accompanied by an annotation if the title of the reference is not sufficiently informative. Whenever possible, annotations included in this bibliography have been extracted from the original reference or from its abstract.

For additional information concerning the structure and function of the Table of Contents, and for a detailed description of the arrangement of references, the user is referred to the "User's Guide" which follows this Introduction.

AVAILABILITY OF DOCUMENTS

Articles cited in this bibliography are available for examination in the designated issues of the original journals. Copies of particular issues may be borrowed from libraries maintaining sets of these journals. In some instances, reprints may be obtained by writing to the editorial office of the journal. Copies of many of the reports cited herein can be purchased from the Clearinghouse for Federal Scientific and Technical Information (CFSTI), Springfield, Virginia, 22151. In those cases where CFSTI is unable to provide this service, the requester should direct his inquiry to the originating agency.

Copies of NASA SP-7022(03), the third volume of Space Communications: Theory and Applications, can be obtained from the Scientific and Technical Information Division, National Aeronautics and Space Administration (Code ATSS-A), Washington, D.C., 20546, without charge, by NASA offices and contractors, U.S. Government agencies and their contractors, and organizations that are working in direct support of NASA programs.

Other organizations and individuals can purchase copies of NASA SP-7022(03) from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402.

USER'S GUIDE

The Table of Contents for each volume best illustrates the general structure of the volume and the arrangement of its contents. The main subject is synonymous with the subtitle of the volume and is designated by the number 1, 2, 3 or 4. Each volume or subject (1) is divided into divisions (1.0, 1.1, 1.2, etc.), sections (1.10, 1.11, 1.12, etc.) and finally, into subdivisions (1.110, 1.111, 1.112, etc.).

Arrangement of references and other text under the four categories is as follows:

Subject 1: A general description of the contents of the entire volume which briefly identifies all important subtopics.

Division 1.1: A more detailed statement of content is usually presented with emphasis on the fundamental aspects of the topics to be considered. Specific references to related sections and subdivisions are included.

Section 1.10: An explanatory note is provided, when appropriate, to describe a single topic covered in detail in the following subdivisions.

Subdivision 1.100: This is the most limiting level of categorization and will normally contain a complete compilation of information on a specific topic. It opens with a statement that identifies the types of references Included and the types that are Not Included. Cross-reference instructions follow and refer only to those related sections or subdivisions that appear in the same volume. Finally, all citations and annotations appear in this category, divided into two groups: Principal Publication and Related Publications. The last digit of the subdivision number has special significance in the listing of pertinent references. For example, if the complete category number is 1.111, the final "1" signifies that references pertaining to the fundamental and theoretical aspects of the subject appear under it. If the last digit is "7" or "8", the references which appear under it will pertain to specific applications related to the topic under discussion. Similarly, testing and simulation references are denoted when the last digit is "9". The user may note that all of the final digits in a category are not used in the bibliography. This apparent omission does not mean that divisions, sections, or subdivisions are missing but that pertinent references have not been identified at this time. However, the unused numbers have been assigned and if relevant references appear in the future, they can be incorporated in a supplementary or revised issue of the bibliography.

The index for each volume is constructed on a two-tier basis, i.e., a major subject or technical expression and those supporting expressions that are directly associated with the major subject. A special effort has been made to retain the original terminology of authors in the index. New terms and translations of foreign terms, as used by individual authors, have been mixed with older and more familiar expressions and are included in the index in proper alphabetical order.

Duplicate entries to the same reference will be found occasionally within a subdivision. The user will note that both entries are included because different sources are identified and the repetition may provide more convenient access to the reference. Documents originally announced by the Defense Documentation Center (DDC, formerly ASTIA) are designated AD, followed by six digits. Documents originally announced in the NASA journal Scientific and Technical Aerospace Reports (STAR) are designated N62 (or N63, N64) followed by five digits. Documents originally announced in International Aerospace Abstracts (IAA), a journal published by the American Institute of Aeronautics and Astronautics (AIAA), are designated A62 (or A63, A64) followed by five digits.

Titles of foreign language citations have been translated into English.

ABBREVIATIONS OF PRIMARY SOURCE DOCUMENTS

AIEE - American Institute of Electrical Engineers
Conf. - Conference
Conv. - Convention
Engng. - Engineering
IEE - Institution of Electrical Engineers
IEEE - Institute of Electrical and Electronic Engineers
Inst. - Institute
Instn. - Institution
Internat. - International
IRE - Institute of Radio Engineers
J. - Journal
Nat. - National
Proc. - Proceedings
Rec. - Record
Symp. - Symposium
Trans. - Transactions

Ann. Radioelect. - Annales de Radioelectricite
Arch. Elekt. Ubertragung - Archiv der Elektrischen Ubertragung
Avtomat. i Telemekh. - Avtomatika i Telemekhanika
Bell Syst. Tech. J. - Bell Systems Technical Journal
Elektron. Rundschau - Elektronische Rundschau
IRE Trans. Comp. Parts - IRE Transactions Component Parts
IRE Trans. Commun. Syst. - IRE Transactions Communications Systems
IRE Trans. Electronic Comp. - IRE Transactions Electronic Components
IRE Trans. Inform. Th. - IRE Transactions Information Theory
IRE Trans. Microwave Th. Tech. - IRE Transactions Microwave Theory and Techniques
IBM J. Res. Developm. - IBM Journal of Research and Development
J. Appl. Phys. - Journal of Applied Physics
JPL Res. Summ. - JPL Research Summary
JPL Space Progr. Summ. - JPL Space Program Summary
Nachrichtentech. Z. - Nachrichtentechnische Zeitschrift
Proc. Electronic Comp. Conf. - Proceedings Electronic Computer Conference
Radio Engng. - Radio Engineering
RCA Rev. - RCA Review
Rec. Nat. Commun. Symp. - Record National Communications Symposium
Rev. Sci. Instrum. - Review of Scientific Instruments
Telecomm. Radio Engng. - Telecommunications and Radio Engineering

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SATELLITES AND DEEP SPACE APPLICATIONS

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VOLUME 4

SATELLITE AND DEEP SPACE APPLICATIONS

The fourth volume of this bibliographical series is divided into four parts, each dealing with one particular class of spacecraft and its communications equipment.

Part A contains references about communications satellites; Part B is about instrumented satellites, i.e., unmanned scientific satellites; Part C deals with the equipment for deep space flight, primarily the unmanned missions; and Part D concentrates on the communications problems for manned space flight.

In all four parts the references relate to publications of a predominantly systems character. Hardware oriented publications have been, to a large degree, excluded from the bibliographies to keep their volume within the specified limits. References to sub-systems and to modulation and coding methods may be found in the previous volumes of this series.

Division 8, in all four parts of this volume, is reserved for references to actual project reports on actually flown or actively developed space missions. These references are organized according to the code names of the various projects. As the total number of such mission reports is, as yet, comparatively small, we preferred to include references on space electronics systems, thus waiving the restriction to space communications oriented publications. This appeared desirable, as many of the space electronics reports contain much material on space communications, even if this fact is not suggested by their titles.

VOLUME 4 - PART A

COMMUNICATIONS SATELLITES

The organization of the part on communications satellites is built around several divisions representing the principal classes of such satellite systems.

Division 4A.1 contains common systems fundamentals which apply to all classes of satellite systems.

Division 4A.2 is concerned with the low altitude systems and Division 4A.3 deals with medium and high altitude systems (synchronous orbits).

Other divisions discuss the common modulation and multiplexing problems.

Ground stations and economic problems have their own divisions and the last division presents collections of references in the order of special projects which were executed to test various approaches to communications satellite systems.

DIVISION 4A.0
INTRODUCTION

4A.000: Communications Satellites in General

Included: Telecommunications by artificial satellites; Worldwide communications links via artificial satellites; Books and surveys; Communications Satellite Corporation; Commercial communications satellite systems; International problems in connection with Comsat activities.

Not Included: Organization of NASA; Legal aspects of the Communications Satellite Corporation.

Cross References: Economic problems of communications satellites (4A.600); Description of specific communications satellite projects (Div. 4A.8).

Principal Publications:

ORBITAL RADIO RELAYS
J. R. Pierce, Jet Propulsion, vol. 25, April 1955, p. 153/157.

TRANSOCEANIC COMMUNICATION BY MEANS OF SATELLITES
J. R. Pierce, et al., Rec. Nat. Symp. Ext. Range & Space Comm., Oct. 1958, p. 55/66.

One of the best original articles. Appears to contain one or two charts which are copied . . .

THE ROLE OF AN EARTH SATELLITE IN WORLDWIDE MILITARY COMMUNICATIONS
B. R. Jacobellis, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 391/396.

. . . Success of the first space relay station . . . Known as Project SCORE, it was the first tangible product to stem from a concentrated effort of communications planning. . . . two types of communication satellites. Both of these act as repeaters. . . . The first type satellite is a delay repeater and is also known as the Courier Satellite. The second type is known as the Real Time Repeater. . . .

TRANSOCEANIC COMMUNICATION BY MEANS OF SATELLITES
J. R. Pierce, et al., Proc. IRE, vol. 47, March 1959, p. 372/380.

COMMUNICATION SATELLITES
D. L. Jacoby, Proc. IRE, vol. 48, April 1960, p. 602/607.

AN EVENTUAL COMMUNICATION SYSTEM
S. G. Lutz, IRE Trans. Nat. Symp. Space, no. 2-4, Sept. 1960, p. 1/12.

. . . this paper attempts to predict features of an "eventual" global satellite communication system under the assumption that (a) no technological limitations remain on satellite weight, orbital accuracy, attitude control, electrical power, etc., (b) nuclear or other improved power sources remove present power limitations (c) satellite communications shares frequencies with surface services, without interference, over most of the useful spectrum . . .

RADIO COMMUNICATION USING EARTH-SATELLITE REPEATERS
L. Pollack, Elect. Commun., vol. 36, no. 3, 1960, p. 180/188.

COMMUNICATION USING EARTH SATELLITES
J. B. Wiesner, IRE Trans. Mil. Electronics vol. MIL-4, no. 1, Jan. 1960, p. 51/58.

SOME INTERNATIONAL ASPECTS OF SATELLITE COMMUNICATION SYSTEM PLANNING
C. F. Booth, J. Brit. Instn. Elect. Engrs., no. 22, Sept. 1961, p. 227/230.

. . . The prime need for satellite communication systems is the allocation of frequency bands . . . but some sharing with low-power radio-relay systems may be necessary. Other aspects requiring international agreement include the minimization of interference with other services and the modulation and base-band characteristics.

RADIO STATIONS OVER OUR PLANET
V. Chestnov, Aerospace Technical Intelligence Center, Wright-Patterson Air Force Base, Ohio, 7 March 1961, 5 p., Trans. no. MCL-825 of Krasnaya Zvezda 220: p. 4, Sept. 1960, AD 258 490.

. . . communications systems with satellites . . .

APPLYING SPACE SCIENCE TO COMMUNICATIONS, WEATHER, AND NAVIGATION 4. THE ROLE OF THE FEDERAL COMMUNICATIONS COMMISSION IN COMMUNICATION SATELLITES
T. A. M. Craven, Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 144/147.

APPLYING SPACE SCIENCE TO COMMUNICATIONS, WEATHER, AND NAVIGATION. 6. INTERNATIONAL IMPLICATIONS OF GLOBAL COMMUNICATIONS VIA SATELLITES
P. J. Farley, Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 151/153.

COMMUNICATION SATELLITES
W. F. Hilton, In Advisory Group for Aeronautical Research and Development, Paris, France, Proc. of the Eleventh AGARD Gen. Assembly, 27 and 28 July 1961, p. 69/75, 3 refs., N63-17052.

SURVEY. COMMUNICATIONS SATELLITES: THE TECHNICAL PROBLEMS
J. Holahan, Space/Aeronautics, vol. 36, no. 3, Sept. 1961, p. 112/121.

. . . number of serious engineering difficulties. . . . ultrareliability . . . higher sensitivity and effective radiated powers . . . attitude stabilization, position-keeping, booster performance, trajectory, and antenna directivity.

THE NASA COMMUNICATIONS SATELLITE PROGRAMME
L. Jaffe, IN: Space Radio Communication, New York, Elsevier Publishing Co., 1962, p. 481/490, Discussion, p. 491, A63-14260.

Brief description of the NASA program, covering both active and passive communication satellites.

In addition, the communication satellite experience to date is reviewed, with emphasis on Projects Rebound, Relay, and TSX.

COMMUNICATIONS SATELLITES AND THE LAW
J. Kraus, Nat. Comm. Symp. Rec., vol. 7, Oct. 1961, p. 36/39.

SATELLITES FOR COMMERCIAL LONG-RANGE COMMUNICATIONS
A. M. McCalmont, Scientific Analysis Corp., Concord, Mass., June 1961, 93 p., incl. illus., 44 refs., AD 277 140.

. . . Various proposed communications satellite systems and their possible limitations are discussed in relation to the need for reliability, quality, speed of operation, capacity, flexibility, economy, security, and jamming . . . Based on available information, conclusions are reached which indicate there is a useful role for commercial communication satellites and that they are economically feasible. Communications using passive satellites in orbit of the three to five thousand mile category should be the first step in the system. Eventually the communications satellite systems would evolve into one system using active repeaters in 24-hour stationary orbit.

IN THE MATTER OF AN INQUIRY INTO THE ADMINISTRATIVE AND REGULATORY PROBLEMS RELATING TO THE AUTHORIZATION OF COMMERCIALLY OPERABLE SPACE COMMUNICATIONS SYSTEMS
J. A. McKenna, Jr., General Electric Co., Philadelphia, Pa., Docket no. 14024, 19 June 1961, 58 p., AD 414 722.

SATELLITE COMMUNICATIONS SYSTEM
R. E. Sageman, Nat. Commun. Symp. Rec., vol. 7, Oct. 1961, p. 86/92.

. . . preparatory to launching experimental satellite communications trials in the Spring of 1962. A commercial system, initially employing some 20-30 satellites in 7000 miles high random polar orbits, is attainable within 3 to 4 years. Thereafter, a worldwide system could be established with approximately 50-60 satellites. . . .

THE ALLOCATION OF FREQUENCIES FOR EXPERIMENTS IN SPACE COMMUNICATIONS
R. L. Smith-Rose, IN: Space Radio Communication, New York, Elsevier Publishing Co., 1962, p. 103/111, Discussion, p. 111/113, A63-14241.

FREQUENCY ALLOCATION FOR SATELLITE COMMUNICATION
A. G. Steinmayer, Jr., et al., Nat. Commun. Symp. Rec., vol. 7, Oct. 1961, p. 95/99.

APPLYING SPACE SCIENCE TO COMMUNICATIONS, WEATHER, AND NAVIGATION. 3. A REVIEW OF INDUSTRY PROPOSALS FOR SATELLITE COMMUNICATION SYSTEMS
H. Trotter, Jr., Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 143.

TELECOMMUNICATIONS SPATIALES ET TRANSMISSION A GRANDE DISTANCE PAR SATELLITES ARTIFICIELS (Space Communications and Long Distance Communications via Artificial Satellites) (In French)
J. Voge, L'Onde Electrique, vol. 41, no. 411, June 1961, p. 573/587.

. . . useful data on radio transmission systems.

PRELIMINARY VIEWS OF THE U.S.A. FOR FREQUENCY ALLOCATIONS FOR SPACE RADIO COMMUNICATION. APPENDIX I—GUIDE FOR USE OF THE 1959 ITU SPACE AND EARTH-SPACE RESEARCH BANDS. APPENDIX IIa—SUMMARY OF CHANGES IN AND ADDITIONS TO THE 1959 ITU SPACE RESEARCH BANDS-SPACE RESEARCH REQUIREMENTS UNTIL 1967. APPENDIX IIb—PROPOSED NEW INTERNATIONAL SPACE RESEARCH BANDS
W. H. Watkins, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, IN: Space Radio Communication, New York, Elsevier Publishing Co., 1962, p. 114/133, A63-14242.

PATENT POLICY FOR COMMUNICATIONS SATELLITES: A UNIQUE VARIATION
R. F. Allnutt, Marquette Law Rev., vol. 46, no. 1, Summer 1962, p. 63/78, N63-19592.

THE POTENTIALITIES OF COMMUNICATION SATELLITES
W. J. Bray, J. Instn. Elect. Engrs., vol. 8, no. 86, Feb. 1962, p. 77/81.

COMMUNICATIONS SATELLITES (British Interplanetary Society, Symposium on Communications Satellites, London, England, May 12, 1961)
L. J. Carter (editor), New York, Academic Press, Inc., 1962, 202 p., A63-12455.

Collection of eight articles on various aspects of active and passive communications satellites, including engineering, non-military, and economic considerations. Specific topics covered include channel dropping, coding and decoding, TV transmission, satellite orbits, tracking, telemetering, and reliability. Each article is abstracted and indexed in this issue.

MODERN COMMUNICATIONS
T. H. Crowley, et al., New York, Columbia University Press, 1962.

Describes the principles of communication technology in a way which will make them easily understood by readers whose training is in other fields. Such recent developments as pulse-code modulation, time-division switching, and satellite communication are included.

PROPAGATION TROPOSPHERIQUE ET FAISCEAUX HERTZIENS TRANSHORIZON: TELECOMMUNICATIONS PAR SATELLITES (Tropospheric Propagation, Transhorizon Radio Relay Links and Communication Satellites) (In French)
F. Du Castel, Paris, France, Editions Chiron, 1962, 452 p.

NASA PROGRAM OF INTERNATIONAL COOPERATION
A. W. Frutkin, 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. 17/21, A64-14984.

. . . contribution to the Telstar experiment was made through the construction by England and France of major ground terminals. . .

A STUDY OF THE INFLUENCE OF COMMERCIAL COMMUNICATION SATELLITES
R. G. Gould, Stanford Research Inst., Menlo Park, Calif., Final Report, Jan. 1962, 116 p., refs., N64-10618.

. . . describes proposed communication satellite systems and the advantages and disadvantages of each. . . most important conclusion is that, while a random orbit system would satisfy the present requirement for transatlantic circuits, it would be incapable of satisfying many other communication needs. A stationary system would not only satisfy present and future needs on these high-density routes, but would satisfy many other anticipated communication requirements . . .

URSI-SYMPOSIUM UBER NACHRICHTEN-SATELLITENFORSCHUNG (URSI Symposium on Communications Satellite Research) (In German)
J. Grosskopf, Nachrichtentech. Z., vol. 15, Jan. 1962, p. 42/45.

COMMUNICATIONS SATELLITE SYSTEMS SUITABLE FOR COMMONWEALTH TELECOMMUNICATIONS
W. F. Hilton, In: Communications Satellites, British Interplanetary Society, Symposium on Communications Satellites, London, England, May 12, 1961, New York, Academic Press, Inc., 1962, p. 95/112, A63-12460.

Examination of some of the logical steps involved in designing a complete satellite communications system suitable for application as a British Commonwealth telecommunications network. . . .

THE 1970 COMMUNICATION SATELLITE—A HIGH-POWER SATELLITE
N. I. Korman, RCA Defense Electronic Products, Princeton, N. J., 1962, 58 p., AD 419 271.

Two designs. . . one. . . 24 hours. . . the other. . . 10,000 kilometers. . . larger number of satellites. . . satellite transmitter powers . . . 10 watts. . . ground receivers. . . noise temperatures on the order of 100 K and low side-lobe antennas with apertures on the order of 25 meters in diameter. . . .

COMMUNICATIONS SATELLITE PROGRAM
R. J. Mackey, Jr., American Rocket Society, Annual Meeting, 17th, and Space Flight Exposition, Los Angeles, Calif., Nov. 13-18, 1962, Paper 2617-62, 27 p., A63-12796.

Discussion of the NASA passive and active communications satellite program, including the objectives of individual projects. Project Echo A-12, the purposes of which are to develop a rigidized sphere and to prove spacecraft deployment and satellite rigidization techniques, is described and illustrated. Brief descriptions of Projects Telstar, Relay, and Syncom are included.

COMMUNICATIONS SATELLITES
G. E. Mueller, et al., In: Communications Satellites, British Interplanetary Society, Symposium on Communications Satellites, London, England, May 12, 1961, New York, Academic Press, Inc., 1962, p. 131/183, 12 refs., A63-12462.

Analysis of the salient problems encountered in the creation of a communications satellite system, with emphasis on their interrelationship and their relation to the operational or customer requirements. Covered are requirements, active vs passive satellites, orbits, choice of frequency, attitude control, temperature control, communications system, telemetry, tracking and command, reliability, and cost. . . .

INTERNATIONAL COMMUNICATION AND SPACE
J. R. Pierce, In USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8-May 21, 1962, p. 35/49, N63-23439.

. . . Plans for international communication using satellites are discussed. . . budgetary problems. . . require the type of international cooperation pioneered by the Internation Communications Union under the auspices of the United Nations for the worldwide telephone cable network.

OFFICE OF APPLICATIONS
M. J. Stoller, Presented at the Natl. Acad. Sci. Space Sci. Summer Study, Iowa State U., Iowa City, June, 1962, 79 p., N64-11795.

. . . three major areas of activity-meteorological systems, the communication systems, and future application. . . efforts leading to the. . . active repeaters have been initiated. Also, investigations into the construction and utility of passive satellites is continuing. . .

OUTER SPACE: THE PROSPECTS OF INTERNATIONAL REGIMES
T. Black, Jr., American Institute of Aeronautics and Astronautics, Summer Meeting, Los Angeles, Calif., June 17-20, 1963, Paper 63-244, 10 p., 17 refs., A63-18754.

. . . state of international relations in terms of outer-space conquest and communications satellites. . . .

SOME CONSIDERATIONS IN SATELLITE COMMUNICATIONS SYSTEMS
B. C. Blevis, et al., Defense Research Telecommunications Establishment, Ottawa (Canada) Communications Lab., DRTE-1122, Jan. 1964, 81 p., refs., N64-18241.

. . . Propagation factors and antenna noise . . . Antennas for earth terminals . . . Low-noise receivers for earth terminals. . . Requirements for on site computing facilities . . . Siting. . .

APPLIED RESEARCH STUDY ON SATELLITE COMMUNICATIONS. VOLUME 2
D. Campbell, et al., ITT Federal Labs., Nutley, N. J., Quarterly prog. rept. no. 4, 1 April-30 June 1963, Oct. 1963, lv., AD 433 884.

COMMUNICATIONS SATELLITE CORPORATION: OBJECTIVES AND PROBLEMS
J. V. Charyk, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 45/47, A63-21537.

THE WORLD OF THE COMMUNICATIONS SATELLITE
A. C. Clarke, Astronautics and Aeronautics, vol. 2, Feb. 1964, p. 45/48, 6 refs., A64-15207.

. . . future applications of communications satellites. The possibilities of rapid intercontinental transmission of mail, newspapers, and telephone messages via satellites are considered, and the application of worldwide television for educational purposes is outlined.

DEFENSE COMMUNICATIONS SATELLITE PROGRAM
J. S. Dorsey, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 48/51, A63-21539.

. . . for launching of satellites to be used for the command and control of widely dispersed and highly mobile strategic forces that must operate continuously despite enemy interference and physical attack. . . . history. . . through Project Score, the ARPA projects (Steer, Tackle, and Decree), and the DOD Project Advent. The present program consists of an R & D effort which will yield a family of 24 to 30 satellites in random polar orbits. . . Satellite orbital altitudes will be in a range of 5,000 to 12,000 nautical miles.

SATELLITE COMMUNICATIONS
H. L. Dryden, et al., Hearings before the Subcommittee on Communications of the Committee on Commerce, U. S. Senate, Feb. 18, 19, and 27, 1963, Congress, Senate, Committee on Commerce, Washington, GPO, 1963, 99 p., 88th Cong. 1st Sess. Serial 3, N63-15504.

SPACE TECHNOLOGY IN WESTERN EUROPE
K. W. Gatland, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 80/87, A63-21545.

. . . R & D programs concerning European communications satellites.

THE NASA COMMUNICATIONS SATELLITE PROGRAM
L. Jaffe, 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. 528/540, A64-15032.

. . . description of some of the latest results of this program. . . NASA's passive satellite program. . . general configuration of an active repeater, the Telstar satellite, the Relay satellite. . . and Syncom. . . .

NASA COMMUNICATIONS SATELLITE DEVELOPMENTS
L. Jaffe, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 48/51, A63-21538.

. . . consist of three flight programs (Relay, Syncom, and Echo), a proposed flight program for an advanced synchronous satellite, and a program of supporting research and technology. . . .

APPLICATIONS SATELLITES-COMMUNICATIONS AND WEATHER
L. Jaffe, National Aeronautics and Space Administration, Washington, D. C., In its Proc. of the Conf. on Space-Age Planning, Chicago, May 6-9, 1963, p. 81/93, N63-21135.

. . . Communication satellites, meteorological satellites, and future applications satellites are reviewed. . . Echo I. . . Relay and Telstar. . . Syncom I. . . Tiros. . . Nimbus. . . Transit. . .

COMMUNICATIONS SATELLITES
L. Jaffe, Presented at the First World Conf. on World Peace Through Law, Athens, Greece, June 30-July 7, 1963, 32 p., N63-17758.

. . . active and passive satellites. . .

MANAGING OUR COMMUNICATIONS SATELLITES
B. Kovit, Space/Aeronautics, vol. 39, May 1963, p. 78/82, A63-18827.

. . . centralized management structures set up recently to deal with both military and commerical communications satellite programs. . . .

SATELLITES FOR COMMERCIAL LONG-RANGE COMMUNICATIONS
A. M. McCalmont, Technical Communications Corp., Concord, Mass., July 1961, rev. Jan. 1963, 97 p., AD 433 766.

. . . Various proposed communications satellite systems and their possible limitations are discussed in relation to the need for reliability, quality, speed of operation, capacity, flexibility, economy, security, and jamming. . . . conclusions. . . indicate there is a useful role for commercial communication satellites and that they are economically feasible.

COMMUNICATIONS
S. Metzger, Astronautics and Aerospace Engineering, vol. 1, Nov. 1963, p. 110/113. A64-10163.

Review of the state-of-the-art of communication satellites. Recent developments in space tracking techniques and radio command systems are discussed. . . . objectives of the Mariner experiment are outlined. . . . Advances in technology. . .

DATA COLLECTION BY SATELLITES
A. B. Moody, Astronautics and Aerospace Engineering, vol. 1, April 1963, p. 57/58, A63-15192.

Presentation of a potential meteorological data collection system, which would overcome global satellite deficiencies. The proposal outlines the establishment of fixed-positioned, land- and sea-based automatic weather stations, and constant level balloons which would relay data by a satellite system for analysis at a meteorological processing center.

SATELLITE SCIENCE AND TECHNOLOGY
J. R. Pierce, Science, vol. 141, July 19, 1963, p. 237/244, A63-22077.

General discussion of scientific, technological, and social problems arising in connection with the development and operation of communications satellites. . . .

WORLDWIDE SATELLITE COMMUNICATIONS
J. R. Pierce, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 23/25, A63-21534.

COMMUNICATIONS SATELLITES: TECHNOLOGY, ECONOMICS, AND SYSTEM CHOICES
S. H. Reiger, et al., RAND Corp., Santa Monica, Calif., Research memo. no. RM-3487-RC, Feb. 1963, 101 p., incl. illus., tables, refs., AD 296 068.

. . . study. . . of possible system choices to establish a commercial communications satellite system. . . satellite reliability. . . Cost estimates are made for representative stationary and non-stationary active satellite systems. . . .

COMMERCIAL SATELLITE SYSTEMS
S. H. Reiger, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 26/30, A63-21535.

. . . the major features of various communication systems satellites. . . .

TELECOMMUNICATIONS SPATIALES AVEC RELAIS MULTIPLES (Space Communications via Chains of Satellites) (In French)
G. Valensi, Ann. Telecomm., vol. 18, no. 3-4, Mar./April 1963, p. 60/71.

INTERCONTINENTAL TELECOMMUNICATIONS BY ARTIFICIAL SATELLITES (In French)
J. Voge, Onde Electr., vol. 43, no. 434, May 1963, p. 489/502.

After recalling the results obtained by the CNET with the experimental satellites Echo (1960) and Telstar (1962), the author examines the provisions of international traffic for 1970 and 1980 which justify the recourse to the telecommunications by satellites. . .

THE FUNCTION OF SPACE TELECOMMUNICATION IN THE COSMIC INTERNATIONAL LAW
S. Yamamoto, 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. 61/66, A64-14989.

. . . the international regulation of this communication field can be a testcase in setting the pattern of international cooperation in the peaceful uses of outer space. . . .

PLANS FOR SATELLITE COMMUNICATIONS NETWORKS
Interavia, vol. 18, Nov. 1963, p. 1721/1726, A64-11593.

EUROPE MAPS ITS OWN COMSAT SYSTEM
Space/Aeronautics, vol. 40, Aug. 1963, p. 81/85, A63-23008.

. . . emphasizing the low-capacity channels of the traditional broad trunk routes that would be served by any U. S. Communications satellite network. . . .

QUARTERLY INDEX AND ABSTRACTS OF TECHNICAL DOCUMENTARY REPORTS—FIRST QUARTER 1963.
Air Force Systems Command, Wash., D. C., 1963, 236 p., AD 415 391.

Descriptors: Military satellites. . . Communication satellites. . .

Beginning with technical documentary reports distributed on and after 1 Jan. 1962, the individual quarterly indexes and the command annual index were discontinued in favor of a command quarterly index. The index contains only unclassified information, in order to permit wide distribution. . . .

Related Publications:

THE DWINDLING HIGH-FREQUENCY SPECTRUM
G. Jacobs, et al., IRE Trans. Commun. Syst., vol. CS-9, no. 9, Dec. 1961, p. 399/408.

. . . urging that space satellite communications systems, intercontinental microwave links and expanded underwater multichannel cables as well as other communication systems not dependent upon the vagaries of the ionosphere, be developed at an accelerated pace.

SATELLITE COMMUNICATIONS RESEARCH
R. Kompfner, Proc. Instn. Radio Engrs. Australia, vol. 22, June 1961, p. 371/382.

THE FUTURE OF DIGITAL COMMUNICATIONS
W. S. Litchman, IEEE Trans. Commun. Syst., vol. CS-11, no. 2, June 1963, p. 149/158.

. . . current global telecommunications plant . . . built around the 4-kc channel and frequency division multiplex (FDM). . . . paper considers the characteristics of digital communications resulting from increases in intercontinental traffic, and indicates the effect of impact of these characteristics on future telecommunication networks.

DIVISION 4A.1
SYSTEMS FUNDAMENTALS FOR ORBITAL COMMUNICATIONS RELAYS

4A.100: Communications Satellites Systems Fundamentals

Included: Systems planning in general; Comparison between the various approaches; Overall systems considerations.

Cross References: Economic problems of communications satellites (4A.700); Low orbit comsat systems (Div. 4A.2); Medium and synchronous orbit systems (Div. 4A.3).

Principal Publications:

DESIGN CONSIDERATIONS FOR SPACE COMMUNICATION
J. E. Bartow, et al., IRE Nat. Conv. Rec., Pt. 8, 1959, p. 154/167.

ACTIVE VS PASSIVE SATELLITES FOR A MULTI-STATION NETWORK
L. Pollack, et al., IRE Conv. Rec. Pt. 5, vol. 8, March 1960, p. 141/146.

USE OF MOON OR SATELLITE RELAYS FOR GLOBAL COMMUNICATIONS
L. P. Yeh, Commun. Engineering, vol. 79, no. 51, Nov. 1960, p. 607/615, 27 refs.

. . . practical system performance point of view. . . .

APPLICATION OF ARTIFICIAL EARTH SATELLITES TO COMMUNICATIONS ON ULTRA SHORT WAVES
M. Dolukhanov, Radio, Moskow, May 1961, p. 21/22.

A note on satellite period and transmitter power for heights of 1000, 2000, 3000, 4000, 5000, and 35818 km.

SATELLITE TO SATELLITE COMMUNICATIONS: A LITERATURE SURVEY OF RECENT TECHNIQUES
J. B. Goldman, Lockheed Aircraft Corp., Sunnyvale, Calif., Special bibliogrpahy no. SB-61-59; Rept. no. 3-77-61-18, Oct. 1961, 32 p., 93 refs., AD 271 037.

. . . annotated bibliography . . . includes publications released from January 1960 to June 1961. . . . communications satellites. . . . Emphasis is placed upon active satellites. References to the Echo satellite are omitted.

SATELLITES FOR COMMERCIAL LONG-RANGE COMMUNICATIONS
A. M. McCalmont, Scientific Analysis Corp., Concord, Mass., June 1961, 93 p., incl., illus., 44 refs., AD 277 140.

. . . Various proposed communications satellite systems and their possible limitations are discussed in relation to the need for reliability, quality, speed of operation, capacity, flexibility, economy, security, and jamming . . . Based on available information, conclusions are reached which indicate there is a useful role for commercial communication satellites and that they are economically feasible. Communications using passive satellites in orbit of the three to five thousand mile category should be the first step in the system. Eventually the communications satellite systems would evolve into one system using active repeaters in 24-hour stationary orbit.

SATELLITES GO COMMERCIAL – FOR COMMUNICATIONS
H. E. Weppler, Electrical Engng., vol. 80, no. 8, Aug. 1961, p. 569/574.

. . . the Bell System has proposed a preliminary plan involving 26 ground terminals and active satellites in somewhat random polar orbits, 3,000 miles high. Broadband channels, . . . survey of satellite communications.

A STUDY OF THE INFLUENCE OF COMMERCIAL COMMUNICATION SATELLITES
R. G. Gould, Stanford Research Inst., Menlo Park, Calif., Final Report, Jan. 1962, 116 p., refs., N64-10618.

. . . describes proposed communication satellite systems and the advantages and disadvantages of each . . . most important conclusion is that, while a random orbit system would satisfy the present requirement for transatlantic circuits, it would be incapable of satisfying many other communication needs. A stationary system would not only satisfy present and future needs on these high-density routes, but would satisfy many other anticipated communication requirements . . .

THE QUEST FOR RELIABLE EARTH-SPACE COMMUNICATIONS
H. T. Hayes, J. Brit. Instn. Radio Engrs., vol. 23, no. 6, June 1962, p. 481/488.

. . . practical aspects of the evolution of a space communication system from the initial design concept to the performance in orbit. . . . The telemetry, tracking and command system used to collect the data from Pioneer I, Explorer VI and Pioneer V are used in the paper as examples of system evolution. . . . discussion of current work to improve the efficiency and reliability of space communication systems. . . .

CURRENT PRACTICES IN SPACE COMMUNICATION SYSTEMS
E. L. Key, et al., Mitre Corp., Bedford, Mass., Technical memo. no. TM-3335, ESD TDR 62-326, 18 June 1962, 1v., incl. illus., tables, refs., AD 292 734.

Current practices in space communication, including power supply, antennas, equipment, command telemetering, stabilization and other aspects are reported. Discussion on technical limitations and feasible areas for future improvements are also included. . . . also directly or indirectly applicable to deep space missions. The 24-hour active system appears to be the most desirable system for global communications. . . .

OPTIMUM SATELLITE DISPENSING VELOCITIES FOR AN EQUATORIAL HIGH ALTITUDE NONSYNCHRONIZED SATELLITE COMMUNICATION SYSTEM
W. E. Morrow, Jr., Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 36G-3, AFESD TDR 62-255, 5 Dec. 1962, 5 p., illus., AD 292 995.

. . . advantages of a communication system employing many active satellites in high altitude (15,000 to 30,000 miles) unsynchronized equatorial orbits over 24-hour synchronous and unsynchronized medium altitude orbits. . . .

TRANSMISSION PROBLEMS OF SATELLITE COMMUNICATION WITH SPECIAL REFERENCE TO TRANSMISSION TIME
K. W. Pearson, In: Space Radio Communication International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 577/582, Discussion, M. Valenski and W. R. Vincent, p. 583/585, A63-14265.

. . . Each of the three fields of transmission-telephony, data, and television - are discussed in relation to their transmission over a satellite system. Attention is then focused on the active low-level and active synchronous satellite systems. Major advantages and disadvantages of each of the two systems are discussed from the transmission point of view. The effects of the line transmission time associated with the synchronous satellite system are considered to be the major disadvantage of this system.

SOME PRACTICAL PROBLEMS OF SATELLITE COMMUNICATION
J. R. Pierce, In: Communications Satellites, British Interplanetary Society, Symposium on Communications Satellites, London, England, May 12, 1961, New York, Academic Press, Inc., 1962, p. 85/94, A63-12459.

. . . difficulties in radiation, orientation, and design of equipment. In addition, the problem of how satellite communication can be fitted into the present, already highly developed, communications systems is discussed. . . .

THE SCIENTIFIC AND RESEARCH PROBLMS OF COMMUNICATION SATELLITE SYSTEMS
H. Stanesby, et al., In: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, New York, Elsevier Publishing Co., 1962, p. 17/26, A63-14234.

Brief description of a program of research for the development of future communication satellite systems. Discussed are the satellite environment, satellite-to-ground radio propagation, ground-station antennas, internal equipment for ground stations, and satellite-borne equipment.

SATELLITE COMMUNICATIONS
H. P. Hutchinson, Electro-Technology, vol. 73, April 1964, p. 44/52, A64-16647.

. . . The prerequisites for a successful satellite communications system . . . design and fabrication . . . testing and pre-aging . . . automatically controlled devices . . . means for adapting the satellite to several transmission modes after launch. . . .

CRITERIA FOR THE CHOICE OF SYNCHRONOUS OR MEDIUM ALTITUDE SYSTEM
W. L. Pritchard, International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 84, 25 p., A63-25971.

Comparison . . . in terms of conventional communications purposes (without consideration of vulnerability, resistance to jamming, and other military considerations) . . . .

4A.110: Systems Design of Communications Satellites

Included: Design examples; Optimum frequency selection; Echo suppression; Relay problems in phone conversations; Digital channels over communications satellites; Quality criteria for satellite channels; Attitude control; Interference problems in comsat systems.

Not Included: Intelligibility test procedures; Modulation methods in communications (1); Multiplexing methods (2); Attitude control subsystems.

Cross References: Special design problems for low altitude systems (Div. 4A.2); Special design problems for high altitude (synchronous) systems (Div. 4A.3); Multiple access operation (Div. 4A.4).

Principal Publications:

ARTIFICIAL SCATTERING AND REFLECTING MEDIA FOR LONG RANGE COMMUNICATION
H. F. Meyer, Proc. Nat. Aeron. Electronics Conf., vol. 7, May 1959, p. 111/116.

. . . to compare the active relay system with the passive system in terms of the power received on the ground. . . .

DESIGN AND EVALUATION OF SPACE COMMUNICATIONS SYSTEMS USING COMPUTER SIMULATION TECHNIQUES
J. White, Nat. Symp. Space Electronics Telem., no. 1.1, Sept. 1959, p. 1/35.

SYSTEM DESIGNING – COMMUNICATING IN SPACE
L. P. Yeh, Electrical Industr., vol. 18, Feb. 1959, p. 54/58.

PROGRESSIVE COMMUNICATION SATELLITE SYSTEMS DESIGN
J. E. Bartow, IRE Trans. Mil. Electronics, vol. MIL-4, no. 2-3, April/July 1960, p. 208/215.

TELEPHONE ECHO TESTS
D. L. Richards, et al., Proc. Instn. Elect. Engrs., Pt. B, vol. 107, no. 36, Nov. 1960, p. 553/556.

Electrical reflection on telephone circuits having appreciable times of propagation can cause delayed sidetone effect subjectively similar to echo. The variations in subjects' tolerance of this echo is examined experimentally as a function of echo attenuation and delay. The dispersion of tolerance between subjects is also considered . . .

GEOMETRIC ASPECTS OF SATELLITE COMMUNICATION
F. W. Sinden, et al., IRE Trans. Space Electronics Telem., vol. SET-6, no. 3/4, Sept./Dec. 1960, p. 146/157.

GEOMETRIC ANALYSIS OF COMMUNICATIONS PROBLEMS WITH POLAR ORBITING SATELLITES
J. A. Webb, Proc. Nat. Commun. Symp., vol. 6, Oct. 1960, p. 51/57.

. . . Problem of data retrieval from a global system of low altitude earth satellites are described in this paper. The analysis covers both the geometric and electrical aspects of the problem.

SIMULATING SPEECH THROUGH SPACE
Bell Lab Record, vol. 38, Aug. 1960, p. 296/298.

. . . communication research . . . Bell Laboratories Sibyl simulator. . . . now being used to collect information on how users will react to a satellite-relay communications system even before the satellite goes up. . . . "Project Echo" . . .

THE INTERNATIONAL PLANNING OF SATELLITE COMMUNICATION SYSTEMS
C. F. Booth, In: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 27/30., A63-14235.

Brief survey of some aspects of satellite communication systems which telecommunication administrations are considering jointly with the technical advisory committees of the International Telecommunication Union. Attention is focused on the following topics: (1) frequency allocations, (2) transmission parameters and interconnection with nation networks, and (3) operational aspects.

PROPAGATION PROBLEMS OF A COMMUNICATION SATELLITE
H. B. Collins, Jr., et al., Nat. Commun. Symp. Rec., vol. 7, Oct. 1961, p. 116/121.

. . . to draw together all the propagation problems of a communication satellite . . . as band sharing with other services, ground site selection, and doppler effects are discussed . . .

DEVELOPMENT OF A QUARTZ CRYSTAL OSCILLATOR FOR COMMUNICATIONS SATELLITES
H. E. Gruen, et al., Delta-fa, Inc., Geneva, Ill., Quarterly rept. 2, 15 Jan.-15 April 1961, 28 p., AD 257 984.

THE DELAY/COVERAGE PROBLEM IN TELECOMMUNICATIONS VIA SATELLITES
R. P. Haviland, et al., Conv. Rec. Nat. Symp. Global Commun., May 1961, p. 184/187.

EVALUATION OF THE EFFECTS OF ECHO IN SATELLITE TELECOMMUNICATION SYSTEMS
W. A. Runge, Nat. Commun. Symp. Rec., vol. 7, Oct. 1961, p. 101/105.

. . . speaker's echo was delayed six-tenths of a second at various intensities. . . . fifty per cent of the observers rated the circuit as "acceptable" at an echo intensity of 9 db and 25 db below the transmitted speech level for reading and conversational type tests, respectively . . .

SATELLITE COMMUNICATIONS SYSTEM PROVIDING CHANNEL DROPPING. APPENDIX I, II - COMPARATIVE SATELLITE R. F. POWERS REQUIRED WITH DIFFERENT CODES
E. K. Sandeman, In: Communications Satellites, British Interplanetary Society, Symposium on Communications Satellites, London, England, May 12, 1961, New York, Academic Press, Inc., 1962, p. 17/73, 27 refs., A63-12457.

INTERFERENCE IN SATELLITE COMMUNICATION SYSTEMS
W. R. Vincent, et al., In: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 134/164, Discussion, L. G. Abraham and R. P. Haviland, p. 164/165, 19 refs., A63-14243.

Presentation of some of the factors that influence the sharing of frequency spectrum space between satellite and terrestrial microwave relay systems. . . .

SATELLITES GO COMMERCIAL—FOR COMMUNICATIONS
H. E. Weppler, Electrical Engng., Aug. 1961, p. 569/574.

To meet multifold increase in international communication within the next 20 years, the Bell System has proposed a preliminary plan involving 26 ground terminals and active satellites in somewhat random polar orbits, 3,000 miles high. Broadband channels, each accommodating 600 telephone circuits, would be provided.

PASSIVE SATELLITE SYSTEM
D. T. Worthington, Rome Air Development Center, Griffiss Air Force Base, N.Y., RADC TN 61-65, April 1961, 16 p., AD 272 296.

A comparison of the advantages and disadvantages of the various communication satellites. . . . Reflectivity coefficients of both active and passive satellite systems, and the mathematical relationship between the two systems are developed. . . . refined passive satellite system is then compared costwise with the typical active satellite system. Finally, a series of conclusions are drawn with reference to the implementation of both passive and active satellite systems.

SATELLITE COMMUNICATION EQUIPMENT: SOME DESIGN CONSIDERATIONS
J. E. Clegg, Royal Aircraft Establishment (Gt. Brit.), Technical note no. Space 6, Feb. 1962, 16 p., illus. 3 refs., AD 278 027.

The subdivision of the power supply and communication equipment into a number of units is suggested to improve reliability and make better use of the power available. The use of transponder which amplifies and changes carrier frequency without demodulation and remodulation is shown to have advantages. A multiple receiving aerial system . . . is described. . . .

A TEMPERATURE-STABILIZED MICROWAVE POWER LIMITER FOR COMMUNICATION SATELLITE USE (Correspondence)
R. L. Comstock, et al., Proc. IRE, vol. 50, no. 4, April 1962, p. 470/471.

A ferrimagnetic microwave power limiter has been developed for use in an experimental active communication satellite repeater. At a given frequency the limiting level can be varied with the magnetic bias field in contrast to coincidence limiters . . .

PRECIPITATION SCATTER AS AN INTERFERENCE SOURCE IN COMMUNICATION SATELLITE SYSTEMS
A. S. Dennis, IRE Internat. Conv. Rec., vol. 10, no. 1, March 1962, p. 145/151, 24 refs.

. . . theoretical and experimental data from the field of radar meteorology show that scattering by precipitation particles at 3 Gc can easily exceed the tropospheric scatter component by orders of magnitude.

EFFECTS OF TIME DELAY AND ECHOES ON TELEPHONE CONVERSATIONS
J. W. Emling, et al., IRE Internat. Conv. Rec., Pt. 8, vol. 10, March 1962, p. 122.

. . . presents a summary of our present knowledge on the effects of time delay, echoes and echo suppressors on telephone conversations. . . . essentially tutorial and covers the historical background of this subject. . . .

APPLICATION AND FEASIBILITY OF INTERSATELLITE COMMUNICATION LINKS
E. H. Gavenman, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 2.2, Oct. 1962.

. . . worldwide communication networks with large data capabilities, high security, and high reliability . . . feasibility of providing such communication links within the next few years by the use of intersatellite relay repeaters. . . .

GROUND RECEIVERS FOR THE SATELLITE TELEVISION SYSTEM
W. Y. Pan, et al., American Rocket Society, Annual Meeting, 17th, and Space Flight Exposition, Los Angeles, Calif., Nov. 13-18, 1962, Paper 2722E-62, 10 p., 25 refs., A63-12739.

Cursory description of different aspects of a ground receiver for a satellite TV system. In general, the contemplated receiver is similar in design to those used at present for home TV reception. . . . specifications on the reliability and durability under extreme environments are more rigid. . . .

DESIGN OF A SATELLITE COMMUNICATION SYSTEM FOR OPTIMUM COVERAGE
I. Sugai, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 173/183.

Although there are a few papers published in the coverage study . . . many . . . neglect the effect of the earth's rotation.
The present paper develops a systematic mathematical model by which coverage patterns of satellites in circular orbits are investigated with time as the only independent variable. A few useful explicit solutions are presented.

AN ACTIVE ATTITUDE CONTROL SYSTEM FOR COMMUNICATION SATELLITES
J. K. Abbott, Royal Aircraft Establishment (Gt. Brit.), RAE Technical note no. Space 34, May 1963, 23 p., AD 415 189.

An active system of satellite attitude control is suggested. . . . The system is suitable without modification for each of the control phases, acquisition, orbit adjustment and long term control.

TECHNIQUES FOR DIGITAL COMMUNICATION VIA SATELLITES
F. Assadourian, et al., Rec. Nat. Space Electronics Symp., no. 3.1, 1963.

. . . for handling some of the synchronization problems which arise in digital communication via subsynchronous and synchronous satellite repeaters. The complexity of these problems depends upon the kind of communication network in which the satellite links are employed . . . involves both (1) bit synchronization (and) identification) and (2) frame synchronization. . . . Handover problems and techniques will be discussed in some detail, particularly the instantaneous type which is needed to preserve bit integrity during handover. . . .

DESIGN AND USE OF AN EARLY COMMUNICATION SATELLITE SYSTEM
L. D. Attaway, et al., RAND Corp., Santa Monica, Calif., RM-3514-NASA, July 1963, 118 p., refs., N63-23601.

COMMUNICATION SATELLITE DESIGN FOR ENVIRONMENT EFFECTS
E. L. Bischoff, et al., International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 83,39 p., 12 refs., A63-25964.

Discussion of the effects of thermal and particle radiation upon the performance of a communications satellite. The radiation environment is analyzed on a state-of-the-art basis, and its effect on the life and reliability of the satellite is examined. Noted are current techniques used to protect electronic components by controlling the internal environment of the satellite.

THE OPTIMUM FREQUENCIES FOR AN ACTIVE SATELLITE SYSTEM
W. T. Blackband, Royal Aircraft Establishment (Gt. Brit.), RAE Tech. note. no. Rad841, June 1963, 15 p., AD 417 739.

. . . factors influencing the choise of optimum working frequencies . . . for up and down links . . . The assumption of fixed size or fixed gain for the satellite aerial lead to different values for the optimum frequency.

SOME CONSIDERATIONS IN SATELLITE COMMUNICATIONS SYSTEMS
B. C. Blevis, et al., Defence Research Telecommunications Establishment (Canada), DRTE 11 22, Jan. 1964, 1 v., AD 430 769.

Propagation parameters of satellite communications systems operating at frequencies above 1 Gc/s are discussed. . . . effects of tropospheric factors. Various antenna configurations . . . modern low-noise receivers . . . Computer requirements for antenna control and data analysis are assessed. . . . choice of a ground terminal site . . .

ECHO SUPPRESSOR DESIGN IN TELEPHONE COMMUNICATIONS
P. T. Brady, et al., Bell Syst. Tech. J., vol. 42, no. 6, Nov. 1963, p. 2893/2917.

An elementary echo suppressor is described which consists of a single voice-operated switch located at each end of a four-wire toll connection. It is shown that this circuit is unsuitable for telephone conversations if there is an appreciable delay between the speakers. Modifications and additions to the elementary echo suppressor are made in an effort to improve its performance . . .

THE TELSTAR EXPERIMENT
A. C. Dickieson, Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 739/746.

The papers that follow describe in depth the satellite and ground systems designed for the Telstar experiment and give the results to date. The purpose of this introduction is to set the scene in which the project was undertaken and to state some general conclusions.

THE EFFECTS OF TIME DELAY AND ECHOES ON TELEPHONE CONVERSATIONS
J. W. Emling, et al., Bell Syst. Tech. J., vol. 42, no. 6, Nov. 1963, p. 2869/2891.

A DISCUSSION OF THE QUALITY FACTORS IN AN EARTH-SATELLITE-EARTH COMMUNICATION SYSTEM
N. W. Feldman, et al., Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 342/345.

. . . Laboratory analysis of a satellite relay transmission system . . . hazards which may be anticipated in this type of communications. . . .

HIGH-SPEED DIGITAL DATA TRANSMISSION OVER THE TELSTAR SATELLITE (Correspondence)
F. E. Froehlich, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 609.

COMBATING ECHO IN SPEECH CIRCUITS WITH LONG DELAY
M. B. Gardner, et al., J. Acoust. Soc. Amer., vol. 35, Nov. 1963, p. 1762/1772, A64-10956.

RESULTS OF THE TELSTAR SYSTEM COMMUNICATIONS TESTS
R. W. Hatch, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1561/1629.

. . . results of the communications tests on the Telstar satellite system which have been conducted at the Andover earth station are presented . . . included successful transmissions of telephone, television, and data signals . . . measurements of received carrier power, noise, transmission characteristics, linearity, data system errors, absolute delay, and Doppler shift have been made. The results are in good agreement with expected performance.

SATELLITE SYSTEMS RELIABILITY
S. S. Jamison, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 322/325.

The effects of random failure and wearout on the deployment and maintenance of a satellite system are discussed. A general mathematical model is presented . . .

ATTITUDE CONTROL FOR COMMUNICATION SATELLITES
J. E. Metzger, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 443/446.

. . . Systems based on active repeaters at medium and higher altitudes appear to have one problem in common, that is the repeater is power and weight limited because of presently existing payload weight and launch vehicle capability constraints. . . . to improve the gain of the critical link . . .

AIDS FOR THE GROSS DESIGN OF SATELLITE COMMUNICATION SYSTEMS
G. M. Northrop, RAND Corp., Santa Monica, Calif., Rept. no. P2785, Aug. 1963, 38 p., AD 417 655.

. . . compiling a computational aid for designers of communication systems employing earth satellites as active relays. . . . intended to be of practical utility . . . to assimilate in one place most of the nomograms and graphs normally employed in performing the gross design of analysis of a communication system, with emphasis placed on the parametric ranges pertinent to communication satellites.

EFFECT OF NODAL REGRESSION ON SPIN-STABILIZED COMMUNICATION SATELLITES
B. Paul, et al., AIAA Journal, vol. 1, Oct. 1963, p. 2388/2389, A63-23782.

. . . calculating the tolerance angle which must be added to the antenna angle in a spin-stabilized satellite whose spin axis is initially perpendicular to the orbital plane, in order that the antenna pattern maintain full coverage of the visible Earth surface. . . .

SUBJECTIVE EVALUATION OF DELAY AND ECHO SUPPRESSORS IN TELEPHONE COMMUNICATIONS
R. R. Riesz, Bell Syst. Tech. J., vol. 42, no. 6, Nov. 1963, p. 2919/2941.

The effect of transmission delay upon the quality of a telephone circuit was investigated using naturally occurring telephone conversations. Round-trip delays of 600 and 1200 msec went almost unnoticed at first when no echo sources or echo suppressors were present in the circuit. After exposure to pure delays of up to 2400 msec, considerable dissatisfaction, indicated by rejection of the circuit, developed with the 600- and 1200-msec delays. When echo sources and echo suppressors were added to the circuit, some dissatisfaction developed immediately for round-trip delays of 600 and 1200 msec. No adaptation to the effects of delay occurred; in fact dissatisfaction increased with experience under certain conditions.

OPTIMUM POLAR SATELLITE NETWORKS FOR CONTINUOUS EARTH COVERAGE. Appendix — DERIVATION OF RELATIONS AND METHOD OF SOLUTION FOR NON-SYMMETRICAL SATELLITE SYSTEM
M.H. Ullock, et al., AIAA Journal, vol. 1, Jan. 1963, p. 69/72, A63-11905.

Proposal of an optimum arrangement in which the motion of satellites in one orbital plane is synchronized with that of the satellites in adjacent planes in order to provide continuous coverage of the surface of the Earth. Relations are developed between the number of satellites, their relative positions, and the required minimum latitude of continuous coverage. The method of solution of these relations is outlined, and an example is presented. The resultant number of satellites required for this case as a function of altitude is compared with the number required for a symmetric, nonsynchronous act of satellite orbits.

ECHO SUPPRESSOR IMPROVES SATELLITE COMMUNICATIONS
Space/Aeronautics, vol. 40, Sept. 1963, p. 127/129, A63-23412.

Brief description of a split-echo suppressor (Model 931A) for satellite communications, which provides 20-30 db more suppression than conventional units and affords simultaneous two-way conversation with reduced echo suppression. The split arrangement can accommodate round-trip delays equivalent to 3,000 miles of carrier between the suppressor unit and the talker. . . .

Related Publications:

SYSTEM DESIGN CRITERIA FOR SPACE TELEVISION
A.J. Viterbi, J. Brit. Instn. Radio Engrs., vol. 19, no. 9, Sept. 1959, p. 561/570.

A SATELLITE DATA TRANSMISSION ANTENNA
C.A. Belfi, et al., IEEE Trans. Antennas Propagation, vol. AP-12, March 1964, p. 200/206, 9 refs., A64-16610.

Description of a retrodirective satellite antenna for a broad bandwidth, satellite-to-ground transmission link. The satellite is an information-collecting device which transmits its data in the direction of the ground receiver upon command. The antenna is an active retrodirective antenna which utilizes the beam-forming characteristics of a phasing matrix. . . . The active Van Atta array, the automatic three-dimensional electronic scanning antenna, the Luneberg lens, and various other antenna array techniques are also considered.

A SELF-STEERING ARRAY REPEATER
C.C. Cutler, et al., Bell Syst. Tech. J., vol. 42, no. 5, Sept. 1963, p. 2013/2032.

A scheme is disclosed whereby an antenna array is automatically directed by a simple intermodulation of signal components. . . . scheme lends itself to multiple-element, low-power circuitry and may be used in either space or terrestrial systems . . . An experimental verification of the basic principle is described.

THE TELSTAR SATELLITE SYSTEM
D.F. Hoth, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 765/799.

. . . discusses the over-all system design . . . A general description of the . . . satellite and . . . ground station . . . transmission performance is given with some discussion of system parameters.

A GENERAL DESCRIPTION OF THE TELSTAR SPACECRAFT
R.H. Shennum, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 801/830.

. . . emphasis on the electronics system . . . includes early planning, starting with frequency allocation considerations, and carries the program through electrical and mechanical design, construction and evaluation of the electronics system. . . .

4A.120: Passive Communications Satellites

Included: Corner reflectors on passive comsats; Lens reflectors; Luneburg lens; Expandable structures for passive satellites; Balloon satellite; Passive spherical satellites; Sunlight pressure perturbations; Reflectivity characteristics of balloons.

Not Included: Structural design problems.

Cross References: Project Echo (Div. 4A.8); Belts of needles (4A.250).

Principal Publications:

EXTRATERRESTRIAL FACTORS INFLUENCING PERFORMANCE OF A PASSIVE SPHERICAL SATELLITE
R.W. Chittenden, Melpar, Inc., Watertown, Mass., RADC TN 60-224, Aug. 1960, 105 p., AD 246 787.

. . . These balloons, with 100-ft diameters, are fabricated of 0.25-mil Mylar and coated with a vapor-deposited aluminum layer of 2200-angstom thickness. This coating provides electromagnetic reflectivity of approximately 0.98 for microwave frequencies and also provides protection against ultraviolet radiation . . . the useful lifetime of the satellite . . . may be limited . . . Meteoric activity in the space environment will lead to erosion or pitting of the aluminum surface . . . cathode sputtering of the aluminum surface by high-energy protons from the Sun and sublimation by the extended solar corona, were investigated as far as possible, in the light of presently available information . . . A discussion of signal propagation by means of ionized meteor trails includes development of equations for the effective radar cross section of ionized coumns and calculations of received signal levels for specific system parameters. . . .

MILLSTONE OBSERVATIONS DURING THE NASA SHOTPUT IV EXPERIMENT 1 APRIL 1960
D.P. Hynek, Lincoln Lab., Mass. Inst. of Tech., Lexington, Group rept. no. 30G-004, 20 April 1960, 14 p., incl. illus. tables, AD 236 129.

The Shotput IV experiment . . . balloon was tracked from separation to reentry . . . Radar cross-section calculations yield a value of the order of 500 square meters . . . Unlike Shotput III . . . no significant interference pattern in the echo signal was observed during flight . . .

CONTINUOUS INTERZONE COVERAGE FROM PASSIVE COMMUNICATION SATELLITES
P.H. Kirchner, General Electric Co., Syracuse, N.Y., Rept. no. DSD-ASER-70-60, RADC TN 60-287, Dec. 1960, 44 p., incl. illus. tables, AD 249 914.

Sites were selected for a chain of eight trunk stations to provide a worldwide radio communication network using passive reflecting satellites. A method was devised to determine the optimum system of satellite orbits to insure continuous availability of a radio path between each pair of adjacent trunk stations.

PASSIVE SATELLITE COMMUNICATION
J.L. Ryerson, Proc. IRE, vol. 48, April 1960, p. 613/619.

DIRECTIVE NON-ORIENTED REFLECTORS AS PASSIVE SATELLITES IN LONG DISTANCE COMMUNICATIONS
Y.E. Stahler, et al., Comm. & Nav. Lab., Wright Air Develop. Div., Wright-Patterson Air Force Base, Ohio, March 1960, 18 p., incl. illus., AD 235 635.

DIRECTIVE NON-ORIENTED REFLECTORS AS PASSIVE SATELLITES IN LONG DISTANCE COMMUNICATIONS
Y.E. Stahler, et al., Proc. Nat. Aeron. Electronics Conf., vol. 8, May 1960, p. 257/265.

PASSIVE SATELLITE COMMUNICATION COVERAGE STUDY
R.D. Turner, et al., General Electric Co., Syracuse, N.Y., 27 June 1960, AD 239 581.

Extensive computations were made of the availability of passive satellite communication service as a function the satellite altitude, spacing between surface stations, orbital inclination angle and other parameters. A fairly extensive methodology was developed which is quite generally applicable. The note deals only with satellites in circular orbits at altitudes between 1000 and 2000 statute miles. Two classes of systems are considered: those for which only one satellite is in each orbit, and those for which several satellites are in the same orbit. In the latter case, the effects of both uniform spacing and random placement within the orbit are considered. One conclusion is that the constraint of requiring several satellites to lie in the same orbit does not markedly increase the number of satellites required to provide continuous service.

THE USE OF A PASSIVE SPHERICAL SATELLITE FOR COMMUNICATION AND PROPAGATION
T.H. Vea, et al., Proc. IRE, vol. 48, April 1960, p. 620/624.

TRANSMIT-RECEIVE SYSTEM FOR PROJECT ECHO
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 44/47.

EXPERIMENTAL PASSIVE-SATELLITE COMMUNICATION LINK
Philco Corp., Philadelphia, Pa., 29 Nov. 1960, AD 249 373.

An experimental one-way 2 kmc communication link was established between the Rome Air Development Center test sites at Trinidad, W.I.F., and Floyd, New York, utilizing spherical satellites as passive reflectors of electromagnetic energy.

USE OF AUTOMATIC ANGLE RETURN ARRAYS FOR COMMUNICATIONS SATELLITES
R.C. Hansen, Aerospace Corp., El Segundo, Calif., Rept. no. TDR-594(1321-01)TR-2, April 1961, 36, incl. illus. table, 22 refs., AD 259 164.

An investigation is made of automatic angle return satellite arrays for both passive and active systems. Automatic angle return arrays, called Van Atta arrays, return a signal in the direction of incidence of the impinging signal, and are effective over an angle of at least + or - 45 degrees from the array axis. Further, the active Van Atta array (AVA) offers inherent high reliability, since many of the distributed amplifiers may fail without causing serious system performance degradation, and also because the distributed amplifier arrangements permit the use of low-power, solid state devices.

COMMUNICATIONS SATELLITES USING ARRAYS
R.C. Hansen, Proc. IRE, vol. 49, June 1961, p. 1066/74.

SATELLITE CHARGE-UP AS A MEANS OF MAINTAINING THE SHAPE OF ECHO-TYPE SATELLITES IN THE OUTER VAN ALLEN BELT
R.O. Hundley, Rand Corp., Santa Monica, Calif., Research memo RM-2921-NASA, Dec. 1961, 21 p., AD 269 104.

. . . possibility of using satellite charge-up as a means of maintaining the shape of Echo-type satellites in the outer Van Allen belt is considered . . . concluded . . . would probably not be useful for opaque satellites. For partially transparent balloon satellites . . . the method might be useful part of the time . . .

THE INFLATED SATELLITE
H. Mark, et al., Aerospace Engineering, vol. 20, no. 4, April 1961, p. 10/11 + 30/38.

Characteristics in Sunlight and Darkness.

TWENTY-YEAR-LIFE COMSAT CONCEPT PROPOSED
B. Miller, Aviation Week and Space Technology, vol. 75, no. 11, Sept. 1961, p. 89/91.

Concept of a 24-hour passive communications satellite system using high-gain reflectors and capable of relaying up to 20 television channels between New England and Europe was outlined recently before the Sixth Symposium on Ballistic Missile and Aerospace Technology . . . one of two proposed reflector types would enable each television channel to be transmitted between continents with no more power than is currently used for some local television broadcasting. . . . each audio channel with an information bandwidth of 5,000 cps. may be transmitted between continents with 50 watts of average power . . . Each 5-mc. bandwidth television channel similarly might be transmitted between continents with 50 kilowatts . . .

THE APPARENT TEMPERATURE OF ISOLATED OBJECTS
W.H. Peake, Antenna Lab., Ohio State U. Research Foundation, Columbus, Rept. on Theoretical and Experimental Analysis of the Electromagnetic Scattering and Radiative Properties of Terrain, with Emphasis on Lunar-Like Surfaces, 1 Oct. 1961, 20 p., incl. illus., 8 refs., AD 295 193.

The emission and absorption cross-sections of an arbitrary object are defined in terms of its scattering cross-section, and the principle of detailed balance is then used to derive Kirchhoff's radiation law for the object, taking into account both the polarization of the emitted and absorbed radiation and the orientation of the object . . . use to calculate the apparent brightness temperature . . . a simple formula for the change in antenna temperature caused by introducing the object into the beam of a high-gain microwave radiometer antenna is found.

PROJECT ECHO. SYSTEM CALCULATIONS
C.L. Ruthroff, et al., National Aeronautics and Space Admin., Washington, D.C., NASA Tech. note D-1128, Nov. 1961, 13 p., AD 266 835.

. . . include path loss computations, expected audio signal-to-noise ratios, and received signal strength based on orbital parameters.

STATIC REFLECTIVITY MEASUREMENTS OF 12 FOOT DIAMETER INFLATABLE SATELLITE
Radiation Inc., Palo Alto, Calif., Rept. no. 6458, RADC TR 61-181, 1 July 1961, 17 p., AD 262 448.

. . . measurements were made using vertical and horizontal polarizations and using scale model techniques to simulate frequencies of 400 and 2270 mcs.

A LUNEBURG LENS AS A PASSIVE REFLECTOR FOR SATELLITE COMMUNICATION
R.N. Assaly, Lincoln Lab., Mass. Inst. of Tech., Lexington, Technical rept. no. 277, AFESD TDR 62-248, 21 Aug. 1962, 27 p., incl. illus. tables, 8 refs., AD 291 781, N63-17451.

SATELLITE COMMUNICATION STUDIES
S. Cok, et al., Montana State Coll., Bozeman, Final rept., RADC TR-6196, 27 June 1962, 101 p., incl. illus. tables, 35 refs., AD 283 407.

. . . Passive satellite communications . . . Low noise amplifiers. State of the art of power supplies . . .

TRANSCONTINENTAL SATELLITE TELEVISION TRANSMISSION (Correspondence)
D. H. Hamilton, Jr., et al., Proc. IRE, vol. 50, June 1962, p. 1522/1523.

. . . during the week of April 22, 1962 . . . accomplished by employing very powerful and sensitive microwave radio equipment to reflect signals from coast to coast via the orbiting Echo balloon.

RADAR CROSS-SECTION OBSERVATIONS OF THE ECHO I COMMUNICATIONS SATELLITE AT 440 MC/S
D. P. Hynek, Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 30 G-2, AFESD TDR 62-72, 19 Feb. 1962, 94 p., AD 274 065.

SPHERICAL SCATTERING CENTERS UTILIZED AS PASSIVE SATELLITES
K. H. Kriz, Radioplane Div., Northrop Corp., Van Nuys, Calif., RP rept. no. 2489, RADC TDR-2489, 10 Jan. 1962, 112 p., incl. illus. talbes, 8 refs., AD 274 941.

MICROWAVE CROSS SECTION OF THIN DIPOLES
C. L. Mack, Jr., Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 36G-2, AFESD TDR 62-243, 15 Nov. 1962, 31 p., incl. illus. tables, 18 refs., AD 291 231.

Efficient electromagnetic scatterers were sought for a passive satellite communication system. Attempts to elongate short dipoles into half-wave resonance are reported, as well as cross-section measurements of various other scatterers. . . .

THE INSTRUMENTATION OF AN ARRAY OF REFLECTORS FOR PASSIVE SATELLITE COMMUNICATIONS
A. E. Ruvin, et al., Airborne Instruments Lab., Inc., Mineola, N.Y., 1962, 9 p., incl. illus. 5 refs., AD 287 876.

. . . Four 30-foot reflectors have been instrumented for the University to make adaptively coherent the signals received by each dish from an Echo satellite. The satellite is illuminated by a remote transmitted signal. The effective gain of a 60-foot dish is obtained by the effects of slow irregularities in propagation and phase shifts, which are automatically compensated for in the signal-processing equipment. . . .

LINE-OF-SIGHT TRACKING OF BALLOON TYPE SATELLITES IN PERTURBED CIRCULAR ORBITS
S. Samet, Flight Sciences Lab., Inc., Buffalo, N.Y., Final rept., RADC TDR 62-303, Aug. 1962, 51 p., incl. illus., 22 refs., AD 291 768.

Analytical solutions for the short time motion of a balloon type satellite displaced from a circular orbit by the perturbing forces of Earth oblateness, air drag, and solar radiation pressure were obtained. . . .

APPLICABILITY AND EFFICIENCY OF ANGLE RETURN ARRAYS (VAN ATTA ARRAYS) IN PASSIVE COMMUNICATION SATELLITES
Y. E. Stahler, Directorate of Operational Support Engineering, Aeronautical Systems Div., Wright-Patterson Air Force Base, Ohio, Rept. for Oct. 1961-Feb. 1962, ASD TDR 62-439, June 1962, 18 p., incl. illus. 3 refs., AD 284 396.

. . . Although the reflection from a Van Atta array theoretically does not appear to depend on angle of incidence, the requirements of a passive communication satellite severely limit the applicability of such arrays and practically annihilate the angle independence. Particularly degrading requirements are: the need for three-dimensional symmetry of the reflection, the independence from the plane of polarization, and a wide frequency range. Practical tests show that Van Atta arrays at short wavelengths are not as independent of angle as theoretically assumed. Finally the overall gain of a spherical arrangement of Van Atta arrays is estimated, and the directivity may be improved by approximately 10-db. This improvement appears rather insignificant if compared with the 7-db gain of an extremely simple wire-grid sphere.

PASSIVE SPHERICAL SATELLITE COMMUNICATIONS STUDY
J. V. Wilding, et al., ITT Labs., Federal Labs., Nutley, N.J., RADC TDR 62-89, March 1962, 152 p., incl. illus., AD 273 870.

. . . The nature of the transmission medium poses several problems, including: a variable length transmission path, an instant of transfer of communications from a setting satellite to a rising satellite, and the handling of traffic in the several forms of voice, graphics, teletype, and data. It is proposed that all traffic be handled in digital form once it enters the system and that transmission on each link be in the form of a time-division multiplexed serial binary stream.

REFLECTIVITY CHARACTERISTICS OF ECHO BALLOONS
Radiation, Inc., Melbourne, Fla., Final Report, Oct. 1962, 66 p., refs., N64-19618.

Scale-model techniques were used to measure the bistatic response to the Echo I and II balloons, with the primary effort being devoted to Echo II.

Test frequencies of 3,000 and 9,600 mc/s simulate data at 55.5, 178, and 890 mc/s. . . .

PASSIVE SPHERICAL SATELLITE COMMUNICATIONS STUDY
General Electric Co., Syracuse, N.Y., Final rept., vol. 1, Rept. no. DSD-ASER6-62, RADC TDR 62-136, vol. 1, July 1962, lv., incl. tables, refs., AD 282 713.

. . . Orbital coverage and satellite switching . . . Lifetime of perturbed orbit system . . . The global station network. . . . Modulation studies; Tracking and acquisition; Combination of communicating and tracking functions; typical frequency assignment of European A and B stations . . . Number of frequency allocation channels . . .

THE USE OF SIMPLIFIED ORBITAL THEORY FOR SATELLITES OF LARGE AREA-TO-MASS RATIO
G.E. Cook, Royal Aircraft Establishment (Gt. Brit.), RAE Techical Note space 28, March 1963, 15 p., AD 409 932.

. . . originally developed to investigate the orbital behaviour of operational belts of Needle satellites, is used to compute the perturbations of two balloon satellites. These perturbations are found to agree well with observed values . . .

STUDIES IN RADAR CROSS SECTIONS XLVIII - DIFFRACTION AND SCATTERING BY REGULAR BODIES II
R.E. Kleinman, et al., Michigan U. Radiation Lab., Ann Arbor, AFCRL-63-29; Rept. 3648-2-T, N63-18269.

ENERGIE DE RAYONNEMENT CAPTEE PAR UN RECEPTEUR PLAN OU SPHERIQUE DANS L'ESPACE (The Energy of Radiation Picked Up By A Plane Or Spherical Receiver in Space) (In French)
E. LeGrives, et al., La Recherche Aerospatiale, Jan.-Feb. 1964, p. 31/36, A64-16181.

Application of the unit tangent sphere method to obtain the expression of the angle factor relative to a plane surface element. By integration, the general angle factor of any shape can be obtained. Having obtained this factor, it is possible to calculate the amount of energy absorbed by a receiver of any shape, which is exposed in space to the radiation from a body producing uniform emissions. . . .

CHARACTERISTIC OF PASSIVE COMMUNICATION SATELLITES WITH LAMERTIAN SURFACES
H.P. Raabe, NASA, Washington, D.C., Sept. 1963, 17 p., 3 refs., Presented at the XIII Intern. Cong., Varna, Bulgaria, Sept. 28, 1962, N63-20601.

. . . with surfaces reflecting diffusely according to Lambert's law . . . they afford a directional pattern well matched to the optimum pattern of satellites in lower orbits . . . such surfaces are easily realized . . . Compared with a rigidized specularly reflecting sphere, a Lambertian reflector affords a 7-db stronger echo for the same weight. Model tests of reflectivity agree well with the theory.

TABLES OF THE AMPLITUDE AND PHASE OF THE BACKSCATTER FROM A CONDUCTING SPHERE (RADIUS/WAVELENGTH = 0.01 TO 19.00 IN STEPS OF 0.01)
J. Rheinstein, Lincoln Lab., Mass. Inst. of Tech., Lexington, 19 June 1963, 44 p., AD 413 103.

. . . calculations . . . on an IBM 7090 . . . presented in both graphical and tabular form.

SUNGLIGHT PRESSURE PERTURBATIONS ON SATELLITE ORBITS
I.I. Shapiro, In: Advances in the Astronautical Sciences, vol XI, American Astronautical Society, Annual Meeting, 8th, Washington, D.C., Jan. 16-18, 1962, Proceedings, Edited by Horace Jacobs, North Hollywood, Calif., Western Periodicals Co., 1963, p. 35/60, 35 refs., A64-11445.

. . . Particlar emphasis is given to resonant and to stable orbits. Deductions from the effects of sunlight pressure on the Echo balloon are discussed, as are some implications for passive satellite communication systems. In addition, the influences of sunlight pressure on the dust belt that may be orbiting the Earth are considered.

CORNER REFLECTORS AS ELEMENTS OF PASSIVE COMMUNICATION SATELLITES
Y.E. Stahler, Aeronautical Systems Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, ASD TDR63 353, July 1963, 32 p., AD 416 689.

. . . corner types of 2.5 wavelength size were investigated: (a) two-dimensional corner (folded plate), (b) spherical corner (quarter of a hemisphere), (c) trihedral corner (open and filled with a dielectric), and (d) concave cone. Bistatic reflection tests defined the beam-spreading as 12 to 16 degrees, and monostatic reflection tests of rotating objects resulted in an average scan angle of 50 degrees. . . .

CORNER REFLECTORS AS ELEMENTS OF PASSIVE COMMUNICATION SATELLITES
Y.E. Stahler, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 161/172.

ON THE EFFECT OF WRINKLES ON THE REFLECTIONS BY A SPHERE
F.J. Tischer, Alabama U. Research Inst., Huntsville, Research Report No. 7, Sept. 1963, 11 p., Presented at the 5th Intern. Symp. on Space Technol. and Sci., Tokyo, 2-7 Sept. 1963, N64-13182.

Scattering of microwaves by a wrinkled spherical surface is considered. A rigorous formulation of the problem is considered.

Approximate solutions based on geometrical and physical optics are presented.

EVALUATION OF MODEL LENS-REFLECTOR-TYPE-COMMUNICATIONS SATELLITE
Goodyear Aerospace Corp., Akron, Ohio, Rept. for Oct. 1961-May 1963, Rept no. GER11123, ASD TDR63 779, Oct. 1963, 69 p., AD 424 174.

. . . model showed a substantial gain over a simple sphere, but exhibited large signal fluctuations . . . possibility of a constant return from a full-size design.

AEROSPACE EXPANDABLE STRUCTURES
Flight Dynamics Lab., Aeronautical Systems Div., Wright-Patterson AFB, Ohio, 1963, 418 p., AD 432 006.

Descriptors: Symposia . . . Inflatable structures . . . Communication satellites (passive) . . . Solar panels . . .

ORBIT POSITION CONTROL SYSTEMS COMPARISON AND SELECTION STUDY REPORT
Westinghouse Electric Corp., Baltimore, Md., Aerospace Div., Interim Report, 8 Nov. 1963, 131 p., N64-18440.

A system is considered in which solar flux is used as a force to change orbital parameters of a passive communication satellite in a manner that, when controlled, will permit sufficient change of these parameters to provide means for station keeping of a satellite, with respect to others in the same orbital plane, the purpose is to be able to maintain spacing of a minimum number of these satellites in order to provide maximum communications coverage around the earth's surface . . .

Related Publications:

SPHERICAL RADAR REFLECTORS WITH HIGH-GAIN OMNIDIRECTIONAL RESPONSE
H.E. Schrank, East Coast Conf. Aerospace Navig. Electronics, vol. 6, no. 11.5, Oct. 1959, p. 1/6.

. . . have high-gain radar cross sections, with omnidirectional response in at least one plane . . . one uses the . . . spherical Luneberg lens with a circumferential reflecting ring, while the other is essentially hollow and can be made in the form of a balloon target. . . .

A PASSIVE COMMUNICATIONS SYSTEM UTILIZING A PHOTOCONDUCTIVE MODULATION TECHNIQUE
W.E. Bulman, et al., Rept. on Ion Sheath Research, 24 Feb. 1960, 19 p., incl. illus. tables, AD 236 012.

PROJECT ECHO
JPL Res. Summ., vol. 1, no. 36-2, Feb./March 1960, p. 1/3.

The transmit-receive stations located at Goldstone, California . . . and Holmdel, N.J. . . . will provide an east-to-west communication link at 960.05 mc and a west-to-east communication link at 2390 mc via a 100-foot diameter balloon functioning as a passive repeater. An additional 2388-mc signal will be used at the Goldstone site to track the balloon. . . . and provide data useful for orbit determination. Approximately 1 kw of RF power will be transmitted to the balloon from the Goldstone transmitting site to provide a balloon-reflected signal for the 2388-mc tracking receiver at the Goldstone receiving site. . . .

SPECTRAL SUITABILITY, MODULATION AND DETECTION TECHNIQUES IN COMMUNICATION WITH WAVELENGTHS BETWEEN 30 AND 10,000 ANGSTROMS, PART I
D.S. Bayley, et al., General Precision Lab., Inc., Pleasantville, N.Y., Final rept., rept. no. A24-3, RADC TDR 62-224, vol. 1, April 1962, 190 p., incl. illus. tables, refs., AD 282 726.

. . . Detailed analyses are given of various arrangements for demonstrating the long-range communication potential of the laser by using a diffusely - reflecting earth satellite (such as Echo II) as a highly attenuating link between ground-based transmitting and receiving stations.

PROGRAMMED SATELLITE TRACKING
G. Negus, Rome Air Development Center, Griffiss Air Force Base, N.Y., Rept. no. RADC TDR 62-210, May 1962, 13 p., incl. illus. tables, 3 refs., AD 276 360.

. . . orbital data analyses associated with the satellite acquisition and tracking aspects of a global communication passive satellite system is explored. . . .

ECHO COMMUNICATION SATELLITE. A DDC REPORT BIBLIOGRAPHY
E.E. Thompson (comp.), Defense Documentation Center, Alexandria, Va., Bibliography for Dec. 1959-Nov. 1963, Nov. 1963, lv., 49 refs., AD 422 849.

. . . 49 documents cataloged by DDC from December 1959 to the present. . . .

SPACE COMMUNICATIONS TECHNIQUES
Page Communications Engineers, Inc., Washington, D.C., Final rept., RADC TDR 63 111, April 1963, lv., AD 402 834.

. . . expansion of interim simplex space communication facilities at Rome, N.Y., and Trinidad to full duplex for use in communication experiments using passive satellites. . . . improved tracking accuracy . . .

4A.130: Celestial Communications Relays

Included: Moon relays; Sun relays; Venus relay; Theory of scattering by the Moon; Wideband lunar relay communications; Radar analysis of the Moon; Radio communications via the Moon; Moon-bounce tests; Bandwidth of Moon circuits.

Not Included: Astrophysics of the Moon; Characteristics of multipath channels (1); Antenna problems.

Cross References: Modulation problems of Moon relays (4A.420).

Principal Publications:

STUDIES IN RADAR CROSS SECTIONS XXVIII - THE PHYSICS OF RADIO COMMUNICATION VIA THE MOON
M. L. Barasch, et al., Radiation Lab., Univ. of Michigan, Ann Arbor, Report No. 2673-1-f; RADC TR-58-73, March 1958, 86 p., AD 148 748.

UKW-FUNKVERBINDUNG AMERIKA-DEUTSCHLAND VIA MOND (Radio Connection USA - Germany via the Moon) (In German)
P. Lengrusser, Funk Technik, vol. 13, July 1958, p. 476/477.

LUNAR RADIO ECHOES
J. H. Trexler, Proc. IRE, vol. 46, Jan. 1958, p. 286/292.

COMMUNICATIONS CONSIDERATIONS
Radiation Lab. University of Michigan, Ann Arbor, Report on Studies in Radar Cross Section 28. The Physics of Radio Communication via the Moon, Report No. 2673-1-FM suppl. to Report No. 2673-1-F - AD 148 748, July 1958, 2 p., AD 211 053.

SIGNALS REFLECTED FROM THE MOON
H. D. Webb, Electrical Engineering Res. Lab., U. of Illinois, Urbana, Quarterly progress rept. 11, 1 Aug.-31 Oct. 1959, 30 Nov. 1959, 9 p., AD 226 063.

. . . See also AD 226 578.

RADIO RELAYING BY REFLECTION FROM THE SUN
D. J. Blattner, IRE Conv. Rec. Pt. 5, vol. 8, March 1960, p. 135/140.

RADIO RELAYING BY REFLECTION FROM THE SUN
D. J. Blattner, IRE Trans. Commun. Syst., vol. CS-8, no. 3, Sept. 1960, p. 169/172.

. . . The possibility of using radio reflection from the sun to provide a communication link supplementing that using moon reflections is investigated analytically.

CHARACTERISTICS OF 488 MEGACYCLES PER SECOND RADIO SIGNALS REFLECTED FROM THE MOON
B. C. Blevis, et al., Reprint from J. of Res. Nat. Bur. Stand.-D, Radio propagation 64D:331-334, July-Aug. 1960, AD 256 826.

. . . experiments were carried out during 1957 and consisted of monitoring the signals received on two orthogonal dipoles mounted at the focus of a 28 foot parabolic tracking antenna.

CHARACTERISTICS OF 488 MEGACYCLES PER SECOND RADIO SIGNALS REFLECTED FROM THE MOON
B. C. Blevis, et al., J. Res. Nat. Bur. Stand., vol. 64D, no. 4, July-Aug. 1960, p. 331/333.

A LUNAR AND PLANETARY ECHO THEORY
W. E. Brown, Jr., Jet Propulsion Lab., Calif., Inst. of Tech., Pasadena, Technical release no. 34-54, 30 April 1960, 32 p., incl. illus., AD 240 772.

A relatively simple statistical approach is used to derive a theoretical impulse response of the lunar reflection . . . The same value appears to be consistent with data from Goldstone and Millstone experiments. The echo was assumed to consist of two components, specular and scatter . . . ratio of total scatter power and total specular power reflected (cpr) is found to fall between 0.1 and 1.0. The depth of the surface layer, could be as great as 10 km.

A THEORY OF RADAR REFLECTIONS FROM THE MOON
F. B. Daniels, Army Signal Research and Development Lab., Fort Monmouth, N.J., ASDRL tech. rept. no. 2163, Nov. 1960, 25 p., AD 247 077.

A METHOD OF EVALUATING THE INTENSITY OF RADIO SIGNALS REFLECTED FROM THE SURFACE OF THE MOON
M. P. Dopukhanov, Radio Engng: Transl. of Radiotekhnika, vol. 15, no. 5, 1960, p. 5/11.

Losses in propagation on the reflection of radio signals from the surface of the moon have until recently been determined from the "radar equation". . . . The proposed method enables the phenomena arising on reflection from the surface of the moon to be explained more accurately in the physical sense. . . .

COMPUTATION AND MEASUREMENT OF THE FADING RATE OF MOON REFLECTED V. H. F. SIGNAL
S. J. Frickler, et al., J. Res. Nat. Bur. Stand., no. 64D, Sept. 1960, p. 455/465.

SOME PROPERTIES OF RADIO WAVES REFLECTED FROM THE MOON AND THEIR RELATION TO THE LUNAR SURFACE
T. Hagfors, Stanford Electronics Labs., Stanford U., Calif., SED TN 60-779, 8 Aug. 1960, 26 p., AD 241 719.

. . . A theoretical discussion of the statistical properties of radio waves reflected from the moon is presented. This discussion is based on the assumption of a large number of scattering areas simultaneously contributing to the signal. The properties of the echoes are usually described in terms of pulse broadening or by means of an average-power pulse-response when very short pulses are transmitted. It is shown that the same type of information may be obtained by studying the correlation of complex amplitudes of two sine waves reflected from the moon at frequencies separated $\Delta\omega$ . . . It is suggested that his method will prove particularly useful in the study of the surface properties of distant targets such as the planets of our solar system. . . .

EVIDENCE THAT THE MOON IS A ROUGH SCATTERER AT RADIO FREQUENCIES
R. L. Leadabrand, et al., Stanford Research Inst., Menlo Park, Calif., Preliminary rept. no. 2, Feb. 1960, 21 p., incl. illus., AD 240 790.

Radar echoes from the moon were observed at 400 mc for the purpose of determining the scattering properties of the moon . . . A procedure for mapping the details of the moon's surface by radar, using range and Doppler shift coordinates is suggested. This technique does not require angular resolution.

RADIO FREQUENCY SCATTERING FROM THE SURFACE OF THE MOON (Correspondence)
R. L. Leadabrand, et al., Proc. IRE, vol. 48, May 1960, p. 932/933.

MEASUREMENTS OF LUNAR REFLECTIVITY USING THE MILLSTONE RADAR
G. H. Pettengill, Proc. IRE, May 1960, p. 933/934.

MEASUREMENTS OF LUNAR REFLECTIVITY USING THE MILLSTONE RADAR (Correspondence)
G. H. Pettengill, Proc. IRE, vol. 48, May 1960, p. 933/934.

REFLECTION OF SOUND FROM RANDOMLY ROUGH SURFACES
J. M. Proud, Jr., et al., J. Appl. Phys. vol. 31, no. 3, March 1960, p. 543/552.

LUNAR COMMUNICATION TEST SUMMARY
P. B. Sebring, Lincoln Lab., MIT, Lexington, Rept. 30G-0011, 30 Sept. 1960, 9 p., AD 244 207.

. . . operating parameters and the results obtained on several UHF "moon-bounce" voice communications trails between the Millstone Station and other activities having large sterable antennas. As predicted, most multi-path distortion problems arising from the large physical size of the moon were minimized by the use of single side-band transmission . . . very successful test of a voice circuit from Millstone to the 250-ft diameter radio telescope at the Jodrell Bank Experimental Station in England.

A THEORY OF RADAR SCATTERING BY THE MOON
T. B. Senior, et al., J. Res. Nat. Bur. Stand., vol. 64D, no. 3, May/June 1960, p. 217/229.

SIGNALS REFLECTED FROM THE MOON
H. D. Webb, Electrical Engineering Res. Lab., U. of Illinois, Urbana, Final rept. 1 Feb. 1957-31 Dec. 1959, 29 Feb. 1960, 72 p., AD 236 064.

USE OF MOON OR SATELLITE RELAYS FOR GLOBAL COMMUNICATION
L. P. Yeh, Electronics, vol. 34, Nov. 1960, p. 607/615.

The moon as passive reflector is compared to an active satellite relay. The moon relay is discussed in detail. . . .

PRELIMINARY MOON BOUNCE TESTS
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 35/38.

. . . These tests, conducted at 960.05 mc, were designed primarily to determine the optimum system for Moonbounce taped and live voice communications between the Goldstone and Woomera Tracking Stations. Single-sideband (SSB) transmission was used throughout the experiments and various receiving system methods were evaluated. . . .

AN INVESTIGATION OF LUNAR AND AURORAL RADIO ECHOES
H. A. von Biel, Cornell Aeronautical Lab., Inc., Buffalo, N. Y., Summary scientific rept. for period ending 15 Oct. 1960, lv., AD 251 632.

. . . at 915 mc . . . about 90% of the total power contained in lunar echoes is reflected from an area on the moon not larger than 3% of the visible lunar surface. The echo exhibits Rayleigh-like fading when averaged over a one-minute time interval . . .

NAVY DEMONSTRATES SATELLITE RELAY
Missiles and Rockets, vol. 6, no. 6, Feb. 1960, p. 22/23.

Radio signals bounced off moon's surface to provide complete high-frequency link between Washington and Hawaii.

THE SCATTERING PROPERTIES OF THE LUNAR SURFACE AT RADIO WAVELENGTHS
J.V. Evans, Lincoln Lab., MIT, Lexington, Rept. 3G-0004, 10 Jan. 1961, AD 250 684.

BANDWIDTH OF A MOON COMMUNICATION CIRCUIT
J.V. Evans, Brit. J. Appl. Phys., vol. 12, no. 8, Aug. 1961, p. 406/409.

Radar studies of the moon . . . shown that the principal reflections occur from a region at the center of the visible disk having a radius of about one-tenth of that of the moon. Thus it is possible to use the moon as a reflector in a communication system . . . This paper describes measurements made at Jodrell Bank to determine the single-channel bandwidth of the system using double-sideband amplitude-modulated transmissions. . . .

AVAILABILITY OF MOON FOR GLOBAL COMMUNICATIONS
P.M. Hahn, et al., IRE Trans. Space Electronics Telemetry, vol. SET-7, Sept. 1961, p. 57/59.

. . . method for quickly and quite accurately estimating the time that the moon is in common view of two stations on earth during the lunar day. . . .

RADAR SCATTERING CROSS SECTION — APPLIED TO MOON RETURN (Correspondence)
H.S. Hayre, Proc. IRE, vol. 49, Sept. 1961, p. 1433.

RADAR MEASUREMENTS OF THE LUNAR SURFACE
G.H. Pettengill, et al., In: Advances in the Astronautical Sciences, vol. VIII, American Astronautical Society, Annual Meeting, 7th, Proceedings, Dallas, Tex., Jan. 16-18, 1961, New York, Plenum Press, Inc., 1963, p. 564/570, 13 refs., A63-17662.

. . . recent measurements of the radio-echo power scattered by the lunar surface . . . at 440 Mc . . . parabolic reflector 84 feet in diam. . . . peak transmitted power of approximately 2.5 Mw . . . measurements are shown to be consistent with a surface dielectric constant of 2.8, which corresponds approximately to the bulk value for sand . . . it is deduced that only about 5% of the surface is rough to the scale of 68 cm. Measurements of the depolarization of the scattered energy offer verification of the surface properties.

RADIO CHARACTERISTICS OF LUNAR SURFACE MATERIAL
K.M. Siegel, In: 12th International Astronautical Congress, Proceedings, vol. 2, Washington, D.C., Oct. 1-7, 1961, New York and London, Academic Press, Inc., 1963, p. 662/669, 13 refs., A63-21282.

The different theories of radio scattering from the Moon are compared and analyzed . . .

ATTEMPTS TO MEASURE THE FARADAY ROTATION AND FADING RATES OF MOON-REFLECTED RADIO SIGNALS AT 23.1MC
H.D. Webb, Stanford Electronics Labs., Stanford U., Calif., Scientific rept. no. 3, 25 Aug. 1961, 26 p., AD 267 166.

. . . Equations are presented which may be used to calculate the total electron content in the ionosphere, using the Faraday fading period and the difference between the polarization angles at 2 frequencies. Criteria are given for selecting the second frequency. . . . A method of correlation analysis is presented. Equations are given for calculating the autocorrelations, cross-correlation, and spectra from experimental data. The methods of data analysis are applied to data taken on 31 July 1960.

LONG DISTANCE COMMUNICATION VIA THE MOON
P.A. Webster, J. Brit. Instn. Radio Engrs., no. 22, Sept. 1961, p. 257/264.

Three experiments in Moon reflection using 1 kW v.h.f. transmitters and the Jodrell Bank radio telescope are described. The results are discussed in terms of practical long-distance communication circuits using the Moon as a passive reflector. Consideration is given to the optimum frequency, type of modulation, aerial size, etc., for economic utilization of such a circuit.

SURFACE ELECTROMAGNETIC REFLECTION CHARACTERISTICS
Antenna Lab., Ohio State U. Research Foundation, Columbus, Final engineering rept., 1 Sept. 1960-31 Oct. 1961, Rept. no. 1179-4, 1 Nov. 1961, 26 p., incl. illus., refs., AD 295 195.

. . . investigation into the relations between what is known of the electromagnetic scattering properties of the moon and the nature of its surface structure are reviewed.

LUNAR REFLECTION STUDY
B. Claxton, et al., General Electric Co., Schenectady, N.Y., Final rept., pt. 1, AFCRL 62-300, vol. 1, 20 March 1962, 96 p., incl illus. tables, 25 refs., AD 276 233.

. . . A step-by-step approach is presented to the design of a lunar reflection communication system. . . . Limitations of the moon path . . . distortion present on the reflected signals. Methods for the calculation of signal strength, moon availability, moon position, and libration are given, as well as antenna formulas and system noise temperature calculations.

LUNAR REFLECTION STUDY
B. H. Claxton, et al., General Electric Co., Schenectady, N.Y., Final rept., pt. 2, AFCRL 62-300, vol. 2, 31 Aug. 1962, 48 p., incl. illus. table, 21 refs., AD 286 277.

The effective bandwidth of the lunar reflection path was determined. Doppler shift, signal strength, and amplitude fading of CW signals were measured, and the results analyzed and compared to theoretical predictions. Double sideband suppressed carrier transmissions centered at 915 Mc, with audio frequency modulation to produce two signals separated in frequency by a small amount, were reflected from the moon and received. The amplitudes of the two sidebands were separately recorded, and their correlation coefficient computed to give a measure of the quality of the circuit. Forty-five determinations of the correlation gave a value of .26 ± .07, showing that the coherent bandwidth of the moon reflection path is extremely narrow. A standard word list was expected . . . 74% of the moon-reflected words, whereas 95% of the words on a similar list presented without distortion but in the same signal/white noise environment, were correctly judged. . . .

RADIO-ECHO OBSERVATIONS OF THE MOON AT 68-CM WAVELENGTH
J. V. Evans, Lincoln Lab., Mass. Inst. of Tech., Lexington, Technical rept. no. 272, AFESD TDR 62-241, 22 June 1962, 24 p., incl. illus. table, 34 refs., AD 291 102 (See also AD 274 669).

. . . short-pulse experiments. . . .

A METHOD OF RADIO COMMUNICATION USING THE MOON
N. A. Kalashnikov, et al., Foreign Tech. Div., Air Force Systems Command, Wright-Patterson AFB, Ohio, 4 June 1962, 4 p., including illus. Trans. no. FTD-TT-62-441 from Soviet Patent no. 132680 (652243/26), 28 Jan. 1960, AD 281 510.

. . . broad-band communications system is proposed . . . each discrete communication being transmitted using two pulses, shifted with respect to one other; they are modulated by different frequencies such that at the reception point the output pulse is determined by the difference in the envelopes of these two pulses; this makes it possible to decrease the mutual influence of the pulse of neighboring channels.

RADAR REFLECTIONS FROM THE MOON AT 425 Mc/s
G. H. Millman, et al., J. Res. Nat. Bur. Standards, Section D - Radio Propagation, vol. 67D, March-April 1963, p. 107/117, 20 refs., A63-13523.

RADIO-BRIGHTNESS DISTRIBUTION ON THE LUNAR DISK AT 0.8 CM (Translation)
A. E. Salomonovich, et al., Soviet Astronomy, vol. 6, May-June 1963, p. 833/839, 11 refs., A63-17303.

RADAR REFLECTION FROM A ROUGH MOON DESCRIBED BY A COMPOSITE CORRELATION FUNCTION
F. B. Daniels, J. Geophys. Res., vol. 68, Dec. 1, 1963, p. 6251/6254, A64-11581.

Examination of the theory of radar reflections from a rough planetary surface for the case of deep modulation where the surface correlation function consists of two components having greatly different structure sizes. It is found that a modified superposition principle holds for the angular power spectrum and that the individual components may be detectable by high-resolution pulse techniques. Recent lunar experiments by Mehuron are found to show the existence of two such components.

THE USE OF AN HF LUNAR REFLECTION CIRCUIT IN THE STUDY OF IONOSPHERIC ELECTRON DENSITY
J. R. Davis, et al., Naval Research Lab., Washington, D.C., NRL rept. 5968, 19 July 1963, 12 p., AD 414 850, N64-15130.

A high-power hf transmitter was used to illuminate the moon at moonrise. The returned signals which have been observed display both the smooth-sphere scattering components and the rough-scatter components reported previously by observers utilizing the vhf and uhf bands. . . . The received moon echoes were subjected to a high degree of predetection bandwidth narrowing and were analyzed to yield information regarding the possible extent of polarization-rotation undergone by radio waves traversing the ionosphere.

THE RADAR CROSS SECTION OF THE MOON
J. V. Evans, et al., J. Geophys. Res., vol. 68, Sept. 1, 1963, p. 5098/5099, 16 refs., A63-22364.

THE SCATTERING PROPERTIES OF THE LUNAR SURFACE AT RADIO WAVE LENGTHS
J. V. Evans, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, 1963, 32 p., AD 416 095.

THEORY OF RADAR SCATTER FROM ROUGH SURFACES, BISTATIC AND MONOSTATIC, WITH APPLICATION TO LUNAR RADAR RETURN
A. K. Fung, J. Geophys. Res., vol. 69, no. 6, 15 March 1964, p. 1063/1073, refs., N64-19499.

. . . theoretical expression for the bistatic radar return without neglecting terms involving partial derivatives of the surface. . . . final results are specialized for backscatter cases to permit comparisons with the lunar radar observations . . .

A NUMERICAL METHOD FOR FINDING BACKSCATTER FUNCTIONS
W.F. Gillmore, Jr., JPL Space Progr. Summ., vol. 4, no. 37-23, Aug./Sept. 1963, p. 188/191.

A backscatter function is a relationship between incident radiation and radiation scattered backward along the same direction. . . . It is also possible to define an average backscatter function for a lunar or planetary surface. For this purpose the surface is replaced by a homogeneous sphere. This sphere has as nearly as possible the same radius, position, and velocities in space as the original surface.

FEASIBILITY OF A LUNAR OPTICAL RANGING EXPERIMENT
R.L. Iliff, et al., Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 63 908, Dec. 1963, 24 p., AD 434 586.

. . . using a high energy pulsed laser . . . giving special attention to the required minimum return signal, interfering radiation, detector devices, and pulse length.

LUNAR RADAR EXPERIMENTS
G. Levy, JPL Space Progr. Summ., vol. 4, Feb./March 1963, p. 142/145.

In SPS 37-18, Vol. IV, p. 194 and SPS 37-19, Vol. IV, p. 199, Faraday rotation experiments using the planet Venus were described. . . . Faraday rotations observed could be completely accounted for by the interaction of the Earth's ionosphere with the 2388-Mc microwave energy. To verify this conclusion, a series of lunar radar experiments are now in progress. The experiments began March 3, 1963.

RADAR OBSERVATIONS OF THE MOON AT A WAVELENGTH OF 8.6 MILLIMETERS
V.L. Lynn, et al., J. Geophys. Res., vol. 69, Feb. 15, 1964, p. 781/783, A64-14365.

. . . to determine the distribution of radar microwave beam scattering at 8.6 mm wavelength and 12 watts power output. Use of precision radar antenna gave a high degree of angular resolution with low signal-to-noise ratio. No difference in reflectivity between Maria and lunar continents was observed. Approximately 85 per cent of the total reflection is the result of rough scattering. . . .

LUNAR ECHO BORESIGHTING OF LARGE APERTURE SYSTEMS
W. Mehuron, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 301/313.

An automatic technique for boresighting large aperture radar systems has been demonstrated and implemented. The technique uses the actively tracked Moon as a reference standard and achieves angular accuracies on the order of 0.1 mil using a simple error theory. The automatic reduction technique used for processing the large number of measurements is presented. . . .

RADAR BACK SCATTERING MEASUREMENTS FROM "MOON LIKE" SURFACES
W.H. Peake, et al., Ohio State U., Research Foundation, Antenna Lab., Columbus, Ohio, Rept. 1388-9, May 1, 1963, 18 p., 2 refs., N63-18395.

BACK-SCATTERING PROPERTIES OF MOON AND EARTH AT X BAND
H. Safran, AIAA Journal, vol. 2, Jan. 1964, p. 100/101, A64-13137.

Presentation of the back-scattering cross section per unit area of lunar surface. The knowledge of this functional dependence is necessary for the design of vehicle-borne radars measuring altitude and velocity very accurately for the purpose of navigation over the Moon. Analogous results for the Earth are also given. . . .

RADAR ANALYSIS OF THE MOON. PHASE II: SURFACE PROPERTIES
J.D. Shaw, et al., Texas Instruments, Inc., Dallas, AFCRL-64-74, 16 Jan. 1964, 113 p., refs., AD 432 403, N64-17505.

. . . relevant diffraction theory for describing radar return from an arbitrary terrain clearly shows the inherent ambiguity between geometrical and electromagnetic contributions and the deficiencies of the frequently used Huygens-Kirchoff theorem . . .

WIDE BAND LUNAR RELAY COMMUNICATIONS
W.M. Waters, et al., Electronic Communications Inc., Timonium, Md., Research Div., Final Report, AFCRL-63-332, May 16, 1963, 44 p., 23 refs., N63-23701, AD 422 223.

. . . problem of increasing lunar relay bandwidth. An adaptive receiving array is described which makes possible the use of exceptionally large apertures capable of being focused on a small spot on the lunar surface. However, an analysis shows that sidelobe effects considerably reduce expected bandwidth gains. A bandwidth of 25 kc is calculated for a 1000 ft^2 X-band array which employs a "maximum energy" taper. Between 256 and 1024 array elements are required.

ADAPTIVE RECEIVING ARRAYS FOR WIDE-BAND LUNAR RELAY COMMUNICATIONS
W.M. Waters, et al., IEEE Trans. Antennas Propagation, vol. AP-12, March 1964, p. 195/199, 23 refs., A64-16609.

. . . for increasing lunar relay bandwidth. Because of the size of the Moon, bandwidths of lunar relay communications links have been below 10 kc. An adaptive receiving array makes possible the use of exceptionally large apertures capable of being focused on a small spot on the lunar surface. . . .

RADAR REFLECTIONS FROM INHOMOGENEOUS DIELECTRICS: APPLICATIONS TO THE MOON
C. Yeh, et al., JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 138/142.

. . . This report contains a preliminary discussion of our attempts to analyze the radar measurements from a more rigorous standpoint using exact electromagnetic theory. The ultimate goal of this investigation is to develop a theoretical approach to all of these phenomena which will allow applications to the Moon and the planets.

LUNAR RADAR SYSTEM NOISE TEMPERATURE MEASUREMENTS
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 54/59.

In SPS 37-23, Vol. III, pp 51/55, a discussion of a proposed adaptation of the Venus site planetary radar for lunar measurements was given. . . . The results of measurements are presented here of system temperature as a function of elevation angle, and system noise temperature as a function of klystron beam voltage. A figure of merit is defined as the power that would be transmitted with the klystron beam voltage on and RF excitation applied, divided by the system temperature measured with this beam voltage alone applied. The figure of merit is presented as a function of the power which would be transmitted if RF excitation were applied.

Related Publications:

THE APPARENT TEMPERATURE OF ISOLATED OBJECTS
W.H. Peake, Antenna Lab., Ohio State U. Research Foundation, Columbus, Rept. on Theoretical and Experimental Analysis of the Electromagnetic Scattering and Radiative Properties of Terrain, with Emphasis on Lunar-Like Surfaces, 1 Oct. 1961, 20 p., incl. illus., 8 refs., AD 295 193.

The emission and absorption cross-sections of an arbitrary object are defined in terms of its scattering cross-section, and the principle of detailed balance is then used to derive Kirchhoff's radiation law for the object, taking into account both the polarization of the emitted and absorbed radiation and the orientation of the object. . . . used to calculate the apparent brightness temperature . . . a simple formula for the change in antenna temperature caused by introducing the object into the beam of a high-gain microwave radiometer antenna is found.

A VHF-UHF MISSILE- AND SPACE-RESEARCH RADAR WITH A 150-FOOT STEERABLE ANTENNA
L. V. Blake (editor), Naval Research Lab., Washington, D. C., NRL Rept. no. 5801, 27 Aug. 1962 107 p., incl. illus. tables, refs., AD 284 575.

. . . The frequencies will initially be 138.6 and 435 mc, with pulse power of 500 kw, and pulse lengths of 100 and 12.8 microseconds, respectively. . . . Signal-to-noise ratios for echoes from the moon are estimated to be 23 db and 20 db, at these two frequencies. . . . Other possible applications are planet detection, space-probe tracking and communication, cosmic and solar noise study, and bi-static experiments.

IONOSPHERIC RESEARCH AND PROPAGATION STUDIES
H.D. Webb, et al., Electrical Engineering Research Lab., U. of Illinois, Urbana, Quarterly progress rept. no. 8, 1 April-30 June 1962, 14 p., incl. table, AD 282 100.

A calibration program was started for measuring the beamwidths and gains of the antenna at approximately 50 mc intervals from 300 to 1200 mc, using the sun as a radio source . . . Signals received by reflection from meteor bursts should be at the same frequency as the transmitted frequency except for a small Doppler frequency component due to ionospheric winds. Moon reflected signals were received on 47 days during the period for a total of approximately 470 hours. . . .

4A.140: Semipassive and Active Relays in General

Included: Quasi-passive satellite relay; COMMARRAY; Self-steering array repeater; Active scatterer area enhancement; Active retrodirective array; Spherical retrodirective array; Storage relays; Store-and-forward satellites; Data collection satellites.

Not Included: Antenna design.

Cross References: Project SCORE (Div. 4A.8); Broadcast satellite systems (Div. 4A.3); Project Courier (Div. 4A.8).

Principal Publications:

THE ACTIVE COMMUNICATION SATELLITE
J.K. Webb, Proc. Nat. Aeron. Electronics Conf., vol. 7, May 1959, p. 117/123.

WHAT THE DESIGNER FACES IN ACTIVE SATELLITE COMMUNICATIONS
Space Aeronautics, June 1959, p. 122/125.

A PASSIVE COMMUNICATIONS SYSTEM UTILIZING A PHOTOCONDUCTIVE MODULATION TECHNIQUE
W.E. Bulman, et al., Rept. on Ion Sheath Research, 24 Feb. 1960, 19 p. incl. illus. tables, AD 236 012.

. . . If a cw signal is modulated at a distant point and the modulated signal is reflected back to the transmitter site or to some other designated point, communication may be achieved using extremely small modulation power. Since only the power required to modulate the signal is supplied at the reflecting point, the system is, to all intents and purposes, a passive communications system. Modulation of the absorption of rf energy by a photoconductive process will cause amplitude modulation of a cw signal. Details of the modulating technique are given. Experimental results obtained from a small, low-power system are also given. Applications of this technique to ground-air, ground-space, and space-space communications are discussed.

THE EFFECT OF INTERFERENCE IN HARD LIMITING SATELLITE REPEATERS
R. Eschelbach, Proc. Nat. Commun. Symp., vol. 6, Oct. 1960, p. 312/322.

A DELAYED-REPEATER SATELLITE COMMUNICATION SYSTEM OF ADVANCED DESIGN
T.P. Mottley, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 2-3, April/July 1960, p. 195/207.

. . . consisting of an orbiting delayed-repeater radio-relay station which passes over terminal ground stations located within the viewing area of the satellite. . . .

TECHNIQUE FOR AMPLITUDE MODULATING A VAN ATTA RADAR REFLECTOR
W.F. Bahret, Proc. IRE, vol. 49, Nov. 1961, p. 1692.

ANTENNAFIERS FOR ECHO AREA CONTROL
J.R. Copeland, et al., Antenna Lab., Ohio State U. Research Foundation, Columbus, Rept. no. 903-30, 15 Dec. 1962, 12 p. incl. illus., AD 292 979.

. . . has been combined with a pair of orthogonal T-bar slot antennas in a ground plane so that a signal arriving through either antenna is amplified and reradiated from the other. Echo area measurements of this system are presented, and the general problem of echo area control with integrated antenna-active element systems is discussed . . . applications . . . passive or pseudo-passive satellite communications, and ground-based repeaters . . .

QUASI-PASSIVE SATELLITE RELAY COMMUNICATION SYSTEM
E.L. Gruenberg, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 363/370.

. . . A quasi-passive approach, which we call COMMARRAY, is presented in this paper. The system requires no on-board R-F power but it overcomes the limited sensitivity of passive satellites without sacrificing reliability and vulnerability. . . . The satellite employs an antenna of the Van Atta type . . . which is modulated by solid-state devices inserted in each of the paths that connect conjugate array elements. . . . The information in the COMMARRAY satellite is really transferred from sending link to receiving link in the satellite rather than relayed or amplified in the conventional sense. . . .

SCATTERER ECHO AREA ENHANCEMENT (Correspondence)
J.L. Ryerson, Proc. IRE, vol. 50, no. 9, Sept. 1962, p. 1979/1980.

Various communications systems have been proposed in which the received signal is one scattered from an object irradiated by a distant source. . . . making the echo area of the scatterer large in the direction of the receiver. . . . Van Atta array . . . amplifiers inserted in the lines connecting the array elements . . .

providing reliability through the redundancy of small components . . . array theory could be used to develop an entire class of pseudopassive scatterers for application to problems of communications and field measurement. . . . A dimensionally resonant dipole . . . would represent a 10^3 Mc bandwidth between half-power points. . . . Amplification . . . using the negative resistance characteristics of tunnel diodes . . .

SATELLITE DATA TRANSMISSION SYSTEM
S. Andre, Sylvania Electric Products, Inc., Buffalo, N.Y., Final rept., ASD TDR63 759, May 1963, 118 p., AD 422 651.

. . . a one-way satellite-to-earth data link using an automatic angle return adaptive phased array . . . The isolation achieved by orthogonally polarized receiving and transmitting arrays is analyzed, yielding array decoupling of better than 30 db. A 90% reduction in primary vehicular power in comparison to alternate approaches is shown to be obtainable with this system, using tunnel diode amplifiers and mixers. . . . test results of a feasibility model are presented. This model consists of two-orthogonally polarized, nine-element phased arrays for receiving and transmitting, with tunnel diode amplifiers and modulators in the interconnecting lines between the arrays. The amplifiers, mixers, filters, and circulators are fabricated in single strip transmission line modules . . . demonstrating the desired operation of the adaptive array and communication system technique. (See also AD 289 210, AD 283 952.)

AN ACTIVE RETRODIRECTIVE ARRAY FOR SATELLITE COMMUNICATIONS
S. N. Andre, et al., IEEE Trans. Antennas Propagation, vol. AP-12, March 1964, p. 181/186, 5 refs., A64-16607.

. . . The problem of instability is defined and several aspects of the solution, namely, frequency offsetting and polarization isolation, are explained. . . . Techniques for constructing the active circuitry required for the functions of RF amplification, frequency conversion, and modulation are described . . .

A SELF-STEERING ARRAY REPEATER
C. C. Cutler, et al., Bell Syst. Tech. J., vol. 42, no. 5, Sept. 1963, p. 2013/2032.

A scheme is disclosed whereby an antenna array is automatically directed by a simple intermodulation of signal components. In reception, each array element feeds a pilot signal and the modulated signal to a third-order mixer wherein the phase associated with the signal in that element is automatically cancelled. This allows in-phase addition of the contributions from the many elements irrespective of the array shape or the direction of the incoming signal. For transmission, a pilot signal received from the distant receiver location provides by intermodulation a phase compensation to the signal radiated from each transmitting element so as to automatically direct the radiated signal to the distant receiver. There are no significant restrictions as to the shape of the array or the frequencies used. The scheme lends itself to multiple-element, low-power circuitry and may be used in either space or terrestrial systems . . . An experimental verification of the basic principle is described.

SATELLITE COMMUNICATIONS RELAY SYSTEM USING A RETRODIRECTIVE SPACE ANTENNA
E. L. Gruenberg, et al., IEEE Trans. Antennas Propagation, vol. AP-12, March 1964, p. 215/223, 10 refs., A64-16612.

. . . The satellite employs an antenna of the Van Atta type which is modulated by solid-state devices inserted in each of the paths that connect conjugate array elements. A ground station located anywhere within the field of view of the antenna can receive information from the satellite by irradiating the modulated antenna. . . .

RESULTS OF THE TELSTAR SYSTEM COMMUNICATIONS TESTS
R. W. Hatch, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1561/1629.

. . . at the Andover earth station . . . included successful transmissions of telephone, television, and data signals . . . results are in good agreement with expected performance.

COMMUNICATIONS SATELLITES: TECHNOLOGY, ECONOMICS, AND SYSTEM CHOICES
S. H. Reiger, et al., RAND Corp., Santa Monica, Calif., Research memo. no. RM-3487-RC, Feb. 1963, 101 p., incl. illus. tables, refs., AD 296 068.

. . . study . . . of possible system choices to establish a commercial communications satellite system . . . satellite reliability . . . Cost estimates are made for representative stationary and non-stationary active satellite systems. . . .

SPHERICAL RETRODIRECTIVE ARRAY
E. M. Rutz-Philipp, IEEE Trans. Antennas Propagation, vol. AP-12, March 1964, p. 187/194, 8 refs., A64-16608.

. . . The array can receive an incoming signal over 4π steradians, amplify, frequency translate, and modulate the signal, and then return it in the direction of the incident wave . . . The retrodirective characteristic is achieved by a phase inversion technique that employs tunnel-diode image frequency

converters. . . . The output spectrum of the converters in the array contains not only the image frequency signal but additional frequency components as well. Because of the phase characteristics of the spectral components, only the image frequency signal will add coherently in direction of the incident wave when reradiated by the array elements.

Related Publications:

SATELLITE ENVIRONMENT VIA ONE-MILLIWATT OSCILLATORS
F. M. Riddle, Proc. Nat. Symp. Telem., no. 3.5, Sept. 1958, p. 1/22.

. . . discusses circuit-design philosophy, and practical circuits using fractions of a milliwatt per measurement in systems requiring filters and a minimum of other components. Circuit design is centered around energy-storage passive (inductance and capacitance) devices rather than dissipative resistors, thereby obtaining maximum power efficiency. The active elements are transistors used at very low power levels. . . . Some of these circuits have been used in Explorer I and subsequent Army satellites with excellent results. . . .

THE ATLAS-SCORE COMMUNICATION SYSTEM
M. I. Davis, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 401/406.

Project SCORE, or signal communication via orbital relay equipment, was an experiment to demonstrate conclusively that a radio relay system could be achieved utilizing a repeater installed in an orbiting space vehicle, . . . A maximum communications range of 1,000 miles . . . The satellite antenna pattern was essentially that of a multi-wavelength doublet. .1. selection of 40 kc (± 20 kcs) IF bandwidth . . . The satellite was conceived to perform a dual communications function. It was capable of serving as a "delayed repeater" or as a "real time" radio relay repeater. . . .

SEMI-ACTIVE CORRELATION RADAR EMPLOYING SATELLITE-BORNE ILLUMINATION
O. E. Rittenbach, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 268/269.

COURIER SATELLITE COMMUNICATION SYSTEM
G. F. Senn, IRE Trans. Mil. Electronics, vol. MIL-4, no. 4, Oct. 1960, p. 407/413.

THE COURIER COMMUNICATIONS SATELLITE ELECTRICAL DESIGN
J. M. Rosenberg, et al., IRE Internat. Conv. Rec., vol. 8, March 1961, p. 174/178.

For eighteen consecutive days, every one of the Courier Satellite's 39 electronic components worked perfectly within their design and predicted parameters. A comprehensive test program to demonstrate various kinds of data handling, vulnerability to jamming environmental analysis, propagation characteristics, and military communications operational procedures, was carried out at Deal, New Jersey and Salinas, Puerto Rico . . . . One hundred and fifty-four days after orbit, the solar power subsystem and acquisition and tracking transmitter are still working perfectly with no observable deterioration in performance.

TV BROADCAST FROM AN EARTH SATELLITE
R. G. Gould, IRE Internat. Conv. Rec., Pt. 8, vol. 10, March 1962, p. 96/109.

. . . considers the need for and the feasibility of direct continental TV broadcast to conventional home receivers from an orbiting stationary satellite. . . .

APPLICABILITY AND EFFICIENCY OF ANGLE RETURN ARRAYS (VAN ATTA ARRAYS) IN PASSIVE COMMUNICATION SATELLITES
Y. E. Stahler, Directorate of Operational Support Engineering, Aeronautical Systems, Div., Wright-Patterson Air Force Base, Ohio, Rept. for Oct 61-Feb 62, ASD TDR 62-439, June 1962, 18 p. incl. illus., 3 refs., AD 284 396.

. . . Although the reflection from a Van Atta array theoretically does not appear to depend on angle of incidence, the requirements of a passive communication satellite severely limit the applicability of such arrays and practically annihilate the angle independence. Particularly degrading requirements are: the need for three-dimensional symmetry of the reflection, the independence from the plane of polarization, and a wide frequency range. Practical tests show that Van Atta arrays at short wavelengths are not as independent of

angle as theoretically assumed. Finally the overall gain of a spherical arrangement of Van Atta arrays is estimated, and the directivity may be improved by approximately 10-db. This improvement appears rather insignificant if compared with the 7-db gain of an extremely simple wire-grid sphere.

DIRECT TV BROADCASTING USING SATELLITE REPEATERS

D. S. Bond, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 31/37, A63-21536.

Summary of recent system studies on the feasibility of direct TV broadcasting to home or community receivers from satellite repeaters. A TV broadcasting system is described which consists of one repeater satellite approximately 22,300 miles above the Earth's surface, with a 24-hour period, remaining stationary on the central meridian of the selected ground-covering area. The satellite contains a nuclear reactor providing an electrical power output of the order of 30-60 kw. It also carries a directive antenna and as many as four TV repeaters.

DIVISION 4A.2
LOW ALTITUDE COMMUNICATION SATELLITE SYSTEMS

4A.210: Low Altitude Active Communications Satellite Systems

Included: Coverage predictions of satellite systems; Innage outage intervals; Satellite coverage charts; Statistics of visibility; Various satellite configurations; Non-synchronous comsat systems; Orbit position control systems; Random satellite systems; Global coverage requirements; Number of satellites required for given coverage; Handover procedures in comsat systems; Station loading in multi-satellite systems.

Not Included: Satellite equipment design; Antenna problems.

Cross References: General design problems of active comsat systems (4A.140); Groundstation problems for communications satellites (4A.500).

Principal Publications:

INTERFERENCE AND CHANNEL ALLOCATION PROBLEMS ASSOCIATED WITH ORBITING SATELLITE COMMUNICATION RELAYS
F.E. Bond, et al., Proc. IRE, vol. 48, April 1960, p. 608/612.

DETERMINATION OF THE REQUIRED NUMBER OF RANDOMLY SPACED COMMUNICATION SATELLITES
F.V. Bennett, et al., National Aeronautics and Space Administration, Washington, D.C., Jan. 1961, 29 p. incl. illus., AD 249 293.

THE COVERAGE OF SYSTEMS OF NEAR EARTH SATELLITES
R.B. Kershner, et al., The Johns Hopkins Univ. Applied Physics Laboratory, Jan. 1961, 40 p.

SATELLITE NETWORKS FOR GLOBAL COVERAGE
F.W. Gobetz, United Aircraft Corp., East Hartford, Conn., Aug. 1961, 37 p., AD 415 247.

. . . problem of establishing a network of satellites positioned such that at least one satellite is in view at all times from any point on Earth. . . .

INTERFERENCE PROBLEMS OF CO-CHANNEL COMMUNICATION SATELLITE SYSTEMS
S.G. Lutz, et al., Nat. Commun. Symp. Rec., vol. 7, Oct. 1961, p. 100.

. . . many different orbits: low, medium, or high; circular or highly elliptical; polar, equatorial or inclined at any intermediate angle . . . What interference problems could arise between systems employing different orbits? . . .

APPLYING SPACE SCIENCE TO COMMUNICATIONS, WEATHER, AND NAVIGATION 1. ACTIVE AND PASSIVE LOW-ALTITUDE COMMUNICATION SATELLITES
J.R. Pierce, Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 135/138.

COMMUNICATION TIME PROBABILITIES FOR SATELLITES RANDOMLY DISTRIBUTED IN A CIRCULAR EQUATORIAL ORBIT
R.N.A. Plimmer, Royal Aircraft Establishment (Gt. Brit.), Technical note, no. GW-591, Nov. 1961, 57 p., illus., 3 refs., AD 275 629.

SATELLITE COMMUNICATIONS SYSTEM
R.E. Sageman, Nat. Commun. Symp. Rec., vol. 7, Oct. 1961, p. 86/92.

. . . preparatory to launching experimental satellite communication trials in the Spring of 1962. A commercial system, initially employing some 20-30 satellites in 7000 miles high random polar orbits, is attainable within 3 to 4 years. Thereafter, a worldwide system could be established with approximately 50-60 satellites. . . .

FURTHER DEVELOPMENTS ON THE REQUIRED NUMBER OF RANDOMLY SPACED COMMUNICATION AND NAVIGATION SATELLITES
F.V. Bennett, National Aeronautics and Space Administration, Washington, D.C., NASA Technical note D-1020, Feb. 1962, 93 p., AD 271 898.

. . . continuation of the research . . . presented in NASA Technical Note D-619 (AD 249 293) . . . limited to near-earth satellites deployed singly in randomly spaced circular orbits. . . . For a worldwide navigation satellite system (or communication system based on circular regions of mutual communication) it was found that, for the range of circle diameters considered,

the optimum orbit inclination angle lies between 53 and 64 degrees.

INTERFERENCE BETWEEN SATELLITE COMMUNICATION SYSTEMS AND COMMON CARRIER SURFACE SYSTEMS
H. E. Curtis, Bell. Syst. Tech. J., vol. 42, no. 3, May 1962, p. 921/943.

. . . involving a satellite station and the TD-2 and TH systems . . . it is shown that the separation between systems must be of the order of 100 to 120 miles or more when the antenna of the common carrier transmitter or receiver is pointed directly at the satellite ground station.

STATION LOADING STUDY - AN INVESTIGATION OF VEHICLE BUNCHING AND STACKING
J. B. Day, et al., Philco Corp., Palo Alto, Calif., 28 Nov. 1962, 39 p., AD 405 318.

. . . several tracking stations used in conjunction with a number of surveillance satellites and the ability of the stations to efficiently monitor those satellites in strategic locations.

SOME MOMENTS FOR CIRCLE COVERINGS
W. L. Doyle, et al., RAND Corp., Santa Monica, Calif., Rept. no. P2581, May 1962, 8 p., AD 422 142.

. . . the mean and variance of outage times and the expected number of breaks during a basic period. . . .

ORBITAL ASPECTS OF NON-SYNCHRONOUS COMMUNICATION SATELLITE SYSTEMS
H. K. Karrenberg, et al., Aerospace Corp., Los Angeles, Calif., Rept. no. TDR-169-3550-01)TN-1, SSD TDR 62-193, 24 Sept. 1962, 56 p. incl. illus. tables, 6 refs., AD 292 940.

. . . the ability of pairs of ground terminals to communicate by means of mutually visible satellites in non-synchronous orbital systems. The dependence of communicability upon system parameters such as the number and inclination of the several orbit planes used, the total number of satellites in the system and their apportionment among the orbit planes, and their mode of distribution (random or evenly spaced) within the planes was examined. Several attractive 5000-nautical mile altitude systems were found and compared. . . . use of intermediate ground relay stations between pairs of widely separated or adversely oriented ground terminals. Studies were also made of the probable durations of interrupted and unavailable service and the relative distribution of communication ' holes.'

THE PROBLEM OF OPTIMAL MODE SWITCHING
R. A. Nesbit, California U., Los Angeles, 10 Sept. 1962, 19 p. incl. illus., 20 refs., AD 293 152.

A steepest descent modification of the switching times in a mode switching control system can be based on first variation computations, and the computer storage requirement less than that required for functional descent. . . . Some knowledge of the global properties of the trajectory is required to assure the usefulness of the procedure.

COVERAGE CONSIDERATIONS OF RANDOM SATELLITE COMMUNICATION SYSTEMS
J. G. Poor, MITRE Corp., Bedford, Mass., Technical memo. no. TM-3404, ESD TDR 63-204, 21 Sept. 1962, lv., AD 298 173.

INTERVALS BETWEEN PERIODS OF NO SERVICE IN CERTAIN SATELLITE COMMUNICATION SYSTEMS—ANALOGY WITH A TRAFFIC SYSTEM
S. O. Rice, Bell Syst. Tech. J., vol. 41, no. 5, Sept. 1962, p. 1671/1690.

. . . Such periods are called "outages," and the intervals between successive outages are called "innages." Here the outage and innage time distributions are studied with the help of an analogy between a satellite system and a traffic system. The arrival of a customer in the traffic system corresponds to a satellite coming into view, and the service time of the customer corresponds to the time the satellite remains in view. . . .

CHARACTERISTICS OF THE SERVICE PROVIDED BY COMMUNICATIONS SATELLITES IN UNCONTROLLED ORBITS
J. D. Rinehart, et al., Bell Syst. Tech. J., vol. 41, no. 5, Sept. 1962, p. 1621/1670.

In a communications system which uses satellites in uncontrolled orbits, there would be times when the communication between two stations would be interrupted because no satellites would be in view . . . An example system which could be used to provide initial worldwide service is also discussed. This system has certain nonrandom characteristics, and the effect of these characteristics on the service to various parts of the world is examined by computer simulation.

OPTIMUM INCLINATION OF RANDOMLY-SPACED SATELLITES IN CIRCULAR ORBITS FOR ROUTES WITHIN EUROPE AND TO NORTH AMERICA
L. T. Trollope, SHAPE Air Defense Technical Center, The Hague (Netherlands), SADTC technical memo. no. TM-41, July 1962, 20 p. incl. illus. tables, 2 refs., AD 284 022.

. . . from SHAPE, Paris, the longest routes of communication of primary interest are those to Norway, Turkey, and North America. For three routes . . . mutual visibility provided by satellites in circular

orbits is given as a function of orbit inclination and height . . . polar orbits provide a higher value of mutual visibility than circular orbits at other angles of inclination. The number of randomly-spaced satellites in polar orbits required . . . is given . . .

THE NAVIGATION OF A COMMUNICATION SATELLITE
J. E. Clegg, J. Inst. Navig., vol. 16, April 1963, p. 163/179, A63-17942.

. . . navigational requirements for a medium-altitude communications satellite system . . . Twelve satellites must be injected into a circular equatorial orbit . . . The period and position of the satellite can be measured to desired accuracy through the use of Doppler-effect measurement equipment and Distance Measuring Equipment (DME). A list of necessary navigation equipment is given.

SYSTEM COVERAGE BY RANDOM SATELLITES
M. A. Epstein, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 272.

NOTES ON A NOVEL GNOMONIC NOMOGRAPH OR GRAPHICAL DETERMINATION OF SATELLITE COVERAGE
R. H. Gerhardt, Mitre Corp., Bedford, Mass., Rept. no. W6270, ESD TDR63 450, Oct. 1963, 19 p., AD 422 326.

A graphical method of estimating the time a satellite is within view of a ground point has been devised. . . . uses a gnomonic projection of the earth and three overlays . . . Overlays and a map are given which may be assembled to form a nomograph for solution of problems.

ORBITAL ASPECTS OF NON-SYNCHRONOUS COMMUNICATION SATELLITE SYSTEMS
H. K. Karrenberg, et al., American Institute of Aeronautics and Astronautics, Astrodynamics Conference, New Haven, Conn., Aug. 19-21, 1963, Paper 63-397, 20 p., A63-21714.

Presentation of an analytical technique to determine the communication fractions provided by a variety of nonsynchronous orbital systems for a worldwide network of links. The number and inclination of the orbit planes, the number of satellites used, and their apportionment among the mode of distribution in the orbit planes, are studied . . .

PLOTTING COVERAGE CIRCLES FOR SATELLITE COMMUNICATIONS
D. Levine, et al., Electronics, vol. 37, Jan. 24, 1964, p. 27/29, A64-13794.

. . . a graphical technique which shows how, with simple computation and available charts, the planner and the engineer can determine the coverage circle of a ground station for a satellite in a nearly circular orbit . . .

STATISTICS OF VISIBILITY IN SATELLITE COMMUNICATION SYSTEMS
C. L. Mack, Jr., Lincoln Lab., MIT, Lexington, Rept. no. 36G7, ESD TDR63 562, 12 Sept. 1963, 20 p., AD 422 340.

Methods to calculate the statistics of satellite visibility are discussed. . . . to illustrate the effects of altitude and choice of orbit on the number of satellites that must be placed in orbit. Some statistical consequences of shared use are given and some benefits of non-random satellite disposition are demonstrated.

A DETERMINISTIC APPROACH TO SYSTEMS OF COMMUNICATION SATELLITES
M. Mannos, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 268/271.

. . . A general computer program is now being written to determine the communication potential of a system of satellites for any preselected pair combinations of prescribed stations, any one of which may be either in space or on the ground. For the special case where all stations are motionless on the ground, the program has been completed and used to give the percentage time of possible communication between all desired station pairs of a specified system of communication satellites. . . .

EARTH COVERAGE BY SATELLITE CONFIGURATIONS
L. Norwood, Aerospace Communications and Controls Div., Radio Corp. of America, Burlington, Mass., Rept. no. TDR269 4304 7, SSD TDR 64 20, Feb. 1964, 37 p., AD 433 606.

. . . Conclusions are drawn regarding the number of satellites required, as a function of altitude, to insure complete coverage of a polar cap . . . It is demonstrated that the coverage afforded by elliptical orbits at critical inclination is superior to that provided by circular polar orbits.

SHADOWS PRODUCED BY SPIN-STABLIZED COMMUNICATION SATELLITES
B. Paul, AIAA Journal, vol. 2, May 1964, p. 924/931, 7 refs., A64-17773.

A spin-stabilized generally utilizes a so-called toroidal antenna that has a null cone surrounding the axis of symmetry (spin axis). The greatest gain over isotropic antennas occurs with the widest possible null cone. However, wide null cones may cause shadows on the Earth and prohibit communication between mutually visible ground stations and the satellite. It is shown how the size and shape of the shadowed zones may be calculated for arbitrary orientations of the spin axis . . .

INNAGE AND OUTAGE INTERVALS IN TRANSMISSION SYSTEMS COMPOSED OF LINKS
S. O. Rice, Bell Syst. Tech. J., vol. 42, no. 5, Sept. 1963, p. 2267/2283.

. . . Several results regarding composite transmission systems, including some due to D. S. Palmer, are reviewed, restated, and extended.

A LOW-ALTITUDE SATELLITE COMMUNICATIONS SYSTEM USING TIME COMPRESSION TRANSMISSION
E. L. Roberts, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 273/275.

INVESTIGATIONS OF THE NUMBER OF SATELLITES AND THEIR ORBITS USED FOR RADIO COMMUNICATION BETWEEN TWO EARTH POINTS
F. Vilbig, Air Force Cambridge Research Labs., Bedford, Mass., 1963, lv., AD AD 409 503.

COMMUNICATION-SATELLITE-SYSTEM HANDOVER REQUIREMENT AND ASSOCIATED DESIGN PROBLEMS
H. J. Weiss, RCA Rev., vol. 24, no. 3, Sept. 1963, p. 421/458.

. . . Design "ground rules" to define limitations and capabilities of the concept are derived and applied to a real, typically limited example—a system comprised of station-keeping satellites in equatorial orbits. The concept is then extended to nonequatorial orbits which retain a particular characteristic of the equatorial orbit—the invariance of the satellite subtrack . . .

HANDOVER IN A SATELLITE COMMUNICATION SYSTEM
H. J. Weiss, Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 133/138.

. . . to determine the maximal delay differential expected over two parallel links at any time and to estimate the differential in the rate-of-arrival of identical digital information transmitted simultaneously over both links. . . .

PARAMETRIC ANALYSIS OF MEDIUM-ALTITUDE ACTIVE AND PASSIVE COMMUNICATION SATELLITES
ITT Communication Systems, Inc., Paramus, N.J., Rept. no. ICS63 TR250, 20 Sept. 1963, lv., AD 428 311.

. . . broad systems aspects . . . for possible use in a military communication network. . . . compared primarily on an economic basis, with randomly spaced, medium-altitude orbits assumed. . . . mathematical models provide weight and cost variations for the models as a function of satellite capabilities. . . .

ORBIT POSITION CONTROL SYSTEMS COMPARISON AND SELECTION STUDY REPORT
Westinghouse Electric Corp., Baltimore, Md. Aerospace Div., Interim Report, 8 Nov. 1963, 131 p., N64-18440.

A system is considered in which solar flux is used as a force to change orbital parameters of a passive communication satellite in a manner that, when controlled, will permit sufficient change of these parameters to provide means for station keeping of a satellite, with respect to others in the same orbital plane, the purpose is to be able to maintain spacing of a minimum number of these satellites in order to provide maximum communications coverage around the earth's surface . . .

Related Publications:

RADAS AND SATELLITE COMMUNICATIONS
H. Magnuski, Rec. Nat. Symp. Space Electronics Telemetry, no. I. 2, Oct. 1962.

TECHNIQUES FOR DIGITAL COMMUNICATION VIA SATELLITES
F. Assadourian, et al., Rec. Nat. Space Electronics Symp., no. 3.1, 1963.

. . . for handling some of the synchronization problems which arise in digital communication via subsynchronous and synchronous satellite repeaters. The complexity of these problems depends upon the kind of communication network in which the satellite links are employed. . . . involves both (1) bit synchronization (and identification) and (2) frame synchronization. . . . Handover problems and techniques will be discussed in some detail, particularly the instantaneous type which is needed to preserve bit integrity during handover. . . .

THE EFFECTS OF TIME DELAY AND ECHOES ON TELEPHONE CONVERSATIONS
J.W. Emling, et al., Bell Syst. Tech. J., vol. 42, no. 6, Nov. 1963, p. 2869/2891.

. . . brief history . . . Actual delays involved in typical circuits . . . discussion of the effects of delay only on typical conversations . . . sources of echo . . . measures . . . to reduce echo by improving return loss . . . introduction to echo suppressors and some of the new problems they introduce.

UTILITY PROGRAM DESCRIPTIONS MILESTONE 11 MULTICON
J.G. Hillhouse, System Development Corp., Santa Monica, Calif., TM 715 056 00, 15 July 1963, 343 p., AD 411 916.

. . . (1) to determine problems arising from multiple satellite operations; (2) to optimize the amount of activity by a choice of primary or alternate equipment; (3) to investigate the activity patterns obtained when the launch time of vehicle is varied; and (4) to list this information in the prescribed format. . . .

SUBJECTIVE EVALUATION OF DELAY AND ECHO SUPPRESSORS IN TELEPHONE COMMUNICATIONS
R.R. Riesz, et al., Bell Syst. Tech. J., vol. 42, no. 6, Nov. 1963, p. 2919/2941.

The effect of transmission delay upon the quality of a telephone circuit was investigated using naturally occurring telephone conversations. Round-trip delays of 600 and 1200 msec went almost unnoticed at first when no echo sources or echo suppressors were present in the circuit. After exposure to pure delays of up to 2400 msec, considerable dissatisfaction, indicated by rejection of the circuit, developed with the 600- and 1200-msec delays. When echo sources and echo suppressors were added to the circuit, some dissatisfaction developed immediately for round-trip delays of 600 and 1200 msec. No adaptation to the effects of delay occurred; in fact dissatisfaction increased with experience under certain conditions.

4A.250: Orbital Dipole Systems

Included: Chaff communications; RAKE system over orbital chaff; Space needle communications; Collision between West Ford needles and meteorites; Charge drag on orbiting dipoles.

Not Included: Radar chaff operations.

Cross References: Project West Ford (4A.870).

Principal Publications:

ARTIFICIAL SCATTERING AND REFLECTING MEDIA FOR LONG RANGE COMMUNICATION
H. F. Meyer, Proc. Nat. Aeron. Electronics Conf., vol. 7, May 1959, p. 111/116.

. . . to compare the active relay system with the passive system in terms of the power received on the ground . . .

COMMUNICATIONS BY RE-RADIATION FROM CHAFF
B. V. Blom, Conf. Proc. Nat. Conf. Mil. Electronics, vol. 4, June 1960, p. 542/546.

. . . The scattering pattern of an ensemble of chaff dipoles was analyzed by Dr. R. A. Hessemer, Jr. of the Applied Research Laboratory . . .

THE DICON SYSTEM
R. S. Berg, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, Technical rept. no. 251, 31 Oct. 1961, 28 p., AD 267 536.

Built to demonstrate the applicability of the project West Ford channel as a high capacity digital data link, the DICON system comprises a transmitter which provides a variety of modulation signals to the West Ford RF transmitter and a receiver designed to recover the modulation signal from the output of the West Ford X-band receiving system and to measure and record the perturbations introduced by the West Ford channel. These perturbations are expected to be due principally to Doppler shift, Doppler spread and multipath delay. Since the fluctuation and multipath times may be of the same order, a noncoherent detection scheme is used.

A PRELIMINARY INVESTIGATION OF THE MOTION OF A LONG, FLEXIBLE WIRE IN ORBIT
T. B. Garber, Rand Corp., Santa Monica, Calif., Rept. RM-2705, 23 March 1961, 45 p., AD 258 954.

THE DISPENSING AND BEHAVIOR OF CHAFF IN SPACE
J. H. Henson, et al., Defense Research Lab., U. of Texas, Austin, DRL AF Technical memo 58, 12 April 1961, lv., AD 257 626.

. . . experimental study . . . to determine some possible methods of dispensing chaff at very high altitudes . . . the behavior of chaff when dispensed from an earth satellite in a circular orbit was investigated.

SOLUTION TO REAL TIME MULTIPLE SATELLITE AND WEST FORD TYPE COMMUNICATIONS SYSTEMS COVERAGE REQUIREMENT
H. Hoffman, Jr., Rome Air Development Center, Griffiss Air Force Base, N.Y., RADC TN61-25, April 1961, 19 p., AD 258 263.

. . . a mathematical model whereby a coverage diagram versus time can be plotted such that the criteria for continuous coverage between any two ground stations can be determined. It is seen that for any given two station locations and orbit parameters the number of satellites per orbit can be quickly determined.

COMMUNICATION BY ORBITING DIPOLES
W. E. Morrow, IN: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 492/515, Discussion, p. 515/521, 13 refs., A63-14261.

Discussion of the use of orbiting dipoles as a microwave scattering medium for reliable long-range radio communication. Treated are the coverage characteristics, dipole dispensing techniques, belt dispersion and lifetime, radio transmission properties of dipole belts, transmission techniques, and system performance.

SATELLITE PLASMA SHEATH ANOMALIES
S. F. Singer, Electro Jet Corp., Washington, D. C., Final rept., 1961, lv., AD 403 287.

. . . Interaction of West Ford Needles with the Earth's magnetosphere . . . The generation of electromagnetic waves in the wake of a satellite . . .

PERFORMANCE OF A RAKE SYSTEM OVER THE ORBITAL DIPOLE CHANNEL
P. Bello, et al., Rec. Nat. Commun. Symp., vol. 8, no. 10, Oct. 1962, p. 46/53.

. . . Rake . . . has been used effectively . . . due to the ability of the . . . receiver . . . isolate the various paths, measure the (time-varying) path gains and phases, and coherently add the contributions of the various paths. . . . here, we determine the signal-to-noise ratio of a Rake-like system as a function of the spread factor of the channel. The channel model chosen is that of the Orbital Dipole Channel, for which a tapped delay line representation with independent complex value Gaussian processes for tap functions seems to be applicable. The system analyzed . . . differs from the previous Rake system in two notable ways. First, two independent noise carriers, of which only one is modulated, are transmitted simultaneously. Second, not only digital but analog signal modulation methods (such as PM, FM, SSB) can be used. . . .

DISTRIBUTED SATELLITE CIRCUMGLOBAL COMMUNICATION TECHNIQUE STUDY
R. A. Cushman, et al., Bell Telephone Labs., Inc., Whippany, N. J., Rept. for 11 Jan 61-11 Jan 62, RADC TDR 62-120, 11 Jan. 1962, 167 p. incl. illus. tables, 30 refs., AD 274 911.

. . . first year results of a continuing study of the use of orbiting dipole belts to meet Air Force communication requirements . . . cross section . . . statistical characterization of the scattering medium . . . weight of dipoles, operating frequency, transmitter power, and antenna size, and calculations of the required power for a basic channel using a quaternary frequency-shift code. . . . interference problems . . . survivability and cost, and choice of operating frequency within the 2- and 8-Gc region.

PARAMETRIC ANALYSIS OF AIR GROUND COMMUNICATIONS VIA ORBITING DIPOLES
C. C. Gauder, Electromagnetic Warfare and Communications Lab., Aeronautical Systems Div., Wright-Patterson Air Force Base, Ohio, Rept. on Applied Communication Research for Air Force Vehicles, ASD TDR 62-579, Sept. 1962, 38 p., 8 refs., AD 289 879.

. . . analysis shows that for communication ranges of up to 4000 miles, air/ground communications at a 50-bit per second information rate is feasible for a dipole payload weight of 1500 pounds in a 2000-mile polar orbit. A sophisticated modulation and demodulation technique is evolved to overcome the effects of channel adversities such as multipath spread and Doppler smear. System analysis of an experimental airborne complex is used to predict the degree of performance of an experiment entitled Leap Frog to determine feasibility of an air/ground communication link.

THE WEST FORD ANTENNA FEED SYSTEM
L. Niro, Lincoln Lab., Mass. Inst. of Tech., Lexington, Technical rept. no. 259, AFESD TDR 62-111, 5 March 1962, 29 p. incl. illus. refs., AD 282 311.

. . . orbital scatter communication system, which operates in the X-band, consists of two installations - one located at Camp Parks, Pleasanton, Calif., and the other at Westford, Mass. Each installation employs a Cassegrainian antenna system that uses a paraboloidal reflector 60 ft. in diameter. . . . intended to operate in conjunction with a belt of metallic dipoles orbiting the earth. These dipoles, tune to approximately 8000 Mc, will function as a scattering medium between the two ground systems. . . .

EXPERIMENTAL X-BAND MASER RECEIVING COMPLEX
Collins Radio Co., Cedar Rapids, Iowa, Rept. for 1 May-31 July 62 on Phase 1, rept. no. CRR-267, 31 July 1962, 31 p. incl. illus. tables, AD 282 131.

. . . for use in Project Leapfrog . . . for the reception of communications signals reflected from a belt of orbiting dipoles. The receiving system will consist of a 13.5 foot diameter parabolic reflector mounted on an SCR-584 radar pedestal. A Cassegrainian feed system will reflect the captured energy into a horn antenna near the vertex of the parabolic reflector . . . A twin cavity maser preamplifier will be used to amplify the received signal by approximately 20 db. The maser output then is passed through a dual frequency wave-guide filter to eliminate spurious responses and then is amplified further by a tunnel diode r-f amplifier.

DISTRIBUTED SATELLITE CIRCUMGLOBAL COMMUNICATION TECHNIQUE STUDY
R. E. Graham, et al., Bell Telephone Labs., Inc., New York Rept. for 11 Jan. 62-11 Mar. 63, RADC TDR 63 216, 11 March 1963, 96 p., AD 408 269.

. . . use of orbiting dipole belts to meet Air Force communication requirements . . . (1) an extension of the modulation and detection analysis . . . (2) a further study of transmission medium characterization, (3) propagation of errors resulting from the use of the 1-of-5 quaternary code, (4) the calculation of maximum path loss as a function of dipole belt characteristics, (5) a description of laboratory equipment used to verify the predicted performance of modulation and detection techniques, and (6) studies to determine the approximate cost of the ground equipment for a complete system utilizing belts of orbiting dipoles.

MODULATION TECHNIQUES FOR ORBITING DIPOLE SCATTER COMMUNICATION
W. E. Morrow, Jr., Institute of the Aerospace Sciences, Annual Meeting, 31st, New York, N.Y., Jan. 21-23, 1963, Paper 63-66, 8 p., A63-11617.

COLLISIONS BETWEEN WEST FORD NEEDLES AND MICROMETEORITES
A. Sauval, Liege U. Inst. d' Astrophysique (Belgium), AFCRL-63-649, 10 May 1963, 11 p., 37 refs., N63-17588, AD 408 328.

Over a period of eight years, there are enough collisions of micrometeorites with needles of Project West Ford to break most of them.

EXPERIMENTAL STUDY OF CHARGE DRAG ON ORBITING DIPOLES
I. Shapiro, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, 14 Jan. 1963, 6 p., AD 405 369.

Six tin dipoles (34 cm long and .043 cm in diam.) have been placed in a near-polar near-circular orbit at a mean altitude of about 3100 km. Radar observations . . . indicate that charge drag has not produced a decrease in mean altitude at an average rate greater than 0.3 km/year.

USSR PROTESTS UNITED STATES "SPACE NEEDLE" PROJECT
G. S. Sibiryakov, Joint Publications Research Service, Washington, D.C., JPRS-21142; OTS-63-31787, Sept. 19, 1963, 5 p., Transl. into English of an article from Priroda (Moscow), no. 7, 1963, p. 109/111, N63-21384.

Related Publications:

EXPERIMENTAL INVESTIGATION OF CHAFF TRANSMISSION IN THE 1300 TO 1800 MC FREQUENCY RANGE. VOLUME I
L. H. Bauer, Radiation, Inc., Melbourne, Fla., Final rept., 1 July 61-30 June 62, Rept. no. 4, vol. 1, 30 June 1962, 100 p. incl. illus., AD 283 318.

. . . tests were performed at 1500 and 1750 mc using AN/GRC-50 radio relay equipment . . . In Phase I, chaff was dispersed at an altitude of 10,000 feet from an aircraft and the ground test sites were separated by 4.4 miles. In Phase II, tests were performed with a site separation of 52 miles and the chaff was dispersed at approximately 13,000 feet. Information was obtained on chaff fall rate, chaff cloud drift rate and cloud configuration from radar data . . . It was determined that chaff communication beyond the horizon is feasible using reasonable quantities of chaff dipoles . . .

TESTING CHAFF
J. E. Bloomhuff, et al., Air Force Proving Ground Command, Eglin Air Force Base, Fla., Rept. no. APGC TDR 62-28, May 1962, 25 p. incl. illus., AD 277 054.

Video recording, pulse-to-pulse photography, and frame-type photography integrating several pulses are used at the APGC to obtain data on chaff bloom history, rate of fall, and dispersion rate . . .

TERMINAL FALL VELOCITY OF RADAR CHAFF
J. E. Jiusto, et al., J. Geophys. Res., vol. 68, May 1, 1963, p. 2858/2861, A63-16751.

Presentation of a theoretical expression for the terminal velocity of cylindrical chaff in the continuum regime below 20 km. Comparative data are also shown for the fall velocities of cylindrical and rectangular chaff measured in an altitude chamber under nonturbulent conditions.

DIVISION 4A.3
MEDIUM ALTITUDE AND SYNCHRONOUS SATELLITE COMMUNICATIONS SYSTEMS

4A.320: Synchronous Communications Satellites

Included: Geostationary comsat operation; Control of 24 hour satellites; Perturbations of synchronous satellites; Synchronous lunar satellites.

Not Included: Trajectory problems; Transfer orbit calculations.

Cross References: Syncom project (4A.855).

Principal Publications:

PERFORMANCE EQUATIONS FOR A "STATIONARY" PASSIVE SATELLITE RELAY (22,000-MILE ALTITUDE) FOR COMMUNICATION
M. Handelsman, IRE Trans. Commun. Syst., vol. CS-7, no. 1, May 1959, p. 31/37.

Good bibliography

PERFORMANCE EQUATIONS FOR A STATIONARY PASSIVE SATELLITE RELAY FOR COMMUNICATION (22,000 MILES ALTITUDE)
M. Handelsman, USAF RADC TN 58-379, Jan. 1959, 18 p., AD 296 898.

PROGRESSIVE COMMUNICATION SATELLITE SYSTEMS DESIGN
J. E. Bartow, et al., IRE Trans. Nat. Symp. Space, no. 2-5, Sept. 1960, p. 1/13.

. . . Major sub-systems comprising the satellite payload are described and illustrated . . . A satellite located 22,300 statute miles above the equator, rotating in the direction of the earth's rotation. . .

CRITERIA FOR THE OPTIMUM DESIGN OF ACTIVE SATELLITE COMMUNICATION SYSTEMS
A. R. Giddis, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 6/12, 12 refs.

. . . major factors that must be analyzed . . . we will not investigate the guidance and tracking of vehicles, the logistics of installations, or the economics of launching rockets.
System ground rules are established for a synchronous active relay by analyzing the following factors: (a) wave propagation and radio noise; (b) payload design; (c) performance of communication and control equipment; and (d) type of relay link. . . . The frequency range of interest is 100 to 10,000 mc/s. . . .

ORBITAL CONTROL AND ANALYSIS TECHNIQUES FOR EQUATORIAL 24-HOUR SATELLITES
E. O. Gilbert, Space Technology Labs., Inc., Los Angeles, Calif., Rept. STL/TN-60-0000-27149, Aug. 1960, 74 p., AD 269 304.

. . . The report is limited to the presentation of basic correction techniques and analytic methods. . . minimizing or nearly minimizing total impulse requirements. . . Graphic portrayal of the motion is introduced to present clearly all characteristics of the motion. Orbit specifications are interrelated and tabulated. Important orbital perturbations caused by lunar and solar gravitational fields and earth oblateness are given.

CONSIDERATIONS ABOUT A GUIDANCE AND CONTROL SYSTEM FOR A 24-HOUR COMMUNICATION SATELLITE LAUNCHED WITH THE SATURN VEHICLE
W. Haeussermann, George C. Marshall Space Flight Center, Huntsville, Ala., ARS rept. no. 1479-60, 1960, 9 p., AD 255 045.

SOME ASPECTS OF A SYNCHRONOUS SATELLITE COMMUNICATION SYSTEM
S. Metzger, IRE Trans. Nat. Symp. Space, no. 2-3, Sept. 1960, p. 1/7.

ON THE REQUIREMENTS FOR SYNCHRONOUS ORBITS
D. Duke, Institute for Defense Analyses, Washington, D. C., IDA TN61 22, Sept. 1961, 9 p., AD 428 232.

. . . problems associated with orbiting satellites in such a way that they pass over the same point on the earth at the same time each day. It is found that such orbits are possible and can be maintained for several months. It is also possible to choose the orbit so that the satellite spends a negligible fraction of its useful lifetime in the earth's shadow. . . . only altitudes from 250 to 1000 km are considered. The items of interest are the orbits themselves, their decay times, the injection accuracy required to achieve them, and. . . the relative durations of shadow and sunlight in each orbit.

APPLYING SPACE SCIENCE TO COMMUNICATIONS, WEATHER, AND NAVIGATION 2. 24-HOUR COMMUNICATION SATELLITE SYSTEMS
E. W. Engstrom, Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 139/142.

TRANSISTOR EQUATORIAL SATELLITE STUDIED FOR EUROPEAN-AFRICAN COMMUNICATIONS
A. Erikson, Electronics, vol. 34, no. 25, June 1961, p. 26/27.

. . . Compagnie Francaise Thomson-Houston. . . teamed up with Hughes Aircraft . . . Under the plan, the 33-lb Hughes transistor satellite would be put in a synchronized equatorial orbit so that it would remain fixed with respect to the earth at a point some 22,400 miles above 0 deg latitude, 0 deg longitude. . . .

STATION KEEPING STUDY FOR A TWENTY-FOUR HOUR COMMUNICATION SATELLITE
J. F. Farrell, General Dynamics/Convair, San Diego, Calif., Rept. no. ERR-SD-147, Nov. 1961, 16 p., AD 288 174.

ASPECTS OF SYNCHRONOUS COMMUNICATION SATELLITES
N. E. Feldman, Rand Corp., Santa Monica, Calif., Rept. no. P-2314, 18 May 1961, 53 p., AD 271 753, Presented at the National IAS-ARS Joint Meeting, June 13-16, 1961, Los Angeles, California.

Before 1980, satellites will probably be a well-established means for point-to-point communication on earth. A wide variety of passive and active satellite systems are being studied, and some studies are supplemented by experimental programs. . . . geocentric stabilized station-keeping satellite in a synchronous equatorial orbit. . . . This report concerns the satellite design and payload weight required to provide a given channel capacity. It is oriented toward commercial point-to-point communication, where costs dictate conservative techniques.

SYNCHRONOUS SATELLITES FOR INTER-CONTINENTAL TELEVISION SYSTEMS
M. D. Hull, Brit. Commun. and Electronics, vol. 8, no. 12, Dec. 1961, p. 910.

INTERFERENCE PROBLEMS OF CO-CHANNEL COMMUNICATION SATELLITE SYSTEMS
S. G. Lutz, et al., Nat. Commun. Symp. Rec., vol. 7, Oct. 1961.

. . . Interference is always a problem between 24-hour stationary and any non-stationary system.

COMMUNICATION VIA STATIONARY SATELLITES, A GLOBAL PARTY LINE
J. L. Walker, et al., Conv. Rec. Nat. Symp. Global Commun., vol. 5, May 1961, p. 176/179.

TWENTY-FOUR-HOUR COMMUNICATION SATELLITES
S. P. Brown, In: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 562/572; Discussion, p. 572/573, A63-14264.

Description of the possible design. . . The 24-hr. . . concept (Project Advent) is illustrated. . . .

GUIDANCE AND CONTROL OF 24-HOUR SATELLITES
R. W. Cole, Navigation, vol. 9, Winter 1962-1963, p. 270/279, A63-14004.

ASPECTS OF SYNCHRONOUS COMMUNICATION SATELLITES
N. E. Feldman, ARS Journal, vol. 32, April 1962, p. 564/575.

INSTALLATION TIME REQUIRED BY "STATIONARY" AND RANDOM-ORBIT COMMUNICATION SATELLITE SYSTEMS (Correspondence)
R. G. Gould, IRE Trans. Commun. Syst. vol. CS-10, no. 2, June 1962, p. 217/218.

THE SYNCHRONOUS COMMUNICATIONS SATELLITE
R. P. Haviland, In: Communications Satellites, British Interplanetary Society, Symposium on Communications Satellites, London, England, May 12, 1961, New York, Academic Press, Inc., 1962, p. 113/129, A63-12461.

Examination of the possible applications. . . Considered are payload, coverage, time delay, and replacement time. . . . It is shown that the synchronous satellite appears to be less desirable than lower-altitude satellites for the relay service. On the other hand, it is also indicated that the synchronous satellite appears to be much superior for broadcasting service.

CHARGED PARTICLE ENVIRONMENT IN SPACE NEAR THE GEOSTATIONARY ORBIT
E. W. Hones, Jr., Inst. for Defense Analyses, Washington, D. C., Tech. note 62-59, Oct. 1962, 25 p., 28 refs., AD 401 371.

TWELVE ADVANTAGES OF STATIONARY SATELLITE SYSTEMS FOR POINT-TO-POINT COMMUNICATION
S. G. Lutz, Trans. IRE Space Electronics Telem., vol. SET-8, no. 1, March 1962, p. 57/65.

DIRECTIVE ARRAY FOR A SPINNING VEHICLE
H. A. Rosen, Nat. Telem. Conf., no. 1-4, May 1962, p. 1/11.

. . . this description deals only with the communication satellite application. . . . The relative loss incurred by using an isotropic antenna. . . amounts to 19 db for the 24-hour orbit. . . For this reason, directive antennas are generally used in the design of 24-hour satellites.

A TRULY GLOBAL SATELLITE COMMUNICATION SYSTEM
H. Trotter, Jr., In: Advances in the Astronautical Sciences. Vol. XI, American Astronautical Society, Annual Meeting, 8th, Washington, D. C., Jan. 16-18, 1962, Proceedings, Edited by Horace Jacobs, North Hollywood, Calif., Western Periodicals Co., 1963, p. 431/445, A64-11460.

. . . using a 24-hr stationary satellite. The system allows multiple access to the satellite, with the ground stations in the sector of a particular stationary satellite simultaneously sharing the total input band of the satellite. Channels are allocated for connection only as there is a demand for service with channel selection automatically made through a special control channel. On a demand for a service, an idle channel is selected and automatically routed from the calling to the called ground station. . . .

INVESTIGATION OF THE ORBITAL TRACKING OF A GEOSTATIONARY SATELLITE. VOLUME I OF II: THEORY AND METHODS
Aeronutronic, Newport Beach, Calif. Astrosciences Dept., Feb. 12, 1962, 56 p., refs., N64-10087.

. . . various tracking concepts, accuracies, frequencies, and tracking deviations in an effort to determine the effects of uncertainties in observation quantities on the orbit parameters as they are propagated in the orbit correction technique. The method of least squares is the mathematical tool. . .

PERTURBATIONS OF A GEOSTATIONARY SATELLITE. 2. LUNISOLAR EFFECTS
R. R. Allan, Royal Aircraft Establishment (Gt. Brit.), RAE TN SPACE 47, Sept. 1963, 19 p., AD 428 457.

LES PROBLEMES D'INTERCONNEXION DANS LES RESEAUX DE TELECOMMUNICATIONS PAR SATELLITES (Problems of Linkage in Satellite Telecommunication Systems) (In French)
P. Deman, International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 87, 20 p., A63-26039.

. . . interaction between the modulation systems, the type of satellite repeater, and the type of orbit of the satellite. . . The optimization problem is discussed for a synchronous satellite.

COMMENT ON "APPLICATION OF DYNAMIC PROGRAMMING TO OPTIMIZING THE ORBITAL CONTROL PROCESS OF A 24-HOUR COMMUNICATIONS SATELLITE."
T. N. Edelbaum, AIAA Journal, vol. 2, May 1964, p. 974/975, A64-17785.

LONGITUDE POSITIONING AND ORBIT CONTROL OF THE 24-HOUR, EQUATORIAL SATELLITE
G. Kang, et al., Institute of the Aerospace Sciences, Annual Meeting, 31st, New York, N. Y., Jan. 21-23, 1963, Paper 63-17, 43 p., 24 refs., A63-14740.

PERTURBATIONS ET STABILISATION ARTIFICIELLE D'UN SATELLITE EQUATORIAL DE 24 H (Perturbations and Artificial Stabilization of a 24-hr Satellite) (In French)
C. Marchal, Deutsche Gesellschaft fur Ratkentechnik und Raumfahrt, European Space Flight Symposium, 3rd, Stuttgart, Germany, 21-24 May 1963, Paper 1551 (63), 25 p., A63-19634.

Theoretical analysis of the perturbing effects on a 24-hr satellite and of optimum stabilization methods.

PERTURBATIONS ET STABILISATION ARTIFICIELLE D'UN SATELLITE EQUATORIAL DE 24 H (Perturbations and Artificial Stabilization of an Equatorial 24-Hour Satellite) (In French, with summaries in English and German), A64-12023.

Discussion of the three principal sources of satellite perturbations; (1) faulty period, (2) longitudinal dissymmetries of the Earth's potential, and (3) solar and lunar effects upon the orbital plane. It is shown that the optimum corrections consist of applying a thrust tangentially to the trajectory in the cases (1) and (2) (the thrust is applied at the perigee if the period is too long, and at the apogee if it is too short); while a thrust normal to the equator at one of the nodes is required for correction of perturbations in case (3). . . .

SCIENTIFIC USES OF SYNCHRONOUS SATELLITES
E. B. Mullen, 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. 506/514, 18 refs., A64-15030.

. . . significant observational data. . . can be obtained from synchronous satellites. . . that will augment our store of scientific knowledge of the Earth and outer space. . . .

ON THE MOTION OF A 24-HOUR SATELLITE
P. Musen, et al., NASA, Goddard Space Flight Center, Greenbelt, Md., Washington, NASA, June 1963, 23 p., 5 refs., NASA TN D-1750, N63-17547.

SCALER DIFFERENTIAL EXPRESSIONS FOR THE GEOSTATIONARY SATELLITE
L. Nicola, et al., J. Brit. Interplanetary Soc., vol. 19, pt. 6, Dec. 1963, p. 241/247, A64-13557.

. . . relating topocentric observations of range, range-rate, right ascension, and

declination to the parameters of a geostationary, 24-hr equatorial satellite. These expressions are fundamental for the differential correction of the geostationary orbit, and for error analyses of tracking concepts for this orbit.

MOTION OF THE SUB-SATELLITE POINT FOR 24-HOUR ORBITS
W. H. Stafford, et al., National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala., 22 Aug. 1963, 50 p., refs., N64-15864.

The effects of small changes in eccentricity, inclination, and argument of perigee on the motion of the subsatellite point for 24-hour orbits were investigated. . .

CONTROL OF THE ATTITUDE AND POSITION OF A SYNCHRONOUS SATELLITE BY CONTINUOUS RADIAL THRUST
R. S. Toms, et al., American Inst. of Aeronautics and Astronautics, New York, AIAA 63008A, 1963, 37 p., AD 407 770.

DES SATELLITES SYNCHRONES DE LA LUNE SERAIENT-ILS STABLES ET UTILES? (Would Synchronous Lunar Satellites be Stable and Useful?) (In French)
S. Travers, Technique et Science Aeronautiques et Spatiales, Sept. - Oct. 1963, p. 373/376, A64-16346.

General study of the feasibility and utility of lunar satellites for interstation communication on the Moon. In view of the absence of a lunar ionosphere, radio wave communication systems are confined to line-of-sight transmission. High towers are considered impractical, hence the possibility of a synchronous lunar-orbiting satellite becomes attractive.

Related Publications:

DATA TRANSMISSION OVER MAXIMUM DISTANCES (In German)
W. T. Runge, Elektrotech. Z (ETZ), vol. 81, no. 24, Nov. 1960, p. 854/860.

. . . use of satellites. . . discussed with reference to the I.T.T. System of three 24-stage satellites to give complete world coverage for telephone service. . . .

OPTIMUM SATELLITE DISPENSING VELOCITIES FOR AN EQUATORIAL HIGH ALTITUDE NONSYNCHRONIZED SATELLITE COMMUNICATION SYSTEM
W. E. Morrow, Jr., Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 36G-3, AFESD TDR 62-255, 5 Dec. 1962, 5 p., illus., AD 292 995.

. . . advantages of a communication system employing many active satellites in high altitude (15,000 to 30,000 miles) unsynchronized equatorial orbits over 24-hour synchronous and unsynchronized medium altitude orbits. . . .

FREQUENCY AND TIME CONTROL FOR COMMERCIAL MULTIPLE ACCESS SYNCHRONOUS SATELLITE COMMUNICATION SYSTEMS
D. P. Peterson, et al., Rec. Nat. Commun. Symp., vol. 8, no. 10, Oct. 1962, 25 p.

SYNCOM
F. P. Alder, International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 82, 36 p., A63-25974.

. . . synchronous orbit concept in application to global communications. . . . orbital injection and control techniques. . . design, equipment, and development of the Syncom I spin and attitude stabilized communications experiment . . . and of the Syncom II technological development studies aimed at achieving continuous wideband communications, new multiple-access communications, an electronically steerable antenna, and long life in orbit.

TECHNIQUES FOR DIGITAL COMMUNICATION VIA SATELLITES
F. Assadourian, et al., Rec. Nat. Space Electronics Symp., no. 3.1, 1963.

. . . for handling some of the synchronization problems which arise in digital communication via subsynchronous and synchronous satellite repeaters. The complexity of these problems depends upon the kind of communication network in which the satellite links are employed. . . . involves both (1) bit synchronization (and identification) and (2) frame synchronization. . . . Handover problems and techniques will be discussed in some detail, particularly the instantaneous type which is needed to preserve bit integrity during handover. . . .

PERTURBATIONS OF EQUATORIAL SATELLITES DUE TO EQUATORIAL ELLIPTICITY
R. H. Frick, RAND Corp., Santa Monica, Calif., RM-3861-NASA, Sept. 1963, 33 p., 6 refs., N63-22030.

. . . Results of analysis indicate that with the exception of orbits with periods of 12, 24, and 36 hours, the perturbations due to equatorial ellipticity are negligible and completely dominated by the perturbations resulting from initial condition errors. . . the 24-hour. . . orbit which undergoes long-period oscillations in longitude about the position of the minor axis of the earth's equatorial section. In addition, the orbits with 12- and 36- hour periods are resonant orbits in which the driving function resulting from equatorial ellipticity has a frequency equal to orbital frequency. This results in a divergent oscillatory perturbation at orbital frequency in both orbital radius and orbital angle.

4A.330: Medium Altitude Satellite Systems

Included: 6000 mile satellite systems.

Cross References: Low altitude comsat systems (4A.210); Synchronous comsat systems (4A.320).

Principal Publications:

DESIGN OF MEDIUM-HEIGHT RANDOM-ORBIT SATELLITE SYSTEMS
J. L. Glaser, In: Space Radio Communications, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 522/542; Discussion, p. 542/544, A63-14262.

Consideration of the factors affecting the design of communiction systems employing active satellites in random orbits with heights in the range of about 4,000 to 15,000 km. . . . no means would be provided for maintaining the precise position of a satellite relative to other satellites in the system. . . .

SYSTEM ORGANIZATION FOR GENERAL COMMUNICATION VIA MEDIUM-ALTITUDE SATELLITES
D.G. Luck, RCA Labs., Div., Radio Corp. of America, Princeton, N.J., Sept. 1962, 5 p., incl. illus., AD 287 913.

Probable early application of satellites to provide trunk-line interconnection between pairs of very heavy-traffic communication centers, in cases where other communication links are not readily usable, has led to considerable system study directed toward this special application. . . . A set of concepts is given that lead to system operating characteristics suitable for general-utility communication. . . .

SYSTEM ORGANIZATION FOR GENERAL COMMUNICATION VIA MEDIUM-ALTITUDE SATELLITES
D.G. Luck, Rec. Nat. Commun. Symp., vol. 8, no. 10, Oct. 1962, p. 1/5, Abstract p. 28/29, Appendix B.

OPTIMUM SATELLITE DISPENSING VELOCITIES FOR AN EQUATORIAL HIGH ALTITUDE NONSYNCHRONIZED SATELLITE COMMUNICATION SYSTEM
W.E. Morrow, Jr., Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 36G-3, AFESD TDR 62-255, 5 Dec. 1962, 5 p., illus., AD 292 995.

. . . advantages of a communication system employing many active satellites in high altitude (15,000 to 30,000 miles) unsynchronized equatorial orbits over 24-hour synchronous and unsynchronized medium altitude orbits. . . .

COMMUNICATION BY A POLAR-ORBIT SATELLITE RELAY
W.K. Hagan, IRE Trans. Commun. Syst., vol. CS-8, no. 4, Dec. 1960, p. 250/254.

Aircraft on transpolar flights do not have highly reliable noise-free communications. By the use of polar-orbiting satellite repeaters, UHF communications can be utilized. Active, wide-band repeaters are proposed in the satellite, using equipment similar to existing hardware. A system is discussed for a 5000-mile altitude satellite orbit and a 3500-mile ground distance separation.

A PROPOSAL FOR AN ACTIVE COMMUNICATION SATELLITE SYSTEM BASED ON INCLINED ELLIPTIC ORBITS
B. Buss, et al., J. Brit. Instn. Radio Engrs., no. 22, Sept. 1961, p. 209/225.

. . . If attitude stabilization and station keeping can be achieved, there are many advantages in using inclined elliptic orbits; this paper describes the design of a communication satellite for use in a 63-deg orbit with apogee 12600 miles and perigee 300 miles, within a weight limitation of 550 lb. The optimum frequency for a commerical communications system, in which due allowance is made for adverse weather conditions, is shown to be about 2 kMc/s. The optimum destribution of weight in the satellite is obtained by considering the W/lb factors

. . . a design based on a semi-sun-seeking concept . . . could have a radiated power of 12 W and a capacity of up to 1000 telephone channels.

INTERMEDIATE-ALTITUDE SATELLITES WITH STATION-KEEPING
R.P. Haviland, In: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 545/557; Discussion, p. 558/561, A63-14263.

. . . medium altitude (6,000 miles), equatorial orbit, attitude-controlled vehicle, and station-keeping, are chosen . . . believed to represent a superior system for the relaying of messages. . . . world coverage requirements, effect of time delay . . . distribution of traffic, interference and sharing, and switch-over problems.

SESSION OF WORKING PARTY ON SATELLITE COMMUNICATIONS EMCC, SADTC-THE HAGUE, NETHERLANDS NOVEMBER 6 THROUGH 10, 1961. ACTIVE COMMUNICATION SATELLITES IN ORBITS HAVING HEIGHTS FROM 3,000 TO 8,000 NAUTICAL MILES

J. Kaiser, Institute for Defense Analyses, Washington, D.C. 1961, lv., AD 420 182.

Investigations were made of the active real time communications satellites operating in orbits at an altitude from 3,000 to 8,000 nautical miles, above the surface. . . . Presented is the weight estimates, estimates of achievable orbits, estimates of mutual visibility, estimates of orbit stability, estimates of channel capacity . . .

A PASSIVE GRAVITATIONAL ATTITUDE CONTROL SYSTEM FOR COMMUNICATION SATELLITES

J.W. West, International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 80, 43 p., A63-25962.

. . . proposed Earth-pointing attitude-control system which fulfills the basic requirements for orienting a commerical satellite repeater. . . . particularly adaptable to a satellite communications system consisting of randomly spaced satellites at orbital heights in the order of 6,000 nautical miles.

PARAMETRIC ANALYSIS OF MEDIUM-ALTITUDE ACTIVE PASSIVE COMMUNICATION SATELLITES

ITT Communications Systems, Inc., Paramus, N. J., Rept. no. ICS63 TR250, ESD RDR 63 677, 20 Sept. 1963, lv., AD 428 311.

. . . broad systems aspects . . . for possible use in a military communication network. . . . compared primarily on an economic basis, with randomly spaced, medium-altitude orbits assumed. . . . mathematical models provide weight and cost variations for the models as a function of satellite capabilities. . . .

4A.340: Broadcasting Satellites

Included: RADAS and satellite communications; TV-broadcast from satellites

Not Included: Television space links.

Cross References: Multiple access problems in satellite communications (4A.430).

Principal Publications:

BROADCASTING FROM SATELLITES

C.M. Crain, In: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 614/624, A63-14267.

. . . definition of broadcasting, potentially available parts of radio spectrum, type of orbiting devices, and reception capabilities of the audience to be reached.

TV BROADCAST FROM AN EARTH SATELLITE

R.G. Gould, IRE Trans. Commun. Syst., vol. CS-10, no. 2, June 1962, p. 193/201.

This paper considers the need for and the feasibility of direct continential TV broadcast to conventional home receivers from an orbiting stationary satellite. Among the factors considered are time and language differences of the potential audience . . . and frequency allocation problems. Required transmitter and primary power . . . are significantly above previous estimates published elsewhere, and above the power capability of even the proposed SNAP 8, 60-kw nuclear reactor . . .

TV BROADCAST FROM AN EARTH SATELLITE

R.G. Gould, IRE Internat. Conv. Rec., Pt. 8, vol. 10, March 1962, p. 96/109.

. . . considers the need for and the feasibility of direct continental TV broadcast to conventional home receivers from an orbiting stationary satellite. . . .

TELEVISION BROADCASTING FROM SATELLITES. APPENDIX - EARLY CALCULATIONS ON TV SATELLITE BROADCASTING

N. I. Korman, et al., American Rocket Society, Annual Meeting, 17th, and Space Flight Exposition, Los Angeles, Calif., Nov. 13-18, 1962, Paper 2722A-62, 15 p., 19 refs., A63-12708.

. . . technology and economics . . . of a national (educational) television system. . . . considered realizable within this decade, is based on the use of satellites in synchronous orbit which serve as signal repeaters. . . .

RADARS AND SATTELITE COMMUNICATION

H. Magnuski, Rec. Nat. Symp. Space Electronics Telemetry, no. 1.2, Oct. 1962.

SOME TECHNICAL FACTORS AFFECTING THE FEASIBILITY OF DIRECT BROADCASTING FROM EARTH SATELLITES
E.T. Martin, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 2.1, Oct. 1962.

. . . Among the factors considered are the most satisfactory orbit for such broadcasts and the order of satellite primary power that would be required for Band 7-AM (HF), Band 8-FM (VHF), Band 8-TV (VHF), Band 9-TV (UHF), and Band 10-TV (SHF) transmissions. . . . frequency allocation problem . . . need for minimizing changes in present transmission standards and home receiving equipment. . . .

GROUND TRANSMITTERS AND SATELLITE RELAYS FOR TV BROADCASTING
R.B. Marye, et al., American Rocket Society, Annual Meeting, 17th, and Space Flight Exposition, Los Angeles, Calif., Nov 13-18, 1962, Paper 2722D-62, 19 p., 22 refs., A63-12792.

Discussion of some of the problems of the up-link from the transmitter to the satellite, and of the TV transmitter in the satellite. . . .

DIRECT TV BROADCASTING USING SATELLITE REPEATERS
D.S. Bond, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 31/37, A63-21536.

Summary of recent system studies on the feasibility of direct TV broadcasting to home or community receivers from satellite repeaters. A TV broadcasting system is described which consists of one repeater satellite approximately 22,300 miles above the Earth's surface, with a 24-hour period, remaining stationary on the central meridian of the selected ground-covering area. The satellite contains a nuclear reactor providing an electrical power output of the order of 30-60 kw. It also carries a directive antenna and as many as four TV repeaters.

SATELLITES FOR AREA COMMUNICATIONS
G.E. Mueller, Astronautics and Aerospace Engineering, vol. 1, March 1963, p. 66/69, A63-14431.

Related Publications:

SYSTEM DESIGN CRITERIA FOR SPACE TELEVISION
A.J. Viterbi, J. Brit. Instn. Radio Engrs., vol. 19, Sept. 1959, p. 561/570.

Discussion of the possibility of extending the presently conceived stabilized satellites in synchronous orbit for area communications. It is found that the satellite can relatively easily have its usefulness extended to provide TV broadcast service as a direct link between the USA and Africa and Asia, as well as the USA, Canada, and South America. . . .

DIVISION 4A.4
MODULATION AND MULTIPLEXING FOR COMMUNICATIONS SATELLITES

4A.420: Modulation for Comsat Applications

Included: Television channel modulation problems in satellite communications; FM in satellite relays; Limiters in communications satellite links; Modulation methods for lunar links; Modulation problems for orbital dipole links.

Not Included: Modulation methods for communications (1).

Cross References: Lunar communications relay (4A.130); Orbital dipole links (4A.250).

Principal Publications:

SOME THOUGHTS ON MODULATION AND DEMODULATION FOR THE NEEDLES CHANNEL. PART I
R. Price, Lincoln Lab., Mass. Inst. of Tech., Lexington, Group rept. no. 34-36, 15 April 1959, 18 p., AD 262 922.

A highly random model for the Needles channel is adopted, and the application of detection theory yields a cross-correlator-radiometer receiver that is near-optimal at low S/N in the channel. Relationships to the Rake system are discussed. It is concluded that under certain conditions desirable waveforms for the Needles channel are sinusoids employed in a manner that circumvents intersymbol interference. . . .

LUNAR ECHOES RECEIVED ON SPACED RECEIVERS AT 106.1 MC (Correspondence)
R.B. Dyce, et al., Proc. IRE, vol. 48, May 1960, p. 934/935.

RADIO COMMUNICATION USING MOON REFLECTED SIGNALS
J.V. Evans, Lincoln Lab., MIT, Lexington, 19 Dec. 1960, AD 249 355.

. . . New results are presented for the bandwidth of the system. This has been determined by measuring the demodulation of a double sideband A.M. signal as a function of modulation frequency. Three communications systems are discussed which could overcome some of the limitations of a single channel circuit.

PRELIMINARY MOONBOUNCE TESTS
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 35/38.

. . . Single-sideband (SSB) transmission was used throughout the experiments and various receiving system methods were evaluated. Based on the results of these tests, equipment has been purchased for installation at the Woomera Station for a series of communication experiments . . .

LUNAR AND PLANETARY ECHO THEORY
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 1/9

. . . The behavior of lunar radio echoes observed and reported by Trexler . . . did not conform to an echo shape which is characteristic of a spherical scatterer, i.e., having specular and Lambert scatter components. For the central region of the Moon's disk, the trailing edge of the response to a narrow radar pulse decayed very rapidly, and virtually all the echo power had returned within 300 μ sec of its leading edge.

ETUDE GENERALE COMPAREÉ DES SYSTEMES DE MODULATION EN VUE DES COMMUNICATIONS PAR SATELLITES ARTIFICIELS (Central Comparative Study of the Modulation Systems With A View To Communications By Artificial Satellites) (In French)
G. Battail, In: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 383/408, 14 refs., A63-14254.

SOME INTERNATIONAL ASPECTS OF SATELLITE COMMUNICATION SYSTEM PLANNING
C.F. Booth, J. Brit. Instn. Radio Engrs., no. 22, Sept. 1961, p. 227/230.

. . . include the minimization of interference with other services and the modulation and baseband characteristics.

BANDWIDTH OF A MOON COMMUNICATION CIRCUIT
J.V. Evans, Brit. J. Appl. Phys., vol. 12, no. 8, Aug. 1961, p. 406/409.

Radar studies of the moon by a number of workers have shown that the principal reflections occur from a region at the centre of the visible disk having a radius of about one-tenth of that of the moon. Thus it is possible to use the moon as a reflector in a communication system, and several successful systems of this type have

been demonstrated. This paper describes measurements made at Jodrell Bank to determine the single-channel bandwidth of the system using double-sideband amplitude-modulated transmissions. It is found that the demodulation of the signals caused by the multiple scattering at the moon's surface restricts the bandwidth to about ± 1 kc/s, although the demodulation does not appear to increase rapidly at higher modulation frequencies.

FREQUENCY MODULATION WITH FEEDBACK RECEIVER PERFORMANCE AND MODULATION METHODS FOR SATELLITE COMMUNICATION

J.R. Pierce, In: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elesvier Publishing Co., 1962, p. 429/432, A63-14256.

PROJECT ECHO - FM DEMODULATORS WITH NEGATIVE FEEDBACK

C.L. Ruthroff, National Aeronautics and Space Administration, Washington, D.C., Technical note D-1134, Oct. 1961, 8 p., AD 264 029.

. . . A wide-band frequency modulation technique was used in which bandwidth was traded for signal-to-noise ratio. The FM receiving demodulators are described. Negative feedback applied to the local oscillator reduces the FM modulation index in the receiver IF amplifiers, resulting in threshold performance superior to that of conventional FM receivers.

LONG DISTANCE COMMUNICATION VIA THE MOON

P.A. Webster, J. Brit. Instn. Radio Engrs., no. 22, Sept. 1961, p. 257/264.

Three experiments in Moon reflection using 1 kW v.h.f. transmitters and the Jodrell Bank radio telescope are described. The results are discussed in terms of practical long-distance communication circuits using the Moon as a passive reflector. Consideration is given to the optimum frequency, type of modulation, aerial size, etc., for economic utilization of such a circuit.

CHOICE OF OPTIMUM MODULATION METHOD IN ACTIVE SATELLITE COMMUNICATION SYSTEMS

W.L. Wright, In: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 409/424; Discussion p. 425/428, A63-14255.

DEMODULATION OF WIDEBAND FREQUENCY MODULATION UTILIZING PHASE-LOCK TECHNIQUE

R.C. Booton, Jr., Proc. Nat. Telem. Conf., vol. 2, no. 6-4, May 1962.

. . . The modulation technique chosen for the early satellite relays has been wideband analog frequency (or phase) modulation. . . . considerable effort has been devoted to the development of more efficient demodulation schemes. Two examples are the BTL FM-feedback demodulator and the phase-lock demodulator to be described in the present paper. . . .

LA COMPRESSION DE FREQUENCE ET SON UTILISATION POUR LES TELECOMMUNICATIONS PAR SATELLITES (Frequency Compression And Its Use In Satellite Telecommunications) (In French)

C. Cardot, In: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 433/446, A63-14257.

. . . The basic principle of frequency compression is indicated - i.e., the application of the general properties of feedback systems to FM receivers. . . .

STUDY OF ADAPTABLE COMMUNICATIONS SYSTEMS

D. Chesler, Sylvania Electric Products, Inc., Waltham, Mass., Final rept. Rept. no. F-1008-1, RADC TDR 62-314, 14 June 1962, 293 p., incl. illus. tables, refs., AD 286 504.

. . . One investigation demonstrates the utility of a rake-type system for orbital dipole channels. The rake system studied is a generalization of the conventional rake system and has the advantage of allowing analog as well as digital modulation.

COHERENT FDM/FM TELEPHONE COMMUNICATION

J.A. Develet, Jr., Proc. IRE, vol. 50, no. 9, Sept. 1962, p. 1957/1966.

. . . telephone communication as applied to a satellite repeater system. Particular emphasis is placed on a method of coherent reception . . . new to the field of common carrier telephony. . . . for the class of signals utilized in common carrier telephony, an attempt is made to place on a quantitative footing the design of FDM/FM satellite communication systems. The interrelation among such quantities as sensitivity, bandwidth occupancy, and channel quality is presented for a simply realized second-order receiving system. In addition, the maximum sensitivity achievable with the optimum receiving system is shown. . . .

PARAMETRIC ANALYSIS OF AIR GROUND COMMUNICATIONS VIA ORBITING DIPOLES

C.C. Gauder, Electromagnetic Warfare and Communications Lab., Aeronautical Systems Div., Wright-Patterson Air Force Base, Ohio, Rept. on Applied Communication Research for Air Force Vehicles, ASD TDR 62-579, Sept. 1962, 38 p., incl. illus. tables, 8 refs., AD 289 879.

. . . A sophisticated modulation and demodulation technique is evolved to overcome the effects of channel adversities such as multipath spread and Doppler smear. . . .

DESIGN AND PERFORMANCE OF A BROADBAND FM DEMODULATOR WITH FREQUENCY COMPRESSION
C.L. Ruthroff, et al., Proc. IRE, vol. 50, no. 12, Dec. 1962, p. 2436/2445.

. . . threshold improving properties . . . experimental broad-band demodulator . . . intended for use in an intercontinental satellite communication system . . . is suitable for either television or telephone service. Circuit details, performance data, and a measured comparision with FM are presented.

ON THE USE OF HARD LIMITERS IN MILITARY SATELLITE REPEATERS
P.H. Sawitz, Institute for Defense Analyses, Wash., D. C., Rept. no. TN62 8, March 1962, 15 p., AD 428 217.

Active satellite repeaters . . . may have a linear range, or they may incorporate hard limiters. The present ADVENT repeater design, for example, includes a hard limiter. . . . The performance characteristics of hard limiters will be summarized, and it will be seen that, while they have disadvantages, certain military performance requirements cannot be met without them.

TELEVISION EN COULEURS PAR SATELLITE (Color Television Via Satellites) (In French)
G. Valensi, Ann. Telecomm., vol. 17, no. 3-4, March/April 1962, p. 67/76.

OPTIMUM SYSTEM ENGINEERING FOR SATELLITE COMMUNICATION LINKS WITH SPECIAL REFERENCE TO THE CHOICE OF MODULATION METHOD
W.L. Wright, et al., J. Brit. Instn. Radio Engrs., vol. 23, May 1962, p. 381/391.

PASSIVE SPHERICAL SATELLITE COMMUNICATIONS STUDY
General Electric Co., Syracuse, N.Y., Final rept., vol. 1, Rept. no. DSD-ASER 6-62, RADC TDR 62-136, vol. 1, July 1962, lv., incl. tables, refs., AD 282 713.

. . . Modulation studies . . . Combination of communicating and tracking functions . . .

LES PROBLEMES D'INTERCONNEXION DANS LES RESEAUX DE TELECOMMUNICATIONS PAR SATELLITES (Problems Of Linkage In Satellite Telecommunication Systems) (In French)
P. Deman, International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 87, 20 p., A63-26039.

. . . interaction between the modulation systems, the type of satellite repeater, and the type of orbit of the satellite . . . The optimization problem is discussed for a synchronous satellite.

DISTRIBUTED SATELLITE CIRCUMGLOBAL COMMUNICATION TECHNIQUE STUDY
R.E. Graham, et al., Bell Telephone Labs., Inc., New York, Rept. for 11 Jan. 1962 - 11 March 1963, RADC TDR 63 216, 11 March 1963, 96 p., AD 408 269.

. . . extension of the modulation and detection analysis . . . study of transmission medium characterization . . . propagation of errors resulting from the use of the 1-of-5 quaternary code . . . studies to determine the approximate cost of the ground equipment for a complete system utilizing belts of orbiting dipoles.

A RAKE SYSTEM FOR LUNAR RELAY COMMUNICATIONS
S. Kasowski, IEEE Internat. Conv. Rec., Pt. 8, vol. 11, March 1963, p. 197/214, 15 refs.

. . . The transmission technique investigated is a multilevel, matched filter type using wide-band, binary, pseudorandom sequences. It is studied specifically for transmission of digitalized information on a moon bounce link, i.e., for communication between two distant ground stations using the moon as a reflective scatter relay.

A LUNAR ECHO STUDY AT 425 MCS.
R.C. Mathis, Texas U., Austin, June 1963, 81 p., AD 415 812.

. . . (1) the type of return must be determined . . . (2) the area on the moon from which the echo comes must be found and (3) a mathematical model of the moon must be derived . . . Finding solutions to these three key problems is the main purpose of this study . . .

MODULATION TECHNIQUES FOR ORBITING DIPOLE SCATTER COMMUNICATION
W.E. Morrow, Jr., Institute of the Aerospace Sciences, Annual Meeting, 31st, New York, N.Y., Jan. 21-23, 1963, Paper 63-66, 8 p., A63-11617.

PRELIMINARY STUDY OF MODULATION SYSTEMS FOR SATELLITE COMMUNICATION
S. Plotkin, Hughes Research Labs., Malibu, Calif., Rept. 6R, June 1963, 69 p., 22 refs., N63-23817.

. . . A comparative study of power and bandwidth requirements for SSB, FM, and PCM modulation systems is given, as related to multiple-access satellite communications. Composite power-loading factors for multichannel speech are treated as a function of the number of channels . . . Multiple access

considerations show that serious difficulties arise in both all FM and all-PCM systems. Thus, the concluding modulation system choice is SSB for the up link, and wideband FM for the down link. It was further concluded that frequency division multiplex is preferable to time division multiplex.

OPTIMUM PULSE TRANSMISSIONS FOR MULTIPATH CHANNELS
J.G. Proakis, Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. 64G-3, 16 Aug. 1963, 40 p., refs., AD 416 639, N64-17454.

. . . performance of an incoherent M-ary communication system . . . computed under very restrictive conditions on the channel behavior, namely, that the received signal consists of resolvable, independent Rayleigh fading paths, each of which has been corrupted additively by indpendent gaussian noise . . . generalizations of results obtained earlier. From these expressions the optimum time duration for pulse transmissions is computed for two channels-the orbital dipole channel and the moon.

WIDE BAND LUNAR RELAY COMMUNICATIONS
W.M. Waters, et al., Electronic Communications, Inc., Timonium, Md. Research Div., AFCRL-63-332, May 16, 1963, 44 p., 23 refs., N63-23701.

. . . problem of increasing lunar relay bandwidth. An adaptive receiving array is described which makes possible the use of exceptionally large apertures capable of being focused on a small spot on the lunar surface. However, an analysis shows that sidelobe effects considerably reduce expected bandwidth gains. A bandwidth of 25 kc is calculated for a 1000 ft^2 X-band array which employs a "maximum energy" taper. Between 256 and 1024 array elements are required.

IONOSPHERIC RESEARCH AND PROPAGATION STUDIES
H.D. Webb, et al., Electrical Engineering Research Lab., U. of Illinois, Urbana, Quarterly progress rept. no. 11, 1 Jan.-31 March 1963, 13 June 1963, 27 p., AD 419 683.

Observations of moon reflected signals were made on 40 days for a total of over 322 hours. The relative polarization angles have been read out from all of the data.

MODULATION METHODS FOR MULTI-STATION SATELLITE COMMUNICATION SYSTEMS
W.L. Wright, Point to Point Telecommunications, vol. 7, Feb. 1963, p. 27/52, A63-14059.

Analysis of three methods of modulation for satellite communication systems - wideband FM with feedback, PCM carried by bipolar vestigial sidebands, and SSB. . . .

Related Publications:

A LUNAR AND PLANETARY ECHO THEORY
W.E. Brown, Jr., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Technical release no. 34-54, 30 April 1960, 32 p., incl. illus., AD 240 772.

A relatively simple statistical approach is used to derive a theoretical impulse response of the lunar reflection . . . The same value appears to be consistent with data from Goldstone and Millstone experiments. The echo was assumed to consist of two components, specular and scatter . . . ratio of total scatter power and total specular power reflected (cpr) is found to fall between 0.1 and 1.0. The depth of the surface layer could be as great as 10 km.

EXPERIMENTAL PASSIVE-SATELLITE COMMUNICATION LINK
Philco Corp., Philadelphia, Pa., 29 Nov. 1960, AD 249 373.

An experimental one-way 2 kmc communication link was established between the Rome Air Development Center test sites at Trinidad, W.I.F., and Floyd, New York, utilizing spherical satellites as passive reflectors of electromagnetic energy.

EFFECTIVE BANDWIDTH MEASUREMENTS USING THE MOON AND ECHO SATELLITE
R.E. Anderson, et al., Proc. Nat. Electronics Conf., vol. 17, Oct. 1961, p. 509.

The constantly changing multipath structure of the lunar propagation path creates distortions of several types on signals reflected from the moon. . . .

THE DICON SYSTEM
R.S. Berg, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, Technical rept. no. 251, 31 Oct. 1961, 28 p., AD 267 536.

. . . comprises a transmitter which provides a variety of modulation signals to the West Ford RF transmitter and a receiver designed to recover the modulation signal from the output of the West Ford X-band receiving system and to measure and record the perturbations introduced by the West Ford channel. . . .

SIDEBAND CORRELATION OF LUNAR AND ECHO SATELLITE REFLECTION SIGNALS IN THE 900-MC RANGE
Proc. IRE, vol. 49, no. 6, June 1961, p. 1081/1082.

LUNAR REFLECTION STUDIES
General Electric Co., Syracuse, N.Y., Interim rept. 6 July 1961, 30 p., AD 264 312.

. . . Tests were conducted utilizing double sideband suppressed carrier transmissions at 915 Mc. . . . The results show that the moon has a very low coherent bandwidth which is less than 1000 cps if stringent requirements are placed on the required quality of the transmission path. . . .

STATISTICAL PROPERTIES OF THE DICON RECEIVER
J.A. Dumanian, Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 52 G-2, AFESD TDR 62-85, 2 March 1962, 11 p., illus., 3 refs., AD 275 278.

. . . frequency-shift keying and energy detection. . . . The final bit decision is performed by subtracting the outputs of two channel receivers tuned to the two information frequencies and determining the sign of the result. Results were obtained for a variety of parameters representative of the range of experimental conditions expected in West Ford communications.

TRANSCONTINENTAL SATELLITE TELEVISION TRANSMISSION (Correspondence)
D. H. Hamilton, Jr., et al., Proc. IRE, vol. 50, June 1962, p. 1522/1523.

. . . during the week of April 22, 1962 . . . accomplished by employing very powerful and sensitive microwave radio equipment to reflect signals from coast to coast via the orbiting Echo balloon.

4A.430: Multiplexing Problems for Communications Satellites

Included: Multiple access satellite relays; PN sequences for multiple access communications satellites; RACEP for communications satellites; Random multiple access in comsat systems; Random access satellite communications network; RASAC system.

Not Included: Multiplexing in communications systems (2); PN sequences in data transmission (1); Theory of PN codes (2); Random access multiplexing systems (2).

Cross References: Modulation problems for communications satellites (4A.420); Synchronous communications satellites (4A.320).

Principal Publications:

MULTIPLEXING TECHNIQUES FOR SATELLITE APPLICATIONS
O. B. King, Electronics, vol. 32, no. 44, Oct. 1959.

SATELLITE TO SATELLITE COMMUNICATIONS: A LITERATURE SURVEY OF RECENT TECHNIQUES
J. B. Goldmann, Lockheed Aircraft Corp., Sunnyvale, Calif., Special bibliography no. SB-61-59; Rept. no. 3-77-61-18, Oct. 1961, 32 p., 93 refs., AD 271 037.

. . . annotated bibliography. . . includes publications released from January 1960 to June 1961. . . . communications satellites. . . . Emphasis is placed upon active satellites. References to the Echo satellite are omitted.

CONCEPT FOR AN INTERCONTINENTAL SATELLITE COMMUNICATIONS SYSTEM
E. A. Laport, et al., RCA Rev., vol. 22, no. 3, Sept. 1961, p. 555/566.

. . . provides for simultaneous and continuous access by any desired number of earth stations with full interconnectivity between them. . . uses a single repeater in a stabilized stationary satellite, with standard single-sideband suppressed-carrier telephone channels (width and separation) translated to the microwave region. The various station transmitting channels are interleaved at the satellite input, and their aggregate frequency-modulates the satellite transmitter.

A STUDY OF A MICROWAVE AEROSPACE GLOBAL INTER-SATELLITE COMMUNICATION SYSTEM
A. P. Martin, East Coast Conf. Aerospace Navig. Electronics, vol. 8, no. 5.1.2, Oct. 1961, p. 1/4.

SATELLITE COMMUNICATION SYSTEM PROVIDING CHANNEL DROPPING
E. K. Sandeman, British Aircraft Corp., London, 1961, 39 p., Paper delivered at British Interplanetary Society Symposium on Communication Satellites, May 6, 1961, AD 262 637.

. . . The satellite. . . behaves like a telephone exchange: all that is necessary for two ground stations to get into communication is for each of the ground radio receiving stations to tune into one of the communication bands assigned to the radio transmitter of the other ground station. The feature afforded in this way is sometimes referred to as channel dropping.

MUTUALLY DISTINGUISHABLE NONBINARY PN SEQUENCES
D. Anderson, JPL Space Progr. Summ., vol. 4, no. 37-17, Aug./Sept. 1962, p. 96/97.

Since there are only limited numbers of binary PN sequences of a given length, a natural problem is the construction of periodic signals which are distinguishable, have good out-of-phase autocorrelation, and occupy the same bandwidth. This occurs, for instance, when it is desired to construct multiple-address systems for groups of satellites or to range several instrument packages simultaneously.

The system to be described here consists of sending, as signals, certain periodic sequences of phases and receiving them by the use of word detection.

FREQUENCY AND TIME CONTROL FOR COMMERCIAL MULTIPLE ACCESS SYNCHRONOUS SATELLITE COMMUNICATION SYSTEMS
D. P. Peterson, et al., Rec. Nat. Commun. Symp., vol. 8, no. 10, Oct. 1962, p. 25a-g.

PASSIVE SPHERICAL SATELLITE COMMUNICATIONS STUDY
J. V. Wilding, et al., ITT Labs., Federal Labs., Nutley, N. J., RADC TDR 62-89, March 1962, 152 p., incl. illus., AD 273 870.

. . . The nature of the transmission medium poses several problems, including: a variable length transmission path, an instant of transfer of communications from a setting satellite to a rising satellite, and the handling of traffic in the several forms of voice, graphics, teletype, and data. It is proposed that all traffic be handled in digital form once it enters the system and that transmission on each link be in the form of time-division multiplexed serial binary stream.

LOW-LEVEL SATELLITE COMMUNICATIONS USING RACEP
H. W. Grossman, Rec. Nat. Space Electronics Symp., no. 3.3, 1963.

. . . presents the Martin Company's concept for a military satellite communication system using RACEP techniques. . . offers random-multiple communication access to a satellite relay without the use of a central pre-programming control facility.

A RANDOM ACCESS SATELLITE COMMUNICATIONS SYSTEM (Correspondence)
P. I. Hershberg, IEEE Trans. Commun. Syst., vol. CS-11, no. 4, Dec. 1963, p. 501/502.

. . . proposal of order-wire systems, in which one or more channels are set aside strictly to accommodate the system control function. . . . Other proposals have been adaptive systems, . . . and networks which allocate separate channels to each receiving station. The latter proposal is usually unsatisfactory. . . The result has been the design of the presently described modified party-line system. . . .

SYSTEM OFFERS PRIVATE-LINE RADIO SERVICE
P. J. Klass, Aviation Week and Space Technology, vol. 78, May 13, 1963, p. 115/117+, A63-17203.

. . . random access discrete address (RADA) system. . . provides the radio equivalent of private-line telephone service. Research aimed at the incorporation of the system into a communications-satellite system and its use for military and space applications is described.

RANDOM MULTIPLE ACCESS
H. E. Lanning, Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 169/174.

The most obvious means of providing random multiple access to a satellite communication system is through the use of frequency and time division multiplex. . . . methods of assigning channels are not completely satisfactory. . . It is possible to eliminate some of the problems associated with standard frequency and time division multiplex by combining them and using one wideband channel in a signal stacking arrangement. . . . orthogonal signals can be constructed. . . Unfortunately, these codes require inter-channel synchronization and complex address generation. . . . by constructing interference rejecting codes an efficient system of channel utilization could be developed. The generation of these interference rejecting codes is most easily accomplished by utilizing pseudo-random sequence generators. The resulting signals will be quasiorthogonal and have a cross channel interference level controllable to any arbitrarily low level. . . .

AN INTRODUCTION TO MULTIPLE ACCESS SATELLITE COMMUNICATION
S. G. Lutz, Hughes Research Labs., Malibu, Calif., Rept. no. 5, Feb. 1963, 56 p., 10 refs., N63-23651.

. . . adaptability of multiple-access systems, orbital constraints with regard to communication coverage and economics, modulation and multiplexing requirements, and possible calling techniques with associated problems.

SYNCOM II TO USE MULTIPLE-ACCESS DEVICES
B. Miller, Aviation Week and Space Technology, vol. 78, June 10, 1963, p. 108/109+, A63-19648.

Block diagrams of the proposed dual-mode communications transponders and of the phased-array transmitting antenna are given, along with a description of these systems. The reaction-control system is also described.

RANDOM ACCESS STATIONARY SATELLITE RELAY COMMUNICATION SYSTEM
Z. Prihar, Rec. Nat. Space Electronics Symp., no. 3.4, 1963.

. . . condensed version of a more extensive and detailed report. . . discusses a method of . . . a random access. . . system via active stationary satellite relays. . . . operation of the Control Center is analyzed. Two service channel transmission speeds have been considered, namely, 50 bits per second and 1200 bits per second. . . . predicted number of service channels. . . Queuing (waiting line) problems. . . alternative multiple access methods. . . substitution of an adaptive system . . .

K TEORII PROKHOZHDENIIA SHIROPOLOSNYKH SIGNALOV V SISTEMAKH NAZEMNOI KOSMICHESKOI SVIAZI (Contribution to the Theory of Wide-band Signal Transmission in Ground-Based Space Communications Systems) (In Russian)
A. V. Prosin, Radiotekhnika i Elektronika, vol. 8, Nov. 1963, p. 1822/1833, A64-12029.

Theoretical investigation of distortions due to dispersion that arise in the passage of FM signals through a dispersing medium. Developed is a method for calculating cross noise created by the dispersion-induced distortions in multi-channel multiplexed FM communications systems based on the use of artificial Earth satellites.

A TRULY GLOBAL SATELLITE COMMUNICATION SYSTEM
H. Trotter, Jr., In: Advances in the Astronautical Sciences, Vol. XI, American Astronautical Society, Annual Meeting, 8th, Washington, D. C., Jan. 16-18, 1962, Proceedings, Edited by Horace Jacobs, North Hollywood, Calif., Western Periodicals Co., 1963, p. 431/445, A64-11460.

. . . using a 24-hr stationary satellite. The system allows multiple access to the satellite, with the ground stations in the sector of a particular stationary satellite simultaneously sharing the total input band of the satellite. Channels are allocated for connection only as there is a demand for service with channel selection automatically made through a special control channel. On a demand for a service, an idle channel is selected and automatically routed from the calling to the called ground station. . . .

POWER REQUIRED TO JAM A SATELLITE REPEATER
F. F. Yates, Aerospace Corp., El Segundo, Calif. Materials Science Lab., SSD TDR-63-203; TDR-269(4111)-3, Dec. 1963, 18 p., refs., AD 428 375, N64-14344.

A general expression is derived for the ratio of interference power to signal power required at the terminals of the receiving antenna of a communication satellite (in the bandpass of a communication channel) to reduce the performance of the channel to any specified minimum condition. The expression may be applied to the analysis of spread-spectrum multiple access systems as well as to the analysis of jamming vulnerability.

APPLIED RESEARCH STUDY ON SATELLITE COMMUNICATIONS
ITT Federal Labs., Nutley, N. J. Quarterly rept. no. 3, 1 Jan.-31 March 1963, 31 March 1963, 231 p., AD 413 948.

Task IV - Traffic routing techniques study. Task V - Multiple access techniques. Task VI - Mobile ground stations.

MULTIPLE SATELLITE AUGMENTATION PROGRAM TRACKING STATION COMPUTER OPERATIONAL PROGRAMS (MILESTONES 2 & 3)
Philco Corp., Palo Alto, Calif., Technical Operating Report, Rev. 1 to rept. no. WDL-TR1931, 28 Feb. 1963, lv. incl. illus., AD 297 411.

. . . data processing subsystem operational computer programs to be used at remote tracking sites in support of satellite acquisition, tracking, commanding, telemetry, and station control operations. . .

RASAC. RACEP ADAPTIVE SATELLITE COMMUNICATIONS
Martin Marietta Corp., Orlando, Fla., Rept. no. OR2544P, 1963, 14 p., AD 418 653.

RASAC is a military satellite communication system employing RACEP modulation techniques. Approximately 50 active satellites are employed in asynchronous orbits at an approximate altitude of 700 miles. Routing and switching . . . by a new technique called propagated switching which has evolved from studies in survivable communications networks. The summary characteristics of RASAC are given.

Related Publications:

AN ANALYSIS OF CASCADED BINARY COMMUNICATION LINKS
H. D. Goldman, et al., IRE Trans. Commun. Syst., vol. CS-10, no. 3, Sept. 1962, p. 291/299.

. . . The use of satellite relays appears to be particularly advantageous for wide-band VHF and UHF global communications. . . . the error probabilities of cascaded links have been found for the following modulation techniques: 1) Coherent phase-shift keying (CPSK) 2) Coherent frequency-shift keying (CFSK) 3) Coherent carrier keying (CCK) 4) Noncoherent frequency-shift keying (NCFSK) 5) Differentially coherent phase-shift keying (DCPSK).

DYNAMIC PROGRAMMING TECHNIQUES
Sylvania Electric Products, Inc., Waltham, Mass., Final rept., Rept. no. F2030 1, RADC TDR 64 10, 11 Dec. 1963, 108 p., AD 433 897.

The general theory of the recursive formulation of optimization problems is developed in this report. . . . the distinction between deterministic and nondeterministic programming problems is included. . . . Problems discussed include the optimum scheduling of link-to-satellite assignments in a nonsynchronous satellite communication system and the computation of optimum discrete allocations.

PROGRAM TEST PLAN FOR MULTIPLE SATELLITE AUGMENTATION—PHASE A
Philco Corp., Palo Alto, Calif., Technical operating rept., Rept. no. WDL-TR2015, 28 Feb. 1963, lv. incl. tables, AD 297 410.

ENGINEERING PLAN GDHE/MUSAP COMMAND INTERFACE
Philco Corp., Palo Alto, Calif., Rept. no. WDL-TR2029, 26 Feb. 1963, 10 p., incl. illus., AD 297 250.

. . . equipment and modifications necessary to interface the existing Ground Data Handling Equipment (GDHE) with certain Multiple Satellite Augmentation Program (MUSAP) command equipment.

MAINTAINABILITY TEST AND DEMONSTRATION PLAN FOR NEW HAMPSHIRE STATION MULTI-SATELLITE AUGMENTATION PROGRAM, PHASE "A"
Philco Corp., Palo Alto, Calif. Technical operating rept., Rept. no. WDL-TR-2025, 25 Jan. 1963, lv., AD 299 147.

DIVISION 4A.5
GROUND STATIONS

4A.500: Ground Stations for Communications Satellites

Included: Satellite communications terminals; Holmdel station for TELSTAR communications; Andover ground station; Precision tracker for satellite acquisition; Antenna pointing systems for comsat tracking; Site noise in comsat ground stations; Goonhilly Downs station.

Not Included: Ground stations for deep space links (4C); Antenna control by stored program controllers (3A); Ground data processors for satellite control (3A).

Cross References: Telstar project (4A.860); Relay project (4A.840); Syncom project (4A.855).

Principal Publications:

RFI IN SATELLITE COMMUNICATIONS SYSTEMS
O. M. Salati, Electronic Industr., vol. 19, no. 4, April 1960, p. 92/97.

HOW COURIER SATELLITE'S GROUND SYSTEM WORKS
Electronics, no. 33, July 1960, p. 38/39.

EXPERIMENTAL PASSIVE-SATELLITE COMMUNICATION LINK, APPENDIX I. DESCRIPTIVE HANDBOOK, VOLUME I
Philco Corp., Philadelphia, Pa., 29 Nov. 1960, AD 249 374.

. . . the system and equipment which comprise the experimental passive-satellite communication link. . . . Volume I contains an unclassified description of the communication and tracking equipment at the Trinidad and Rome sites and an analysis of communication link performance. . . .

PROPAGATION PROBLEMS OF A COMMUNICATION SATELLITE
H. B. Collins, Jr., et al., Nat. Commun. Symp. Rec., vol. 7, Oct. 1961, p. 116/121.

. . . ground site selection . . .

PASSIVE SPHERICAL SATELLITE COMMUNICATIONS STUDY. VOLUME II. TERMINAL FACILITIES
H. A. George, et al., ITT Labs., Fort Wayne, Ind., RADC TN 61-36 B, 22 Jan. 1961, AD 251 569.

. . . Block diagrams of terminal equipment required to handle voice, teletype, data, and graphics are presented. Possible application of existing equipment and operational plans in the satellite ground station are discussed. Routing, address coding, and priority handling methods are treated.

PROJECT ECHO - RECEIVING SYSTEM
E. A. Ohm, National Aeronautics and Space Administration, Washington, D. C., Technical note no. D-1130, Dec. 1961, 30 p., AD 268 452.

A tracking horn-reflector antenna, a maser preamplifier (and standby parametric preamplifier), and a special FM demodulator were combined to form a low-noise receiving system which made possible the establishment of a high-quality voice circuit via the Echo I passive satellite. A description is given of the 2390-mc receiving system located at the Bell Telephone Laboratories facility in Holmdel, New Jersey.

PROJECT ECHO-960-MEGACYCLE, 10-KILOWATT TRANSMITTER
J. P. Schafer, et al., National Aeronautics and Space Administration, Washington, D. C., Tech. note D-1129, Oct. 1961, 23 p., AD 265 484.

A 10-kw transmitter operating at 960 to 961 mc was used at the eastern terminus of the Project Echo communications experiment. . . located on Crawford's Hill near Holmdel, New Jersey. . . 60-foot dish antenna. . . various modulations, such as wide-deviation FM, low-index phase modulation, single-sideband or double-sideband modulation with or without carrier, 960.05 or 961.05 mc constant-frequency CW, and radar on-off pulses at 961.05 mc. . . . four-stage, externally-tuned-cavity, water-cooled klystron, operating at a beam voltage of 16 to 18 kv. The transmitter was operated during many Moon-bounce, tropospheric scatter, and Echo I tests with very satisfactory results.

GROUND EQUIPMENT FOR SATELLITE COMMUNICATION
W. K. Victor, Jet Propulsion Lab., CIT, Pasadena, Calif., Tech. rept. 32-137, Rev. 30 Oct. 1961, 35 p., AD 266 547, Supersedes AD 261 357.

. . . cost of a single operational satellite-communication ground station capable of handling television bandwidths is 2 to 4 million dollars. The station includes one 85-ft-diameter Az-El antenna designed to operate both as a standard UHF monopulse tracking radar and as a microwave communications relay. It is capable of operating with both passive and active satellites, and this dual capability is included with very little increase in cost over that required for operating with either passive

satellites only or active satellites only. All significant items of ground equipment are listed, together with their estimated cost. Illustrative designs showing the pertinent communication system parameters for both active and passive satellites are included in order to define the performance requirements of the ground equipment. It is noted that another station of the type described may be required to reduce switch-over time between satellites, thereby approximately doubling the indicated cost.

MAJOR SYSTEM TRADEOFFS AMONG FIXED, TRANSPORTABLE, AND MOBILE STATIONS IN SATELLITE COMMUNICATION SYSTEMS

A. Alma, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 193.

THE POST OFFICE SATELLITE SYSTEM GROUND STATION AT GOONHILLY DOWNS

W. J. Bray, et al., Brit. Commun. and Electronics, vol. 9, no. 8, Aug. 1962, p. 574/579.

A brief description of the lay-out and equipment of the Goonhilly Downs station is given.

SATELLITE COMMUNICATION EQUIPMENT: SOME DESIGN CONSIDERATIONS

J. E. Clegg, Royal Aircraft Establishment (Gt. Brit), Tech. note no. Space 6, Feb. 1962, 16 p., illus., 3 refs., AD 278 027.

The subdivision of the power supply and communication equipment into a number of units is suggested to improve reliability and make better use of the power available. The use of a transponder which amplifies and changes carrier frequency without demodulation and remodulation is shown to have advantages. A multiple receiving aerial system which may reduce the cost of ground stations is described. It is shown that the system can be used by 50 separate ground stations provided they are uniformly distributed around the world in longitude.

THE RADC PASSIVE SATELLITE COMMUNICATIONS RESEARCH TERMINAL

A. Feiner, et al., Hughes Aircraft Co., Culver City, Calif., 1962, 7 p., incl. illus., AD 287 891.

A general design of a passive satellite communications research terminal is given. . . .

A STUDY OF THE MULTISATELLITE CONTROL PROBLEM

Y. Fukuda, et al., In: Symposium on Ballistic Missile and Space Technology, 7th, Transactions, Volume II, Colorado Springs, Colo., Aug. 13-16, 1962, Los Angeles, Aerospace Corp.; USAF, Systems Command, Office of the Deputy Commander for Aerospace Systems, 1962, p. 415/441, A63-13375.

. . . a method of solving the multisatellite-control problem . . . Service is supplied in the form of tracking, readout, and command by a system of ground stations. This "horizontal method" is based on the concept of sequentially selecting each service requirement, and then sequentially making service assignments over the entire scheduling period. The method is capable of handling any number of satellites, services, and ground stations, and is amenable to graphic implementation for small systems. Large systems will require an electronic computer program to implement a schedule devised by the method.

A STUDY OF THE MULTISATELLITE CONTROL PROBLEM

Y. Fukuda, et al., Planning Research Corp., Los Angeles, Calif., 1962, lv. incl. illus., tables, 1 ref., AD 278 200.

A MEDIUM CAPACITY SATELLITE COMMUNICATIONS TERMINAL

W. Glomb, et al., Rec. Nat. Commun. Symp., vol. 8, no. 10, Oct. 1962, p. 26a-j, Appendix D.

. . . The facility is experimental and is intended to demonstrate the performance of such a station with both active and passive satellites in both trunking and multiple access systems. With linear repeater satellites having a 10 watt capability, the station has a capacity of 24 voice channels to CCIR standards. . . .

THE 85 FT STEERABLE DISH AERIAL AT GOONHILLY DOWNS

H. C. Husband, Brit. Commun. and Electronics, vol. 9, no. 8, Aug. 1962, p. 584/586.

The design of the dish, its steering gear and control system are briefly discussed.

STANDBY RECEIVER SYSTEM

L. U. Kibler, Bell Syst. Tech. J., vol. 41, no. 4, July 1962, p. 1129/1148.

. . . The use of this system in the initial Moonbounce experiments and in Project Echo is described. The details of an emergency operation at the beginning of a balloon pass are also presented.

ANTENNA STEERING SYSTEM
R. Klahn, et al., Bell Syst. Tech. J., vol. 41, no. 4, July 1962, p. 1207/1225.

. . . While the dynamic control of antennas has not been required in prior Bell System communications, it will play an important role in future systems utilizing many orbiting repeaters. Although communications antennas could be slaved to optical or radar trackers at each antenna site, the use of basic orbital information to generate antenna steering instructions is expected to be more economical when many antennas and sites are served . . .

RECEIVING SYSTEM
E.A. Ohm, Bell Syst. Techn. J., vol. 41, no. 4, July 1962, p. 1065/1094.

THE 1700 Mc/s TRANSMITTER
E.A. Ratlue, et al., Brit. Commun. and Electronics, vol. 9, no. 8, Aug. 1962, p. 587/589.

. . . The transmitter, designed for use in project "Relay" provided a maximum of 10 kW output with alternative output klystrons. The equipment is briefly described. . . .

CHARACTERISTICS OF THE SERVICE PROVIDED BY COMMUNICATIONS SATELLITES IN UNCONTROLLED ORBITS
J.D. Rinehart, et al., Bell Syst. Tech. J., vol. 41, no. 5, Sept. 1962, p. 1621/1670.

In a communications system which uses satellites in uncontrolled orbits, there would be times when the communication between two stations would be interrupted because no satellites would be in view . . . An example system which could be used to provide initial world-wide service is also discussed. This system has certain nonrandom characteristics, and the effect of these characteristics on the service to various parts of the world is examined by computer simulation.

THE INSTRUMENTATION OF AN ARRAY OF REFLECTORS FOR PASSIVE SATELLITE COMMUNICATIONS
A.E. Ruvin, et al., Airborne Instruments Lab., Inc., Mineola, N.Y., 1962, 9 p. incl. illus. 5 refs., AD 287 876.

. . . Four 30-foot reflectors have been instrumented for the University to make adaptively coherent the signals received by each dish from an Echo satellite. The satellite is illuminated by a remote transmitted signal. The effective gain of a 60-foot dish is obtained by the effects of slow irregularities in propagation and phase shifts, which are automatically compensated for in the signal-processing equipment . . .

THE INSTRUMENTATION OF AN ARRAY OF REFLECTORS FOR PASSIVE SATELLITE COMMUNICATIONS
A.E. Ruvin, et al., Rec. Nat. Commun. Symp., vol. 8, no. 10, Oct. 1962, p. 3/3a-h, Appendix C.

960-mc, 10-kw TRANSMITTER
J.P. Schafer, et al., Bell Syst. Tech. J., vol. 41, no. 4, July 1962, p. 1041/1064.

GROUND EQUIPMENT FOR SATELLITE COMMUNICATION
W.K. Victor, IN: Space Radio Communications, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 259/287, Discussion, p. 287/288, 13 refs., A63-14249.

THE SOLID-STATE MASER IN SATELLITE COMMUNICATION SYSTEMS
J.C. Walling, et al., Brit. Commun. and Electronics, vol. 9, no. 8, Aug. 1962, p. 596/598.

TELSTAR SATELLITE SYSTEM EARTH STATION AT ANDOVER, MAINE
I. Welber, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 850.

. . . performs three major functions: 1. Acquisition and tracking. 2. Command and telemetry. 3. Communications. . . .

PASSIVE SPHERICAL SATELLITE COMMUNICATIONS STUDY
J.V. Wilding, et al., ITT Labs., Federal Labs., Nutley, N.J., RADC TDR 62-89, March 1962, 152 p. incl. illus., AD 273 870.

. . . The nature of the transmission medium poses several problems, including: a variable length transmission path, an instant of transfer of communications from a setting satellite to a rising satellite, and the handling of traffic in the several forms of voice, graphics, teletype, and data. . . .

SATELLITE CONTROL FACILITY EQUIPMENT AUGMENTATION. DESIGN CRITERIA, INTER-STATION COMMUNICATION SUBSYSTEM
Aerospace Corp., Los Angeles, Calif., TOR930 2110 6 RA, 3 Aug. 1962, lv., AD 404 201, Supersedes rept. no. TOR-930(2110)-6, dated April 1962.

. . . re-configuration of the inter-station communications equipment of the satellite control facility.

SATELLITE CONTROL FACILITY EQUIPMENT AUGMENTATION. DESIGN CRITERIA: SATELITE TEST ANNEX DATA SUBSYSTEM
Aerospace Corp., Los Angeles, Calif., TOR169 3110 2, 31 Aug. 1962, 17 p., AD 404 199.

. . . data-handling equipment of the Satellite Test Annex (STA) . . . supports the satellite control, acquisition, tracking, commanding, telemetry, and STA control operations as required for each applicable project. It will be integrated with the timing subsystem, control consoles, and the inter- and intrafacility communications subsystems.

THE PRECISION TRACKER
J.V. Anders, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1309/1356.

. . . a simultaneous lobing, amplitude-comparison, passive, continuous-wave tracker based in principle and design upon a monopulse tracking radar . . . employed at the Andover, Maine, and Pleumeur-Bodou, France . . . Telstar satellite radiates a 4079.73-mc continuous-wave (CW) carrier 90 mc below the frequency of the communications carrier. This signal is designed as a beacon for the processes of tracking and initial acquisition . . .

THE GROUND STATION HIGH-POWER TRAVELING-WAVE TUBE
R.J. Coller, et al., Bell Syst. Tech. J., vol. 42, no. 4.3, July 1963, p. 1829/1861.

The M4040 is a 2-kw CW traveling-wave tube developed specifically for communications applications. It was used as the power amplifier in the Project Telstar ground transmitter. Analytic methods employed in the design of the electron gun, the beam collector, the RF circuit and the output match are presented. Typical performance characteristics and drawings of the tube subassemblies serve to describe the electrical and physical features of the M4040 traveling-wave tube. Methods used to inhibit oscillation and the effects of ion drainage and collector depression on tube performance are also discussed.

SATELLITE SYSTEM INTERFERENCE TESTS AT ANDOVER, MAINE
H.E. Curtis, Bell Syst. Tech. J., vol. 42, no. 6, Nov. 1963, p. 2715/2739.

Because of the shortage of suitable frequencies, it appears that it will be necessary for satellite communication systems and ground microwave systems to operate in the same frequency band. To do this without excessive interference between them requires that stringent criteria be met. This paper presents the results of radio interference tests from two test transmitter sites into the Andover, Maine, earth station receiver for experimental satellite communications . . .

A SMALL EXPERIMENTAL COMMUNICATIONS SATELLITE GROUND TERMINAL
T.W.G. Dawson, et al., Royal Aircraft Establishment, (Gt. Brit), RAE TN Rad 832, March 1963, 16 p., AD 409 677.

. . . Transmissions are at 9.34 Gc/s and are also planned for approximately 8.4 Gc/s

. . . The equipment includes a 1kW C.W. transmitter, an 8 kW transmitter still under construction, an experimental cavity maser, narrow band receivers incorporating equipment for the elimination of rapidly changing Doppler shift and frequency multiplier chains for the generation of stable microwave frequencies. . . .

BETEILIGUNG DER DEUTSCHEN BUNDESPOST AN DEN VERSUCHEN ZUR NACHRICHTENUBERTRAGUNG MIT HILFE KUNSTLICHER ERDSATELLITEN
(Participation of the German Federal Post Office Department in the Experimental Communication Transmission by Artificial Earth Satellite) (In German)
E. Dietrich, Deutsche Gesellschaft fŸr Rakententechnik und Raumfahrt, European Space Flight Symposium, 3rd, Stuttgart, Germany, May 21-24, 1963, Paper 1540(62), 4 p., A63-19630.

. . . German ground station for satellite communications, under construction in Raisting near Weilheim. . . . employing a 9-m diameter parabolic reflector with a capacity of 12 telephone channels . . . to be completed in 1963. More distant (summer 1964) is the completion of a wideband installation employing a 25 m diameter parabolic reflector with a capacity of several hundred telephone channels and a TV capability. . . . liquid-helium cooled maser. The 6-Gc transmitter will have an output power of 2 kw. . . . use of a spherical inflatable 49m diameter radome. Satellite tracking by the antenna will be based on a computer-controlled automatic precision tracking system.

SITING
R.M. Dohoo, Defence Research Telecommunications Establishment, Ottawa (Canada) Communications Lab., In its Some Considerations in Satellite Commun. Systems, Jan. 1964, 7 p., refs., N64-18247.

The factors affecting the siting of a ground terminal are considered . . . (1) The site should be as far as possible from radar, navigational, and microwave communications-systems installations. (2) The site should not be close to large centers of population or industry . . . (3) The site should be remote from airfield and busy air routes. (4) The site should be surrounded by hills to reduce the near-horizontal direct signals from sources of interference.

THE MECHANICAL DESIGN OF THE HORN-REFLECTOR ANTENNA AND RADOME
J.C. Dolling, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1137/1186.

Telstar ground station . . . mechanical considerations . . . engineering aspects . . . design, fabrication, and erection . . . accessory equipment.

SITE NOISE AND ITS CORRELATION WITH VEHICULAR TRAFFIC DENSITY
A.G. Ellis, Proc. Instn. Radio Engrs. Australia, vol. 24, no. 1, Jan. 1963, p. 45/52.

. . . effective noise factor. This factor is a combination of the receiver's internal noise factor, a relatively small and constant component, and another noise factor, called the site noise factor, which assesses the intensity of the noise fields enveloping the receiver's antenna. . . . This paper shows that predictions of greater accuracy are obtained when the site noise is related to the nearby traffic density, and as a result of measurements taken at various sites in Victoria and New South Wales, suggests the law between them. . . .

MILITARY SATELLITE CONTROL
L.G. Fischer, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 54/57, A63-21540.

. . . facilities control of the planned military communications satellite system of the Defense Communications System (DCS). . . . To be compatible, the satellite facilities control includes a satellite-communications control center, and three of four area control centers . . . A diagram of a generalized model of the tracking and orbital computation subsystem is presented.

THE GROUND TRANSMITTER AND RECEIVER
A.J. Giger, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 1063/1107.

. . . for the Telstar experiment includes a k-kmc transmitter and a f-kmc receiver used for television and telephone channels. This paper describes the over-all transmitting and receiving arrangements and presents detailed accounts of the RF and power-supply subsystems. Information is also presented on protection, control and equipment features, and on receiver noise performance.

DIGITAL EQUIPMENT FOR THE ANTENNA POINTING SYSTEM
J.A. Githens, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1223/1252.

. . . describes the digital control and data processing portions of the antenna pointing system used to track the Telstar satellite . . .

ANTENNA POINTING SYSTEM: ORGANIZATION AND PERFORMANCE
J.A. Githens, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1213/1221.

. . . used in the satellite ground station at Andover, Maine . . . for the Telstar experiment . . . "pencil" beam of about 1/5 degree in diameter . . . requires an antenna pointing system of high accuracy . . .

A MEDIUM CAPACITY SATELLITE COMMUNICATIONS TERMINAL (Correspondence)
W. Glomb, et al., IEEE Trans. Commun. Syst., vol. CS-11, no. 4, Dec. 1963, p. 502/505.

. . . The ITT Federal Laboratories embarked on a research program in space communications early in 1959. The experimental station described represents an aspect of this program. Its design is based on its use for low- and medium-capacity transmission via both active and passive satellites and on its use as a research tool . . .

PRELIMINARY VERSION OF STANDARDS AND CONVENTIONS FOR THE UTILITY PROGRAM AREA OF THE SATELLITE CONTROL FACILITY
E.L. Griffith, System Development Corp., Santa Monica, California, Technical memo no. TM-1019/000/00, 6 Feb. 1963, 29 p., AD 297 782.

MUTUAL INTERFERENCE BETWEEN SURFACE AND SATELLITE COMMUNICATION SYSTEMS (NOVEMBER 1961)
W. J. Hartman, et al., National Bureau of Standards, Washington, D.C., NBS-TN-126, Aug. 1, 1963, 55 p., 10 refs., N63-20739.

. . . to occur between the ground terminals of space communications systems and surface point-to-point systems . . . estimates are obtained from recently developed methods for predicting the transmission loss over tropospheric paths . . . It is concluded that these systems can share the same frequency assignment under suitable conditions.

COMPUTER PROGRAM OPERATING INSTRUCTIONS FOR MULTICON (MODIFICATION AE) MILESTONE 7
J. Hillhouse, System Development Corp., Santa Monica, Calif., Rept. no. TM 1028 001 02, 2 Aug. 1963, 47 p., AD 415 475.

. . . Reports that MULTICON (1) investigates multiple satellite operations, (2) determines the problems arising from station-satellite assignments using a variety of launch times and equipment configurations, and (3) seeks solutions which will produce the optimum amount of activity. . . .

THE ELECTRICAL CHARACTERISTICS OF THE CONICAL HORN-REFLECTOR ANTENNA
J.N. Hines, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1187/1211.

Telstar groundstations . . . broadband and low-noise properties. Prior to the construction of the full-size antenna, theoretical and model studies of its electrical characteristics were undertaken . . . consisted of computing gain and radiation patterns for two modes of excitation, constructing of model antennas and measuring them. . . .

COMMUNICATION SATELLITE PROJECT ADVENT
D.F. Huebner, Space Sciences Lab., General Electric Co., Philadelphia, Pa., Final technical rept., vol. 17, sec. 10, Ground Station Checkout, 15 March 1963, 12 p., AD 405 363.

A series of integrated over-all Tracking, Telemetry and Command (TT&C) system tests were conducted as a part of the ADVENT Program. Each participating TT&C Ground Station was checked out and exercised in a System Acceptance Test. . . . it is necessary to utilize a TT&C simulation of the satellite.

PARTICIPATION OF THE HOLMDEL STATION IN THE TELSTAR PROJECT
W.C. Jakes, Jr., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1421/1447.

The facility for satellite communication studies at Holmdel, New Jersey, was originally established to take part in Project Echo. This paper describes the modifications required to participate in the Telstar experiments and the results obtained during operations from July 10 to November 9, 1962. Reception of television from the satellite was successfully accomplished, studies were made of the signal levels, and the changes with time of the satellite spin rate and spin axis orientation were determined.

TRANSPORTABLE PASSIVE SATELLITE COMMUNICATIONS TERMINAL
R.W. Kille, et al., General Electric Co., Syracuse, N.Y., Final technical report, RADC TDR 62-502, Jan. 1963, 151 p., AD 297 950.

OPERATIONS WITH AN EXPERIMENTAL SATELLITE
D.G. Mazur, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TM X-50104; NASA, X-620-63-86, May 1, 1963, 44 p., N63-17203.

. . . techniques and procedures employed and experience gained in the successful in-orbit operation of the RELAY communication satellite.

. . . The operations center for RELAY is described and its functions detailed. The operational support communications, such as teletype, telephone and video monitor links, required to perform effective control of the satellite through the test and control station and coordination of the complex of ground stations is illustrated . . .

COMPUTER PROGRAM SUBSYSTEM INTEGRATION IN SUPPORT OF THE AIR FORCE SATELLITE CONTROL FACILITY
T.W. Polk, System Development Corp., Santa Monica, Calif., Rept. no. SP-1022, 10 Jan. 1963, 15 p. incl. illus., AD 296 329.

. . . describes the Satellite Control Facility from a data processing point of view . . . supporting computer program subsystems . . . Typical real-time and non-real-time data flow . . . tracking stations . . . Satellite Test Center in Sunnyvale, California. . . . to support launch, orbit, and recovery operations . . .

LOW-NOISE RECEIVERS FOR EARTH TERMINALS
O.S. Roscoe, Defence Research Telecommunications Establishment, Ottawa (Canada) Communications Lab., In its Some Considerations in Satellite Commun. Systems, Jan. 1964, 19 p., refs., N64-18245.

The relation between receiver and antenna noise temperature . . . masers and parametric, tunnel-diode, and traveling-wave-tube amplifiers as applied in receiving systems for use in communications satellite terminals.

THE REQUIREMENTS FOR ON-SITE COMPUTING FACILITIES
O.S. Roscoe, Defence Research Telecommunications Establishment, Ottawa (Canada) Communications Lab, In its Some Considerations in Satellite Commun. Systems, Jan. 1964, 5 p., ref., N64-18246.

The following operations, associated with satellite tracking, that can be performed most efficiently with a digital computer, are discussed: prediction of satellite entry into

regions of mutual visibility, acquisition by computer-controlled search, tracking from computed look-angles, smoothing of tracking data, determination of the orbital elements for upgrading, detection and correction of systematic errors, backup to active tracking by providing course extrapolation, prediction and minimization of signal loss due zenith gimbal lock, handover control for continuous communication in multiple satellite systems . . .

PLANNING, OPERATION AND EXTERNAL COMMUNICATIONS OF THE ANDOVER EARTH STATION
D.H. Smith, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1383/1420.

. . . describes the station layout, the operating plan and the Long Lines interconnections. Power facilities, air conditioning, heating and dehumidification arrangements are also covered.

A TRANSPORTABLE TRACKING AND COMMUNICATION TERMINAL FOR PASSIVE SATELLITES
R.F. Stone, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 276/280.

THE TELSTAR PROJECT AND THE PLEUMEUR-BODOU EXPERIMENTAL STATION FOR SATELLITE TELECOMMUNICATIONS (In French)
M. Thue, Onde Electr., vol. 43, no. 432, March 1963, p. 341/360.

. . . description of the experimental station at Pleumeur-Bodou, and particularly the radio equipment and the telecommunication equipment. There follows an account of the principal experimental results obtained since the launching of Telstar I.

MULTIFREQUENCY, HIGH-POWER, CASSEGRAINIAN ANTENNA FEED SYSTEMS FOR SATELLITE GROUND STATIONS
H. Scheiner, et al., IEEE Internat. Conv. Rec., Pt. 1, vol. 11, March 1963, p. 10.

. . . Abstract Only . . . The antenna feed system must provide the capability for high-power transmission and reception of signals for communications and tracking . . . used in a satellite communications ground terminal . . . The feed configuration is located at the vertex of a 30-foot parabolic reflector.

GOONHILLY DOWNS ANTENNA PICKS UP SATELLITES AT LOW ANGLES
Space/Aeronautics, vol. 39, March 1963, p. 131/133, 136, 137, A63-13438.

THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE ELECTROMAGNETIC SCATTERING AND RADIATIVE PROPERTIES OF TERRAIN, WITH EMPHASIS ON LUNAR-LIKE SURFACES
Ohio State U., Research Foundation, Columbus Antenna Lab., Semi-Annual Report, 1 May-31 Oct. 1963, Rept. 1388-12, 1 Nov. 1963, 26 p., refs., N64-15186.

Relations between the electromagnetic scattering properties of a surface (in particular the lunar surface) and its surface structure were examined. Measurements of the complete bistatic scattering pattern of a number of rough surfaces were carried out at X-band. Theoretical studies have been made of the polarization transformation properties of rough surfaces, and these have been used to interpret lunar scattering measurements made with linear polarization . . .

GROUND STATIONS FOR COMMUNICATIONS SATELLITES
Interavia, vol. 18, Nov. 1963, p. 1727/1731, A64-11594.

Review of the needs and characteristics of proposed and operating ground stations for communications satellite networks. Both stationary and transportable stations are considered, including the ITT station at Andover and the transportable station at Lakehurst which is currently in use for Syncom experiments and will later be used for military communications satellites. A table of 29 operational and near-operational ground ground stations, and a map indicating their locations throughout the world, are included.

SPACE COMMUNICATIONS TECHNIQUES
Page Communications Engineers, Inc., Washington, D.C., RADC TDC 63 111, S1, Dec. 1963, 28 p., AD 427 098.

. . . modification and completion of instrumentation for use in communications experiments with passive satellites are described . . . at the Floyd test site near Rome, N.Y. . . . To a 60 ft. antenna reflector at that site . . . Instrumentation for pulse operation at the communications frequency at the Trinidad site was completed . . . (See also N63-15696.)

Related Publications:

SATELLITE TRACKING TECHNIQUES AND AN EVALUATION OF INTERFERENCE PHENOMENA
R.J. Massa, et al., Melpar, Inc., Watertown, Mass., RADC TN 60-172, June 1960, 262 p. incl. illus. tables, AD 244 264.

HIGH GAIN ANTENNA ARRAY FACILITIES AT THE OHIO STATE UNIVERSITY
J.W. Eberle, Antenna Lab., Ohio State U. Research Foundation, Columbus, Rept. on High Gain Antenna Realization and Tracking Study, Rept. no. 1072-3, RADC TN 61-241, 22 Sept. 1961, 16 p., AD 270 839.

. . . antenna array consisting of highly accurate 30 foot diameter parabolic reflectors

. . . experiments dealing with communication systems employing passive reflectors in orbits about the earth . . . techniques . . . for coherently combining the signals, for acquiring the signals in the presence of doppler and for automatic tracking is given . . .

A STEERABLE AIRBORNE ANTENNA FOR SATELLITE COMMUNICATIONS
C.D. Lunden, et al., East Coast Conf. Aerospace Navig. Electronics, vol. 8, no. 5.1.4, Oct. 1961, p. 1/12.

. . . upward-looking, steerable, high-gain antenna for very-long-range, two-way communications with signals relayed by satellites (active or passive) or scattered by belts of orbiting chaff. Critical antenna design problems connected with the very-high average transmitter power (10 kw) and the very-low receiver noise figure ($\sim 20^{\circ}K$) are considered in detail . . .

STATION LOADING STUDY - AN INVESTIGATION OF VEHICLE BUNCHING AND STACKING
J.B. Day, et al., Philco Corp., Palo Alto, Calif., WDL TN62 4, 28 Nov. 1962, 39 p., AD 405 318.

. . . several tracking stations used in conjunction with a number of surveillance satellites and the ability of the stations to efficiently monitor those satellites in strategic locations.

ON THE LOGICAL ESTABLISHMENT OF GLOBAL SURVEILLANCE AND COMMUNICATION NETS
B.H. Billik, et al., Aerospace Corp., Los Angeles, Calif., Rept. no. TDR269 4513 10 5, SSD TDR 64 5, 3 March 1964, 46 p., AD 437 121.

. . . criteria for the formation of global surveillance and communication nets and synthesizes some practical examples of these nets. . . . Certain lower bounds are obtained for the numbers of satellites and/or ground stations necessary for establishing worldwide surveillance and communication capability.

. . . Trade-offs between the number and altitude of satellites in a net are discussed at length.

SYSTEM ORGANIZATION FOR GENERAL COMMUNICATION VIA MEDIUM ALTIDUE SATELLITES
D.G.C. Luck, RCA Rev., vol. 24, no. 3, Sept. 1963, p. 293/324.

COMMUNICATION NETS IN RANDOM BEHAVIOR
Z. Prihar, Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 175/189, 18 refs.

Concepts of random neural nets, as treated in mathematical biophysics, are used to describe the random behavior of communication nets. Application of the steady state as well as message spread threshold concepts to communication nets are considered. . . . Part II of this paper discusses the use of the spread of contagion theory and Part III deals with the random behavior of mobile communication nets.

POWER REQUIRED TO JAM A SATELLITE REPEATER
F.F. Yates, Aerospace Corp., Los Angeles, Calif., Rept. no. TDR 269 4111 3, SSD TDR63 203, Dec. 1963, 16 p., AD 436 812.

. . . The expression may be applied to the analysis of spread-spectrum multiple access systems as well as to the analysis of jamming vulnerability.

DIVISION 4A.6
ECONOMIC CONSIDERATIONS

4A.600: Economic Considerations for Communications Satellite Systems

Included: Cost models for comsat systems; Satellite systems reliability; Systems tradeoff for satellite relay systems.

Not Included: Communications economy in general; Reliability theory.

Cross References: Communications Satellite Corporation (4A.000).

Principal Publications:

THE ECONOMICS OF COMMUNICATIONS SYSTEMS
L. Schwartzman, et al., Proc. Nat. Commun. Symp., vol. 6, October 1960, p. 104/109.

. . . the 24-hour synchronous satellite has been selected for study. The use of a 100-foot satellite has been chosen, and both active and passive systems are analyzed . . .

THE ECONOMICS OF COMMUNICATIONS SATELLITES
W. Meckling, et al., Conv. Rec. Nat. Symp. Global Commun., May 1961, p. 247.

MAJOR SYSTEM TRADEOFFS AMONG FIXED, TRANSPORTABLE, AND MOBILE STATIONS IN SATELLITE COMMUNICATION SYSTEMS
A. Alma, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 193.

COMMUNICATIONS SATELLITES (British Interplanetary Society, Symposium on Communications Satellites, London, England, May 12, 1961)
L. J. Carter, editor, New York, Academic Press, Inc., 1962, 202 p., A63-12455.

. . . including . . . economic considerations . . .

SATELLITE COMMUNICATION EQUIPMENT: SOME DESIGN CONSIDERATIONS
J. E. Clegg, Royal Aircraft Establishment (Gt. Brit.), Technical note no. Space 6, Feb. 1962, 16 p., illus., 3 refs., AD 278 027.

. . . A multiple receiving aerial system which may reduce the cost of ground stations is described. . . .

INSTALLATION TIME REQUIRED BY "STATIONARY" AND RANDOM-ORBIT COMMUNICATION SATELLITE SYSTEMS (Correspondence)
R. G. Gould, IRE Trans. Commun. Syst., vol. CS-10, no. 2, June 1962, p. 217/218.

THE ENGINEERING AND ECONOMICS OF SATELLITE COMMUNICATIONS SYSTEMS
G. K. C. Pardoe, IN: Communications Satellites, British Interplanetary Society, Symposium on Communications Satellites, London, England, May 12, 1961, New York, Academic Press, Inc., 1962, p. 1/15, A63-12456.

Review of the factors that influence the engineering and economics of satellite system, and the manner in which it is done. Covered are the following: the overall system, the launching vehicle, the satellite, and the terminal facilities. For purposes of demonstration, the proposed Blue Streak satellite launcher and its facilities are considered.

INTERNATIONAL COMMUNICATION AND SPACE
J. R. Pierce, Bell Telephone Labs., Inc., Murray Hill, N.J., In USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8-May 21, 1962, p. 35/49, N63-23439.

. . . Plans for international communication using satellites are discussed . . . budgetary problems . . . require the type of international cooperation pioneered by the Internation Communications Union under the auspices of the United Nations for the worldwide telephone cable network.

ECONOMIC ASPECTS OF COMMUNICATION SATELLITE SYSTEMS
S. H. Reiger, et al., IN: Space Radio Communication, International Scientific Radio Union (URSI), Symposium, Paris, France, Sept. 18-22, 1961, New York, Elsevier Publishing Co., 1962, p. 586/598, A63-14266.

Examination of the cost of communication satellite systems and of the prospects for utilizing a vast increase in transoceanic capacity. On the basis of this analysis it is concluded that communication satellites promise substantial reductions in cost, if high rates of utilization can be achieved, and that the real economic question is the demand.

ON THE LOGICAL ESTABLISHMENT OF GLOBAL SURVEILLANCE AND COMMUNICATION NETS
B. H. Billik, et al., Aerospace Corp., Los Angeles, Calif., Rept. no. TDR269 4513 10 5, SSD TDR 64 5, 3 March 1964, 46 p., AD 437 121.

. . . criteria for the formation of global surveillance and communication nets and synthesizes some practical examples of these nets. . . . Certain lower bounds are obtained for the numbers of satellites and/or ground stations necessary for establishing worldwide surveillance and communication capability. . . . Trade-offs between the number of

ground stations and the number and altitude of satellites in a net are discussed at length.

COMMUNICATION SYSTEMS OF CHANNELS WITH BOUNDED NONDECREASING COSTS PER UNIT OF INFORMATION FLOW

I. T. Frisch, IEEE Trans. Commun. Syst., vol. CS-11, no. 1, March 1963, p. 36/40.

Given a communication system of stations and capacitated channels in which there is associated with each channel a bounded nondecreasing cost per unit of information flow, flow patterns are found that maximize the information rate between a given pair of terminal stations at minimum over-all cost. . . .

SATELLITE SYSTEMS RELIABILITY

S. S. Jamison, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 322/325.

The effects of random failure and wearout on the deployment and maintenance of a satellite system are discussed. A general mathematical model is presented which estimates the launching rate (boosters per unit of time) required to deploy and maintain a satellite system as a function of the following parameters: number of satellites to be deployed in the system; mean and maximum satellite lifetime; launching reliability (reliability of liftoff and staging); number of satellites launched per payload; and orbital injection reliability per satellite. . . .

ELECTRONIC SYSTEM COST MODEL

T. J. Jannsen, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 407/410.

The Economic Factors Department of MITRE has developed a computerized electronic system cost model for costing alternative configurations of command and control "L" systems. . . .

HARD LINE VS MICROWAVE LINK TRADE-OFF STUDY, VAFB/NMFPA DATA TRANSMISSION SYSTEM

R. P. McGarrity, Aerospace Corp., El Segundo, Calif., Telecommunications and Tracking Dept., TOR-269(4110-03)-2, Jan. 1964, 20 p., AD 431 743, N64-16655.

. . . tradeoff study . . . lists the advantages and disadvantages of each type of link in regard to security, electromagnetic interference, data quality, reliability, total bandwidth capacity, single-channel bandwidth capacity, hardness, flexibility, and link length . . . For runs of 5 to 8 miles, the cost of an overhead wire system becomes approximately equal to the cost of the microwave system. For even shorter distances, the microwave system is the more expensive system.

AROUND THE WORLD BY MICROWAVE FOR HALF A BILLION DOLLARS

L. G. Martin, RAND Corp., Santa Monica, Calif., Rept. no. P2790, Sept. 1963, 13 p., AD 424 688.

. . . It suggests that a worldwide microwave communication system of video capacity might be built for a sum comparable to what has been spent thus far on research and development of communication satellite systems . . . cost estimates are presented for two hypothetical round-the-world routes.

COMMUNICATIONS SATELLITES: TECHNOLOGY, ECONOMICS, AND SYSTEM CHOICES

S. H. Reiger, et al., RAND Corp., Santa Monica, Calif., Research memo. no. RM-3487-RC, Feb. 1963, 101 p. incl. illus. tables, refs., AD 296 068.

. . . Cost estimates are made for representative stationary and non-stationary active satellite systems . . .

OPTIMIZATION OF RANDOM SATELLITE SYSTEMS THROUGH THE USE OF INTEGER PROGRAMMING TECHNIQUES

N. Tonelson, et al., American Institute of Aeronautics and Astronautics, Astrodynamics Conference, New Haven, Conn., Aug. 19-21, 1963, Paper 63-398, 19 p., A63-21715.

. . . method for evaluating satellite communications systems, to satisfy global requirements. A technique is outlined for obtaining a minimum cost satellite overlay, and examples are presented to satisfy minimum cost criteria, and using minimum number of satellites . . .

THE DESIGN OF AIRBORNE RADIO RELAY COMMUNICATION SYSTEMS

T. G. Williams, RADC, Griffiss AFB, N. Y., Equipment Lab., RADC-TDR-63-278, July 1963, 24 p., 7 refs., N63-19927.

. . . channel capacity and reliability . . . are specified . . . if the vehicle cost as a function of vehicle reliability and as a function of the distance between relay vehicles is known, the number of relay vehicles, the distance between relay vehicles, and the vehicle reliability required to realize a minimum cost system can be computed by the application of formulae which are derived. . . .

PARAMETRIC ANALYSIS OF MEDIUM-ALTITUDE ACTIVE AND PASSIVE COMMUNICATION SATELLITES

ITT Communication Systems, Inc., Paramus, N. J., Rept. no. ICS63 TR250, ESD RDR63 677, 20 Sept. 1963, lv., AD 428 311.

. . . broad systems aspects . . . for possible use in a military communication network. . . . compared primarily on an economic basis, with randomly spaced, medium-altitude orbits assumed. . . . mathematical models provide weight and cost variations for the models as a function of satellite capabilities. . . .

DIVISION 4A.8
SPECIAL COMMUNICATIONS SATELLITE PROJECTS

4A.825: Project Advent

Principal Publications:

CONFIGURATION STRUCTURE AND SUBSYSTEM ENGINEERING ANALYSIS REPORT. SECTION 1. VEHICLE THERMAL ANALYSIS
J. D. Selby, General Electric Co., Philadelphia, Pa., Report on Communications Satellites, Rept. no. 62SD4300, vol. 1, 12 Oct. 1962, lv., AD 298 754.

Descriptors: Communications satellites (Active), Thermal insulation, Air conditioning equipment, Temperature control.

COMMUNICATION SATELLITE PROJECT ADVENT. THERMAL CONTROL SUBSYSTEM ENGINEERING ANALYSIS
J. D. Selby, General Electric Co., Philadelphia, Pa., Rept. no. 62SD4300, vol. VII, 12 Oct. 1962, 202 p., AD 298 755.

Descriptors: Temperature control, Thermal conductivity, Thermal radiation, Heat transfer, Cooling.

PROJECT ADVENT
W. M. Thames, Wire & Radio Communications, vol. 4, April 1962, p. 14/20.

LONG LIFE SATELLITE PROGRAM
T. M. Walsh, et al., Space Sciences Lab., General Electric Co., Philadelphia, Pa., 62SD4299, Aug. 1962, lv., AD 405 368.

As a portion of the ADVENT Communications Satellite Program, an approach was developed for assuring long life based on strength degradation theories and the utilization of design standards, part specifications and design data sheets.

COMMUNICATION SATELLITE PROJECT ADVENT INTERIM REPORT LIFE TESTING
General Electric Co., Philadelphia, Pa., 63SD4237, 1 April 1963, 44 p., AD 405 360.

COMMUNICATION SATELLITE PROJECT ADVENT
D. F. Huebner, Space Sciences Lab., General Electric Co., Philadelphia, Pa., Final technical rept., vol. 17, Sect. 10, Ground Station Checkout, 63SD4288 V17, 15 March 1963, 12 p., AD 405 363.

A series of integrated over-all Tracking, Telemetry and Command (TT&C) system tests were conducted as a part of the ADVENT Program. Each participating TT&C Ground Station was checked out and exercised in a System Acceptance Test. . . . it is necessary to utilize a TT&C simulation of the satellite.

COMMUNICATION SATELLITE PROJECT ADVENT LONG LIFE RELIABILITY
D. F. Huebner, Space Sciences Lab., General Electric Co., Philadelphia, Pa., Interim rept., June-Dec 62, 63SD4211, 1 Feb. 1963, lv., AD 405 361.

COMMUNICATION SATELLITE PROJECT ADVENT. SECTION 1. SYSTEM DESIGN AND ANALYSIS AND SECTION 2. VEHICLE DESIGN
D. F. Huebner, Space Sciences Lab., General Electric Co., Philadelphia, Pa., Final technical rept., vol. 1, 63SD4288, V1, 15 March 1963, 81 p., AD 405 365.

COMMUNICATION SATELLITE PROJECT ADVENT. SECTION 5. ELECTRICAL POWER SUBSYSTEM. VOLUME VIII
D. F. Huebner, Space Sciences Lab., General Electric Co., Philadelphia, Pa., Final technical rept., 63SD4288, V7, 15 March 1963, 174 p., AD 405 367.

(See also AD 405 364, AD 405 366.)

COMMUNICATION SATELLITE PROJECT ADVENT. SECTION 8. RELIABILITY LONG LIFE HIGH RELIABILITY PART EVALUATION
D. F. Huebner, General Electric Co., Philadelphia, Pa., Final technical rept., Document no. 63SD4288, vol. 15A, 1963, 326 p., AD 410 344.

COMMUNICATION SATELLITE PROJECT ADVENT. SECTION 8. RELIABILITY. FAILURE MECHANISM STUDIES
D. F. Huebner, General Electric Co., Philadelphia, Pa., Final technical rept. June 62-May 63, Document no. 63SD4288, vol. 15B, 1963, 107 p., AD 410 341.

COMMUNICATION SATELLITE PROJECT ADVENT. SECTION 8. RELIABILITY LONG LIFE HIGH RELIABILITY PART APPLICATION TO HIGH REPLICATION CIRCUITS
D. F. Huebner, General Electric Co., Philadelphia, Pa., Final technical rept., Document no. 63SD4288 vol. 15C, 1963, lv., AD 410 339.

COMMUNICATION SATELLITE PROJECT ADVENT. SECTION 8. RELIABILITY. LONG LIFE HIGH RELIABILITY PACKAGING CRITERIA
D. F. Huebner, General Electric Co., Philadelphia, Pa., Final technical rept., Document no. 63SD4288, vol. 15D, 1963, 72 p., AD 410 340.

COMMUNICATION SATELLITE PROJECT ADVENT. SECTION 8. RELIABILITY.
D. F. Huebner, General Electric Co., Philadelphia, Pa., Final technical rept., 1 Jan - 29 May 62, Document no. 63SD4288, vol. 14, 1963, 40 p., AD 410 343.

. . . reliability summary . . . reliability analysis of each major subsystem and an electronics and electromechanical parts list of the Advent Satellite. High and low usage part failure rates are also given.

COMMUNICATION SATELLITE PROJECT ADVENT. SECTIONS 9. APPROVED PARTS. LONG LIFE HIGH RELIABILITY PARTS SELECTION AND APPROVED PARTS LIST
D. F. Huebner, General Electric Co., Philadelphia, Pa., Final technical rept., Document no. 63SD4288, vol. 16, 1963, 90 p., AD 410 342.

WHAT WENT WRONG WITH ADVENT
J. P. Kushnerick, Aerospace Management, vol. 6, May 1963, p. 26/29, A63-18028.

. . . reasons for the failure of Advent from the point of view of management control . . . history of the project . . .

ADVENT PROGRAM
Philco Corp., Palo Alto, Calif., Final rept., Rept. no. WDL-TR1995, 30 Jan. 1963, lv. incl. illus., AD 401 167.

. . . tracking, telemetry, and command equipment developed and delivered by Philco . . .

COMMUNICATION SATELLITE. PROJECT ADVENT. SECTION 8. RELIABILITY. VOLUME XV E. DETAILED TECHNICAL REPORTS-PACKAGING CRITERIA
General Electric Co., Philadelphia, Pa., Final technical rept., DN63SD4288, vol. 15E, 1963, 308 p., AD 411 793.

4A.830: Project Courier

Principal Publications:

COURIER SATELLITE COMMUNICATION SYSTEM
G. F. Senn, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 4, Oct. 1960, p. 407/413.

HOW COURIER SATELLITE'S GROUND SYSTEM WORKS
Electronics, no. 33, July 1960, p. 38/39.

RANGING SUBSYSTEM
M. F. Easterling, et al., JPL Res. Summ., no. 36-8, Feb.-March 1961, p. 52/57.

History of ranging experiments . . . Analysis of Echo ranging data . . . Analysis of Courier ranging data . . . the following conclusions may be drawn: (1) the experiments were generally successful in that they showed the basic ideas of the ranging system to be correct and workable. (2) The accuracy of the measurement appears to be good, although it is as yet uncertain just how good. The present uncertainties of a few kilometers in several thousand kilometers are fractions of 1% and may well be due more to uncertainties in the computed orbit than to uncertainties in the range measurement itself. More work is being done to try to obtain a better standard for evaluation of the ranging data. . . .

COURIER SATELLITE COMMUNICATION SYSTEM
E. Imboldi, et al., IN: Advances in the Astronautical Sciences, vol. VIII, American Astronautical Society, Annual Meeting, 7th, Proceedings, Dallas, Tex., Jan. 16-18, 1961, New York, Plenum Press, Inc., 1963, p. 25/36, A63-17622.

. . . designed to explore operational properties required for highspeed teletype transmission . . . ground system features . . .

THE COURIER COMMUNICATIONS SATELLITE ELECTRICAL DESIGN
J. M. Rosenberg, et al., IRE Internat. Conv. Rec., vol. 8, March 1961, p. 174/178.

For eighteen consecutive days, every one of the Courier Satellite's 39 electronic components worked perfectly within their design and predicted parameters. A comprehensive test program to demonstrate various kinds of data handling, vulnerability to jamming environmental analysis, propagation characteristics, and military communications operational procedures, was carried out at Deal, New Jersy and Salinas, Puerto Rico. . . . One hundred and fifty-four days after orbit, the solar power subsystem and acquisition and tracking transmitter are still working perfectly with no observable deterioration in performance.

COURIER COMMUNICATION SATELLITE
P.W. Siglin, et al., J. Instn. Elect. Engrs., vol. 7, Aug. 1961, p. 504/508.

. . . discusses the exchange of messages between ground stations through the Courier satellite, gives a typical operating sequence and describes the satellite. . . .

RANGING EXPERIMENTS
R.C. Titsworth, et al., JPL Res. Summ., no. 36-11, Aug.-Sept. 1961, p. 33/38.

A series of radar ranging experiments was conducted at Goldstone during the period of October 1960 through January 1961 to evaluate the ranging system by skin tracking convenient Earth satellites. The first group of experiments was made using the Echo satellite, and later another group of experiments was made using the Courier satellite . . .

A SKIN TRACKING RADAR EXPERIMENT INVOLVING THE COURIER SATELLITE
M. Easterling, IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 76/84.

Range measurements are a very powerful type of tracking data for spacecraft operating at interplanetary distances. As a step in the development of a technique for making such measurements, an experimental system was devised in which the technique was adapted to the radar tracking of artificial Earth satellites. The system was tried out by tracking the Echo balloon and, after modifications, proven by tracking the Courier satellite. . . . Evaluation of the range data was made by comparing it with angle and Doppler data. . . .

4A.835: Project Echo

Principal Publications:

BELL LABORATORIES' PART IN THE ECHO EXPERIMENT
W. J. Jakes, Signal, vol. XIV, no. 11, July 1960, p. 44/45.

SPIN RATE OF THE SATELLITE ECHO I AS DETERMINED BY A TRACKING RADAR
G. E. K. Lockwood, Canad. J. Phys. vol. 38, p. 1713, AD 250 764.

THE GOLDSTONE STATION COMMUNICATIONS AND TRACKING SYSTEM FOR PROJECT ECHO
R. Stevens, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Technical rept. no. 32-59, 1 Dec. 1960, AD 251 505.

. . . design and construction of the Project Echo system, the test phase of the system, the experiments conducted with the Echo satellite, and the experimental results of the project. A recording of messages transmitted and received by the Goldstone station via Moon reflection and via the satellite reflection is included.

THE ROLE OF THE JET PROPULSION LABORATORY IN PROJECT ECHO
W. K. Victor, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Technical release no. 34-141, 14 Oct. 1960, AD 245 544.

PROJECT ECHO TRANSMITS TELEPHONE MESSAGES VIA SATELLITE
Bell Labs Record, vol. 38, Sept. 1960, p. 334/337.

Radio telephone signals were successfully transmitted for the first time via a satellite last month between the Holmdel, New Jersey, location of the Laboratories and the Jet Propulsion Laboratory at Goldstone, California. . . .

THE COURIER SATELLITE MICROWAVE ANTENNAS
M. L. Ingalsbe, Philco Corp., Palo Alto, Calif., WDL TR1248, 1963, lv. AD 419 800.

The relative merits are compared of a flush-mounted circularly polarized antenna and an externally-mounted linearly polarized antenna for use as the microwave radiator on the Courier Satellite. . . .

THE COURIER SATELLITE
P.W. Siglin, et al., IN: Communications Satellites, British Interplanetary Society, Symposium on Communications Satellites, London, England, May 12, 1961, New York, Academic Press, Inc., 1962, p. 185/197, A63-12463.

COURIER SATELLITE
Philco Corp., Palo Alto, Calif., Final rept., WDL TR1339, 31 Jan. 1963, lv., AD 403 881.

. . . final report . . . Courier Communications Satellite Program.

Related Publications:

THE COURIER RECORDER-REPRODUCER
J.P. Buffington, et al., IRE Internat. Conv. Rec., vol. 5, March 1961, p. 241/249.

THE COURIER RECORDER-REPRODUCERS
J.G. Frayne, et al., IRE Internat. Conv. Rec., Session 36, 1961.

A descriptive coverage of techniques used on a single-track serial recording system.

PROJECT ECHO
JPL Res. Summ., vol. 1, no. 36-2, Feb./March 1960, p. 1/3.

The transmit-receive stations located at Goldstone, California . . . and Holmdel, N. J. . . . will provide an east-to-west communication link at 960.05 mc and a west-to-east communication link at 2390 mc via a 100-foot diameter balloon functioning as a passive repeater. An additional 2388-mc signal will be used at the Goldstone site to track the balloon. . . . and provide data useful for orbit determination. Approximately 1 kw of RF power will be transmitted to the balloon from the Goldstone transmitting site to provide a balloon-reflected signal for the 2388-mc tracking receiver at the Goldstone receiving site. . . .

TRANSMIT-RECEIVE SYSTEM FOR PROJECT ECHO
JPL Res. Summ., vol. 1 no. 36-4, June/July 1960, p. 44/47.

. . . comprised of a 960-mc low-noise TRAC(E) listening receiver, a 2388-mc tracking receiver, and a 2390/2388-mc 10-kw transmitter. . . .

GOLDSTONE 2388-MC CW DOPPLER RADAR OPERATION WITH RANGING CLOCK MODULATION
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 41/42.

. . . The final tracking system will be capable of measuring two angles, range and range rate simultaneously. . . . early performance data on the clock portion of the ranging subsystem. The experiment was performed utilizing the Echo balloon satellite, and the object of the experiment was to check the performance of the clock portion of ranging subsystem by measuring the doppler shift of the 497.5-kc clock signal. . . .

LATEST RESULTS ON PROJECT ECHO
H. S. Black, In: Advances in the Astronautical Sciences, vol. VIII, American Astronautical Society, Annual Meeting, 7th, Proceedings, Dallas, Tex., Jan. 16-18, 1961, New York, Plenum Press, Inc., 1963, p. 48/53, A63-17624.

PROJECT ECHO° SATELLITE TRACKING RADAR
O. E. De Lange, National Aeronautics and Space Admin., Washington, D. C., NASA Tech. note D-1135, Nov. 1961, 25 p., AD 265 888.

The radar . . . at . . . Holmdel, New Jersey . . . Recently . . . has also been employed to measure earth-balloon-earth path loss at regular intervals of time in order to ascertain the balloon's condition.

RANGING SUBSYSTEM
M. F. Easterling, et al., JPL Res. Summ., no. 36-8, Feb./March 1961, p. 52/57.

History of ranging experiments . . . Analysis of Echo ranging data . . . Analysis of Courier ranging data . . . the following conclusions may be drawn: (1) the experiments were generally successful in that they showed the basic ideas of the ranging system to be correct and workable. (2) The accuracy of the measurement appears to be good, although it is as yet uncertain just how good. The present uncertainties of a few kilometers in several thousand kilometers are fractions of 1% and may well be due more to uncertainties in the computed orbit than to uncertainties in the range measurement itself. More work is being done to try to obtain a better standard for evaluation of the ranging data. . . .

PARTICIPATION OF BELL TELEPHONE LABORATORIES IN PROJECT ECHO AND EXPERIMENTAL RESULTS
W. C. Jakes, Jr., National Aeronautics and Space Administration, Washington, D. C., NASA Technical note D-1127, Dec. 1961, 54 p., AD 268 841.

A TRANSATLANTIC COMMUNICATION EXPERIMENT VIA ECHO I SATELLITE
W. C. Jakes, Jr., Nature, May 1961, p. 709.

PARTICIPATION OF BELL TELEPHONE LABORATORIES IN PROJECT ECHO AND EXPERIMENTAL RESULTS
W. C. Jakes, Jr., Bell Syst. Tech. J., vol. 40, no. 4, July 1961, p. 975/1029.

PROJECT ECHO
W. C. Jakes, Jr., Bell Laboratories Record, vol. 39, no. 9, Sept. 1961, p. 306/311.

BEACON TRANSMITTERS AND POWER SUPPLY FOR ECHO I
J. G. McCubbin, et al., RCA Rev., vol. 22, no. 1, March 1961, p. 147/161.

PROJECT ECHO – RECEIVING SYSTEM
E. A. Ohm, National Aeronautics and Space Administration, Washington, D. C., Technical note no. D-1130, Dec. 1961, 30 p., AD 268 452.

PROJECT ECHO-960-MEGACYCLE, 10-KILOWATT TRANSMITTER
J. P. Schafer, et al., National Aeronautics and Space Administration, Washington, D. C., Tech. note D-1129, Oct. 1961, 23 p., AD 265 484.

RANGING EXPERIMENTS
R. C. Titsworth, et al., JPL Res. Summ., no. 36-11, Aug./Sept. 1961, p. 33/38.

A series of radar ranging experiments was conducted at Goldstone during the period of October 1960 through January 1961 to evaluate the ranging system by skin tracking convenient Earth satellites. The first group of experiments was made using the Courier satellite . . .

THE ROLE OF THE JET PROPULSION LABORATORY IN PROJECT ECHO
W. K. Victor, et al., IRE Trans. Space Electronics Telemetry, vol. SET-7, no. 1, March 1961, p. 20/28.

TRANSCONTINENTAL SATELLITE TELEVISION TRANSMISSION (Correspondence)
D. H. Hamilton, Jr., et al., Proc. IRE, vol. 50, June 1962, p. 1522/1523.

. . . during the week of April 22, 1962. . . . accomplished by employing very powerful and sensitive microwave radio equipment to reflect signals from coast to coast via the orbiting Echo balloon.

RESULTS OF SPACE TRACKING AND PREDICTION WITH PRECISION RADAR
S. Shucker, Rec. Nat. Symp. Space Electronics Telemetry, no. 6.1, Oct. 1962.

Two successive passes of satellite . . . Echo I, over Moorestown, New Jersey, were tracked by the RCA AN/FPQ-4 precision C-band tracking radar. . . . Radar measurements of range, azimuth and elevation taken during the first satellite passage were used to compute orbital elements by a simple smoothing-prediction process and also by a more complicated differential correction computation. . . . used to predict the satellite position at the time of the second passage. Five prediction models, of succeedingly more complex form, were used in determining the second passage conditions. . . .

ETUDE DE L'ACCELERATION DU MOUVEMENT D'ECHO OBSERVE A MEUDON (Study of the Acceleration of Echo Observed at Meudon), (In French, with summaries in English and Russian.)
F. Barlier, In: The use of Artificial Satellites for Geodesy; Proceedings of the First International Symposium on the Use of Artificial Satellites for Geodesy, Washington, D. C., April 26-28, 1962, Edited by G. Veis, New York, Interscience Publishers Div., John Wiley and Sons, Inc., 1963, p. 115/119, A63-24715.

Determination of the acceleration of the nodal period of Echo I . . . from Dec. 1961 to Jan. 1962. The observations were made for a period of 10-15 min., from which the osculating orbit and the time of the nodal passage are determined. . . .

PASSIVE SATELLITE DEVELOPMENT AND TECHNOLOGY
J. R. Burke, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 72/75, 10 refs., A63-21543.

. . . Echo I . . . and Echo II . . . satellite construction, launch, communications experiments, and results. . . . inflation systems. . . .

FIVE YEARS OF OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES IN POLAND
L. Cichowicz, Royal Aircraft Establishment (Gt. Brit.) RAE LT1052, Nov. 1963, 8 p., AD 428 466.

. . . Polish organization for the optical observation of earth satellites, with some account of the instruments used . . . Between 1957 and 1962 Polish stations made 19,242 observations on a total of 20 satellites, but over 17,000 of these were of Echo 1.

CATALOGUE OF SATELLITE OBSERVATIONS NO. C-35
B. Miller, Smithsonian Astrophysical Observatory, Cambridge, Mass., Research in Space Sciences, SAO Special Rept. -131, July 18, 1963, 77 p., N64-10348.

. . . A catalogue of observations of the Echo 1 and Explorer VIII satellites . . . during the period from July 1 through December 31, 1962 . . . observations . . . from the SAO Baker-Nunn camera stations . . . Moonwatch teams, from U. S. and foreign observatories, military stations, Phototrack stations, and miscellaneous observers.

A REPORT ON THE CAMERA CALIBRATION PHASE OF THE C AND GS SATELLITE GEODESY PROGRAM
E. A. Taylor, et al., Photogrammetric Engineering, vol. 30, March 1964, p. 245/250, 5 refs., A64-17063.

. . . The program is based on the optical tracking of passive satellites simultaneously from three or more camera tracking stations . . .

ECHO COMMUNICATION SATELLITE. A DDC REPORT BIBLIOGRAPHY
E. E. Thompson (comp.), Defense Documentation Center, Alexandria, Va., Bibliography for Dec. 1959-Nov. 1963, Nov. 1963, 1v., 49 refs., AD 422 849.

. . . 49 documents cataloged by DDC from December 1959 to the present. . . .

NASA TO LAUNCH SECOND ECHO COMMUNICATIONS SATELLITE
National Aeronautics and Space Administration, Washington, D. C., News Release 64-11, 21 Jan. 1963, 18 p., N64-13203.

. . . Echo II, will be launched no earlier than January 23, 1964. The 135-foot-diameter balloon will be injected into a 800-mile-high circular, near-polar orbit at an inclination of 82° by a Thor-Agena launch vehicle . . .

Related Publications:

HIGH GAIN ANTENNAS REALIZATION AND TRACKING STUDY
Antenna Lab., Ohio State U. Research Foundation, Columbus, Ohio, Final engineering rept., vol. 2, 22 Jan. 1961-22 Jan. 1962, rept. no. 1072-4, RADC TDR62-308, vol. 2, 22 Jan. 1962, 8 p., incl. illus., 4 refs., AD 282 330.

. . . This array will first be used in conjunction with Echo II in a communication experiment. . . .

RADAR CROSS-SECTION OBSERVATIONS OF THE ECHO I COMMUNICATIONS SATELLITE AT 440 MC/S
D. P. Hynek, Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 30 G-2, AFESD TDR 62-72, 19 Feb. 1962, 94 p., incl. illus., tables., AD 274 065.

LINE-OF-SIGHT TRACKING OF BALLOON TYPE SATELLITES IN PERTURBED CIRCULAT ORBITS
S. Samet, Flight Sciences Lab., Inc., Buffalo, N. Y., Final rept., RADC TDR 62-303, Aug. 1962, 51 p., incl. illus., 22 refs., AD 291 768.

Analytical solutions for the short time motion of a balloon type satellite displaced from a circular orbit by the perturbing forces of Earth oblateness, air drag, and solar radiation pressure were obtained. . . .

4A.840: Project Relay

Principal Publications:

PROJECT RELAY
S. Metzger, et al., American Rocket Society, Annual Meeting, 17th, and Space Flight Exposition, Los Angeles, Calif., Nov. 13-18, 1962, Paper 2620-62, 32 p., A63-12688.

PROJECT RELAY DIGITAL COMMAND SYSTEM
S. H. Roth, et al., IRE Trans. Aerospace Navig. Electronics, vol. ANE-9, no. 2, June 1962, p. 100/103.

. . . (NASA) has developed a coded message sequence consisting of discrete, pulse-duration-modulated (PDM) tone bursts for commanding satellites. The message consists of a sync pulse followed by some combination of six pulses, three each of zeros and ones. This code allows for 20 commands (the combination of six things taken three at a time). . . . equipment developed for the Relay satellite program which demodulates the tone bursts, converts the pulse-duration modulation into a binary code, and then decodes the message into twenty discrete commands. . . . The subcarrier tone amplitude-modulates a VHF carrier for transmission to the vehicle. . . .

REDUNDANCY AS APPLIED TO ANALOG CIRCUITRY FOR PROJECT RELAY
R. A. Smith, et al., In Defense Dept. Off. of the Director of Def. Res. and Eng., Wash. D. C., (Papers Presented at the) Seventh Mil.-Ind., Missile and Space Reliability Symp., NAS, North Island, Calif., 18-21 June 1962, 1962, p. 179/198, N63-17281.

. . . The incorporation of redundancy in Project Relay results in a predicted reliability of .9508, increasing reliability by a factor of 1.5 over that of a nonredundant system.

THE TRAVELING-WAVE TUBE FOR THE PROJECT RELAY COMMUNICATION SATELLITE
P. R. Wakefield, et al., Proc. Nat. Telem. Conf., vol. 2, no. 1-3, May 1962.

. . . based on a traveling-wave tube which has proven very reliable while operating in the RCA Victor MM600-2 Canadian Microwave System. . . . operated continuously for more than a year without a failure. . . .

SATELLITE ATTITUDE DETERMINATION: DIGITAL SENSING AND ON-BOARD PROCESSING
J. S. Albus, et al., IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 53/63.

. . . discusses in general the attitude determination problem for spin stabilized satellites using a digital aspect sensor system, and describes in some detail attitude determination systems used and to be used on seven NASA satellites. . . . include those flown on Explorer X, XII, XIV, XV, as well as those to be flown on the Atmospheric Structures Satellite (S-6), the Relay Satellite, and the Interplanetary Monitoring Probe (IMP). . . .

QUICK-LOOK REDUCTION OF RELAY TELEMETRY
C. Lundy, Space/Aeronautics, vol. 40, Oct. 1963, p. 124/128, A63-24936.

Description of a small, general-purpose digital computer used to edit, translate, and disseminate quick-look telemetry data from the Relay communications satellite . . . Two mobile data centers are involved, one in the Mojave desert, Calif., and the other in Nutley, N. J. At each station, a computer controls a high-speed teletype punch, from which messages are sent immediately over a NASA network to all engineering groups involved in the project. . . .

OPERATIONS WITH AN EXPERIMENTAL SATELLITE
D. G. Mazur, National Aeronautic and Space Administration, Goddard Space Flight Center, NASA TM X-50104; NASA X-620-63-86, Greenbelt, Md., May 1, 1963, 44 p., N63-17203.

. . . techniques and procedures employed and experience gained in the successful in-orbit operation of the RELAY communication satellite. . . .

RELAY
S. Metzger, et al., Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 64/67, A63-21541.

. . . description of the subsystems of Relay 1 . . . (1) the wide-band communication equipment; (2) telemetry, tracking, and command; (3) power supply subsystem; (4) radiation experi- and results; (5) spacecraft temperature; and (6) transmission tests . . .

THE DYNAMICAL DESIGN OF THE RELAY SATELLITE
C. C. Osgood, Radio Corp. of America, Princeton, N. J., Astro-Electronics Div., 1963, 23 p., refs., Presented at the 14th Intern. Astronautical Congr., Paris IAC Paper 137, 25 Sept. - 1 Oct. 1963, N64-11895.

. . . design, background development, and requirements of the Relay satellite. In particular, the control of vibratory-force transmissibility by the design of damping devices and conditions is discussed.

THE COMMUNICATION SATELLITE RELAY
W. A. Schreiner, Radio Corp. of America Princeton, N. J., 1963, 40 p., Presented at the 14th Intern. Astronautical Congr., Paris, IAC Paper 81, 25 Sept. -1 Oct. 1963. N64-11894.

. . . subsystems . . . transponders and the equipment needed to support them . . . experiments designed to obtain data on particle radiation in space . . .

NASA TO LAUNCH ANOTHER RELAY COMMUNICATIONS SATELLITE
National Aeronautics and Space Administration, Washington, D. C., News Release 64-9, 19 Jan. 1963, 16 p., N64-13202.

. . . The new Relay has no automatic cut-off device. It has N-on-P (negative on positive) solar cells which give greater resistance to radiation than the P-on-N cells in the previous Relay. Other component changes are different transistors . . . electrically operated mechanical switches . . . and a new traveling-wave tube . . . Relay II will be in much better mutual visibility in relation to Europe, South America, and Asia than Relay I.
The newest Relay, like Relay I, will transmit one-way wideband communications (television, 300 one-way voice channels or highspeed data) or two-way narrowband communications (12 two-way telephone conversations or teletype, photofacsimile and data).

RELAY SATELLITE TRANSMITS "BRAIN WAVES" FROM ENGLAND TO MAYO CLINIC NASA
NASA, Washington, D. C., News Release 63-85, April 25, 1963, 3 p., N63-17735.

. . . by land lines to . . . at Goonhilly, to RELAY and back down to . . . the signal was fed into a computer from which a diagnosis was made within one minute, and the results were immediately sent back to England. . . .

4A.850: Project Score

Principal Publications:

THE ATLAS–SCORE COMMUNICATION SYSTEM
S. P. Brown, et al., Proc. Nat. Conv. Mil. Electronics, June 1959, p. 401/406.

THE ATLAS-SCORE COMMUNICATION SYSTEM
M. I. Davis, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 401/406.

Project SCORE, or signal communication via orbital relay equipment, was an experiment to demonstrate conclusively that a radio relay system could be achieved utilizing a repeater installed in an orbiting space vehicle . . . A maximum communications range of 1000 miles . . . The satellite antenna pattern was essentially that of a multi-wavelength doublet. .1. selection of 40 kc (± 20 kcs) IF bandwidth . . . The satellite was conceived to perform a dual communications function. It was capable of serving as a "delay repeater" or as a "real time" radio relay repeater. . . .

SCORE-FIRST COMMUNICATIONS SATELLITE
M. I. Davis, Astronautics, vol. 4, no. 5, May 1959, p. 37/39.

PROJECT SCORE: SIGNAL COMMUNICATION BY ORBITING RELAY EQUIPMENT
S. P. Brown, IRE Trans. Mil. Electronics, vol. MIL-4, no. 2-3, April/July 1960, p. 193/194.

PROJECT SCORE
S. P. Brown, et al., Proc. IRE, vol. 48, no. 4, April 1960, p. 624/630.

PROJECT SCORE–THE FIRST SATELLITE COMMUNICATION SYSTEM
G. V. Kedrowsky, Aerospace Engng., vol. 19, no. 10, Oct. 1960, p. 36/39-74/77.

4A.855: Project Syncom

Principal Publications:

THE SYNCOM I COMMAND DECODER
D.C. Mead, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 7.4, Oct. 1962.

. . . processes and executes commands sent to the satellite from the earth. . . . is a rugged, reliable, all silicon system, which uses only one transistor type, one diode type, and requires only one power supply input. Redundancy is used for critical circuits to improve subsystem reliability. The decoder is automatically turned off during non-usage in order to minimize power dissipation. . . .

THE HUGHES AIRCRAFT COMPANY'S SYNCOM SATELLITE PROGRAM
C. G. Murphy, American Rocket Society, Annual Meeting, 17th and Space Flight Exposition, Los Angeles, Calif., Nov. 13-18, 1962, Paper 2619-62, 12 p., A63-12758.

THE HUGHES AIRCRAFT COMPANY'S SYNCOM SATELLITE PROGRAM
C. G. Murphy, In: International Symposium on Space Technology and Science, Tokyo, Japan, August 27-31, 1962, 4th, Proceedings, Edited by Tamiya Nomura, Tokyo, Japan and Ruthland, Vt., Japan Publications Trading Co., 1963, p. 541/548, A64-15033.

. . . NASA's Syncom Mark I and Syncom Mark II communication satellites . . . A second Syncom II, placed over the Pacific Ocean, will be able to interconnect continuously the telephones of Japan, Western Asia, the Philippine Islands, Australia, Hawaii, the West Coast of South America, and the West Coast of the U.S. . . . a completely world-wide system of satellites could be put in place before the end of 1964.

SYNCOM
F.P. Alder, Hughes Aircraft Co., Culver City, Calif., Space Systems Div., Sept. 1963, 36 p., Presented at the 14th Intern. Astronautical Congr., Paris, IAC Paper 82, 25 Sept. - 1 Oct. 1963, N64-12350.

. . . Included are the characteristics of the synchronous orbit; Syncom orbit injection and control techniques; and the primary mission objectives and operation techniques of the Syncom I and the Syncom II spacecraft.

THE ADVANCED SYNCOM COMMUNICATION ANTENNA SYSTEM — A DIRECTIVE ARRAY FOR A SPIN-STABILIZED SATELLITE
H.R. Erhardt, et al., Rec. Nat. Space Electronics Symp., no. 2.2, 1963.

. . . The Advanced SYNCOM Communication Antenna System approaches the optimum antenna pattern for a synchronous satellite while maintaining the control system simplicity of spin stabilization. This pattern, a cone which just covers the earth, is achieved by the use of a sixteen element phased array.

The beam, which is used for transmitting from the satellite to the earth, is held stationary in earth-satellite coordinates by electronically spinning the beam at spacecraft spin speed, in a direction opposite to spacecraft rotation. . . .

ADVANCED SYNCOM. I-TECHNOLOGY FOR STATIONARY COMMUNICATIONS SATELLITES
J. Holahan, Space/Aeronautics, vol. 40, Sept. 1963, p. 79/86, A63-23402.

. . . major control and command systems of the proposed Advanced Syncom. . . . The polarization angle of the linearly polarized phased-array beam provides the information for final corrections in spin-axis orientation . . . The core of this system consists of four "dual-mode" transponders, each of which can serve as a single, wide-band transmission-reception channel, or for transmitting and receiving many narrow-band channels. The dual-mode transponder block diagram is presented.

ADVANCED SYNCOM. II - HIGH-GAIN ANTENNA
J.R. McDermott, Space/Aeronautics, vol. 40, Sept. 1963, p. 86/88, A63-23403.

. . . phased-array antennas to be used in advanced Syncom . . . consist of . . . 16 co-linear elements in a circle of one-wavelength radius . . . When the vehicle spins, this basic phasing pattern progresses in the opposite direction at the same rate, so that a pencil beam is constantly directed at the Earth. The phased-array control electronics systems are described and diagramed.

SYNCOM II TO USE MULTIPLE-ACCESS DEVICES
B. Miller, Aviation Week and Space Technology, vol. 78, June 10, 1963, p. 108/109+, A63-19648.

Block diagrams of the proposed dual-mode communications transponders and of the phased-array transmitting antenna are given, along with a description of these systems. The reaction-control system is also described.

A SYNCOM SATELLITE PROGRAM
C.G. Murphy, AIAA Summer Meeting, Los Angeles, June 17-20, 1963, AIAA Paper 63-264, N63-20938.

. . . The first flight of Syncom I is described, including telemetry data and communications experiments. Proposed changes for the second flight are outlined.

SYNCOM
P. E. Norsell, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 76/78, A63-21544.

. . . design and objectives . . . Syncom I . . . employs spin-stabilization and elementary pulse-jet control for maintaining position long enough to make experiments. Advanced Syncom is being designed to operate from an equatorial, 24-hour synchronous orbit, and to demonstrate continuous wideband communications, new multiple-access communications, an electronically steerable antenna, and long-term station-keeping. The launching of . . . Syncom 2 . . . is described, including the post-launch maneuvers . . .

SYNCOM EVENT SCHEDULE NETWORKS — THE BEST OF PERT
B. W. Vaughan, et al., IEEE Trans. Engineering Management, vol. EM-10, Sept. 1963, p. 104/112, A64-14702.

. . . details of the Events Schedule Network (ESN) Project Control System . . . for the . . . project SYNCOM . . . The ESN is a reporting system with a 24-hour status response capability and a single denominator feature which provides three levels of detail for decision making purposes by various levels of management . . .

PROJECT SYNCOM
National Aeronautics and Space Administration, Washington, D. C., Washington GPO, NASA FACTS C-6-63, 1963, 8 p., N63-18423.

SECOND SYNCOM SCHEDULED FOR LAUNCH
NASA, Wash., D. C., July 19, 1963, 25 p., N63-19137.

If successful, it will be the first satellite to operate in the 24-hour orbit 22,300 miles above the earth. . . . control systems, electronics, and changes in Syncom since the first launch.

4A.860: Project Telstar

Principal Publications:

TELSTAR: TOWARD LONG-TERM COMMUNICATIONS SATELLITES
J. Holahan, Space Aeron., vol. 37, May 1962, p. 64/69.

TELSTAR SATELLITE SYSTEM EARTH STATION AT ANDOVER, MAINE
I. Welber, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 850.

. . . performs three major functions: 1. Acquisition and tracking. 2. Command and telemetry. 3. Communications.

TELSTAR SATELLITE SYSTEM
I. Welber, American Rocket Society, Annual Meeting, 17th, and Space Flight Exposition, Los Angeles, Calif., Nov. 13-18, 1962, Paper 2618-62, 28 p., A63-12225.

Description of the Telstar satellite and of the operation of the Andover station for tracking and telemetry. . . .

A DATA REDUCTION AND ANALYSIS PROGRAM FOR THE "TELSTAR" SATELLITE COMMUNICATION SYSTEM
D. A. Aaronson, Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 146/155.

Raw data . . . is processed on a High-Speed Digital Computer to produce tables and plots for evaluating communication and tracking performance. Data from the satellite and the Andover Earth Station is recorded in digital form on 7-track magnetic tape at the earth station, compressed, sent to a data center via Bell System data service, then reduced and analyzed on an IBM 1401-and 7090. Plots of various quantities are produced by a Stromberg-Carlson Microfilm Printer. . . .

THE PRECISION TRACKER
J. V. Anders, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1309/1356.

. . . a simultaneous lobing, amplitude-comparison, passive, continuous-wave tracker based in principle and design upon a monopulse tracking radar . . . employed at the Andover, Maine, and Pleumeur-Bodou, France . . .

. . . Telstar satellite radiates a 4079.73-mc continuous-wave (CW) carrier 90 mc below the frequency of the communications carrier. This signal is designed as a beacon for the processes of tracking and initial acquisition. . . .

THE SPACECRAFT ANTENNAS
J. T. Bangert, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 869/897.

. . . employs two microwave antennas for communications and a single VHF antenna for telemetry, beacon, and command functions. One microwave antenna centered at 6 gc is used to receive broadband signals from a ground transmitter while the other microwave antenna centered at 4 gc is used to transmit signals to a ground receiver. Each microwave antenna is composed of a large number of circularly polarized radiating elements equally spaced around the equator of the spacecraft. . . . The VHF antenna is a small multi-element helix mounted at the pole of the spacecraft and radiates a linearly polarized signal. . . .

THE TELSTAR COMMUNICATIONS SATELLITE EXPERIMENT PLAN
S.B. Bennett, et al., IEEE Conf. Paper 63-373, Feb. 1963, 18 p.

THE SATELLITE TRAVELING-WAVE TUBE
M.G. Bodmer, et al., Bell Syst. Tech. J., vol. 42, no. 4.3, July 1963, p. 1703/1748.

The traveling-wave tube amplifier described provides a minimum output power of 3.5 watts at 4.0 to 4.2 gc. Design aspects that lead to lifetimes in excess of 10 years and to tube efficiencies between 35 to 40 per cent are discussed . . .

THE SPACECRAFT POWER SUPPLY SYSTEM
D.C. Bomberger, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 943/972.

. . . in the Telstar spacecraft consists of a solar cell plant to convert solar radiation to electrical energy when the satellite is illuminated by the sun, a 19-cell nickel-cadmium battery to store energy, and a regulation circuit to supply constant output voltages over a wide variation in input voltages . . . provides switching to . . . allow battery recharging during periods between communications experiments.

NICKEL-CADMIUM CELLS FOR THE SPACECRAFT BATTERY
D.C. Bomberger, et al., Bell Syst. Tech. J., vol. 42, no. 4.3, July 1963, p. 1687/1702.

. . . To date, the only failures occurring during continuing life tests have been among cells subjected to 100 per cent discharge daily; this operation is far in excess of the expected duty cycle of satellite cells.

PROJECT TELSTAR
C.F. Booth, J. Instn. Elect. Engrs., vol. 9, April 1963, p. 160/163, A63-15869.

Review of the cooperative efforts of NASA and the British Post Office in establishing an operational satellite communications system. . . .

THE SPACECRAFT RADIATION EXPERIMENTS
W.L. Brown, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 899/941.

. . . on the Telstar spacecraft . . . designed to measure the electron and proton particle distributions in the region of space explored by the satellite orbit and to give information on the integral semi-conductor radiation damage produced by these particles. . .

RESULTS OF THE TELSTAR RADIATION EXPERIMENTS
W.L. Brown, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1505/1559.

. . . data from the particle experiments of the Telstar satellite have been analyzed to provide maps of the distribution of electrons and protons as measured in three of the Telstar detectors during the period from July through October, 1962 . . . The connection of these observations to the high-altitude nuclear explosion of July 9, 1962, is discussed. The introduction of additional electrons by Russian tests at the end of October was also observed . . .

ELECTRONICS IN THE TELSTAR SATELLITE
R.C. Chapman, et al., Rec. Nat. Space Electronics Symp., no. 2.1, 1963.

. . . The telemetry and command portions of the TELSTAR system . . . The telemetry system uses a VHF carrier to transmit encoded information from the satellite. Data on 112 items are provided once each minute. By means of the command system, the states of 9 magnetic latching relays in the satellite are controlled from the ground. . . .

COMMAND AND TELEMETRY SYSTEMS
R.C. Chapman, Jr., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 1027/1062.

. . . By means of the command system, the states of 9 magnetic latching relays in the satellite by coded signals modulated on a carrier in the VHF band. The telemetry system also uses a VHF carrier to transmit encoded information from the satellite. Data on 112 items are provided once each minute. . . .

ORBIT DETERMINATION AND PREDICTION, AND COMPUTER PROGRAMS
A.J. Claus, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1357/1382.

. . . needed to generate ephemerides for the Telstar satellite. Orbit determination is from tracking data consisting of angles only, and is based on a modified version of a method by R.E. Briggs and J.W. Slowey of the Smithsonian Institution. Trends in the data due to perturbations from a Keplerian orbit are removed before this process, and estimates of the orbital elements from individual passes are combined statistically to produced refined estimates . . . The programs to implement these procedures have been written for both the IBM 7090 and the IBM 1620 computers.

THE GROUND STATION HIGH-POWER TRAVELING-WAVE TUBE
R.J. Coller, et al., Bell Syst. Tech. J., vol. 42, no. 4.3, July 1963, p. 1829/1861.

The M4040 is a 2-kw CW traveling-wave tube developed specifically for communications applications. It was used as the power amplifier in the Project Telstar ground transmitter. . . .

THE AUTOTRACK SYSTEM
J.S. Cook, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1283/1307.

The paper presents a simple analysis of error voltage generation, a description of the system, and a brief discussion of system performance . . . an angular pointing error of less than 0.005 degree is maintained by the antenna . . . (originally designated and often referred to as the "vernier autotrack," or "VAT ") . . . receives the circularly polarized 4080-mc CW beacon signal entering the antenna from the satellite, and, by examining the nature of the propagation of this signal through the antenna feed line, determines the discrepancy between the direction the antenna is pointing and the actual direction of the satellite . . .

THE RESEARCH BACKGROUND OF THE TELSTAR EXPERIMENT
A.B. Crawford, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 747/764.

For several years before the launch of the Telstar satellite, research effort was directed toward an experiment with an active satellite capable of relaying a broadband communication channel. The intention was to utilize and test a number of novel techniques which had become available, to explore those areas in which the current technology was lacking, and to demonstrate the feasibility of this means of communication. . . . interest . . . began in 1955 with . . . the article on "Orbital Radio Relays" by J.R. Pierce . . .

THE SPACECRAFT COMMUNICATIONS REPEATER
C.G. Davis, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 831/867.

This paper describes the electrical characteristics of the waveguide components, the solid-state circuits and the traveling-wave tube used in the microwave communications repeater. The reflex-circuit method of obtaining local oscillator signals for the modulators and ceratin circuit stability problems are discussed.

THE SPACECRAFT TEST AND EVALUATION PROGRAM
T.B. Delchamps, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 1007/1025.

Considerations guiding the planning and execution of environmental tests in the development, design qualification and flight acceptance phases of the Telstar satellite program. . . .

THE TELSTAR EXPERIMENT
A.C. Dickieson, Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 739/746.

The papers that follow describe in depth the satellite and ground systems designed for the Telstar experiment and give the results to date. The purpose of this introduction is to set the scene in which the project was undertaken and to state some general conclusions.

THE MECHANICAL DESIGN OF THE HORN-REFLECTOR ANTENNA AND RADOME
J.C. Dolling, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1137/1186.

Telstar ground station . . . mechanical considerations . . . engineering aspects . . . design, fabrication, and erection . . . accessory equipment.

COMMAND GUIDANCE OF TELSTAR LAUNCH VEHICLE
M.J. Evans, et al., Bell Syst. Tech. J., vol. 42, no. 5, Sept. 1963, p. 2153/2168.

. . . Telstar I . . . was . . . guided by the Bell Telephone Laboratories command guidance system . . . This paper discusses the theory of the guidance equations employed by the command guidance system in the Delta program.

HIGH-SPEED DIGITAL DATA TRANSMISSION OVER THE TELSTAR SATELLITE (Correspondence)
F.E. Froehlich, et al., Proc. IEEE, vol. 51, no. 4, April 1963, p. 609.

THE GROUND TRANSMITTER AND RECEIVER
A.J. Giger, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 1063/1107.

. . . for the Telstar experiment includes a k-kmc transmitter and a f-kmc receiver used for television and telephone channels. This paper describes the over-all transmitting and receiving arrangements and presents detailed accounts of the RF and power-supply subsystems. Information is also presented on protection, control and equipment features, and on receiver noise performance.

THE FM DEMODULATOR WITH NEGATIVE FEEDBACK
A.J. Giger, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 1109/1135.

ANTENNA POINTING SYSTEM: ORGANIZATION AND PERFORMANCE
J.A. Githens, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1213/1221.

. . . used in the satellite ground station at Andover, Maine . . . for the Telstar experiment . . . "pencil" beam of about 1/5 degree in diameter . . . requires an antenna pointing system of high accuracy. . . .

DIGITAL EQUIPMENT FOR THE ANTENNA POINTING SYSTEM
J.A. Githens, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1223/1252.

. . . describes the digital control and data processing portions of the antenna pointing system used to track the Telstar satellite. . . .

RESULTS OF THE TELSTAR SYSTEM COMMUNICATIONS TESTS
R.W. Hatch, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1561/1629.

. . . results of the communications tests on the Telstar satellite system which have been conducted at the Andover earth station are presented . . . included successful transmissions of telephone, television, and data signals . . . measurements of received carrier power, noise, transmission characteristics, linearity, data system errors, absolute delay, and Doppler shift have been made. The results are in good agreement with expected performance.

THE ELECTRICAL CHARACTERISTICS OF THE CONICAL HORN-REFLECTOR ANTENNA
J.N. Hines, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1187/1211.

Telstar groundstations . . . broadband and low-noise properties. Prior to the construction of the full-size antenna, theoretical and model studies of its electrical characteristics were undertaken . . . consisted of computing gain and radiation patterns for two modes of excitation, constructing of model antennas and measuring them. . . .

COMPONENTS FOR THE TELSTAR PROJECT
W.C. Hittinger, Bell Syst. Tech. J., vol. 42, no. 4.3, July 1963, p. 1659/1664.

. . . The program for obtaining . . . components was essentially that originated for submarine cable devices, in which designs of proven integrity were manufactured under controlled conditions, screened and aged to remove defectives, and then life tested and certified using techniques for selecting the most stable components. . . .

THE TELSTAR SATELLITE SYSTEM
D.F. Hoth, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 765/799.

. . . discusses the over-all system design . . . A general description of the . . . satellite and . . . ground station . . . transmission performance is given with some discussion of system parameters.

THE SPACECRAFT STRUCTURE AND THERMAL DESIGN CONSIDERATIONS
P. Hrycak, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 973/1005.

. . . covers the general structural and thermal design considerations of the Telstar satellite. . . .

RESULTS OF THE TELSTAR SATELLITE SPACE EXPERIMENTS
P.T. Hutchison, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1475/1504.

. . . describes how the Telstar satellite has performed in space. Included is information on changes in the temperature, spin rate, spin-axis precession, orbital parameters and power levels of the satellite signals, and comments on the behavior of the electrical circuits in the space environment.

PARTICIPATION OF THE HOLMDEL STATION IN THE TELSTAR PROJECT
W.C. Jakes, Jr., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1421/1447.

The facility for satellite communication studies at Holmdel, New Jersey, was originally established to take part in Project Echo. This paper describes the modifications required to participate in the Telstar experiments and the results obtained during operations from July 10 to November 9, 1962. Reception of television from the satellite was successfully accomplished, studies were made of the signal levels, and the changes with time of the satellite spin rate and spin axis orientation were determined.

THE SERVO SYSTEM FOR ANTENNA POSITIONING
J.C. Lozier, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1253/1281.

Telstar . . . for pointing the horn-reflector antenna . . . giving the characteristics of the various parts of the system . . . over-all performance of the servo system is discussed.

THE COMMAND SYSTEM MALFUNCTION OF THE TELSTAR SATELLITE
J.S. Mayo, et al., Bell System Tech. J., vol. 42, no. 4.2, July 1963, p. 1631/1657.

Loss of the command function of the Telstar satellite first occurred on November 24, 1962. There had been earlier indications of degraded performance. Facts are presented which led to the conclusion that the malfunction of the command system was due to surface damage to certain transistors in the redundant command decoders by the enhanced radiation in the inner Van Allen belt. Correction steps have . . . aided in the gradual rejuvenation of both command decoders . . . subsequent reappearance of the command system malfunction on February 21, 1963. . . .

PHASE-LOCK LOOP DESIGN FOR COHERENT ANGLE-ERROR DETECTION IN THE TELSTAR SATELLITE TRACKING SYSTEM
W. L. Nelson, Bell Syst. Tech. J., vol. 42, no. 5, Sept. 1963, p. 1941/1975.

The function of the angle-error detector is to provide pointing-error signals to the ground antenna control system, which allows operation in the autotrack mode once the satellite beacon has been acquired. The limitations on the accuracy of this system imposed by noise, phase jitter and Doppler effects are evaluated and the optimum design in terms of minimum mean-square error is developed. Design examples are given for both the horn-reflector antenna autotrack system and the precision tracker antenna system.

THE PHYSICAL PERFORMANCE OF TELSTAR IN ORBIT
E. F. O'Neill, Institute of the Aerospace Sciences, Annual Meeting, 31st, New York, N.Y., Jan. 21-23, 1963, Paper 63-65, 11 p., A63-14836.

TELSTAR PROJECT — SATELLITE PRELAUNCH MEASUREMENTS AND SYSTEM CHECKOUT
E. F. O'Neill, Bell Telephone Labs., Inc., Murray Hill, N.J., 1963, 13 p., AD 407 762.

COMPONENT DESIGN, CONSTRUCTION AND EVALUATION FOR SATELLITES
D. S. Peck, et al., Bell Syst. Tech. J., vol. 42, no. 4.3, July 1963, p. 1665/1686.

Components for a high-reliability system such as the Telstar project are obtained by: (a) design of the component for the required environment, (b) careful control of manufacturing processes, (c) elimination of potential early failures by screening tests, and (d) selection of the most stable components. . . . resulting components are aged from two to six months before selection for the satellite . . .

THE NATIONAL PHYSICAL LABORATORY — THE USE OF ARTIFICIAL SATELLITES FOR RELATING TIME AT DISTANT POINTS
V. T. Saunders, Contemporary Phys., vol. 5, Dec. 1963, p. 117/119, A64-15501.

Description of experiments using the Telstar satellite for time synchronization between the U.S. and the United Kingdom. . . . two noteworthy features of the experiments: (1) the remarkably high precision of the Telstar pulses as propagated, and (2) the very close accordance of about 1 km between the ranges given by ephemeris E2 (Aug. 31) and that obtained by multiplying the travel time by the speed of light in free space.

A GENERAL DESCRIPTION OF THE TELSTAR SPACECRAFT
R. H. Shennum, et al., Bell Syst. Tech. J., vol. 42, no. 4.1, July 1963, p. 801/830.

. . . emphasis on the electronics system . . . includes early planning, starting with frequency allocation considerations, and carries the program through electrical and mechanical design, construction and evaluation of the electronics system. . . .

THE DESIGN AND CONSTRUCTION OF THE ELECTRONICS PACKAGE
R. H. Shennum, et al., Bell Syst. Tech. J., vol. 42, no. 4.3, July 1963, p. 1749/1763.

The electronics system of the Telstar satellite is described from the point of view of philosophy of design and construction rather than that of circuit details. The reliability is emphasized . . . The physical construction of modules, subsystems, and finally the entire system is described, including the foam encapsulation and the eventual hermetic sealing of the canister.

PLANNING, OPERATION AND EXTERNAL COMMUNICATIONS OF THE ANDOVER EARTH STATION
D. H. Smith, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1383/1420.

. . . describes the station layout, the operating plan and the Long Lines interconnections. Power facilities, air conditioning, heating and dehumidification arrangements are also covered.

THE SOLAR CELLS AND THEIR MOUNTING
K. D. Smith, et al., Bell Syst. Tech. J., vol. 42, no. 4.3, July 1963, p. 1765/1816.

. . . The spacecraft solar cells use the n-on-p structure, in preference to conventional p-on-n structure, to obtain a factor of 3 to 10 increased life expectancy. . . . the cells are protected against electrons of energy up to 1 Mev by 0.3 gm/cm^2 sapphire cover plates . . .

MASERS FOR THE TELSTAR SATELLITE COMMUNICATIONS EXPERIMENT
W. J. Tabor, et al., Bell Syst. Tech. J., vol. 42, no. 4.3, July 1963, p. 1863/1886.

. . . design and characteristics of ruby traveling-wave masers operating at 4 gc. These masers, characterized by an average gain of $\approx$35 db over a bandwidth of 25 mc, are equipped with waveguide input transmission lines, rather than the previously employed coaxial cables. This change results in an over-all noise temperature of 3.5°K for these devices, rather than the 10°K exhibited by earlier masers . . .

THE TELSTAR PROJECT AND THE PLEUMEUR-BODOU EXPERIMENTAL STATION FOR SATELLITE TELECOMMUNICATIONS (In French)
M. Thue, et al., Onde Electr., vol. 43, no. 432, March 1963, p. 341/360.

. . . description of the experimental station at Pleumeur-Bodou, and particularly the radio equipment and the telecommunication equipment. There follows an account of the principal experimental results obtained since the launching of Telstar I.

4-gc PARAMETRIC AMPLIFIER FOR SATELLITE COMMUNICATION GROUND STATION RECEIVER
M. Uenohara, et al., Bell Syst. Tech. J., vol. 42, no. 4.3, July 1963, p. 1887/1908.

. . . design and performance of a 4-gc parametric amplifier . . . consists of two cascaded stages of similar design: the first of these is operated at liquid nitrogen temperature and the second at room temperature. One 23-gc pump source is used for both amplifier stages. . . . Used in Telstar ground stations.

LAUNCHING OF THE TELSTAR SATELLITE
H. N. Upthegrove, et al., Bell Syst. Tech. J., vol. 42, no. 4.2, July 1963, p. 1449/1473.

. . . emphasis on the pre-launch testing and test facilities. The . . . satellite was launched on July 10, 1962 . . . by a Delta launch vehicle. . . .

THE SATELLITE FERRIMAGNETIC POWER LIMITER
L. J. Varnerin, et al., Bell Syst. Tech. J., vol. 42, no. 4.3, July 1963, p. 1817/1827.

To limit the 4080-mc local oscillator signal power input to the beat oscillator modulator of the Telstar satellite communications repeater, a subsidiary absorption limiter was used which consisted of an optically polished sphere of single-crystal yttrium iron garnet (YIG), placed in a resonant transmission cavity between the amplified 4080-mc output of the traveling-wave tube and the BO modulator input. . . .

TELSTAR
I. Welber, Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 68/71, A63-21542.

. . . results of experiments in Telstar 1 and 2 . . . TWT amplifier, solar cells, the command function . . . the radiation experiment . . . The major differences between Telstar 1 and 2 . . .

SPIN DECAY, SPIN-PRECESSION DAMPING, AND SPIN-AXIS DRIFT OF THE TELSTAR SATELLITE
E. Y. Yu, Bell Syst. Tech. J., vol. 42, no. 5, Sept. 1963, p. 2169/2193.

Dynamical problems of the spin-stabilized Telstar satellite, characterized by spin decay, spin-precession damping, and spin-axis drift, are analyzed in this paper. Both the eddy-current torques and the magnetic torques, which cause the above three phenomena, are evaluated. By extrapolation from the observed data, the characteristic time of the nearly exponential spin decay of the satellite is estimated to be about 330 days . . . A qualitative description is given to illustrate the fundamental mechanism of spin-axis drift. Results of these analyses can be applied to any spin-stabilized satellite.

Related Publications:

TELSTAR SATELLITE POWER SYSTEM
R. E. D. Anderson, et al., American Rocket Society, Space Power Systems Conference, Santa Monica, Calif., Sept. 25-28, Paper 2503-62, A63-11679.

4A.870: Project West Ford

WEST FORD POINT SELECTION PROGRAM
J. D. Drinan, Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 21G0025, 21 Dec. 1960, 15 p., AD 432 786.

REVISION OF WEST FORD TTY CHECKING PROGRAM
J. D. Drinan, Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 21G-0022, Supp. 1, AFESD TDR 62-122, 2 Aug. 1962, 4 p., incl. illus., AD 283 778.

OPTICAL BRIGHTNESS OF THE WEST FORD EXPERIMENT
W. Liller, Nature, vol. 200, Oct. 26, 1963, p. 349/350, A64-10907.

Brief review of optical observations, by various investigators, of the needle belt caused by a large number of fine copper needles placed into orbit about the Earth. . . . It is found that the needle belt is no brighter than predicted.

THE WEST FORD ANTENNA FEED SYSTEM
L. Niro, Lincoln Lab., Mass. Inst. of Tech., Lexington, Technical rept. no. 259, AFESD TDR 62-111, 5 March 1962, 29 p., incl. illus., refs., AD 282 311.

VOLUME 4 - PART B

INSTRUMENTED SATELLITES

Unmanned spacecraft may be grouped into three classes, each with quite different communications equipment. In part A of this volume we discussed communications satellites. They require communications systems for two purposes: One is in common with all other spacecraft and, naturally, involves information exchange between the spacecraft and Earth which is required for the successful flight of the vehicle and its payload. The other purpose, however, is unique to communications satellites and involves the relaying of information from one place on Earth to another.

In part B we discuss a class of unmanned satellites which serves the purpose of scientific and utilitarian observations. They are alternately designated as instrumentation satellites, instrumented satellites, observation satellites, exploration satellites or research satellites. They all have certain specific requirements on the communication system in common and require a large electronic instrumentation system. There are also two purposes for the communications system. One is, as before, the information exchange between the spacecraft and Earth for operation of all subsystems; the other is the satisfactory transmission of observation results from the spacecraft to Earth.

In the next part, C, we discuss a class of unmanned spacecraft specifically designed for operation in deep space, i.e., at the moon and beyond. The communications system for such space probes has the same two purposes as the instrumented satellites. The design conditions, however, are quite different due to the much greater range and the longer mission duration.

The organization of this part follows in general, the pattern of part A. There is an introductory division (4B.0), a design and analytical division (4B.1) and an applications division (4B.8). The remaining two divisions are classified according to the specific missions of the satellites.

Division 4B.2 deals with space research satellites. Their missions are investigations of particular characteristics of the space environment. The results of such missions are the basis on which longer and more sophisticated manned or unmanned space flights can be planned. The communications systems in this class are frequently custom designed for a particular mission and many unknown factors have to be taken into account. In many cases it is only the result of the mission which determines the exact nature of the environment in which the electronics system have to operate. This applies particularly to systems discussed in subdivision 4B.220. Subdivision 4B.230 is of three-fold interest to space communications engineers. It contains references about ionospheric research satellites which require (1) a two-way communications system to secure satisfactory operation of the spacecraft and payload, (2) special radio receivers and transmitters to investigate the ionosphere (preferably from the "top"), and (3) a communications system to transmit to Earth the results of experiments which become available in the spacecraft. Subdivision 4B.240 deals with a new generation of several satellites which are designed for routine scientific observations from Earth orbits. These orbiting observatories are designed for highest flexibility in performing their observations and for long lifetimes in orbit.

Division 4B.3 deals with classes of instrumented satellites which may be aptly designated as utility satellites. They serve the purpose of weather observation (4B.320), navigation (4B.330) or other special uses (4B.340). The communications systems for these various classes show, by necessity, large variations.

The reader is invited to check any particular subdivision mentioned above in connection with those subdivisions in 4B.8 which discuss projects with missions corresponding to the desired class of spacecraft. The DOD observation satellites in operation or under development are excluded from consideration in this bibliography.

DIVISION 4B.0
GENERAL REFERENCES

4B.000: General References on Instrumented Satellites

Included: Instrumentation satellites; Observation satellites; Exploration satellites; Research satellites; Scientific satellites; Automated spacecraft; Recovery of bio-packages from orbit; Surveys of space experimentation techniques.

Not Included: Manned space research satellites (4D); Scientific deep space probes (4C); Scientific sensors (3A).

Cross References: Discoverer satellites (4B.840).

Principal Publications:

THE ENGINEERING OF SATELLITE EXPERIMENTS
W. K. Victor, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 9 May 1958, 17 p., AD 252 201.

. . . Recommendations for planning and executing a satellite experiment . . .

THE SCIENTIFIC USES OF EARTH SATELLITES
J. H. Blythe, J. Brit. Instn. Radio Engrs., vol. 22, no. 5, Nov. 1961, p. 425/432, 35 refs.

A survey is given on the present position of certain branches of research which have been considerably influenced by satellite experiments and the value of the new methods is demonstrated. Topics discussed include the earth's gravitational field, its atmosphere, the upper regions of the ionosphere, magnetic fields near to the earth and in interplanetary space, and the zones of trapped radiation. . . .

SCIENTIFIC SATELLITES. AN ASTIA REPORT BIBLIOGRAPHY
S. E. Bjorge (comp.), Armed Services Technical Information Agency, Arlington, Va., 12 Dec. 1962, 24 p., 120 refs., AD 290 800, N63-16247.

. . . covers the design and instrumentation of scientific satellites, properties of the ionosphere derived from satellite research, and meteorological satellites. . . .

SCIENTIFIC SATELLITES
I. E. Jeter (editor), Proc. of an AAS Symp. on Sci. Satellites—Mission and Design, Philadelphia, Its Advances in the Astron. Sci., vol. 12, Dec. 27, 1962, N63-23412.

ACHIEVEMENTS AND PROSPECTS OF ARTIFICIAL EARTH SATELLITES
S. F. Singer, Proc. IRE, vol. 50, May 1962, p. 1251/1260.

. . . confined mainly to the applications of earth satellites and space probes to space science . . . to geophysics and astrophysics . . . Good survey.

BIOSATELLITE RECOVERY FROM CIRCULAR ORBITS
C. J. Swet, Applied Physics Lab., Johns Hopkins U., Silver Spring, Md., Rept. no. CM-1026, Oct. 1962, 38 p., incl. illus., tables, AD 295 851.

. . . primer for the non-ballistician . . . to provide him with some feeling for the ballistics of biosatellite recovery. It presents in non-specialized terms some results of a recent parametric study of a wide variety of likely descent trajectories from near-earth orbits. . . .

REPORT ON THE SCIENTIFIC INTEREST AND PROBLEMS
P. Swings, Space Science Review, vol. 1, May 1963, p. 762/773, A63-19945.

SCIENTIFIC SPACECRAFT OF THE UNITED STATES
E. M. Cortright, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 133, 53 p., A63-25668.

Review of the automated spacecraft which have been developed and flown, or which are currently under active development in the U.S. by NASA. Considered are scientific satellite history, typical satellies, applications, space probes, test experiences and flight operations, spacecraft complexity, and spacecraft under development.

DAS PROJEKT EINES DEUTSCHEN SATELLITEN (A German Satellite Project) (In German)
W. V. Maydell, Weltraumfahrt Raketentechnik, vol. 15, Jan.-Feb. 1964, p. 23/27, A64-16383.

Brief description of the first German satellite project, which includes the development of a small and a large satellite. The former, a completely conventional satellite, will measure solar phenomena during periods of sunspot minima. The satellite, which is to be fitted to an American Scout booster, will weigh about 60 kg and will use energy supplied from solar cells having a total output of 20 watts to 40 watts. The larger satellite, which will weigh about 860 kg, will be powered by a thermal engine providing a continuous electric output of 2.5 kw. The solar energy is captured by a plastic parabolic mirror. . . .

SCIENTIFIC USES OF SYNCHRONOUS SATELLITES
E. B. Mullen, 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. 506/514, 18 refs., A64-15030.

. . . significant observational data . . . can be obtained from synchronous satellites . . . that will augment our store of scientific knowledge of the Earth and outer space. . . .

Related Publications:

SPACE TELEMETRY SYSTEMS
W. E. Williams, Jr., Proc. IRE, vol. 48, no. 4, April 1960, p. 685/690.

Good table of all systems in use up to launch No. 38.

NOTES ON A NOVEL GNOMONIC NOMOGRAPH OR GRAPHICAL DETERMINATION OF SATELLITE COVERAGE
R. H. Gerhardt, Mitre Corp., Bedford, Mass., Rept. no. W6270, ESD TDR63 450, Oct. 1963, 19 p., AD 422 326.

DIVISION 4B.1
INSTRUMENTED SATELLITE DESIGN

4B.100: Design of Instrumented Satellite Systems

Included: System engineering of synchronous instrumented satellites; Ground stations for instrumented satellites; Data processing telemetry results from scientific satellites.

Not Included: Ground stations for communications satellites (4A); Ground stations for deep space exploration (4C); Information processing subsystems (3A); Antenna subsystems.

Cross References: Design of instrumented satellites for special missions (Div. 4B.2, 4B.3, 4B.8).

Principal Publications:

AUTOMATIC DATA PROCESSING
C. J. Creveling, et al., IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 124/134.

The problems of reducing telemetry signals from scientific earth satellites are assessed and an account is given of the factors governing the establishment of an automatic processing sequence. . . . planning the data reduction facilities at the Goddard Space Flight Center . . . It was considered that the most powerful and versatile approach would be to translate the data into digital form and process it in large-scale general-purpose digital computers or in special computers designed for this kind of work. . . . it was estimated that each hour of telemetry time would require a like period for further computer processing . . .the success of the digitizing approach has resulted in the design of a more flexible automatic digitizing chain . . . The more sophisticated equipment is locally known as the STARS (Satellite Telemetry Automatic Reduction System) and will be in operation by mid-1962. . . .

TRANSMITTER, RADIO T-723 (XE/1)/GMD
U. W. Smith, Army Electronics Research and Development Lab., Fort Monmouth, N.J., AELRDL Technical rept. no. 2305, Sept. 1962, 37 p., incl. illus., AD 295 478.

. . . rawinsonde system operational tests . . . features an automatic-frequency-control circuit that controls the transmitter frequency so as to align it with that of the superheterodyne receiver in Radiosonde Set AN/DMQ-5 ( ). Sudden or gradual frequency changes of the receiver for as much as $\neq$ 1 mc can be tracked by the transmitter.

ADAPTIVE DECOMMUTATION GROUND STATION WITH COMPUTER CONTROL
J. A. Bauer, Proc. Nat. Telem. Conf., no. 11-5, May 1963.

Telemetry ground station support of multi-mission capability requires rapid and accurate control of the station input and output parameters. A system concept is developed for control of the video acquisition input parameters for synchronization and pattern recognition, for control of the decommutation output parameters for channel selection, and for control of decommutation data distribution to displays and reformatting equipment for real-time use. . .

OPERATIONS PLAN 13-63. TELEVISION OBSERVATIONAL SATELLITE (TIROS H)
A. G. Ferris, et al., National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md., NASA TM X-54699; X-535-63-248, Dec. 1963, 41 p., N64-17608.

. . . Included . . . operations and control; field station operations; space communications center operations; and computing center operations.

GROUND OPERATION EQUIPMENT FOR THE ORBITING ASTRONOMICAL OBSERVATORY
E. J. Habib, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TN D-1856, Dec. 1963, 24 p., Presented at the Inst. of Aerospace Vehicles Symp., San Francisco, 19 Feb. 1962, N64-11622.

. . . Orbiting Astronomical Observatory (OAO) is a precisely stabilized satellite . . . will be controlled by ground operation equipment at remote control stations; this equipment will transmit operating commands which have been verified on an operational simulator that includes a large-scale digital computer. Suitable safeguards are incorporated to prevent irreversible command from being transmitted to the satellite. An auxiliary realtime control mode is provided by connecting one remote control station by microwave link to a Central Control Station. The Central Control Station control and display equipment provides a quick-look capability for evaluating the spacecraft status by means of a printer and novel "index-card"-type display system.

PRACTICAL ASPECTS OF DATA PROCESSING AND ENCODING FOR SPACE COMMUNICATIONS
G. E. Mueller, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 471/487.

. . . Communications from spacecraft . . . Surveyor . . . Aeros . . . Ranger . . . OAC . . . Relay . . . Telstar . . . discussing methods for processing and encoding data from spacecraft . . . Four factors must be considered in the process of translating measurements and events at a spacecraft into a form suitable for telemetry transmission; filtering, encoding, the choice of format for this code, and the capability for decoding. . . . each of these will . . . be reviewed. . . .

AUTOMATIC PICTURE TRANSMISSION GROUND STATION INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Fairchild Stratos Corp., Wyandanch, N. Y., Greenbelt, Md., NASA, Goddard Space Flight Center, NASA CR-53594, 15 March 1963, 314 p., N64-18508.

The . . . (APTGS) provides facsimile reproductions of pictures transmitted from an orbiting meteorological satellite . . . will acquire the signals from the satellite when the satellite is more than 10^{o} above the horizon of the receiving station and when the direction antenna is oriented to the satellite position. The recorder reconstitutes the transmitted picture on a line-by-line scan basis . . .

Related Publications:

ROCKET-BORNE IONOSOUNDER EQUIPMENT DEVELOPMENT

L. C. Humphrey, Advanced Electronics Center, General Electric Co., Ithaca, N.Y., Scientific rept. no. 2, AFCRL 62-900, Aug. 1962, 50 p. incl. illus, table, AD 290 726.

. . . Equipment that has been fabricated includes a 250-watt transistor high-frequency radar transmitter, receiver, programmer, power inverter, and inflatable plastic HF antenna structures.

THE X-Y ANTENNA MOUNT FOR DATA ACQUISITION FROM SATELLITES

A. J. Rolinski, et al., IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 159/163.

. . . brief description of NASA's 85 ft. parabolic X-Y antenna located at the Data Acquisition Facility at Gilmore Creek, Fairbanks, Alaska. . . .

THE ORBITING GEOPHYSICAL OBSERVATORIES

G. H. Ludwig, Space Science Reviews, vol. 2, Aug. 1963, p. 175/218, A63-24286.

Description . . . of their ground support systems. . . .

THE INJUN SATELLITES

B. J. O'Brien, Naval Research Reviews, vol. 16, March 1963, p. 15/19, A63 14783.

. . . The design of the satellites is unique in that it is aimed at aligning one axis continuously parallel to the magnetic field of Earth. . . .

SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY. VOLUME I: SUMMARY AND CONCLUSIONS

Republic Aviation Corp., Farmingdale, N.Y., Final Report, Feb./May 1963, RAC-1333, vol. 1, SSD-1027, vol. 1, 17 June 1963, 70 p., refs., N64-17695.

. . . general objectives . . . results of research in the following areas . . . (1) system studies; (2) subsystem studies . . . meteorological communications, operating communications, attitude control and station keeping . . . thermal control, and ground station equipment . . .

SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY, VOLUME 2: CONFIGURATIONS AND SYSTEMS

Republic Aviation Corp., Farmingdale, N.Y., Final Report, Feb.-May 1963, RAC-1333, vol. 2; SSD-1027, vol. 2, 17 June 1963, 180 p., refs., N64-17696.

SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY, VOLUME 3: METEOROLOGICAL SENSORS

Republic Aviation Corp., Farmingdale, N.Y., Final Report, RAC-1333; SSD-1027, 17 June 1963, 187 p., refs., N64-17697.

The meteorological-sensor study in this volume sets forth the essential considerations and requirements for the cloud-cover and heat-budget sensory systems for the synchronous meteorological satellite . . . Comparative data are presented on various photosurfaces, photoemissive tubes, and photoconductive tubes, as well as hybrid and special types of tubes. Included among the topics discussed are heat-budget measurements and infrared cloud-cover sensors.

SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY, VOLUME 6: SYSTEM SYNTHESIS AND EVALUATION

Republic Aviation Corp., Farmingdale, N.Y., RAC-1333; SSD-1027, 17 June 1963, 100 p., N64-17700.

Among the topics . . . (3) nonsensitive subsystems and components-sensor data transmitter, command link, telemetry link, tracking aids, communications relay link, and data-handling subsystem; (4) sensitive subsystems and components-meteorological sensors, stabilizations and station-keeping subsystem, power subsystem, and structure; and (5) design procedures . . .

DIVISION 4B.2
SPACE RESEARCH SATELLITES

4B.220: Space Environment Exploration Satellites

Included: Geophysical research with satellites; Atmospheric research by satellites; Exploration of biological effect in space (with unmanned satellites); Atmospheric density research by satellites; Solar flare satellite; IGY satellite program; Exploration of space radiation by satellites.

Not Included: Project Pioneer (4C); Scientific sensor subsystems (3A); Space environmental conditions.

Cross References: Project Cosmos (4B.837); Project Explorer (4B.846); Project FR-1 (4B.898); Project San Marco (4B.878); Project UK (4B.890); Project Vanguard (4B.892); Orbiting Observatories (4B.240).

Principal Publications:

SCIENTIFIC INSTRUMENTATION IN IGY SATELLITES
H. Friedman, Electrical Engng., vol. 76, June 1957, p. 470.

EARTH SATELLITE INSTRUMENTATION
W. Matthews, Electrical Engng., vol. 76, July 1957, p. 562.

RADIO ASTRONOMICAL OBSERVATIONS WITH THE AID OF ARTIFICIAL SATELLITES
G. G. Getmantsev, et al., Soviet Physics, vol. 66, no. 1, Sept, Oct. 1958, p. 65/67.

DETECTION AND EVALUATION OF SPACE RADIATIONS
D. T. Corkhill, et al., IRE Trans. Mil. Electronics, vol. MIL-3, no. 4, Oct. 1959, p. 160/162.

INHERENT ERRORS IN LOCATING ELECTRICAL STORMS WITH A SURVEILLANCE SATELLITE
R. A. Whiteman, et al., IRE Internat. Conv. Rec., vol. 5, March 1961, p. 157/170.

SCIENTIFIC SATELLITES
S. Bjorge (comp.), ASTIA, Arlington, Va., Report Bibliography, Dec. 1962, 29 p., 120 refs., prepared for the American Astonautical Soc. Scientific Satellite Symp., Dec. 27, 1962, AD 290 800, N63-16247.

OBSERVING THE ATMOSPHERE—A CHALLENGE
V. E. Suomi, Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2192/2197.

Recent developments in aerospace technology make it possible to probe all regions of the atmosphere. Suitable sensors for taking observations in all regions do not yet exist. . . . Evidently more contact between electronic and atmospheric scientists could yield a significant increase in our understanding of the atmosphere.

SOLAR FLARE SATELLITE DESIGN STUDY
L. W. Lewis, et al., Bendix Systems Div., Bendix Corp., Ann Arbor, Mich., RTD TDR63 3010, Dec. 1963, 1 v., AD 427 035.

. . . characteristics required for a satellite to evaluate the solar flare hazard to near-earth manned space missions . . . instrumentation package was selected . . .

BIOS 2 SATELLITE TO ORBIT PRIMATES, PLANTS
B. Miller, Aviation Week and Space Technology, vol. 78, May 20, 1963, p. 79, 83, 87, A63-18367.

. . . experiments tentatively scheduled to be carried out by the NASA Bios 2 satellite series in order to study the effects of weightlessness on a small primate . . .

THE EXPERIMENTAL INVESTIGATION OF SPACE
J. A. Ratcliffe, J. Sci. Instrum., vol. 40, April 1963, p. 158/161, A63-16638.

NASA TO LAUNCH AIR DENSITY EXPLORER
National Aeronautics and Space Administration, Washington, D. C., News Release No. 63-271, 17 Dec. 1963, 12 p., N64-11779.

. . . Plans are underway to launch the inflatable, spherical satellite, Air Density Explorer, by a Scout vehicle, according to an announcement from NASA . . . objectives of the mission . . .

Related Publications:

HIGH-ALTITUDE MEASUREMENTS OF X-RAYS AND FAR ULTRAVIOLET RADIATION
H. Friedman, IRE Trans. Mil. Electronics, vol. MIL-4, no. 1, Jan. 1960, p. 18/25.

. . . Since 1946, the Naval Research Laboratory has conducted basic research in the physics of the upper atmosphere by means of high-altitude rockets. . . .

INSTRUMENTATION FOR A MINERALOGICAL SATELLITE
E. A. Burns, et al., International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 94, 26 p., 20 refs., A63-25261.

Description of a proposed mineralogical satellite . . . It is noted that remote IR spectral measurements made of the lunar surface by such a satellite should provide valuable information for mineralogical mapping and temperature mapping, and may also introduce a method to determine its general particulate structure.

PROPOSED EXPERIMENTAL TEST OF COSMOLOGICAL THEORY BY INFRARED MEASUREMENTS
R. R. Law, Proc. IEEE, vol. 51, no. 9, Sept. 1963, p. 1180/1190.

. . . When the anticipated infrared flux density is related to our present instrumentation capability it appears that important conclusions can be drawn from relatively simple measurements taken with special radiometers carried above the earth's atmosphere by rockets. . . . measurements of the infrared flux coming from selected dark regions of the night sky are reasonably typical of deep space and should tell us whether the universe is in a steady state or whether it has evolved from a much denser configuration.

4B.230: Ionospheric Research Satellites

Included: Satellite ionosounder; Topside sounder; ORBIS experiments; Research with sounding rockets; VLF-receivers in ionospheric research satellites; Application of Langmuir probe; Mars topside ionospheric sounder; Venus topside ionospheric sounder; Results of satellite radio observations; Lunar reflection circuit for ionospheric studies; Ionospheric ducting (satellite observations); Ionospheric beacon satellites.

Not Included: Ionospheric theories; Ionospheric propagation characteristics(1); Sensors for ionospheric research satellites (3A).

Cross References: Project Alouette (4B.825); S-27 satellite (4B.874); S-48 topside sounder satellite (4B.874); S-66 satellite (4B.874); Orbis satellite (4B.866).

Principal Publications:

SATELLITE IONOSOUNDER
S. Horowitz, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 13/20.

A DETAILED DESIGN STUDY FOR A TOPSIDE IONOSPHERIC SOUNDER. VOLUME I
L. C. Humphrey, Advanced Electronics Center, General Electric Co., Ithaca, N.Y., 15 Sept. 1960, AD 246 230.

A DETAILED DESIGN STUDY FOR A TOPSIDE IONOSPHERIC SOUNDER. VOLUME II
L. C. Humphrey, Advanced Electronics Center, General Electric Co., Ithaca, N.Y., 15 Oct. 1960, AD 247 284.

DETERMINATION OF IONOSPHERE PARAMETERS BY MEANS OF A SATELLITE ANTENNA-TYPE PROBE: II. ANALYSIS FOR SPHERICAL GEOMETRY
W. W. Zachary, Electromagnetic Research Corp., College Park, Md., Scientific rept. no. 2; CRC-6656-2, AFCRL-235, 31 Dec. 1960, 39 p., AD 251 231.

The analysis of a spherical antenna-type ionosphere probe is given. The change in input admittance upon immersion of the antenna in a magnetoionic medium is evaluated by expressing the field as the sum of the free-space field and a secondary field.

ROCKET MEASUREMENTS OF THE UPPER IONOSPHERE BY A RADIO PROPAGATION TECHNIQUE
S. J. Bauer, et al., Brit. IRE Canad. Proc., vol. 1, Oct. 1961, p. 22.

Convention Paper during the Brit. IRE Convention, 1961, to be published in full in the Journal.

THE USE OF PROBING ELECTRODES IN THE STUDY OF THE IONOSPHERE
R. L. F. Boyd, J. Brit. Instn. Radio Engrs., vol. 22, no. 5, Nov. 1961, p. 405/408.

DETERMINING LOCAL CONCENTRATIONS OF CHARGED PARTICLES IN THE IONOSPHERE AND INTERPLANETARY SPACE (Methods Used on Soviet Rockets and Earth Satellites and Some Results Obtained)
K. I. Gringauz, J. Brit. Instn. Radio Engrs., vol. 22, no. 5, Nov. 1961, p. 419/424, 18 refs.

. . . measurements using transmission from rockets are discussed with reference to the results obtained by various workers. Charged particle trap experiments carried on satellite and space probes are also described . . .

EFFECTS OF THE EARTH'S IONOSPHERE ON HF RADIO ASTRONOMY FROM ARTIFICIAL SATELLITES
M. D. Grossi, et al., Astrophysical Observatory, Smithsonian Institution, Cambridge, Mass., Rept. 76, Oct. 1961, 16 p., AD 264 900.

. . . HF observations from satellite-borne radio telescopes. A search was conducted for focusing effects of the ionosphere on incoming cosmic noise in the HF band. . . . satellites in various orbital altitudes . . . wide range of observation frequencies. The necessary numerical procedures involved in the ray-tracing in relation to a program suitable for use in an IBM-7090 computer are discussed. Rays were computed and plotted for sources located at infinity and frequencies in the band 1-30 mc.

A TOPSIDE IONOSPHERIC SOUNDER
L. Humphrey, et al., Proc. Nat. Aerospace Electronics Conf., vol. 9, May 1961, p. 358/362.

PROPOSED SATELLITE TECHNIQUES FOR PERFORMING A HIGH RESOLUTION SURVEY OF THE RADIO SKY AT MEDIUM WAVELENGTHS
R. C. Jennison, J. Brit. Instn. Radio Engrs., no. 22, Sept. 1961, p. 205.

The reception pattern of a short dipole above the F layer is considerably modified by refraction in the ionized medium and has the form of a cone with sharply bounded edges modulated by a fine interference pattern. The properties of this reception pattern are discussed and suggestions are made for satellite experiments based on this phenomenon. . . .

THE CANADIAN DEFENCE RESEARCH BOARD TOPSIDE SOUNDER SATELLITE
R. D. Langille, et al., Brit. IRE Canad. Proc., vol. 1, Oct. 1961, p. 5/10.

. . . will be a sweep frequency sounder covering the frequency range 1.8 to 11.5 Mc/s. Its operation will be similar to that of a ground ionospheric station. . . .

AN ECONOMICAL SATELLITE LAUNCHING TECHNIQUE FOR CONDUCTING RADIO RESEARCH IN SPACE
J. D. Nicolaides, Brit. IRE Canad. Proc., vol. 1, Oct. 1961, p. 22.

Convention Paper during the Brit. IRE Convention, 1961, to be published in full in the Journal.

INVESTIGATION OF HIGH FREQUENCY PROPAGATION IN THE IONOSPHERE USING SATELLITE TRANSMISSIONS
W. J. Ross, Ionosphere Research Lab., Pennsylvania State U., University Park, 15 Oct. 1960-15 Jan. 1961, AD 250 897.

. . . status of preparations for the Ionospheric Beacon Satellite is summarized . . . reports are also made of other related projects which are also being conducted using satellite transmissions.

AN UPWARD PULSE DELAY SYSTEM FOR MEASURING ELECTRON DENSITIES OF THE IONOSPHERE
R. E. Watson (comp.), Upper Air Research Labs., U. of Utah, Salt Lake City, Final rept., Scientific rept. no. 5, AFCRL 1022, 1961, 81 p., AD 414 105.

. . . transmission of rf pulses between a rocket, which is passing through the Ionosphere, and the ground. . . . Special emphasis is placed on the design of a ground based low frequency pulsed transmitter. The design of a low frequency rocket-borne receiver also capable of operation from 4 to 12 mc is discussed in detail. The receiver is completely transistorized and incorporates a unique gated AGC system which greatly improves the signal to noise ratio in the receiver output. A ground station for receiving and recording the pulses transmitted from the rocket is also described including the circuit design of the various units.

DETERMINATION OF IONOSPHERE PARAMETERS BY MEANS OF A SATELLITE ANTENNA-TYPE PROBE
W. W. Zachary, et al., Electromagnetic Research Corp., College Park, Md., Rept. no. CRC-6656-4, ARCRL-1096, 30 Nov. 1961, 42 p., 8 refs., AD 270 723.

IONOSPHERIC RADIO; XIIIth GENERAL ASSEMBLY OF URSI, LONDON, 1960
W. J. G. Beynon (editor), New York, American Elsevier Publishing Co., Inc., 1962, 262 p.

. . . Included are short survey papers dealing with . . . rocket and satellite data for the ionosphere . . .

INSTRUMENTATION FOR SATELLITE STUDIES OF THE IONOSPHERE
C. L. Dieter, In: Radio Astronomical and Satellite Studies of the Atmosphere, Advanced Study Institute of Corfu, Conference on Radio Astronomical and Satellite Studies of the Atmosphere, Corfu, Greece, June, 1962, Edited by Jules Aarons, Amsterdam, North-Holland Publishing Co., New York, Interscience Publishers Div., John Wiley and Sons, Inc., 1963, p. 349/384, A63-25995.

Description of various ground radio receiving installations used for recording and analyzing data from satellite radio signals. . . . a simple, continuously recording system which has been in use at Thule, Greenland, since July 1958. Instrumentation for ionospheric studies is also described, including a direct measurement probe designed for use in a satellite.

ROCKET-BORNE IONOSOUNDER EQUIPMENT DEVELOPMENT
L. C. Humphrey, Advanced Electronics Center, General Electric Co., Ithaca, N.Y., Scientific rept. no. 2, AFCRL 62-900, Aug. 1962, 50 p., incl. illus., table, AD 290 726.

. . . consists of a three-frequency top-side ionospheric sounding system capable of measuring natural gradients and man-made perturbations in the top-side of the ionosphere. . . . Equipment that has been fabricated includes a 250-watt transistor high-frequency radar transmitter, receiver, programmer, power inverter, and inflatable plastic HF antenna structures.

FIRST RESULTS IN NASA TOPSIDE SOUNDER SATELLITE PROGRAM
J. E. Jackson, et al., In: Advances in the Astronautical Sciences, vol. XI, American Astronautical Society, Annual Meeting, 8th, Washington, D. C., Jan. 16-18, 1962, Proceedings, Edited by Horace Jacobs, North Hollywood, Calif., Western Periodicals Co., 1963, p. 61/85, A64-11446.

Presentation of the preliminary results of the NASA S-27/S-48 Topside Sounder Satellite Program carried out in order to investigate the ionosphere above the height of maximum ionization, using a two-frequency radio-pulse sounder. Reflections from the topside of the ionosphere were obtained on one or both frequencies during 13 of the 15 minutes that the payload was above the maximum electron-density level in the ionosphere. Unexpected effects were observed as the sounder passed through the levels in the ionosphere where the plasma frequency was equal to the sounding frequency. Some evidence of the presence of ionization irregularities at altitudes between 700 and 950 km was obtained. "Spread F" returns were also obtained in addition to the normal topside echoes.

AN ECONOMICAL SATELLITE LAUNCHING TECHNIQUE FOR CONDUCTING RADIO RESEARCH IN SPACE
J. D. Nicolaides, J. Brit. Instn. Radio Engrs., vol. 23, no. 3, March 1962, p. 205/208.

. . . employs an aircraft and rocket combination to place a 20 lb. satellite into orbit. The paper reviews the progress to date and indicates performance potential. . . .

THE DESIGN AND SUPPORT OF A TOPSIDE SOUNDER
W. B. Offutt, et al., IRE Internat. Conv. Rec., Pt. 5, vol. 10, March 1962, p. 281.

. . . a cooperative program with the Central Radio Propagation Lab. of the Nat'l Bureau of Standards . . . and . . . NASA. Equipment for both the rocket proble phase and the satellite phase of the program is described . . .

INVESTIGATION OF HIGH FREQUENCY PROPAGATION IN THE IONOSPHERE USING SATELLITE TRANSMISSIONS
W. J. Ross, et al., Ionosphere Research Lab., Pennsylvania State U., University Park, Final Rept., 1 July 1959-30 April 1962, 31 May 1962, 55 p., incl. illus., tables, AD 293 430.

CONFERENCE ON SFERICS MEASUREMENTS FROM SATELLITES, WASHINGTON, D.C., APRIL 27, 1962.
S. D. Soules (editor), Weather Bureau, Meteorological Satellite Lab., Washington, D. C., Meteorol. Satellite Lab. Rept. -13, Oct. 1962, 43 p., N63-15516.

THE UTILIZATION OF IONOSPHERE BEACON SATELLITES
G. W. Swenson, Jr., NASA, Goddard Space Flight Center, Greenbelt, Md., In its Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962, May 1963, p. 91/117, 103 refs., N63-17109.

. . . need for world-wide cooperation in beacon-satellite observation. The theories of Faraday rotation and Doppler methods of determining atmospheric electron content are reviewed briefly . . . minimum standards for the production of high-quality data. . . . extensive bibliography . . .

FIRING OF AN ASTROBEE 200 ROCKET WITH A MULTIPLE IONOSPHERIC EXPERIMENT
J. C. Ulwick, et al., Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2272/2286.

MEASUREMENT OF IONOSPHERIC ELECTRON CONTENT WITH A SINGLE SATELLITE FREQUENCY (Correspondence)
P. R. Arendt, Proc. IEEE, vol. 51, no. 2, Feb. 1963, p. 363.

CONVERSION OF TOPSIDE IONOGRAMS TO EXPONENTIAL ELECTRON-DENSITY PROFILES
P. R. Arendt, et al., Army Electronics Research and Development Agency, Fort Monmouth, N.J., AELRDL TR 24 24, Feb. 1964, 21 p., AD 433 210.

Ionograms obtained from the Alouette satellite suggest that above the F2 layer the electron-density profile is an exponential of quasi-exponential function. This concept of electron distribution is used in reducing the ionograms to true-height profiles. . . .

PRELIMINARY RESULTS FROM THE VLF RECEIVER ABOARD CANADA'S ALOUETTE SATELLITE
R. E. Barrington, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TM X-51251; NASA X-615-63-36, 1963, 14 p., N64-11794.

. . . This analysis reveals some very interesting features of whistlers and ionospheric noise as observed in the ionosphere. In addition, some comparisons of simultaneous observations of the VLF band, from the ground and in the satellite are made.

A SMALL MULTI-PURPOSE ROCKET PAYLOAD FOR IONOSPHERIC STUDIES
S. J. Bauer, et al., COSPAR, International Space Science Symposium, 4th, Warsaw, Poland, June 3-11, 1963, Paper X-615-63-95, 34 p., 13 refs., A63-18571.

Description of a payload designed to measure electron density in the altitude region below about 250 km. . . . The electron density is measured by the CW propagation technique by using the dispersive Doppler effect at two harmonically related frequencies (24.5 and 73.6 Mc). . . .

THE USE OF AN HF LUNAR REFLECTION CIRCUIT IN THE STUDY OF IONOSPHERIC ELECTRON DENSITY
J. R. Davis, et al., Naval Research Lab., Washington, D. C., NRL rept. 5968, 19 July 1963, 12 p., AD 414 850.

A high-power hf transmitter was used to illuminate the moon at moonrise. The returned signals which have been observed display both the smooth-sphere scattering components and the rough-scatterer components reported previously by observers utilizing the vhf and uhf bands. . . . The received moon echoes were subjected to a high degree of predetection bandwidth narrowing and were analyzed to yield information regarding the possible extent of polarization-rotation undergone by radio waves traversing the ionosphere.

STUDY OF TOPSIDE SOUNDER FOR MARS AND VENUS IONOSPHERES FROM MARINER SPACECRAFT
T. Flattau, et al., Cutler-Hammer, Deer Park, N.Y., Final Report, Rept. 1844-1, Oct. 1963, 118 p., refs., N64-10903.

. . . This report analyzes the problems and solutions in sounding the topside of the ionospheres of Mars and Venus from a passing spacecraft . . . Transmission of an interrupted CW (50 percent duty cycle) RF pulse train that is small angle modulated by a 150 cps tone is chosen as the optimum modulation . . . 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.

ELECTRON CONTENT VARIATIONS IN THE AURORAL IONOSPHERE DETERMINED FROM SATELLITE RADIO OBSERVATIONS
J. L. Hook, Geophysical Inst., U. of Alaska, College, May 1963, 62 p., AD 413 541.

The relationship between (1) spatial distribution of ionization using 20 and 40 mc/s transmissions from a satellite, (2) the locations and luminosity profiles of auroras as measured from ground stations in Alaska, and (3) the flux and energy spectrum of particles, penetrating to auroral height as measured by satellite instruments is reported. The experiment was carried out in March, 1962 using a polar orbiting satellite which made twelve passes over Alaska during its operational lifetime. . . . Methods of determining the electron content from differential Doppler measurements are discussed in detail. The experimental results show that increases in electron content are morphologically correlated with regions of auroral luminosity and incident particle fluxes. . . .

A STUDY OF IONOSPHERIC IRREGULARITIES USING SATELLITE TRANSMISSIONS AT 54 Mc/s (In Swedish)
L. Liszka, Ark. Geofys., vol. 4, no. Paper 9, 1963, p. 227/246.

A statistical analysis of the diffraction pattern produced by radio waves from artificial satellites is presented. The most important result is the evidence that auroral zone scintillation may be produced at altitudes below F-maximum. Low altitudes, down to 100 km, of the scintillation-producing region occur more frequently during night-time. During the forenoon hours, when some of the measurements were made, the scintillation was produced at or above F-maximum. . . .

INSTRUMENTATION OF THE IONOSPHERIC SOUNDER CONTAINED IN THE SATELLITE 1962 BETA ALPHA (ALOUETTE)
A. R. Molozzi, COSPAR, International Space Sciences Symposium, 4th, Warsaw, Poland, 3-11 June 1963, Paper, 38 p., A63-19746.

Discussed are . . . (1) an antenna system suitable for the employed frequency range of 1.5 - 12 mc, (2) a transmitter to deliver 100-watt peak pulse power throughout the frequency range, (3) a sounder sweep frequency receiver capable of accepting pulse signals with a linear-logarithmic characteristic over a dynamic range of 100 db, and with an AGC range of 40 db, and (4) a wideband (0.5 cps - 10 kc) 2-watt FM telemetry transmitter. A diagram of the spacecraft electronic system is presented.

RADIO PROPAGATION ALONG MAGNETIC FIELD-ALIGNED SHEETS OF IONIZATION OBSERVED BY THE ALOUETTE TOPSIDE SOUNDER
D. B. Muldrew, Defense Research Telecommunications Establishment, Ottawa, Ontario, 7 June 1963, 16 p., AD 437 408.

Some of the traces obtained from the topside sounder ionograms recorded at low latitudes are identified as being caused by propagation along magnetic field-aligned sheets of ionization. . . .

compared with the vertical electron-density distribution obtained from the regular topside F-layer traces. Close agreement . . . indicating . . . that radio waves propagated along the field lines are reflected very near the vertical-incidence reflection level.

ORBIS: AN IONOSPHERIC TRAPPING EXPERIMENT
J. P. Mullen, et al., Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 297/301.

. . . consists of synoptic observations of an orbiting two-frequency beacon. The purpose of the experiment is to investigate ionospheric ducting by ground reception of the signals. Qualitative analysis and ray tracings are used to describe the pertinent mechanism. Toward the end of 1963, the ORBIS experiment will be launched. ORBIS, the mnemonic for Orbiting Radio Beacon Ionospheric Satellite, is the first attempt to perform a synoptic study of near critical frequencies transmitted from within the ionosphere. . . . riding "piggyback" on an established and scheduled experimental vehicle . . . The ORBIS payload consists of two beacons, each of one watt nominal output, transmitting continuously on frequencies of 5.002 and 10.004 respectively. In addition, a few milliwatts will be "leaked" on 15.006 for tracking purposes.

INVESTIGATING IONOSPHERIC DUCTING WITH THE ORBIS BEACON
J. P. Mullen, Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 64 29, Jan. 1964, 19 p., AD 430 420.

An experiment is described which uses a satellite-borne, two-frequency HF beacon to perform a synoptic investigation of ionospheric ducting. The expected ducting modes are described qualitatively and quantitatively using the AFCRL ray tracing computers.

RADIO TELEMETRY FOR UPPER ATMOSPHERE SOUNDING ROCKETS
J. K. Pulfer, Radio and Electrical Engineering Div., National Research Council of Canada, Nov. 1963, 21 p., AD 436 321.

. . . discussed from the experimenter's point of view. . . . results of experimental measurements of errors in the standard FM-FM rocket telemetry system . . . Modifications of theFM-FM system to suit particular user needs, such as high accuracy, wide bandwidth, or the ability to transmit digital data are considered in detail.

ALOUETTE TOPSIDE SOUNDINGS MONITORED AT STANFORD UNIVERSITY
J. O. Thomas, et al., Technical Report No. 6, Dec. 1963, 95 p., refs., N64-19309.

Alouette topside soundings have been used to determine the diurnal, seasonal, and latitudinal variations of electron density at the orbit of the satellite over a wide range of latitudes. The necessary data manipulations and calculations were carried out in a digital computer program that is described briefly. Examples of topside ionograms observed under a wide variety of conditions are presented, and their main features are described.

TRANSMITTING SATELLITE PROPAGATION STUDIES, COMPILATION OF ABSTRACTS
Library of Congress, Washington, D. C. Aerospace Information Div., AID-P-64-5, 23 Jan. 1964, 19 p., refs., AD 430 473, N64-16462.

. . . coherent receiving apparatus for recording Doppler shift differences in radio transmissions from artificial earth satellites, radio investigation of the ionosphere by means of Cosmos satellites . . . A comprehensive chart of Cosmos series flight data is included.

TRANSMITTING SATELLITE PROPAGATION STUDIES, COMPILATION OF ABSTRACTS
Library of Congress, Washington, D. C., AID-P-64-9, 5 Feb. 1964, 11 p., refs., AD 429 775, N64-16461.

. . . investigation of charged particles in the ionosphere by the Cosmos-3 and Cosmos-5 satellites . . . description of the particle-sensing apparatus carried onboard; (2) evidence of the existence of currents of electrons and positive ions in the upper ionosphere, having energies that are relatively low but greater than the thermal energy; (3) . . . high-energy particles registered by Geiger counters . . . calculations made on variations in electron density in the upper atmosphere based on the Doppler shift behavior of two simultaneous signals transmitted from the Cosmos-1 and Cosmos-2 satellites . . . equipment carried on Cosmos-2 and Cosmos-7 satellites to measure radiation along the routes of the proposed Vostok-3 and Vostok-4 flights.

NASA TO LAUNCH POLAR IONOSPHERE BEACON SATELLITE (S-66)
NASA, Washington, D. C., 4 Aug. 1963, 31 p., N63-19158.

Related Publications:

INSTRUMENTATION USED FOR IONOSPHERE ELECTRON DENSITY MEASUREMENTS
W. J. Cruickshank, Conf. Proc. Nat. Conf. Mil. Electronics, vol. 4, June 1960, p. 497/502.

ROCKET MEASUREMENTS OF THE UPPER IONOSPHERE BY A RADIO PROPAGATION TECHNIQUE
S. J. Bauer, et al., J. Brit. Instn. Radio Engrs., vol. 23, no. 2, Feb. 1962, p. 139/143.

IONOSPHERE DYNAMICS
G. H. Munro, et al., Proc. IEEE, vol. 51, no. 11, Nov. 1963, p. 1475/1481.

. . . In recent years, the attention of research workers has turned more and more to the study of irregularities and movements in ionization. Irregularities examined range in size from the order of hundreds of kilometers to tens of meters and apparent speeds of movements also show a wide variation. . . .

4B.240: Orbiting Observatories

Included: Orbiting X-ray observatory (OXO); Ultra violet satellite; IQSY experiments; Space astronomy satellite; Topside optical station for atmospheric research; Russian orbiting scientific stations; Stratoscope experiments; Balloon borne astronomical telescopes; Celestial laboratories; Space laboratories; Radio astronomy satellite.

Not Included: Radio astronomy; Sensors for orbiting observatories (3A).

Cross References: Orbiting Astronomical Observatory (4B.862); Orbiting Geophysical Observatory (4B.864); Orbiting Solar Observatory (4B.868); Weather satellites (4B.320); Elektron satellites (4B.842).

Principal Publications:

THE STRATOSCOPE I TELEVISION SYSTEM
L. E. Flory, et al., RCA Rev., vol. 21, no. 2, June 1960, p. 151/169.

. . . a balloon-borne astronomical telescope designed for solar photography. When aloft, the telescope is remotely operated by radio command signals transmitted from a control station on the ground. . . . A special television system has been developed to assist in aiming and focusing Stratoscope I. . . .

SPACE ASTRONOMY
F. T. Haddock, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 851.

Various space astronomy programs, both optical and radio, and their associated space crafts will be described.

THE OAO. A SPACE LABORATORY
D. J. Shergalis, ISA Proceedings, vol. 8, 1962, p. 85/96, A63-12218.

Discussion of the requirements for a space-stabilized platform, the Orbiting Astronomical Observatory, which is intended to overcome the limitations of the atmosphere on astronomical observations. The following requirements are considered: (1) capability of pointing to within ± 1' of arc and holding to ± 15" of arc; (2) provision for fine pointing to within 0.1" of arc; and (3) ability to establish the vehicle attitude, the slew to any other desired attitude, and point with the same precision. The achievement of coarse pointing is shown to be a systems engineering problem which affects structure, thermal control, and stabilization. The effect of each subsystem design on the overall control error is described. A description of a friction-free, air-bearing table designed to demonstrate the operation of the spacecraft in simulated space conditions is included.

OBSERVATORIES IN SPACE
A. L. Berman, Sci. Amer., vol. 209, Aug. 1963, p. 29/37, A63-20243.

CELESTIAL LABORATORIES
R. L. F. Boyd, Nature, vol. 198, April 6, 1963, p. 4/10, A63-15505.

Survey of the extent and variety of space research performed in space vehicles. The history of the rocket is briefly outlined, and the advent of the celestial laboratory is discussed. The information obtained from these laboratories, such as high-atmosphere, cloud, solar, and lunar data, is considered. The techniques for gathering information employed in several space probes and satellites, including TV, telemetric, and photographic, are described. The vehicles which have yielded fruitful information are briefly considered, including the Explorer I (1958 Alpha) from whose findings Van Allen discovered the radiation belt. The experiments conducted with the satellite Ariel (1962 Omicron 1) are briefly considered.

A SUGGESTED DESIGN FOR A SATELLITE FOR STELLAR ULTRA-VIOLET SPECTROMETRY
A. G. Earl, et al., Royal Aircraft Establishment, Farnborough (Gt. Brit.), London, Min. of Aviation RAE-R-SPACE-1, March 1963, 65 p., 34 refs., N63-20838, AD 412 364.

TOPSIDE OPTICAL STATION FOR STUDYING THE ATMOSPHERE (Translation)
A. M. Kasatkin, Planetary and Space Science, vol. 11, Oct. 1963, p. 1235/1249, A64-10018.

OBSERVATION SATELLITES: PROBLEMS AND PROSPECTS, PARTS 1, 2, 3, 4, 5, 6
A. H. Katz, The RAND Corporation, Paper P-1707, 1960, Astronautics, April 1960, p. 26/29, 74, 76, 78, 80; June 1960, p. 26/29, 52/54, July 1960, p. 28/29, 80, 82, 84, 85; August 1960, p. 30,31,59,60,62,64; Sept. 1960, p. 32, 33, 40, 42, 44, 46; Oct. 1960, p. 36, 37, 66, 68, 70, 71.

IQSY - ATTACK ON THE SUN
M. A. Pomerantz, Astronautics and Aeronautics, vol. 2, Jan. 1964, p. 60/65, 11 refs., A64-12081.

. . . objectives of International Quiet Sun Year (IQSY) investigations . . . Projected NASA spacecraft contributing to the IQSY are tabulated.

S-17 OSO COMMUNICATIONS SYSTEM
P. F. Scheele, et al., Proc. Nat. Telem. Conf., no. 6-1, May 1963.

. . . communications and data handling system designed for the Orbiting Solar Observatory spacecraft. . . . the first OSO (S-16) . . . utilized an FM/FM telemeter. . . . design . . . of the second OSO or S-17 program . . . indicated that some type of time multiplexing telemeter would yield a much more efficient method for ground and airborne handling of both experiment and spacecraft housekeeping data than that provided by an FM/FM telemeter. . . .

THE "ELEKTRON" SPACE SYSTEM
S. N. Vernov, et al., Joint Publications Research Service, Washington, D. C., JPRS-23810; OTS-64-21864, 23 March 1964, 23 p., Trans. into English from Pravda (Moscow), 15 March 1964, 3 p., N64-17554.

The scientific stations, Elektron-1 and Elektron-2 were launched into circumterrestrial space for the simultaneous study of the earth's radiation belts . . .

Related Publications:

SPACE TELESCOPES AND COMPONENTS
L. Spitzer, Jr., Princeton U. Observatory, N. J., Scientific rept. 2, 24 March 1960, 22 p., Astron. J., vol. 65, p. 242/263, June 1960, AD 250 979.

A brief analysis is given of some of the major problems involved in the design of a large satellite telescope for stellar observations. A 1000-kg structure is assumed, 2 m on a side, in orbit at an altitude of either 800 km or 36000 km, with orbital periods of 101 min and 24 hr, respectively . . . A mean life of about a year is computed before accumulating failures render the instrument unusable . . . considerable redundance of separate systems.

SOME RADIO ASTRONOMY TECHNIQUES
R. C. Jennison, J. Brit. Instn. Radio Engrs., vol. 23, no. 2, Feb. 1962, p. 121/127, 22 refs.

. . . Radio telescopes and interferometry are described. Cosmic radio sources are discussed and some suggestions made regarding their nature. Radar echoes from the Moon and planets are mentioned and the paper concludes by discussing radio astronomical techniques in space vehicles. . . .

THE TV TELESCOPE
W. H. Manning, Jr., Astronautic and Aerospace Engineering, vol. 1, July 1963, p. 36/40, A63-18582.

. . . characteristics of the image orthicon . . . found to have approximately 1,000 times the sensitivity of high-speed film with an equivalent resolution of 20 line-pair/mm for a 1,000-line system and 50 line-pair/mm for a 2,500-line system, corresponding to film ASA with ratings of 800 to 200. Image information that requires greater resolution can thus be recorded by increasing the focal length, producing a larger but less bright image. . . .

ISPOL'ZOVANIE ORIENTIROVANNOGO NA ZEMLIU SPUTNIKA DLIA ISSLEDOVANII SVIAZANNYKH S SOLNTSEM (Application of an Earth-Oriented Satellite to Solar Investigations) (In Russian)
D. E. Okhotsimskii, et al., Iskusstvennye Sputniki Zemli, no. 16, 1963, p. 94/123, A63-18472.

. . . problem of exposing to the Sun the instruments of a satellite, one axis of which is oriented with respect to the Earth and the other is oriented normal to the orbital plane. . . . calculation of the exposure time at a constant orientation of the orbit with respect to the Sun . . . It is shown that an instrument with a small sighting angle can be made to face the Sun for a sufficient time to conduct a number of scientific experiments.

DIVISION 4B.3
UTILITY SATELLITES

4B.320: Weather Satellites

Included: Instrumentation of weather satellites; Synchronous meteorological satellites; Thermal radiation budget staellite; APT (automatic picture taking) system; DREWS-direct readout equatorial weather satellite system; Data- and picture-reduction for weather satellite systems.

Not Included: Meteorlogical subjects; Sensors for weather satellites (3A).

Cross References: Project TIROS (4B.884); Project Nimbus (4B.856).

Principal Publications:

AN EARTH SATELLITE INSTRUMENTATION FOR CLOUD MEASUREMENTS
R. A. Hanel, et al., IRE Nat. Conv. Rec., no. 5, 1968, p. 136.

METEOROLOGICAL MEASUREMENTS FROM EARTH SATELLITE
W. G. Stroud, et al., Annals of the IGY, vol. 6, no. 2, 1958, p. 340/345.

TRACKING EARTH'S WEATHER WITH CLOUD-COVER SATELLITES
R. Hanel, et al., Electronics, vol. 32, May 1959, p. 44/50.

A PROPOSED WEATHER RADAR AND BEACON SYSTEM FOR USE WITH METEOROLOGICAL EARTH SATELLITES
C. P. Mook, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 206/209.

INSTRUMENTATION FOR A THERMAL RADIATION BUDGET SATELLITE
R. J. Parent, et al., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 824/839.

. . . two types of electronic equipment packages . . . for IGY Earth Satellite experiments. Both incorporate instrumentation and telemetry for an important meteorological experiment which is designed to measure total radiant heat flow to and from the earth. . . .

TIROS METEOROLOGY
A. H. Glaser, Allied Research Associates, Inc., Boston, Mass., Final rept., AFRCL-613, 31 March 1961, p. 109, AD 257 965.

. . . meteorological observational series . . . techniques of TIROS data reduction . . . use of satellite meteorological information.

METEOROLOGICAL SATELLITE SYSTEMS IN WEATHER RESEARCH AND SERVICES
F. W. Reichelderfer, Aerospace Engng., vol. 20, no. 3, March 1961, p. 22/23, 91/97.

. . . Tiros cloud photographs fill in many serious gaps in our observation and measurement of the atmosphere . . .

APPLYING SPACE SCIENCE TO COMMUNICATIONS, WEATHER, AND NAVIGATION — 7. WORLD WEATHER BY SATELLITES
H. Wexler, Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 154/159.

NASA SPACE FLIGHT PROBLEMS — 3. WEATHER AND COMUNICATION SATELLITES
D. D. Wyatt, Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 21/30.

WEATHER DATA PROCESSING, TECHNIQUES DEVELOPMENT PROGRAM
Travelers Research Center, Inc., Hartford, Conn., Status Report, 30 Sept. 1961, 1 v., AD 413 115.

. . . Research, development and testing of an automatic weather data processing subsystem . . . The plan is to develop and test integrated automatic data processing technique packages which are designed to serve specific requirements of the Common Aviation Weather System. . . .

METEOROLOGICAL APPLICATIONS OF NIMBUS DATA
E. G. Albert, In NASA, Goddard Space Flight Center, Greenbelt, Md., Proc. of the Nimbus Program Review (1962), 29 p., 11 refs., See N63-18601 17-32, Paper 3, N63-18604.

. . . Complete surveillance of the entire globe on a daily basis is contemplated with Nimbus. . . . (1) gridded analog pictures (2) digital computer summarys, in a format suitable for use by computational facilities; and (3) a computer prepared mapscale recitification which will be professionally interpreted and annotated . . .

METEOROLOGICAL SATELLITE SYSTEM ANALYSES
T. S. Huang, et al., Allied Research Associates, Inc., Concord, Mass., AFCRL-63-804, 30 June 1962, 155 p., 59 refs., N63-19138, AD 411 398.

. . . three articles relating to the design and use of a weather satellite system. "Some Information-Theoretic Considerations and Measurements Concerning the Efficient Processing of Satellite Cloud Pictures" addresses itself to the problem of efficiently reducing the information-bit content of weather-satellite pictures to an amount that can be economically transmitted to operational users and there assimilated.

WEATHER SATELLITES
D. S. Johnson, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 851.

. . . The successful series of TIROS meteorological satellites has provided data of considerable use in operational weather analysis and forecasting as well as in research. . . . Abstract only.

TECHNIQUES FOR MEASUREING REMOTE METEOROLOGICAL PARAMETERS
E. W. McLaughlin, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 75/77.

EVALUATION OF TIROS INFRARED DATA
C. Prabhakara, et al., National Aeronautics and Space Administration, Goddard Inst. for Space Studies, New York, New York, NASA RP-80 (1962), 14 p., refs., N64-10620.

. . . Based on the most recent and reliable data of the vertical distribution of water vapor, carbon dioxide, and ozone, atmospheric models for different latitudes and seasons have been derived . . .

PROCEEDINGS OF THE NIMBUS PROGRAM REVIEW (HELD AT VALLEY FORGE, PA.) NOVEMBER 14-16, 1962
H Press, et al., National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md., NASA TM X 50151; NASA X 650 62 226, 405 p., 11 refs., N63-18601.

INVESTIGATION OF THE OPERATIONAL USE OF CLOUD PHOTOGRAPHS FROM WEATHER SATELLITES IN THE NORTH PACIFIC
S. M. Serebreny, et al., Stanford Research Inst., Menlo Park, Calif., Final Rept., Nov. 1962, 93 p., AD 413 944.

The operational use of satellite cloud photographs is investigated through a series of TIROS I photographs taken on 21 orbits in the North Pacific. . . .

NIMBUS SPACECRAFT SYSTEM CONCEPT
R. Stampfl, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Proc. of the Nimbus Program Review (1962) 17 p., See N63-18601 17-32, Paper 4, N63-18605.

OBSERVING THE ATMOSPHERE -- A CHALLENGE
V. E. Suomi, Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2192/2197.

Recent developments in aerospace technology make it possible to probe all regions of the atmosphere. Suitable sensors for taking observations in all regions do not yet exist. . . . Evidently more contact between electronic and atmospheric scientists could yield a significant increase in our understanding of the atmosphere.

CLOUD INTERPRETATION FROM SATELLITE ALTITUDES
J. H. Conover, Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 62 680 SUPPL 1; Research note 81, suppl. 1, May 1963, 19 p., AD 411 212.

The guide to cloud interpretation from wide-angle pictures has been improved . . . The cloud categories are newly illustrated by 44 satellite pictures of present day quality.

DIRECT READOUT WEATHER SATELLITES
L. W. Cowan, Astronautics and Aerospace Engineering, vol. 1, April 1963, p. 61/66, A63-15194.

Proposal to increase the capability of predicting local weather conditions by a Direct Readout Equatorial Weather Satellite System (DREWS). Meteorological data would be transmitted from a satellite with an Automatic Picture Transmission (APT) system to local users. The anticipated procedure is described as being economical in terms of the ground equipment necessary. The implementation of such a system would supply both high- and low-resolution meteorological photographs, for local and long-range forecasting.

TERRESTRIAL FEATURES OF THE UNITED STATES AS VIEWED BY TIROS
J. F. Cronin, Allied Research Associates, Inc., Concord, Mass., ARA T 9219 4; Scientific rept., AFCRL Rept. no. 63 664, 1 July 1963, 35 p., AD 413 082.

The photography of the TIROS meteorological satellite series is providing the first continuous view, from outside the atmosphere, of the earth's surface and its cloud masses. To assist in the problems of identification, due to the similiarity of many clouds to certain terrestial features, a map has been compiled portraying the United States as its surface features appear in TIROS photography. . . .

APT USERS' GUIDE
L. Goldshlak, Allied Research Associates, Inc., Concord, Mass., Scientific Report No. 1, ARA-T-9219-1; AFCRL-63-655, June 1963, 51 p., N63-17984.

. ... An automatic picture-taking (APT) subsystem will permit local picture readout at those sites which have appropriate terminal equipment. This guide is intended to serve as an introduction to data-handling procedures at APT acquisition sites. . . .

APPLICATIONS SATELLITES-COMMUNICATIONS AND WEATHER
L. Jaffee, National Aeronautics and Space Administration, Washington, D. C., In its Proc. of the Conf. on Space-Age Planning, Chicago, May 6/9, 1963, p. 81/93, N63-21135.

. . . Communication satellites, meteorological satellites, and future applications satellites are reviewed . . . Echo I . . . Relay and Telstar . . . Syncom I . . . Tiros . . . Nimbus . . . Transit . . .

TOWARDS THE SYNCHRONOUS METEOROLOGICAL SATELLITE
W. W. Jones, Astronautics and Aerospace Engineering, vol. 1, April 1963, p. 59/60, A63-15193.

THE APPLICATION OF PASSIVE MICROWAVE TECHNOLOGY TO SATELLITE METEOROLOGY: A SYMPOSIUM
Y. H. Katz (editor), RAND Corp., Santa Monica, Calif., RM-3401-NASA, Aug. 1963, 265 p., refs,, Proc. of a Symp. held at Santa Monica, 30 July - 1 Aug. 1962, N64-10911.

BIBLIOGRAPHY ON METEOROLOGICAL SATELLITES (1952 - 1962)
E. Kiss (comp.), American Meteorological Society, Boston, Mass., Meteorological and Geoastrophysical Abstracts, Washington, Weather Bureau, April 1963, 400 p., refs., N64-14260.

. . . subjects: (1) general works-books, reports, bibliographies, etc.; (2) instrument carriers . . . (3) instruments; (4) observational methods and techniques; (5) parameters . . . (6) weather observations . . . (7) weather forecasting; and (8) programs and projects.

METODY METEOROLOGICHESKIKH ISSLEDOVANII S POMOSHCHIYU SPUTNIKOV (Methods of Meteorological Investigation by Means of Satellites)
K. Ya. Kondratiev, Royal Aircraft Establishment, Fanborough (Gt. Brit.) London, Ministry of Aviation, RAE-TRANS-1027, Feb. 1963, 20 p., 39 refs., Chap. 3 of the book "Meteorologicheskie Issledovaniya s Pomoshchiyu Raket I Sputnikov", Leningrad, GIMIZ, 1962, Translated into English, N63-16024.

. . . reviews the methods for determining upper atmosphere density from the changes in satellite orbits and from instruments carried on satellites, and discusses some of the results obtained by investigations in Russia and elsewhere.

METEOROLOGICAL SATELLITES, A DDC REPORT BIBLIOGRAPHY
L. S. Korytoko (comp.), Defense Documentation Center, Alexandria, Va., Bibliography for Jan. 1953 - Oct. 1963, Oct. 1963, 1 v., AD 421 910.

WEATHER SATELLITE DATA PROCESSING
W. A. Marggraf, General Dynamics Astronautics, San Diego, Calif., Final rept., Aug. 1961 - Jan. 1964, Rept. no. A DBB 64 002, AFCRL 64 62, Jan. 1964, 107 p., AD 433 731.

. . . Three working areas are documented: 1) automatic mosaicing of rectified TIROS video data, 2) infrared visual correlation of TIROS radiometer data, and 3) analysis of cloud distribution from TIROS rectified mosaics. . . .

FLEET APPLICATIONS — METEOROLOGICAL OPERATIONAL SATELLITES (ANTARCTIC AREA)
E. S. Merritt, Allied Research Associates, Inc., Concord, Mass., Final rept., ARA F9228 2, 15 Aug. 1963, 66 p., AD 415 962.

Studies of meteorological satellite observations in the southern hemisphere, for the period July 1 - Oct. 31, 1962, have led to the development of techniques for extracting operationally useful meteorological information from satellite observed cloud patterns. . . specifically developed . . . for support of the Antarctic resupply . . . operations . . .

FLEET APPLICATIONS METEOROLOGICAL SATELLITES (TROPICS-EASTERLY WAVES)
E. S. Merritt, Aracon Geophysics Co., Div., of Allied Research Assiciates, Inc., Concord, Mass., Final rept., Rept. no. ARA F9252 2, Dec. 1963, 45 p., AD 426 875.

. . . Analyses of tropical perturbations in the Atlantic Region (commonly refered to as easterly waves), utilizing observations from meteorological satellites . . .

DATA COLLECTION BY SATELLITES
A. B. Moody, et al., Astronautics and Aerospace Engineering, vol. 1, April 1963, p. 57/58, A63-15192.

. . . The proposal outlines the establishment of fixed-positioned, land- and sea-based automatic weather stations, and constant level balloons which would relay data by a satellite system for analysis at a meteorological processing center.

NIMBUS: WEATHER EYE OF THE WORLD
E. Murch, Challenge, vol. 2, Spring 1963, p. 6/11, A63-14858.

Description of the design characteristics, principles of operation, and advanced equipment of the NIMBUS meteorological satellite. In addition, the various weather missions to be carried out by this satellite system are outlined. Drawings of NIMBUS and of its control system are included.

DATA STORAGE FOR METEOROLOGICAL SATELLITES
M. I. Schneebaum, et al., Astronautics and Aerospace Engineering, vol. 1, April 1963, p. 48/51, A63-15190.

. . . in the field of electronic and magnetic data storage of video information in meteorological satellites. The storage vidicon, which is the heart of the Automatic Picture Transmission System (APTS) to be used on Nimbus, and the dielectric type camera, also being developed for Nimbus, are detailed and analyzed. . . .

NON-METEOROLOGICAL OBSERVATIONS FROM WEATHER SATELLITES
S. F. Singer, et al., Astronautics and Aerospace Engineering, vol. 1, April 1963, p. 89/92, A63-15193.

Description of possible applications of the weather satellites to uses other than strict meteorological observations. Such applications include conducting ice surveillance, observing the extent of snow-covered ground, estimating snow melting rates, detecting forest fires, and tracing locust migrations. Previous data obtained from meteorological satellite are shown to have been of value in each of these areas, and the applicability of the information is demonstrated.

TIROS METEOROLOGICAL SATELLITE. A DDC REPORT BIBLIOGRAPHY
E. E. Thompson (comp.), Defense Documentation Center, Alexandria, Va., Bibliography for Jan. 1960 - Nov. 1963, Nov. 1963, 1 v., 49 refs., AD 422 848.

. . . 49 documents cataloged by DDC from Jan. 1960 to the present. . . .

PHYSICAL MEASUREMENTS FROM METEOROLOGICAL SATELLITES
D. Q. Wark, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA RP-29, April 1963, p. 85/88, 20 refs., N63-21368.

. . . (1) an infrared grating spectrometer with multiple detectors for deducing atmospheric temperature; (2) a comparison of theoretical concepts and experiments for the detection of infrared rays and microwaves, (3) instrumentation for deducing ozone distribution; (4) methods for determining cloud-top heights; (5) a blackbody method for determining the solar constant; (6) the measurements of "Sferics" - RF emissions by lightning (from "atmospherics").

ANALYSES IN THE FIELD OF SATELLITE METEOROLOGY. PART I. SUMMARY
W.K. Widger, Aracon Geophysics Co., Concord, Mass., Final rept., AFCRL 63 843, 31 July 1963, 10 p., AD 422 285.

. . . Development of Modified Fujita Technique for TIROS Picture Location; Investigation of the Characteristics of the Nimbus Automatic Picture Transmission (APT) System and Preliminary Development of Data Location Techniques . . .

REDUCTION AND USE OF DATA OBTAINED BY TIROS METEOROLOGICAL SATELLITES
National Weather Satellite Center, Washington, D. C., Geneva, World Meteorol. Organ., Tech. Note 49; WMO-131-TP-58, Available from WMO Secretariat, Geneva 6 Sw. Fr., N64-11646.

SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY. VOLUME I: SUMMARY AND CONCLUSIONS
Republic Aviation Corp., Famingdale, N. Y., Final Report, Feb. - May 1963, RAC-1333, Vol. 1, SSD-1027, Vol. 1, 17 June 1963, 70 p., refs., N64-17695.

. . . general objectives . . . results of research in the following areas . . . (1) system studies; (2) subsystem studies . . . meteorological communications, operating communications, attitude control and station keeping . . . thermal control, and ground station equipment . . .

SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY, VOLUME 2: CONFIGURATIONS AND SYSTEMS
Republic Aviation Corp., Farmingdale, N. Y., Final Report, Feb. - May 1963, RAC-1333, Vol. 2; SSD-1027, Vol. 2, 17 June 1963, 180 p., refs., N64-17696.

SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY, VOLUME 3: METEOROLOGICAL SENSORS
Republic Aviation Corp., Farmingdale, N.Y., Final Report, RAC-1333; SSD-1027, 17 June 1963, 187 p., refs., N64-17697.

The meteorological-sensor study in this volume sets forth the essential considerations and requirements for the cloud-cover and heat-budget sensory systems for the synchronous meteorological satellite . . . Comparative data are presented on various photosurfaces, photoemissive tubes, and photoconductive tubes, as well as hybrid and special types of tubes. Included among the topics discussed are heat-budget measurement and infrared cloud-cover sensors.

SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY, VOLUME 6: SYSTEM SYNTHESIS AND EVALUATION
Republic Aviation Corp., Farmingdale, N.Y., RAC-1333; SSD-1027, 17 June 1963, 100 p., N64-17700.

Among the topics . . . (3) nonsensitive subsystems and components-sensor data transmitter, command link, telemetry link, tracking aids, communications relay link, and data - handling subsystem; (4) sensitive subsystems and components-meteorological sensors, stabilization and station-keeping subsystem, power subsystem, and structure; and (5) design procedures . . .

Related Publications:

COMMERCIAL AIRBORNE WEATHER RADAR
A. W. Vose, et al., RCA Rev., vol. 19, no. 2, June 1958, p. 187/207.

. . . factors relating to the detection and penetration of atmospheric precipitation at microwave lengths. Technical design features of both 5.6-centimeter weather penetration and 3.2-centermeter weather avoidance radars used in present-day commercial aircraft are discussed. . . .

COMPATIBILITY EVALUATION OF DATA HANDLING SUBSYSTEM
H. R. Howe, et al., Air Force Cambridge Research Labs., Bedford, Mass., Research note, Rept. no. AFCRL-62-1108, Dec. 1962, 51 p., incl. illus., tables, 5 refs., AD 401 104.

. . . integrated high-speed data-handling subsystem designed to accomodate weather information. . . . utilizes standard telephone data circuits at speeds of 1000 through 2400 bits/second.

SATELLITE-TRACKING HORIZONTAL SOUNDING SYSTEM
H. J. Mastenbrook, Naval Research Lab., Washington, D.C., NRL MR 1277, Feb. 1962, 22 p., AD 429 280.

The Transosonde and the Meteorological Satellite might be combined to form a single system which would incorporate the merits of each, without their respective shortcomings . . .the meteorological satellite would be used to position a global distribution of constant level balloons within the atmosphere to sense the atmospheric motion on a global scale. . . .

OFFICE OF APPLICATIONS
M. J. Stoller, National Aeronautics and Space Administration, Washington, D.C., NASA TM X-51277, June 1962, 79 p., Presented at the Natl. Acad. Sci. Space Sci. Summer Study, Iowa State U., Iowa City, June 1962, N64-11795.

. . . meteorological systems . . .

A CASE STUDY IN THE ECONOMICS OF INFORMATION AND COORDINATION THE WEATHER FORECASTING SYSTEM
R. R. Nelson, et al., RAND Corp., Santa Monica, Calif., Rept. no. P2788, Sept. 1963, 34 p., AD 417 335.

4B.330: Navigation Satellites

Included: SPACESCAN; Doppler navigation with satellites; Aircraft navigation by satellites; Satellite geodesy program; Optical satellite beacons; Optical geodetic stations for navigation satellites; Geodetic satellites; Surveying from space.

Not Included: Lunar mapping satellite (4C).

Cross References: Project TRANSIT (4B.886); Project ANNA (4B.830).

Principal Publications:

DETERMINATION OF NAVIGATIONAL ACCURACY BY AIRCRAFT TRACKING
L. E. Wallingford, Proc. Nat. Aeron. Electronics Conf., vol. 7, May 1959, p. 240/245.

A STUDY OF NATURAL ELECTROMAGNETIC PHENOMENA FOR SPACE NAVIGATION
R. G. Franklin, et al., Proc. IRE, vol. 48, no. 4, April 1960, p. 532/541.

A SATELLITE DOPPLER NAVIGATION SYSTEM
W. H. Guier, Proc. IRE, vol. 48, no. 4, April 1960, p. 507/516.

MECHANIZING A SPACE NAVIGATION SYSTEM
H. B. Haake, et al., IRE Nat. Symp. Space, no. 5-1, Sept. 1960, p. 1/22.

. . . using a positional perturbation guidance equation to compute velocity corrections . . .

NAVIGATION USING SIGNALS FROM HIGH ALTITUDE SATELLITES
A. B. Moody, Proc. IRE, vol. 48, no. 4, April 1960, p. 500/506.

HIGH ALTITUDE NAVIGATION SATELLITES
A. B. Moody, IRE Nat. Symp. Space Electronics Telem., no. 7-2, Sept. 1960, p. 1/3.

EVOLUTION AND TESTING OF A NAVIGATIONAL SATELLITE
M. A. Schreiber, et al., Applied Physics Lab., John Hopkins U., Silver Spring, Md., Rept. no. CM-972, May 1960, 49 p., incl. illus., tables, AD 239 699.

. . . evolution of design and testing of the first two Transit satellites is developed. . . . are intended for use in measuring the precision

of doppler tracking which, in turn, will be employed for navigational test and geodetic determinations. Valuable data. . .satisfactory operation of the electronics during the brief flight of Transit 1A. . . .

SURVEYING AND MAPPING FROM SPACE
C. S. Spooner, Jr., IRE Trans. Mil. Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 256/258.

APPLICATION OF A SATELLITE SYSTEM TO MARINE AND AIR NAVIGATION
C. C. Wan, IRE Nat. Symp. Space Electronic Telem., no. 7-4, Sept. 1960, p. 1/32.

A DOPPLER NAVIGATION SYSTEM USING EARTH SATELLITES
W. Williams, Jr., IRE Nat. Symp. Space Electronics Telem., no. 7-3, Sept. 1960, p. 1/6.

APPLY SPACE SCIENCE TO COMMUNICATIONS, WEATHER, AND NAVIGATION —8. NAVIGATION BY SATELLITES
H. Busignies, Proc. Nat. Conf. Peaceful Uses Space., vol. 1, May 1961, p. 160/163.

A POSITION DIFFERENCE SYSTEM USING SATELLITE DOPPLER SIGNALS
L. Farkas, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 455/461.

. . . extends the utilization of the TRANSIT Satellite Navigation System to the case where it is desired to determine the relative position between a known location and an unknown location. . . . The most significant advantage . . . is that biases caused by inaccurate knowledge of the satellite position are nearly eliminated for nearby stations. . . .

A HYPERBOLIC DOPPLER NAVIGATION SYSTEM USING A SATELLITE AS REFERENCE
I. Kanter, East Coast Conf. Aerospace Navig. Electronics, vol. 8, no. 1.2.5, Oct. 1961, p. 1/4.

DIE ELEKTRISCHEN EINRICHTUNGEN VON NAVIGATIONSSATELLITEN UND DER ZUGEHORIGEN EMPFANGSSTATIONEN (The Electric Installations of Navigational Satellites and Their Ground Stations) (In German)
H. L. Rath, Elektronische Rundschau, vol. 15, no. 10, Oct. 1961, p. 461/466.

FURTHER DEVELOPMENTS ON THE REQUIRED NUMBER OF RANDOMLY SPACED COMMUNICATION AND NAVIGATION SATELLITES
F. V. Bennett, National Aeronautics and Space Administration, Washington, D.C., NASA Technical note D-1020, Feb. 1962, 93 p., AD 271 898.

. . . continuation of the research . . . presented in NASA Technical Note D-619 (AD 249 293) . . . limited to near-earth satellites deployed singly in randomly spaced circular orbits. . . . For a worldwide navigation satellite system (or communication system based on circular regions of mutual communication) it was found that, for the range of circle diameters considered, the optimum orbit inclination angle lies between 53 and 64 degrees.

NAVIGATION SATELLITES WITH PARTICULAR REFERENCE TO RADIO OBSERVATIONS
W. A. Johnson, J. Brit. Instn. Radio Engrs., vol. 23, May 1962, p. 393/397.

. . . in which the Royal Aircraft Establishment has participated.

USE OF ARTIFICIAL EARTH SATELLITES FOR TERRESTRIAL NAVIGATION
A. B. Moody, National Aeronautics and Space Administration, Washington, D. C., NASA-TM-X-51206, 8 Oct. 1962, 16 p., Presented at the Space Seminar, Michigan State U., 8 Oct. 1962, N64-11110.

Desirable characteristics of a navigation satellite system are listed. The following techniques, with their advantages and disadvantages are considered: elevation angle, horizontal angle, range, range rate, and orbits. The only navigation satellite system under active development, TRANSIT, utilizes Doppler range rate technique.

NAVIGATION SATELLITE PROGRESS
A. B. Moody, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 850.

Some 20 techniques have been suggested for use of artificial earth satellites for navigation of ships and aircraft. A study of these indicates that range , range rate and angle measurements are most promising for general navigation. The range rate method, using the Doppler shift of signals from a stable oscillator in the satellite, is used in the TRANSIT system under development by the Navy. . . . Abstract only.

SPACE NAVIGATION
A. B. Moody, Proc. IRE, vol. 50, May 1962, p. 672/678.

TRENDS IN SPACE NAVIGATION
K. N. Satyendra, Proc. IRE, vol. 50, May 1962, p. 1362/1373.

. . . growing use of self-contained navigational systems in space navigation. A figure of merit, called the self-containment index (SCD), is defined in order to define quantitatively the degree of autonomy for which a system design is directed . . . Open-loop and closed-loop m methods of earth satellite navigation are presented and extended to the lunar navigation

problem . . . Some advanced navigational concepts are given using non- rotating and track-while-scan instruments. . . .

SPACESCAN—A RADIO BROADCAST SYSTEM OF SPACE NAVIGATION
A. Tatz, IRE Internat. Conv. Rec., Pt. 5, vol. 10, March 1962, p. 272/280.

. . . navigation guidance with total-volume coverage for on-board space-position measurements of geographical position, velocity and path angle for orbit, re-entry, and recovery of manned vehicles. . . . provides a system of radio navigation aids that broadcast position signals useful in forming a space-position, three-dimensional grid with total-volume radio coverage. . . .

DETERMINATION OF TRACKING STATION LOCATIONS BY DOPPLER AND RANGE MEASUREMENTS TO AN EARTH SATELLITE
D. L. Cain, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TR-32-534, 1 Feb. 1964, 21 p., refs., N64-17226.

The accuracy to which the station coordinates may be obtained from the tracking of single and multiple passes by means of range or Doppler (range-rate) measurements alone is examined under the assumption that the satellite's orbit is perfectly known. The results indicate that dramatic improvement is attained when data from two different passes are statistically combined . . .

TRANSIT/ANNA FLIGHT-TEST OPERATIONS
J. Dassoulas, Astronautics and Aerospace Engineering, vol. 1, July 1963, p. 44/50, A63-18583.

Review of various Transit and ANNA flight tests. . . . unusual payload-borne devices which required special attention in the field, such as the AEC's radioisotope power supply flown on Transit 4A. . . . future designs will be toward lighter payloads, employing welded circuitry and passive gravity stabilization.

NAVIGATION USING ARTIFICIAL SATELLITES — THE TRANSIT SYSTEM
W. H. Guier, In: The Use of Artificial Satellites for Geodesy; Proceedings of the First International Symposium on the Use of Artificial Satellites for Geodesy, Washington, D.C., April 26/28, 1962, Edited by G. Veis, Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers Div., John Wiley and Sons, Inc., 1963, p. 261/276, 15 refs., A63-24730.

. . . The Transit system is described, and the principles of navigation using Doppler data are discussed.

I SATELLIT I GEODETICI (Geodetic Satellites) (In Italian)
E. Guyot, Technica Italiana, vol. 28, April 1963, p. 173/177, A63-18922.

AIRCRAFT NAVIGATION BY SATELLITE
H. A. Myers, J. Inst. Navig., vol. 16, Oct. 1963, p. 435/448, A64-11647.

Demonstration of the feasibility of aircraft navigation using Doppler and orbital information transmitted from a satellite. The demonstration makes use of the least squares, differential correction. It is shown that , if sufficiently accurate velocity information can be provided, the approach could yield positions for long-range aircraft that are an order of magnitude more accurate than have been achieved with other world-wide, all weather, all-altitude systems, such as Doppler and inertial navigators.

CALIBRATION OF DOPPLER SATELLITE OBSERVATIONS BY SHORT ARC SOLUTION FOR STATION COORDINATES
E. H. Nott, Naval Weapons Lab., Dahlgren, Va., NWL 1908, 18 March 1964, 17 p., AD 433 978.

. . . calibrating the Doppler instrumentation used in determining geodetic parameters from satellite observations. . . .

POSITION PREDICTION FOR ACQUISITION IN SATELLITE GEODESY
R. B. Patton, Jr., Ballistic Research Labs., Aberdeen Proving Ground, Md. BRL 1219, Aug. 1963, 26 p., AD 428 301.

The Coast and Geodetic Survey is conducting a program in satellite geodesy for greater accuracy in geodetic measurement. This is a method of spatial triangulation which requires photographic observation of an identified satellite at three or more points on the earth's surface. SPADATA orbital parameters were used . . . In addition, methods are described for estimating the amount of sunlight that is expected to be reflected to tracking stations by passive satellites such as ECHO.

THE INFLUENCE OF ATMOSPHERIC REFRACTION ON DIRECTIONS MEASURED TO AND FROM A SATELLITE
H. H. Schmid, Army Engineering Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va., GIMARADA RN10, 7 Feb. 1963, 17 p., AD 409 851.

. . . discussion of the basic shortcoming of the mathematical expression generally used to compute atmospheric refraction in connection

with . . . satellite observations, an approach is presented for computing corrections for refraction for both the geodetic satellite triangulation and the topographic photogrammetric satellite method . . .

A REPORT ON THE CAMERA CALIBRATION PHASE OF THE C AND GS SATELLITE GEODESY PROGRAM

E. A. Taylor, et al., Photogrammetric Engineering, vol. 30, March 1964, p. 245/250. 5 refs., A64-17063.

Brief consideration of a satellite triangulation program to improve the internal accuracy of the geodetic control network across the U.S. The program is based on the optical tracking of passive satellites simultaneoulsy from three or more camera tracking stations . . . The apparent path of the satellite from each camera station will be defined on the photographic plate by point images closely spaced across the plate, appropriately coded to facilitate image identification. The end result from each plate will be the apparent right ascension and declination of each satellite image with the corresponding exposure time known to better than 0.5 msec. A typical photograph is presented showing Echo I (1960 Iota 1) orbiting past the constellation Ursa Minor.

NAVIGATION SATELLITES — SOME POSSIBILITIES

C. E. Tharratt, Brit. Commun. and Electronics, vol. 10, Aug. 1963, p. 614/617, A63-20912.

. . . need for a world-wide system of aircraft navigation . . . advantages of basing such a system on synchronous satellites . . . communications and navigation satellite should be combined.

NOTES ON THE DEISGN AND OPERATION OF SATELLITE TRACKING STATIONS FOR GEODETIC PURPOSES

F. L. Whipple, Smithsonian Astrophysical Observatory, Cambridge, Mass., SAO Special Report 124, May 27, 1963, 54 p., 20 refs., N63-19959.

. . . intended as a preliminary aid to the design and operation of optical geodetic stations . . . camera requirements . . . camera mounting requirements . . . timing requirements . . .

EVOLTION OF THE ANNA-1 SATELLITE OPTICAL BEACON

T. Wirtanen, Air Force Cambridge Research Labs., Bedford, Mass., Research rept., Rept. no. AFCRL-63-56, Feb. 1963, 7 p., incl. illus., AD 402 213.

. . . first optical beacon system designed for geodetic space experimentation. . . . underwent several major changes . . .

Related Publications:

A NEW AERIAL SURVEYING SYSTEM

R. S. Duggan, Jr., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 114/119.

Ever since we have had airborne vehicles, man has been interested in the application of this new medium to the mapping and charting of the earth's surface. . . . It is the purpose of this paper to describe a new system which has been developed by Lockheed with WADC support and is currently being delivered to the Air Force. This system incorporates several new and improved electronic systems, together with some of the RB-50 systems, integrated for more efficient functioning in a cargo transport, the C-130 A Hercules. . . .

THE DOPPLER DETERMINATION OF ORBITS

W. H. Guier, Applied Physics Lab., John Hopkins U., Silver Spring, Md., 1959, 8 p., AD 409 103.

. . . on the accuracy with which a satellite can be tracked with a radio doppler tracking system when the satellite is properly instrumented for such doppler tracking.

LIGHTWEIGHT NAVIGATION COMPUTER FOR USE WITH DOPPLER NAVIGATORS

L. M. Lawton, Jr., Proc. Nat. Aeron. Electronics Conf., vol. 8, May 1960, p. 346/352.

GUIDANCE AND DATA TRANSMISSION CONSIDERATIONS FOR A LUNAR MAPPING SATELLITE

J. A. Webb, Commun. and Electronics, vol. 81, no. 62, Sept. 1962, p. 225/229.

The lunar mapping satellite will be performing its mission approximately 210,000 nautical miles away from the nearest human control. In this environment, control from the earth becomes limited and tenuous . . . As in the case of the earth satellite, the polar lunar satellite has the only orbit which will permit viewing of the entire lunar surface without changing the plane of the orbit. . . . lowest altitude to probability in the order of 30,000 feet. . . . summary of the equipment . . . 1. Camera subsystem . . . 2. Navigation and Control Subsystem . . . 3. Propulsion Subsystem . . . 4. Data Link Subsystem . . . 5. Electric Power Supply Subsystem . . .

4B.380: Other Utility Satellites

Included: Reconnaissance satellites; RFI monitoring satellite; Nuclear explosion detection satellites; Mineralogical satellites; Range calibration satellites; Calibration satellites; Project SCORPIO; Radar propagation experiments with satellites; Oceanographic satellites.

Not Included: Communications satellites (4A).

Cross References: RCS project (4B.872).

Principal Publications:

THE ANTENNA SYSTEM OF THE RECONNAISSANCE SATELLITE
R. B. MacAskill, Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 292/304.

DETECTION OF NUCLEAR EXPLOSIONS IN SPACE AND UNDERGROUND
I. Maddock, J. Brit. Instn. Radio Engrs., vol. 23, no. 6, June 1962, p. 415/427.

. . . Detection instruments may be carried in satellites. . . . various techniques are reviewed. Seismic methods for the detection of underground explosions are discussed. Signal/noise ratio problems predominate and a seismometer array is described which provides discrimination against waves from different sources. . . .

DESIGN STUDY OF A SPACECRAFT FOR RADAR PROPAGATION EXPERIMENTS
Cornell Aeronautical Lab., Inc., Buffalo, N. Y., RADC TDR63 115, 15 Sept. 1962, 1 v., AD 404 925.

. . . for use in an experimental program of research on propagation of electromagnetic energy . . . to carry a specially designed radio transmitter into a near-polar orbit around the earth, with a minimum altitude in orbit of 400 nautical miles. The transmitter will send out closely controlled, phase-locked signals to receiving stations at Sand Hill, N. Y. (near Buffalo), and Clear, Alaska. Analysis of the results will provide data on the effect of the total atmosphere on attainable radar resolution.

RESEARCH DIRECTED TOWARD THE INVESTIGATION OF SUITABILITY OF THE GLOTRAC TYPE G TRANSPONDER FOR USE IN THE RANGE CALIBRATION SATELLITE
R. Braun, General Dynamics/Astronautics, San Diego, Calif., Final Engineering Report, AFCRL-64-240(A), 1 Dec. 1963, 164 p., refs., AD 433 038, N64-18695.

. . . three studies: (1) heat dissipation and packaging study; (2) component and circuit study; and (3) radiation study . . . examined with respect to the requirements peculiar to the Range Calibration Satellite (RCS) mission . . .

STUDY OF THE FEASIBILITY OF ROCKET AND SATELLITE APPROACHES TO THE CALIBRATION OF TRACKING SYSTEMS
D. C. Brown, et al., Brown (d) Associates, Inc., Eau Gallie, Fla., Final Report, AFCRL-63-789, 23 Oct. 1963, 222 p., refs., AD 425 480, N64-12296.

. . . The overall conclusion is reached that both satellite and rocket programs of calibration are feasible, if properly designed, but that a satellite program would yield appreciably superior results at far less cost than a rocket program of comparable effectiveness.

INSTRUMENTATION FOR A MINERALOGICAL SATELLITE
E. A. Burns, et al., Space Technology Labs., Inc., Redondo Beach, Calif., Rept. 9990-6459-RU-00, 1963, 26 p., refs., Presented at the 14th Intern. Astronautical Congr., Paris, 25 Sept.-1 Oct. 1963, IAC Paper 94, N64-12351.

. . . The theoretical basis, operation considerations, instrument constraints, feasibility, and application of a mineralogical satellite are discussed. From the discussion, it is concluded that the remote infrared spectral measurement of the lunar surface will provide valuable information for mineralogical and temperature mapping . . .

ELECTRONICS PROGRAM. RADIO FREQUENCY INTERFERENCE AT ORBITAL ALTITUDES
L. A. Hoffman, et al., Aerospace Corp., Los Angeles, Calif., Semiannual technical note, 1 Jan.-30 June 1963, Rept. no. TDR169 3250 44TN1, SSD TDR 63 260, 7 Oct. 1963, 11 p., AD 421 754.

. . . essential for future reliable communications in space. . . . increasing RFI problems . . . demand solution. . . . to investigate the design of monitoring instruments suitable for making in-space measurements of the electromagnetic environment. . . . laboratory development of a compact, lightweight receiving system in the 200 to 1000 Mc band has been initiated. . . . is to consist of an antenna array, a bank of interdigital bandpass filters, and sixteen crystal-video receivers. It is anticipated that the first RFI monitor will be placed in orbit in the spring of 1964.

THE OPTIMIZATION OF SATELLITE RECONNAISSANCE BY THE APPLICATION OF DYNAMIC PROGRAMMING TECHNIQUES
J. A. Hunt, Mitre Corp., Bedford, Mass., Final rept., ESD TDR63 168, April 1963, 9 p., AD 402 810.

. . . system with a constrined picture-taking capability. . . .

CALIBRATION SATELLITE
A. Mancini, et al., Air Force Cambridge Research Labs., Bedford, Mass., Geodesy and Gravity Branch, In AF Missile Test Center, New Data Reduction Methods to Improve Range Data, 1963, p. 339/364, N64-15325.

The role of satellites in the calibration of range instrumentation is discussed and includes the simultaneous calibration of several electronic systems and the checking of system performance over the ranges and velocities for which the equipment was developed and will operate.

PROJECT SCORPIO: A PROPOSED SATELLITE SYSTEM FOR IMPROVING ATLANTIC MISSILE RANGE ACCURACY AND CALIBRATING OPERATIONAL MISSILE RANGING SYSTEMS
A. Mancini, et al., Air Force Cambridge Research Labs., Bedford, Mass., Technical Proposal, In its Compendium of Papers in the Fields of Geodesy and Planetary Geometry, Aug. 1963, 52 p., N63-23307.

. . . The satellite will carry a MISTRAM, a GLOTRAC and a DPN-66 transponder, along with an optical beacon which can be photographed against a stellar background. The satellite package will weigh approximately 300 pounds and will be placed into a low eccentricity orbit about 500 miles above the earth . . .

THE USE OF SATELLITES FOR CALIBRATION OF BMEWS RADARS
R. F. Shackford, Mitre Corp., Bedford, Mass., Rept. no. TM3350, ESD TDR 63 454, Feb. 1964, 16 p., AD 431 782.

USE OF THE AN/DPN-66 TRANSPONDER IN A RANGE CALIBRATION SATELLITE
F. Sharp, Motorola, Inc., Scottsdale, Ariz., Military Electronics Div., Final Report of Study Program, AFCRL-63-912, 21 Nov. 1963, 166 p., refs., AD 426 345, N64-13666.

. . . discusses the suitability of the AN/DPN-66 C-Band Transponder for operation in a range calibration satellite, the prime function of which is the calibration of C-band tracking and instrumentation radars . . .

ANTENNA-COUPLING CONSIDERATIONS FOR A RECONNAISSANCE SATELLITE
V. C. Sundberg, Electronic Defense Lab., Mountain View, Calif., Rept. no. EDL-M403, 15 April 1963, 29 p., AD 420 031.

. . . study on the probability of detecting signals from a missile by a reconnaissance satellite. The signals from the missile are assumed to be fixed in frequency, continuous, and linearly polarized. . . . The satellite continuously monitors the signal, and may employ either a linearly polarized or circularly polarized antenna. The probability of signal detection is determined as a function of the satellite's receiver sensitivity, its antenna polarization, and the orientation of the missile. . . .

CALIBRATION SATELLITE SYSTEM STUDY
Wolf Research and Development Corp., West Concord, Mass., Final rept., Rept. no. 63 3258 8, AFCRL 63 920, 6 Nov. 1963, 1 v., AD 426 799.

. . . system for the calibration of the AMR tracking instrumentation . . . all operational requirements including digital computer programs and data links necessary to effect a calibration . . .

INSERTION OF WIDE BANDWIDTH VIDEO DATA FOR COMMUNICATIONS FROM RECONNAISSANCE SATELLITES
General Electric Co., Utica, N. Y., Final rept., Sept. 1962-June 1963, ASD TDR 63 815, 20 Sept. 1963, 81 p., AD 421 526.

. . . design and . . . breadboard implementation of a wide band, high resolution data conversion system for reconnaissance satellites applications. . . . capability of 6 bit quantization of video signals with frequency components up to 25 MC. . . . the system includes parallel to series and series to parallel converters and a digital to analog converter to afford simulation of a complete communications link.

OCEANOGRAPHIC SATELLITE SYSTEM CONCEPT AND FEASIBILITY STUDY. VOLUME 3. APPENDICES
Valley Forge Space Technology Center, Philadelphia, Pa., Final rept., Document no. 63SD717, Aug. 1963, 1 v., AD 436 744.

Related Publications:

PROBLEMS OF THE OCEANOGRAPHER IN THE SPACE AGE -- 1963
J. M. Snodgrass, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 182/191.

. . . During the last two and a half years oceanographers have been very active in seeking allocations of radio frequencies for communications and telemetering. Much has transpired, both nationally and internationally, with formal support being given by the Intergovernmental Oceanographic Commission meeting in Paris, France, September 24th-26th, 1962. New methods of using the radio frequency spectrum, both administratively and operationally, have been developed. . . .

DIVISION 4B. 8
SPECIAL PROJECTS FOR INSTRUMENTED SATELLITES

The projects are referenced in alphabetical order, under the following subdivisions:

4B. 820: Project ABLE

Principal Publications:

1958 NASA/USAF SPACE PROBES (ABLE I) (Final Report)
Space Technology Laboratories, Inc., Los Angeles, Calif., NASA Memo 5-25-59W, vols. 1-4, Feb. 18 1959.

THE SCIENTIFIC OBJECTIVES OF THE ABLE-5 PROGRAM
S. Altshuler, et al., Physics Today, vol. 14, Jan. 1961, p. 20/27.

4B. 825: Project ALOUETTE

Principal Publications:

ALOUETTE SATELLITE 1962 BETA ALPHA ONE
S. Bay, Defense Research Telecommunications Establishment, Canada, Oct. 1962, 6 p., incl. illus., AD 288 217.

PRELIMINARY RESULTS FROM THE VLF RECEIVER ABOARD CANADA'S ALOUETTE SATELLITE
R. E. Barrington, et al., National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md., NASA TM X-51251, NASA X-615-63-36, 1963, 14 p., N64-11794.

. . . This analysis reveals some very interesting features of whistlers and ionospheric noise as observed in the ionosphere. In addition, some comparisons of simultaneous observations of the VLF band, from the ground and in the satellite are made.

PRELIMINARY RESULTS FROM THE VERY-LOW FREQUENCY RECEIVER ABOARD CANADA'S ALOUETTE SATELLITE
R. E. Barrington, et al., Nature, vol. 198, May 18, 1963, p. 651/656, A63-19276.

Presentation and analysis of VLF observations of whistlers and ionospheric noise recorded by the Canadian Alouette satellite (1962 Beta Alpha 1). . . .

VERY-LOW-FREQUENCY NOISE BANDS OBSERVED BY THE ALOUETTE 1 SATELLITE
R. E. Barrington, et al., J. Geophys. Res., vol. 68, Dec. 15, 1963, p. 6539/6541, A64-12465, AD 437 409.

Brief consideration of signals observed by the VLF receiver aboard the Alouette satellite . . . which are bands of noise that vary systematically with the position of the spacecraft in the geomagnetic field. Spectrograms of segments of the VLF signals observed during a full sweep of the satellite from 80°N to 80°S geographic latitude are presented, as are plots of the lower edge of the noise band that shows systematic changes in spectral distribution with satellite latitude . . . Possible explanations of the noise observations are briefly considered.

CHARACTERISTICS OF THE ALOUETTE SATELLITE 1962 BETA ALPHA ONE
G. H. Booth, Defence Research Telecommunications Establishment, Ottawa, Ontario, DRTE 1111, June 1963, 63 p., AD 422 451.

The five basic electronic subsystems of the Alouette satellite . . . and their prelaunch performance characteristics . . . are described. Included are calibration curves, photographs and plots of the various functions. . . .

TOPSIDE SOUNDING OF THE IONOSPHERE
J. H. Chapman, In: Scientific Satellites, Advances in the Astronautical Sciences, vol. 12, NASA, American Association for the Advancement of Science, and American Astronautical Society, Symposium on Scientific Satellites—Mission and Design, Philadelphia, Pa., Dec. 27, 1962, Edited by Irving E. Jeter, North Hollywood, Calif., Western Periodicals Co., 1963, p. 41/63, 12 refs., A63-21524.

. . . Alouette Topside Sounder satellite . . . Block diagrams . . . of the topside sounder and the telemetry system . . . Typical topside ionograms. . . .

THE ALOUETTE TOPSIDE SOUNDER SATELLITE, EXPERIMENTS, DATA AND RESULTS
J. H. Chapman, American Institute of Aeronautics and Astronautics, Canadian Aeronautics and Space Institute, and Royal Aeronautical Society, Anglo-American Conference, 9th, Cambridge, Mass., Oct. 16-18, 1963, and Montreal, Canada, Oct. 21-24, 1963, Paper 63-469, 6 p., 11 refs., A63-23905.

. . . results obtained from a receiver capable of monitoring cosmic radio noise, from a VLF receiver, and from a group of six energetic-particle counters.

ELECTRONIC AND SYSTEM DESIGN OF THE CANADIAN IONOSPHERIC SATELLITE
C. A. Franklin, et al., IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 64/72.

TELEMETRY AND COMMAND SYSTEMS FOR THE CANADIAN IONOSPHERIC SATELLITE
C. A. Franklin, et al., Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 457/470.

. . . Three v.h.f. transmitters are used, two for telemetry and one for tracking. A 2W true f.m. transmitter operating at 136-980 Mc/s is directly modulated by the wideband data from the primary and v.l.f. experiments. A 1/4 W p.m. transmitter operating at 136-590 Mc/s transmits engineering data and narrow band information from secondary experiments. A 50 mW c.w. tracking beacon operates continuously at 136-980 Mc/s.

A 7-tone command system provides means for on-off control of the spacecraft, for selection of redundant units, and for choice of a number of possible operational modes. With relay multiplexing this system controls 19 sets of double throw magnetic latching relays. . . .

TELEMETRY AND COMMAND SYSTEMS FOR THE CANADIAN IONOSPHERIC SATTELITE
C. A. Franklin, et al., Defence Research Telecommunications Establishment, Ottawa, Ontario, Sept. 1963, 20 p., AD 422 729.

. . . in the Alouette earth satellite . . . Data storage is not used and the spacecraft is directly monitored by a network of thirteen ground stations . . . A seven tone command system provides means for ON-OFF control of the spacecraft, for selection of redundant units, and for choice of a number of possible operational modes.

A STUDY OF INTERFERENCE IN THE ALOUETTE TOPSIDE SOUNDER RECORDS
T. R. Hartz, Defence Research Telecommunications Establishment, Canada, DRTE 1123, Oct. 1963, 14 p., AD 430 222.

The Alouette ionograms . . . are found to be of poor quality because of unidentified man-made interference. . . . mainly prevalent over densely populated regions of the world and seriously degrades the night-time ionograms obtained at stations like Ottawa and Winkfield.

. . . not apparent in recordings from the South Atlantic station. The most probable cause of the interference is ground transmissions that propagate above the F-region critical frequency and intermodulate in the satellite receiver. No evidence has been found for a contribution to the interference by way of the whistler mode of propagation.

S-27 (ALOUETTE) SATELLITE SYSTEM CONFIGURATION AND WIRING
H. Kowalik, Defence Research Telecommunications Establishment, Ottawa, Ontario, DRTE 1124, July 1963, 20 p., AD 422 606.

. . . physical configuration of the electronic systems together with the cabling and wiring of the Ionospheric Topside Sounder. . . .

SOME AVERAGE PROPERTIES OF THE OUTER RADIATION ZONE AT 1000 KM
I. B. McDiarmid, et al., National Research Council of Canada, Div. of Pure Physics, Ottawa, Ontario, NRRC 7581, 16 Aug. 1963, 16 p., AD 435 165.

The particle detectors in the Alouette satellite have been used to obtain time-averaged intensity distributions for the particles in the outer radiation zone. . . . at an altitude of 1000 km. . . . Some of the measurements are compared with ground-based measurements of auroral radio-absorption.

CONSTRUCTION TECHNIQUES AND INSPECTION PROCEDURES FOR THE S-27 ALOUETTE SATELLITE PAYLOAD
G. H. C. Mackie, Defense Research Telecommunications Establishment, Canada, DRTE 1119, July 1963, 13 p., AD 422 712.

. . . The physical form of a typical electronic package, with its associated hardware, are described . . . some of the problems that had to be solved before the required high degree of reliability could be achieved . . . inspection procedures . . .

INSTRUMENTATION OF THE IONOSPHERIC SOUNDER CONTAINED IN THE SATELLITE 1962 BETA ALPHA (ALOUETTE)
A. R. Molozzi, COSPAR, International Space Sciences Symposium, 4th, Warsaw, Poland, 3-11 June 1963, Paper, 38 p., A63-19746.

A STUDY OF EARTH RADAR RETURNS FROM ALOUETTE SATELLITE
R. K. Moore, Kansas U., Lawrence Center for Research in Engineering Science, Semi-annual Report, 1 May-31 Oct. 1963, NASA CR-52985, 1963, 8 p., refs., N64-12029.

. . . The ground returns observed by the Alouette topside-ionosphere sounder were studied. The data processing plans and a statement of the data-reduction problem associated with returns from the Alouette satellite are discussed . . .

RADIO PROPAGATION ALONG MAGNETIC FIELD-ALIGNED SHEETS OF IONIZATION OBSERVED BY THE ALOUETTE TOPSIDE SOUNDER
D. B. Muldrew, J. Geophys. Res., vol. 68, Oct. 1, 1963, p. 5355/5370, 12 refs., A63-23363, AD 437 408.

PAYLOAD PACKAGING DESIGN – ALOUETTE SATELLITE
G. G. Phillips, et al., Defence Telecommunications Establishment, Ottawa, Ontario, DRTE 1116, June 1963, 11 p., AD 422 758.

A description of satellite packaging design, discussion of factors influencing design, and enumeration of some practical rules found generally useful during the payload packaging. . . .

ALOUETTE TOPSIDE SOUNDINGS MONITORED AT STANFORD UNIVERSITY
J. O. Thomas, et al., Technical Report No. 6, Dec. 1963, 95 p., refs., N64-19309.

FOUR MORE CANADIAN SATELLITES FROM US-CANADA AGREEMENT
National Aeronautics and Space Administration, News Release 64-6, 14 Jan. 1964, 10 p., refs., N64-13291.

. . . Designated ISIS (International Satellites for Ionospheric Studies), the new program will involve satellites called Alouette B and ISIS A, B, and C. They will be launched at intervals between 1965 and 1970 . . .

(No title)
Defence Research Telecommunications Establishment, Canada, DRTE 1135 U, Annual rept. for 1963, March 1964, 1 v., AD 436 278.

Contents: In Flight Performance of Alouette I; Scientific Results from Alouette I; Properties of the Topside of the Ionosphere . . .

4B.830: Project ANNA

Principal Publications:

PROJECT ANNA—GEODETIC SATELLITE SYSTEM (Report of the Committee on Science and Astronautics, U. S. House of Representatives)
G. P. Miller, Congress, House Committee on Science and Astronautics, Washington, GPO, 1962, 13 p., 87th Cong., 2nd Sess., H.R. 2151 Committee Print, N63-15430.

TRANSIT/ANNA FLIGHT TEST OPERATIONS
J. Dassoulas, Applied Physics Lab., Johns Hopkins U., Silver Spring, Md., Rept. no. 63105 63, 1963, 18 p., AD 407 723.

. . . to monitor and evaluate payload performance during hangar RF checks of electronic, memory, power systems, etc. . . .

THE ANNA EARTH SATELLITE TELEMETRY SYSTEM – SPACE TELEMETRY BY HYBRID TECHNIQUES
A. F. Hogrefe, et al., IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 45/52.

. . . existing hardware of basically different system types are mated to provide a hybrid telemetry system with high versatility and compatible with both manual and fully automated data reduction techniques. . . .

OPTICAL GENERATOR PROGRAM
H. R. Kahler, et al., Wolf Research and Development Corp., West Concord, Mass., AFCRL 63 445, Feb. 1963, 37 p., AD 404 059.

. . . to provide acquisition data to a ground-based instrumentation net consisting of mainly various types of cameras. . . . employed to photograph a flashing strobe light . . . of the ANNA geodetic satellite.. . .

EVOLUTION OF THE ANNA-1 SATELLITE OPTICAL BEACON
T. Wirtanen, Air Force Cambridge Research Labs., Bedford, Mass., Research rept., Instrumentation for Geophysics and Astrophysics no. 26, Rept. no. AFCRL-63-56, Feb. 1963, 7 p., incl. illus., AD 402 213.

. . . first optical beacon system designed for geodetic space experimentation. . . . underwent several major changes . . .

Related Publications:

SATELLITE TELEMETRY AND DATA PROCESSING
H. B. Riblet, et al., Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 254/262.

. . . The satellite program at the Applied Physics Lab., The Johns Hopkins Univ. . . . emphasis on the telemetry and data processing requirements and instrumentation. The telemetry modulation systems used in the APL satellites include f.m./p.m., pdm/fm/pm/pam/fm/pm and pcm/fm/pm. The telemetry data are processed with the aid of a digital computer to automatically produce numerical listings or graphical plots. Some of the results obtained through the processing of satellite telemetry data are presented. . . .

4B.833: Project ARENTS

Principal Publications:

PREDICTED RELIABILITY OF THE ARENTS SATELLITE
M. B. Adelson, ARINC Research Corp., Washington, D. C., Pub. no. 173-1-246, 7 July 1961, 53 p., AD 272 189.

. . . The ARENTS Satellite System will carry a number of experiments to determine the effects of radiation or hard vacuum on various materials and apparatus. The satellite will be launched from a Centaur vehicle using an Atlas booster, and will go into equatorial orbit at an altitude of approximately 20,000 miles . . . three subsystems -- environmental experiments, electrical power generation and conversion, and telemetry. . . .

INVESTIGATION OF ELECTROMAGNETIC ENVIRONMENT OF SPACE FOR THE ARENTS PROGRAM
Harvard College Observatory, Cambridge, Mass., Tech. summary rept. no. 2, Jan. 1963, 1 v., AD 402 157.

. . . to measure the dynamic spectrum of the electromagnetic environment at the synchronous orbit altitude in the frequency domain between 75 and 750 kc. In addition to the dynamic spectra, discrete frequency measurements at 80 kc, 120 kc, and 250 kc will also be obtained.

4B.835: Project BIOS

Principal Publications:

BIOS 2 SATELLITE TO ORBIT PRIMATES, PLANTS
B. Miller, Aviation Week and Space Technology, vol. 78, May 20, 1963, p. 79, 83, 87, A63-18367.

. . . experiments tentatively scheduled to be carried out by the NASA Bios 2 satellite series in order to study the effects of weightlessness on a small primate . . .

4B.837: Project COSMOS

Principal Publications:

SATELLITES, ATMOSPHERE, AND ELECTRONS
Yu. Gal'perin, et al., Foreign Tech. Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, 29 Oct. 1962, 8 p., Trans. no. FTD-TT-62-1547 from Pravda, p. 6, cols., 1-3, 26 Sept. 1962, AD 292 198.

TRANSMITTING SATELLITE PROPAGATION STUDIES, COMPILATION OF ABSTRACTS
Library of Congress, Washington, D. C., Aerospace Information Div., AID-P-64-5, 23 Jan. 1964, 19 p., refs., AD 430 473, N64-16462.

. . . coherent receiving apparatus for recording Doppler shift differences in radio transmissions from artificial earth satellites, radio investigation of the ionosphere by means of Cosmos satellites. . . . A comprehensive chart of Cosmos series flight data is included.

TRANSMITTING SATELLITE PROPAGATION STUDIES, COMPILATION OF ABSTRACTS
Library of Congress, Washington, D. C., AID-P-64-9, 5 Feb. 1964, 11 p., refs., AD 429 775, N64-16461.

. . . investigation of charged particles in the ionosphere by the Cosmos-3 and Cosmos-5 satellites . . . description of the particle-sensing apparatus carried onboard; (2) evidence of the existence of currents of electrons and positive ions in the upper ionosphere, having energies that are relatively low but greater than the thermal energy; (3) . . . high-energy particles registered by Geiger counters . . . calculations made on variations in electron density in the upper atmosphere based on the Doppler shift behavior of two simultaneous signals transmitted from the Cosmos-1 and Cosmos-2 satellites . . . equipment carried on Cosmos-2 and Cosmos-7 satellites to measure radiation along the routes of the proposed Vostok-3 and Vostok-4 flights.

4B.840: Project DISCOVERER

Principal Publications:

SOME CONSIDERATIONS IN THE DESIGN OF THE GUIDANCE AND CONTROL SYSTEM FOR DISCOVERER

J. J. Schmitt, Jr., IRE Trans. Mil. Electonics, vol. MIL-3, no. 4, Oct. 1959, p. 184/185.

4B.842: Project ELEKTRON

Principal Publications:

THE "ELEKTRON" SPACE SYSTEM
S. N. Vernov, et al., Joint Publications Research Service, Washington, D. C., JPRS-23810, OTS-64-21864, 23 March 1964, 23 p., Transl. into ENGLISH from Pravda, Moscow, 15 March 1964, p. 3, N64-17554.

The scientific stations, Elektron-1 and Elektron-2 were launched into circumterrestrial space for the simultaneous study of the earth's radiation belts . . .

4B.844: Project EROS

Principal Publications:

INSTRUMENTATION FOR TESTING A FRESNEL MIRROR IN SPACE ENVIRONMENT
R. L. McNew, et al., American Institute of Aeronautics and Astronautics, Summer Meeting, Los Angeles, Calif., 17-20 June 1963, Paper 63-189, 25 p., A63-19763.

Description of the deployable, all-metal Fresnel reflector chosen for tests of the effect of the space environment on the performance of a small-scale solar reflector, as part of Project EROS (Experimental Reflector Orbital Shot). All components of the EROS experiment have successfully passed a rigorous set of environmental tests to verify the ability of the reflector to withstand the launch and space environments.

. . . accuracy of the EROS instrumentation appears to be better than that of the telemetry system used with it.

4B.846: Project EXPLORER

Principal Publications:

OBSERVATIONS OF THE U.S. SATELLITES EXPLORERS I AND III BY CW REFLECTION
J.D. Kraus, et al., Proc. IRE, vol. 46, Aug. 1958, p. 1534.

RESULTS OF THE IGY SATELLITE PROGRAM
W.H. Pickering, Proc. Nat. Electronics Conf., vol. 14, Oct. 1958, p. 432/441.

Instrumentation of the Explorer Satellites is discussed. A brief description of the Microlock telemetry system is given. . . .

INSTRUMENTING THE EXPLORER I SATELLITE
H.L. Richter, et al., Electronics, vol. 32, Feb. 1959, p. 39/44.

ABLE-3 PAYLOAD DESIGN
J.E. Taber, IRE Trans. Mil. Electronics, vol. MIL-3, no. 4, Oct. 1959, p. 143/149.

SCIENTIFIC OBJECTIVES OF THE ABLE-3 PROGRAM
IRE Trans. Mil. Electronics, vol. MIL-3, no. 4, Oct. 1959, p. 129/143.

. . . The Able-3 vehicle was launched on August 7, 1959, and has since been designated Explorer VI. . . .

CONSIDERATIONS TO THE DEVELOPMENT OF EXPLORER VII SATELLITE
J. Boehm, IRE Trans. Mil. Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 86/92.

. . . design parameters are discussed . . . testing of the satellite with regard to functional and environmental conditions.

SATELLITE RELIABILITY ACHIEVED THROUGH COMPREHENSIVE ENVIRONMENTAL AND FUNCTIONAL TESTING
J.A. Chambers, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 455/460.

. . . Explorer VII. . . . success of the satellite was not a surprise to those familiar with the exhaustive test program which accompanied all phases of its development. Even the flight models themselves went through a modified environmental test series corresponding with launch and orbit conditions. . . .

TELEMETRY CODE AND CALIBRATIONS FOR SATELLITE 1959 IOTA (EXPLORER VII)
I. L. Cherrick, National Aeronautics and Space Administration, Washington, D.C., May 1960, AD 237 313.

A description of the experiments, the detector calibrations, the telemetry codes, samples of actual data recordings, and other pertinent information of the 19,992 MC transmitter of Satellite 1959 Iota are presented. . . .

PROJECT ABLE-3
P. F. Glazer, Space Technology Labs., Inc., Los Angeles, Calif., Final mission rept., Rept. no. STL/TR 50-V002-02903, AFBMD TR 60-154, vol. 2, AD 245 934.

. . . Electromagnetic wave propagation experiments and electron density experiments were conducted as were studies of the geomagnetic field. A spot scanner television system and a micrometeorite counter were also included in the payload instrumentation. Analog and digital data from these experiments were telemetered to four ground stations until loss of contact on 6 October 1959. Data were reduced and studied; some mapping of the radiation zones was accomplished; geomagnetic storm effects were observed; a slow scan television picture of the Pacific Ocean was made.

EXPLORER VI DIGITAL TELEMETRY, TELEBIT
R. E. Gottfried, Space Technology Labs., Inc., Redondo Beach, Calif., 3 Feb. 1960, 36 p., AD 414 545.

. . . purpose of this vehicle was to serve as a test-bed for various systems such as the digital telemetry . . .

EXPLORER VI DIGITAL TELEMETRY — TELEBIT
R. E. Gottfried, IRE Winter Conv. Mil. Electronics, Feb. 1960.

THE DATA SYSTEMS FOR EXPLORER VI AND PIONEER V
E. W. Greenstadt, IRE Trans. Space Electronics Telemetry, vol. SET-6, no. 3/4, Sept./Dec. 1960, p. 122/129.

. . . systems for acquisition and reduction of telemetry data for 1959 Delta (Explorer VI) and 1960 Alpha (Pioneer V) are described. These include an analog and a digital system in Explorer VI and a digital system in Pioneer V. . . . covers digitization of data in the payloads, methods of handling and recording data on the ground, reduction techniques, and the procedures used to disengage signal from noise during periods when the SNR was low.

PROBLEMS CONCERNING THE THERMAL DESIGN OF EXPLORER
G. B. Heller, IRE Trans. Mil Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 98/112.

SIGNAL PROCESSING IN EXPLORER VII
O. B. King, IRE Nat. Symp. Space, no. 4-2, Sept. 1960, p. 1/10.

A description of the individual experiments of EXPLORER VII is given . . . The performance of all the payload electronics for the first ten months of active life is discussed . . .

SCIENTIFIC OBJECTIVES OF EXPLORER VII
A. W. Thompson, IRE Trans. Mil. Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 93/98.

EXPLORER SATELLITE ELECTRONICS
W. K. Victor, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 78/85.

. . . which enabled the Explorer satellites to be first during the IGY to reveal the presence of a belt of intense cosmic radiation encircling the earth's equator . . . Methods used to obtain reliability in the transducing and communications system are described, together with interpretations of space-environment information as deduced from the narrow-band telemetry.

PARTICIPATION IN NASA PROJECT S-30, EXPLORER VIII
JPL Res. Sum., vol. 1, no. 36-6, Oct./Nov. 1960, p. 19.

. . . The goldstone Tracking Station supplied data for the launch pass and the succeeding three orbital passes. The tracking equipment used at Goldstone consisted of a modified Microlock receiver and a two-turn helical antenna. . . .

UNIVERSITY OF CHICAGO PROPORTIONAL COUNTER TELESCOPE EXPERIMENT FOR EXPLORER VI AND PIONEER V.
Laboratories for Applied Sciences, U. of Chicago, Ill., Rept. STL/TR-60-0000-02166, Final rept., 25 June 1960, 20 p., AD 269 307.

IONOSPHERIC RESULTS WITH SOUNDING ROCKETS AND THE EXPLORER VIII SATELLITE (1960 XI)
R. E. Bourdeau, National Aeronautics and Space Administration, Washington, D. C., Technical note no. D-1079, Aug. 1961, 22 p., AD 262 040.

A DATA TRANSMISSION SYSTEM FOR THE GAMMA RAY ASTRONOMY SATELLITE
O. B. King, et al., Proc. Nat. Telem. Conf., May 1961, p. 4/37-4/52.

JUNO II SUMMARY PROJECT REPORT. VOLUME I. EXPLORER VII SATELLITE.
National Aeronautics and Space Administration, Washington, D. C., NASA Technical note D-608, July 1961, 356 p., 13 refs., AD 259 999.

Contents: The Explorer VII flight. Telemetry design. Networks and solar power systems for the Explorer VII. Experiments.

EXPLORER X
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 70/71.

With the tracking of Explorer X, the Woomera and Goldstone DSIF stations participated in the first mission in which the DSIF operated as a net. Explorer X carried a rubidium magnetometer similar to the one to be carried by the Ranger spacecraft and had as its prime function the measurement of the earth's magnetic field intensity.

REVIEW OF DIRECT MEASUREMENTS OF INTERPLANETARY DUST FROM SATELLITES AND PROBES
W. M. Alexander, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TM X-54570, X-613-62-25, Presented at the COSPAR Meeting, May 1962, Submitted for Publication, N64-17609.

. . . Two satellite experiments, Vanguard III . . . Explorer I . . . evidence for dust particle streams . . .

EXPLORER SATELLITES LAUNCHED BY JUNO 1 AND JUNO 2 VEHICLES
J. Boehm, et al., NASA, Marshall Space Flight Center, Huntsville, Ala., In its From Peenemunde to Outer Space (A Volume of Papers) Commemorating the Fiftieth Birthday of Wernher Von Braun, March 23, 1962, p. 163/202, 18 refs., N63-15985.

PLASMA PROBES ON SPACE VEHICLES
R. L. F. Boyd, In: Ionization Phenomena in Gases, vol. II., Union of German Physical Societies, International Conference, 5th, Proceedings, Munich, Germany, Aug. 28-Sept. 1, 1961, Amsterdam, Netherlands, North-Holland Publishing Co., 1962, p. 1387/1396, 11 refs., A63-21936.

PLASMA PROBE INSTRUMENTATION ON EXPLORER X
H. S. Bridge, et al., In: Space Research III, Proceedings of the Third International Space Science Symposium, Washington, D. C., May 2-8, 1962, Edited by Wolfgang Priester, Amsterdam, North-Holland Publishing Co., New York, Interscience Publishers Division, John Wiley and Sons, Inc., 1963, p. 1113/1121, A63-20020.

ON THE MOTION OF EXPLORER XI AROUND ITS CENTER OF MASS
G. Colombo, Smithsonian Astrophysical Observatory, Cambridge, Mass., SAO Special Rept. 94, May 23, 1962, 29 p., 7 refs., N63-21905, AD 276 683.

. . . evaluate separately the magnitudes of the induced and the intrinsic magnetic dipoles of Explorer XI needed to explain quantitatively and qualitatively the precessional motion of the tumbling axis as an effect of both the gravitational torque and the torque that the earth's magnetic field H exerts on the satellite . . .

EXPLORER XII SATELLITE INSTRUMENTATION FOR THE STUDY OF THE ENERGY SPECTRUM OF COSMIC RAYS
U. D. Desai, et al., Proc. Nat. Telem. Conf., no. 7-5, May 1962, p. 1/15.

. . . describes the signal conditioning and programming processes required to digitize, store, and read out the data from the various detectors used in cosmic ray instrumentation aboard the Explorer XII (Energetic Particles) Satellite.

DIRECT OBSERVATIONS OF THE INTER-PLANETARY PLASMA
C. Dilworth, et al., J. Phys. Soc. Japan, v. 17, Suppl. A-11, 1962, p. 553/560, 5 refs., N63-18368.

. . . preliminary results obtained with the earth satellite Explorer X (1961 kappa) are presented . . . experiments included two types of magnetometers (Goddard Space Flight Center) and a plasma probe (Massachusetts Institute of Technology) . . .

THERMAL DESIGN OF EXPLORER XIII MICRO-METEOROID SATELLITE
E.C. Hastings, Jr., et al., NASA, Washington, D.C., Technical note D-1001, May 1962, 118 p., incl. illus., tables, 24 refs., AD 275 062.

USE OF A SEALED SILVER CADMIUM BATTERY ON EXPLORER XII
T.J. Hennigan, et al., American Rocket Society, Space Power Systems Conference, Santa Monica, Calif., Sept. 25-28, 1962, Paper 2509-62, 5 p., A63-11828.

COSMIC RAY EXPERIMENTS FOR EXPLORER XII AND THE ORBITING GEOPHYSICAL OBSERVATORY
G.H. Ludwig, et al., In: Space Research III, Proceedings of the Third International Space Science Symposium, Washington, D.C., May 2-8, 1962, Edited by Wolfgang Priester, Amsterdam, North-Holland Publishing Co., New York, Interscience Publishers Division, John Wiley and Sons, Inc., 1963, p. 1129/1143, A63-20022.

CHRYSLER'S REDSTONE, JUPITER, AND EXPLORER PROGRAMS
T.F. Morrow, National Advanced-Technology Management Conference, Proceedings, Seattle, Wash., Sept. 4-7, 1962, A63-16591.

PULSE-FREQUENCY MODULATION
R.W. Rochelle, IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 107/111.

Pulse-frequency modulation (PFM) has been successfully employed as the encoding technique in a number of small U.S. Earth satellites where reduction of power and weight are prime considerations. This paper is concerned with the introduction of some of the more basic principles of PFM. Rather than presenting a rigorous proof on the orthogonality of this type of modulation, a comparison is made to the better-known characteristics of coded binary sequences. It is shown that PFM with quantized frequencies has the same communication efficiency in the presence of additive white Gaussian noise as a corresponding set of coded binary sequences with an equal number of quantized levels. . . . Vanguard III . . . carrying a combination of pulse-duration modulation and PFM. Similar systems were carrier by Explorer VII . . . and by Explor X . . . Explorer XII carried the first truly PFM system into a highly elliptical orbit with an apogee of 50,000 miles. . . .

REDUCTION AND ANALYSIS OF EXPLORER VI AND PIONEER V DATA, VOLUME I
A. Rosen, et al., Space Technology Labs., Inc., Redondo Beach, Calif., Final Report, Rept. 8626-6006-RU000, 30 Nov. 1962, 199 p., refs., N64-17677.

. . . discussed: (1) the structure composition and dynamics of the Radiation Belt during September 1959; (2) Explorer VI Satellite observations of the geomagnetic field during magnetic storms; (3) Pioneer V data reduction and analyses; (4) an investigation of signal fading on Explorer VI and Pioneeer V transmissions; and (5) satellite signal fluctuation caused by ionospheric irregularity.

P.F.M. SIGNAL PROCESSING
C.M. Stout, Proc. Nat. Telem. Conf., no. 3-5, May 1962.

. . . problems presented to the ground processing system through the use of several variations of the basic P.F.M. system . . . Since this particular type of modulation is relatively new, off the shelf items were not available . . . Ground Processing of Explorer XII Signals . . .

SATELLITE TO STUDY "SPACE WEATHER"
National Aeronautics and Space Administration, Washington, D.C., News Release No. 62-206, 30 Sept. 1962, 18 p., N64-11198.

. . . description is presented of the S-3a Explorer satellite and the Delta launch vehicle. The objective of the satellite is to describe completely the trapped corpuscular radiation, solar particle, cosmic radiation, and the solar winds, and to correlate the particle phenomena with magnetic field observation.

SATELLITE ATTITUDE DETERMINATION: DIGITAL SENSING AND ON-BOARD PROCESSING
J.S. Albus, et al., IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 53/63.

. . . discusses in general the attitude determination problem for spin stabilized satellites using a digital aspect sensor system, and describes in some detail attitude determination systems used and to be used on seven NASA satellites.

. . . include those flown on Explorer X, XII, XIV, XV, as well as those to be flown on the atmospheric Structures Satellite (S-6), the Relay Satellite, and the Interplanetary Monitoring Probe (IMP). . . .

RESULTS ON GAMMA-RAY ASTRONOMY FROM EXPLORER XI
G. W. Clark, et al., In: Space Research III; Proceedings of the Third International Space Science Symposium, Washington, D. C., May 2-8, 1962, Edited by Wolfgang Priester, Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers Division, John Wiley and Sons, Inc., 1963, p. 1087/1096, A63-20018.

REVIEW OF METEOROID ENVIRONMENT BASED ON RESULTS FROM EXPLORER XIII AND EXPLORER XVI SATELLITES
C. T. D'Aiutolo, COSPAR, International Space Science Symposium, 4th Warsaw, Poland, June 3-11, 1963, Paper, 30 p., 20 refs. A63-18797.

EXPLORER XII SATELLITE INSTRUMENTATION FOR THE STUDY OF THE ENERGY SPECTRUM OF COSMIC RAYS
U. D. Desai, et al., Washington, NASA, NASA TN D-1698, May 1963, 19 p., 3 refs., N63-16426.

. . . describes the signal conditioning and programing processes required to digitize, store, and read-out the data from the various detectors used in cosmic-ray instrumentation aboard the Energetic Particles Satellite, Explorer XII. . . .

THE EFFECT OF SOLAR RADIATION PRESSURE ON THE SPIN OF EXPLORER XII
F. V. Fedor, Washington, NASA, NASA TN D-1855, Aug. 1963, 16 p., 5 refs., N63-19735.

EXPLORER 12 OBSERVATIONS OF THE MAGNETOSPHERIC BOUNDARY AND THE ASSOCIATED SOLAR PLASMA ON SEPTEMBER 13, 1961
J. W. Freeman, et al., J. Geophys. Res., vol. 68, no. 8, April 15, 1963, p. 2121/2130, 33 refs., N63-22449.

. . . Phenomena at and near the boundary of the magnetosphere during the prolonged initial phase of a mild magnetic storm were observed with a variety of magnetic field and particle detectors . . . Possible relationships between these observations and the "third radiation belt" of Gringauz are considered . . .

THE EXPLORER XVI MICROMETEOROID SATELLITE, SUPPLEMENT II, PRELIMINARY RESULTS FOR THE PERIOD MARCH 3, 1963 THROUGH MAY 26 1963
E. C. Hastings, Jr. (comp.), Washington, NASA, NASA TM X-899, September 1963, 33 p., 6 refs., N63-20334.

THE EXPLORER XVI MICROMETEOROID SATELLITE, SUPPLEMENT III, PRELIMINARY RESULTS FOR THE PERIOD MAY 27, 1963, THROUGH JULY 22, 1963
E. C. Hastings, Jr., Washington, NASA, NASA TM X-949, March 1964, 38 p., refs., N64-16692.

Both of the telemetry systems have ceased to transmit usable experimental data. Power supply systems were operating satisfactorily when these failures occured, and telemetry temperatures were below design limits in both cases. Punctures were recorded in 44 of the 0.001-in.-thick beryllium-copper pressurized cells and in 11 of the 0.002 in.-thick beryllium-copper pressurized cells . . . Impact detector data indicate higher impact rates than those found in previous impact detector experiments . . .

PROGRAMMER ELECTRONICS. ATMOSPHERIC STRUCTURE SATELLITE EXPLORER XVII (S-6)
J. N. Libby, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TM X-50997; NASA X-632-63-068, Aug. 1963, 70 p., N64-10095.

. . . Instrumentation . . . command programmer system . . . circuit descriptions . . . includes program sequence, the experimental selector switch, calibrators, and squib circuitry . . . mass spectrometer calibrators, calibrator electronics and sequencer electronics.

CATALOGUE OF SATELLITE OBSERVATIONS NO. C-35
B. Miller, Smithsonian Astrophysical Observatory, Cambridge, Mass., SAO Special Rept. 131, July 18, 1963, 77 p., N64-10348.

. . . A catalogue of observations of the Echo I and Explorer VIII satelites . . . during the period from July 1 through December 31, 1962 . . . observations . . . from the SAO Baker-Nunn camera stations . . . Moonwatch teams, from U.S. and foreign observatories, military stations, Phototrack stations, and miscellaneous observers.

RESPONSE OF MODIFIED REDHEAD MAGNETRON AND BAYARD-ALPERT VACUUM GAUGES ABOARD EXPLORER XVII
G. P. Newton, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TN D-2146, Feb. 1964, 13 p., refs., N64-15796.

Two Redhead and two Bayard-Alpert gauges were used in the satellite Explorer XVII to measure the density, pressure, and temperature of the earth's upper atomosphere . . . Comparison of the independent gage outputs yielded values in good agreement with kinetic theory predictions.

EXPLORER VI AND PIONEER V DATA. VOLUME II: A COMPENDIUM OF EXPLORER VI DATA
A. Rosen, et al., Space Technology Labs., Inc., Redondo Beach, Calif., Washington NASA, Oct. 1963, 170 p., 14 refs., N63-22806.

. . . data obtained from the scintillation-counter experiment and the search coil magnetometer experiments on the Explorer VI satellite are presented graphically . . .

VELOCITY DISTRIBUTIONS OF THE INTERPLANETARY PLASMA DETECTED BY EXPLORER 10
F. Scherb, COSPAR, International Space Science Symposium, 4th, Warsaw, Poland, June 3-11, 1963 Paper, 48 p., A63-18569.

Analysis of the plasma data recorded by Explorer 10 . . . The instrumentation and measurement procedures are reviewed. . . .

THE EXPLORERS
I. Stambler, Space/Aeronautics, vol. 41, Feb. 1964, p. 38/46, A64-15356.

. . . including descriptions of orbits, weights, payloads, boosters, and present and future orbital experiments. . . .

FIRST RESULTS FROM THE EXPLORER XVI MICROMETEOROID SATELLITE
Trans. Amer. Geophys. Union, vol. 44, June 1963, p. 648/652, A63-19982.

EXPLORER XVI STOPS TRANSMITTING DATA. RESULTS TERMED SIGNIFICANT
National Aeronautics and Space Administration, Washington, D.C., News Release No. 63-203, Sept. 15, 1963, 5 p., N63-23359.

. . . meteoroid satellite . . . ceased transmitting . . . after seven and one-half months of satisfactory performance . . . there were more than 15,000 meteoroid hits recorded by microphone impact sensors which covered about one-tenth of the total exposed experiment surface. . .

MICROMETEOROID SATELLITE (EXPLORER XIII) STAINLESS-STEEL PENETRATION RATE EXPERIMENT
Washington, NASA, NASA TN D-1986, Oct. 1963, 48 p., refs., N64-10182.

. . . development of the experiment and the conclusions drawn from the satellite's brief lifetime in orbit.

NASA TO LAUNCH AIR DENSITY EXPLORER
National Aeronautics and Space Administration, Washington, D.C., News Release No. 63-271, 17 Dec. 1963, 12 p., N64-11779.

. . . Plans are underway to launch the inflatable, spherical satellite, Air Density Explorer, by a Scout vehicle, according to an announcement from NASA . . . objectives of the mission . . .

Related Publications:

SATELLITE ATTITUDE DETERMINATION: DIGITAL SENSING AND ON-BOARD PROCESSING
J.S. Albus, et al., IEEE Trans. Space Electronics Telemetry, vol. SET-9, no. 3, Sept. 1963, p. 71/77.

. . . Some interesting results of aspect measurements on Explorer XII showed an unexpected increase in spin rate due to solar pressure, and on Explorer XIV an erratic precession history. . . .

A MAGNETIC CORE VOLTAGE-TO-FREQUENCY CONVERTER
S. Paull, IEEE Trans. Space Electronics Telemetry, vol. SET-9, no. 1, March 1963, p. 12/18.

. . . Design experience with this device has been chiefly in connection with . . . Explorer VIII . . . Explorer X . . . Explorer XII, and the first International Satellite UK-1. . . .

4B.848: Project FR-1

Principal Publications:

FRANCE AND BRITAIN PREPARE TO STRIKE OUT INTO SPACE ON OWN
W. Beller, Missiles and Rockets, vol. 12, June 17, 1963, p. 15/18, A63-18342.

. . . The UK3 satellite will be designed, instrumented and completely tested in Britain before delivery to the U. S. in 1966 for launching. . . . Nord Aviation will build an all-French satellite, the FR-1, which will contain a novel experiment for checking out the present theory of electromagnetic wave propagation. . . . Diamant three-stage rocket with which France hopes to launch a satellite in 1965. . . .

MEASUREMENTS IN THE FR-1 SATELLITE (In French)
C. Fayard, Onde Elect., vol. 43, no. 440, Nov. 1963, p. 1119/1124.

After a brief account of the operating conditions on board the satellite FR-1, the writer discusses the problems presented by the transmission of the measured parameters. The accuracy with which it is necessary to transmit the various kinds of intelligence and the complexity involved in disentangling the recorded parameters make it necessary to have the use of a highly specialized telemetry system.

FRENCH NATIONAL REPORT (RAPPORT NATIONAL FRANCAIS)
COSPAR, International Space Science Symposium, 4th, Warsaw, Poland, June 3-11, 1963, Paper, 31 p., A63-22778.

. . . A table supplies detail on the 47 rocket launchings made between May 1962 and Feb. 1963. . . . program for the preparation of the FR-1 satellite. . . .

4B.850: Project GREB

Principal Publications:

ROTATIONAL DECAY OF SATELLITE 1960 ETA 2 DUE TO THE MAGNETIC FIELD OF THE EARTH
R. H. Wilson, Jr., In: 12th International Astronautical Congress, Proceedings, vol. 1, Washington, D. C., Oct. 1-7, 1961, New York and London, Academic Press, Inc., 1963, p. 368/379, A63-21261.

. . . results of observations of the signal null rate of Satellite Greb 1 . . .

4B.852: Project INJUN

Principal Publications:

GEOPHYSICAL RESEARCH WITH SATELLITES INJUNS I, II, AND III
B. J. O'Brien, In: Scientific Satellites, Advances in the Astronautical Sciences, vol. 12, NASA, American Association for the Advancement of Science, and American Astronautical Society, Symposium on Scientific Satellites—Mission and Design, Philadelphia, Pa., Dec. 27, 1962, Edited by Irving E. Jeter, North Hollywood, Calif., Western Periodicals Co., 1963, p. 97/125, A63-21526.

. . . design and experiments . . . carry a wide array of detectors of electrons and protons of various energies, auroral photometers, and, in the case of Injun III, a VLF experiment. . . .

THE INJUN SATELLITES
B. J. O'Brien, Naval Research Reviews, vol. 16, March 1963, p. 15/19, A63-14783.

Discussion of the Injun satellites with respect to their design features and research aims and achievements. The design of the satellites is unique in that it is aimed at aligning one axis continuously parallel to the magnetic field of Earth. The instruments carried aloft by these satellites include particle detectors to determine the intensity, angular distribution, and energy spectrum of electrons with energies between 5 kev and 6 mev and of protons between 50 kev and 100 mev. It is indicated that perhaps the most spectacular achievement of Injun I (1961 Omicron 2) was the discovery of the artificial radiation belt produced by the explosion of a 1.4-megaton bomb.

4B.854: Project LOFTI

Principal Publications:

LOFTI AND OTHER NEW DIMENSIONS IN WIRELESS COMMUNICATIONS

Frank Virden, Signal, vol. 15, July, 1961.

PENETRATION OF THE IONOSPHERE BY VERY-LOW-FREQUENCY RADIO SIGNALS INTERIM RESULTS OF THE LOFTI I EXPERIMENTS

J. P. Leiphart, et al., Naval Research Lab., Washington, D. C., NRL Rept. 5721, Nov. 1961, 27 p., AD 268 726.

LOFTI I is the first of a series of Navy satellite experiments designed for determination of the degree and extent of very-low-frequency (VLF) radio-wave penetration of the ionosphere. The LOFTI I telemetry records show relatively strong signals in the ionosphere from 81-kc transmitters on the terrestrial surface. The signals were attenuated less at night and appeared as far away as Australia, 10,000 miles from the transmitter. Statistical treatment of the data so far reduced shows that the attenuation of magnetic-field intensity of the 18-kc time pulses from Naval Radio Station NBA, as measured near extreme line-of-sight distances to the north of the station, was less than 13 db 50% of the time at night and less than 38 db 50% of the time during the daylight hours. The data studied so far show very little effect of altitude on signal intensity, an observation which agrees with the theoretical treatment based on a model ionosphere. The observed time delays of the 18-kc signals range from 10 to 200 milliseconds, indicating that VLF propagation velocity in the ionosphere is much lower than in free space.

SOME REMARKS ON "PENETRATION OF THE IONOSPHERE BY VERY-LOW-FREQUENCY RADIO SIGNALS" (Correspondence)

H. Hodara, Proc. IRE, vol. 50, no. 9, Sept. 1962, p. 2000.

In a recent article, Leiphart, Zeek, Bearce, and Toth have published some interesting data furnished by the Navy satellite "LOFTI I". . . . Their conclusions . . . seem to confirm early theoretical investigations done by the writer. . . .

PENETRATION OF THE IONOSPHERE BY VERY-LOW-FREQUENCY RADIO SIGNALS--INTERIM RESULTS OF THE LOFTI I EXPERIMENT

J. P. Leiphart, et al., Proc. IRE, vol. 50, Jan. 1962, p. 6/17.

COMMENTS ON "PENETRATION OF THE IONOSPHERE BY VERY-LOW-FREQUENCY RADIO SIGNALS — INTERIM RESULTS OF THE LOFTI I EXPERIMENT" (Correspondence)

C. Altman, et al., Proc. IEEE, vol. 51, no. 1, Jan. 1963, p. 250.

. . . paper Leiphart, et al., . . . Proc. IRE, vol. 50, pp. 6/17; January, 1962.

4B.856: Project NIMBUS

Principal Publications:

NIMBUS TELEMETRY

F. L. Adkins, et al., National Aeronautics and Space Flight Center, Greenbelt, Md., In its Proc. of the Nimbus Program Review, 1962, 19 p., N63-18616 (N63-18601).

. . . Nimbus pulse code modulated (PCM) telemetry subsystem is . . . two electrically independent PCM units: unit A handles 544 channels, which it continually records on tape for readout command; unit B delivers 128 channels by direct transmission. Both units are controlled by signals from the Nimbus clock subsystem. The nimbus PCM ground station has been designed to accept all video outputs of the PCM telemetry receiver and to process, record and display the PCM telemetry data received from satellite.

NIMBUS UNDERGOES TOUGH PRELAUNCH TESTS

G. Alexander, Aviation Week and Space Technology, vol. 76, no. 4, Jan. 1962, p. 54/61.

NIMBUS COMMAND SUBSYSTEM

D. W. Gade, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Proc. of the Nimbus Program Review, 1962, 19 p., N63-18615.

. . . includes the command clock and clock receiver modules in the spacecraft, plus the associated command ground station of the Nimbus spacecraft . . . messages are transformed into frequency shift key signals on the three FM subcarriers in the modulator bay, for transmission to the satellite by means of the command transmitter.

NIMBUS ADVANCED VIDICON CAMERA SUBSYSTEM

J. E. Keigler, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Proc. of the Program Review, 1962, 23 p., N63-18618 (N63-18601).

NIMBUS COMPUTER SYSTEM DESIGN
H. G. Klose, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Proc. of the Nimbus Program Review, 1962, 23 p., N63-18621 (N63-18601).

. . . Control Data Corporation (CDC) 160A computer as part of the fixed ground-station system for Nimbus spacecraft integration and test procedures. The function of the computer is to perform the required computations, logic, formats, routing, and display of reduced results, so that Nimbus project personnel may know the "state vector" of the satellite and all of its subsystems during environmental tests . . .

ENGINEERING APPLICATIONS OF THE NIMBUS TELEMETRY
M. Schmitt, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Proc. of the Nimbus Program Review, 1962, 17 p., N63-18620 (N63-18601).

. . . Discussed are "A" and "B" directories of the Nimbus spacecraft subsystem measured functions and the sampling rate for each function . . .

NIMBUS SPACECRAFT SYSTEM CONCEPT
R. Stampfl, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Proc. of the Nimbus Program Review, 1962, 17 p., N63-18605 (N63-18601).

NIMBUS GROUND SYSTEM
L. Stelter, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Proc. of the Nimbus Program Review, 1962, 20 p., N63-18608 (N63-18601).

. . . consists of two command and data-acquisition (CDA) stations, one being established in Alaska and the other in eastern Canada . . . The Nimbus unique equipment includes a clock/command subsystem, equipment required for processing PCM telemetry data received from the spacecraft, equipment for processing the TV and IR data received from the spacecraft, and computers for additional data processing . . .

AUTOMATIC PICTURE TRANSMISSION SYSTEM
P. H. Werenfels, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Proc. of the Nimbus Program Review, 1962, 19 p., N63-18619 (N63-18601).

. . . (APTS) is composed of two subsystems: a satellite camera and a transmission subsystem, and a ground-station receiving and recording subsystem . . .

NIMBUS ATTITUDE DETERMINATION SUBSYSTEM
R. Bartlett, et al., Allied Research Associates, Inc., Concord, Mass., Final Report, ARA-9207-03-1, 7 June 1963, 96 p., N64-13340, AD 420 987.

. . . details the operational procedures and equipment requirements of a subsystem for determination of Nimbus satellite attitude by photogrammetric techniques. Coordinate measurements of landmarks and common points in adjacent triplets appearing in kinescope-generated cloud cover photographs are measured on a film reader whose output feeds a digital computer for immediate computation of attitude. This computer is programmed to test the film reader data and communicate with the film reader operator if omissions or mistakes are apparent . . .

APT USERS' GUIDE
I. Goldshlak, Allied Research Associates, Inc., Concord, Mass., ARA T9219 1, AFCRL 63 655, June 1963, 43 p., AD 409 109.

A guide to data handling techniques for the Nimbus Automatic Picture Taking (APT) subsystem . . . originally intended to be flown aboard the Nimbus satellite, an experimental TIROS APT sub-system may preceed the Nimbus flight . . .

PHASE II NIMBUS DATA-HANDLING SYSTEM
R. M. Madvig (editor), Stanford Research Inst., Menlo Park, Calif., Final rept., Jan. 1963, 190 p., AD 407 500.

. . . The design of the initial, phase I, system was reported in the first quarterly progress report, May 1962, and was essentially a less advanced system than the one reported here.

. . . Phase II . . . cloud photographs, high resolution infrared data, and medium-resolution infrared data . . . Requirements for future improvements in the data processing system are reviewed. The need to reduce the cost of data transmission is emphasized as the most important future requirement.

NIMBUS: WEATHER EYE OF THE WORLD
E. Murch, Challenge, vol. 2, Spring 1963, p. 6/11, A63-14858.

Description of the design characteristics, principles of operation, and advanced equipment of the NIMBUS meteorological satellite. In addition, the various weather missions to be carried out by this satellite system are outlined. Drawings of NIMBUS and of its control system are included.

NIMBUS SPACECRAFT DEVELOPMENT
H. Press, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA RP-10, 1963, 4 p., 2 refs., Rept. from Astronautics and Aerospace Eng., April 1963, N63-21389.

. . . Performance of the Nimbus spacecraft is monitored by a 672-channel telemetry subsystem. Other subsystems . . . (1) an Advanced Vidicon Camera Subsystem . . . and two S-band transmitters and antennas (2) an Automatic Picture Transmission Subsystem . . . (3) a five-channel Medium-Resolution Infrared Radiometer, and (4) a High-Resolution Infrared Radiometer.

PROCEEDINGS OF THE NIMBUS PROGRAM REVIEW (HELD AT VALLEY FORGE, PA.) NOVEMBER 14-16, 1962
H. Press, et al., National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md., NASA TM X 50151, NASA X 650 62 226, 405 p., 11 refs., N63-18601.

A MEDIUM DATA RATE DIGITAL TELEMETRY SYSTEM
M. Townsend, et al., Rec. Nat. Space Electronics Symp., no. 1.4, 1963.

. . . Earth orbiting satellites . . . system with 10^7 bit storage . . . provided by a tape recorder . . . Hardware applicable to the radiation experiments on the TIROS and Nimbus meteorological satellites has been built . . .

4B.862: Project OAO

Principal Publications:

NASA PREPARING ASTRONOMICAL SATELLITE
F. G. McGuire, Missiles & Rockets, vol. 6, no. 11, March 1960, p. 26/31.

DATA HANDLING EQUIPMENT FOR THE OAO SATELLITE
J. D. Corry, Proc, Nat. Telem. Conf., no. 3-6, May 1962, p. 1/10.

. . . Two types of Sapcecraft Data Handling Equipment are used in the OAO Satellite to reorganize digital and analog input information into a standard output format. The first (SDHE) is synchronized to spacecraft gimbal command information (12 gimbals) and monitors performance. The second (EDHE) is an asynchronous monitoring equipment for the various experiments conducted within the spacecraft.

ULTRAVIOLET INSTRUMENTATION FOR CELESCOPE — AN ASTROPHYSICAL RECONNAISSANCE SATELLITE
R. J. Davis, et al., Applied Optics, vol. 1, March 1962, p. 131/137.

PROJECT CELESCOPE: AN ASTROPHYSICAL RECONNAISSANCE SATELLITE
R. J. Davis, Smithsonian Institution, Cambridge, Mass., Astrophysical Observatory, SAO Spec. Rept. 110 Dec. 14, 1962, 118 p., 48 refs., N63-19948, supersedes SAO Special Report 83.

. . . (1) experimental objectives; (2) experimental instrumentation; (3) requirements for the spacecraft; (4) ground-support system; and (5) data reduction.

PROJECT CELESCOPE. AN ASTROPHYSICAL RECONNAISSANCE SATELLITE
R. J. Davis, Astrophysical Observatory, Smithsonian Institution, Cambridge, Mass., Special rept. no. 83, 31 Jan. 1962, 68 p., incl. illus., tables, 35 refs., AD 274 029.

DATA HANDLING EQUIPMENT (OAO) REDUNDANT DESIGN ITS TRADE-OFFS AND PERFORMANCE ANALYSIS
K. L. Hall, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 7.3, Oct. 1962.

. . . There are two types of data handling equipment in the Observatories; The Spacecraft Data Handling Equipment (SDHE), and the Experimenters' Data Handling Equipment (EDHE). The SDHE is synchronized to the gimbal command information of the spacecraft and monitors the performance of other variable parameters. The EDHE is an asynchronous monitoring system that has the versatility to accommodate the many different experiments planned for later generation satellites. . . .

DATA PROCESSING FOR THE GODDARD EXPERIMENT
D. S. Kushner, Rec. Nat. Symp. Space Electronics Telemetry, no. 4.4, Oct. 1962.

. . . deisgned to measure the ultraviolet radiation from stars over a range of spectral wavelengths. The Data Processing Subsystem of the experiment accumulates and processes the experimental data and controls the performance of the experiment.

Six parallel data channels accumulate pulses that represent the intensity of radiation at six different incremental portions of the ultraviolet spectrum. . . . sequentially sampling. . . automatically. . . Data accumulated. . . stored in spacecraft memory. Compression techniques are employed to reduce the number of bits that must be stored. . . .

OAO: NASA'S BIGGEST SATELLITE YET
O. Romaine, Space Aeronautics, vol. 37, no. 2, Feb. 1962, p. 54/58.

HERMETICALLY SEALED NICKEL-CADMIUM BATTERIES FOR THE ORBITING ASTRONOMICAL OBSERVATORY SATELLITE
R. C. Shair, American Rocket Society, Space Power Systems Conference, Santa Monica, Calif., Sept. 25-28, 1962, Paper 2508-62, 8 p., A63-11720.

THE OAO. A SPACE LABORATORY
D. J. Shergalis, ISA Proceedings, vol. 8, 1962, p. 85/96, A63-12218.

Discussion of the requirements for a space-stabilized platform for the Orbiting Astronomical Observatory, which is intended to overcome the limitations of the atmosphere on astronomical observations. . . . A description of a friction-free, air-bearing table designed to demonstrate the operation of the spacecraft in simulated space conditions is included.

THE NASA ORBITING ASTRONOMICAL OBSERVATORY
R. Stroup, et al., 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. 515/527, A64-15031.

. . . the most complex scientific satellite being developed for NASA. . . . can be pointed anywhere in the celestial sphere with a precision far beyond that realized by contemporary satellites. . . .

DIGITAL COMPUTER APPLICATIONS OF BOSS GENERAL CATALOGUE OF STARS (1950.0)
P. S. Washington, NASA, Technical Rept. no. 5, NASA TM X-50150, NASA-X-543-62-143, July 27, 1962, 24 p., N63-18292.

A television camera with an 8.3^{o} X 8.3^{o} field of view in the OAO (Orbiting astronomical Observatory) is planned. To help determine the star field that might be presented to a ground observer of the TV screen, the Boss General Catalogue of 33,342 stars has been written on magnetic tape. . .

DYNAMIC ANALYSIS OF OAO SPACECRAFT MOTION BY ANALOG-DIGITAL SIMULATION
G. Zetkov, et al., IRE Internat. Conv. Rec., Pt. 5, vol. 10, March 1962, p. 282/296.

THE MISSION OF THE ORBITING ASTRONOMICAL OBSERVATORY
R. R. Ziemer, et al., In: Scientific Satellites. Advances in the Astronautical Sciences, Vol. 12, NASA, American Association for the Advancement of Science, and American Astronautical Society, Symposium on Scientific Satellites - Mission and Design, Philadelphia, Pa., Dec. 27, 1962, Edited by Irving E. Jeter, North Hollywood, Calif., Western Periodicals Co., 1963, p. 217/233, A63-21531.

. . . basic objectives. . . observing equipment now under development for the first three observatories. . .

ORBITING ULTRAVIOLET SYSTEM WILL MAP STARS AND THE SKY'S RADIANT INTENSITY
Electronics, vol. 35, no. 8, Feb. 1962, p. 22/23.

Digital TV, a recently-developed ultraviolet tv pickup tube and large, precision optics will get practical space tests in late 1963 or early 1964 when National Aeronautics and Space Administration launches the first Orbiting Astronomical Observatory (OAO). . . .

OAO IMAGE CONVERTER RESEARCH
J. Burns, Chicago U., Ill. Labs for Applied Sciences, Final Report, LAS-TR-226-3, 1963, 38 p., refs., N64-14840.

Performance requirements are defined for image converters that are used in conjunction with advanced generations of orbiting astronomical telescopes. . . include use of the image converter in various classes of observations that can be performed to advantage from an orbiting observatory. . .

OAO INITIAL STABILIZATION AND CONTROL
J. M. Cook, et al., Astronautics and Aerospace Engineering, vol. 1, Sept. 1963, p. 88/95, A63-21546.

. . . evaluation of OAO motion during the coarse and fine solar orientation phases, and the initial part of the stellar acquisition phase, referred to as stellar search. . . .

ORBITING OBSERVATORY
R. Cuikay, et al., Electronics, vol. 37, Feb. 28, 1964, p. 28/31, A64-15115.

Description of the Orbiting Astronomical Observatory. . . It will carry a 32-inch telescope and spectrometric equipment. . . Seven photon counting channels will be used. . . .

FINE GUIDANCE SENSOR FOR HIGH PRECISION CONTROL OF THE OAO
N. A. Gundersen, American Institute of Aeronautics and Astronautics, Summer Meeting, Los Angeles, Calif., June 17-20, 1963, Paper 63-211, 12 p., A63-18437, N63-18215.

Description of the fine guidance sensor of the Cassegrain telescope which is to be mounted on the Orbiting Astronomical Observatory as part of the Princeton Experiment to investigate the extremely fine absorption lines which are expected to be observed when examining the radiation from selected stars. . . . electronics for signal processing. . . automatic gain control. . . .

GROUND OPERATION EQUIPMENT FOR THE ORBITING ASTRONOMICAL OBSERVATORY
E. J. Habib, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TN D-1856, Dec. 1963, 24 p., Presented at the Inst. of Aerospace Vehicles Symp., San Francisco, 19 Feb. 1962, N64-11622.

. . . Orbiting Astronomical Observatory (OAO) is a precisely stabilized satellite. . . will be controlled by ground operation equipment at remote control stations; this equipment will transmit operating commands which have been verified on an operational simulator that includes a large-scale digital computer. Suitable safeguards are incorporated to prevent irreversible command from being transmitted to the satellite. An auxiliary realtime control mode is provided by connecting one remote control station by microwave link to a Central Control Station. The Central Control Station control and display equipment provides a quick-look capability for evaluating the spacecraft status by means of a printer and novel "index-card"-type display system.

A REALISTIC PART SCREENING PROGRAM FOR IMPROVING THE RELIABILITY OF SPACE ELECTRONIC EQUIPMENT
A. L. Heydrick, Rec. Nat. Space Electronics Symp., no. 2.3, 1963.

. . . designed to improve part reliability by weeding out early life failures, stabilizing part parameters, and eliminating parts with abnormal parameter drifts. The program was developed by EMR for the Celescope electro-optical satellite as an economical and time saving approach to improving part reliability. . . .

PRIMARY PROCESSOR AND DATA STORAGE EQUIPMENT FOR THE ORBITING ASTRONOMICAL OBSERVATORY
T. B. Lewis, IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 1963, p. 677/687.

. . . a low-power, long-life, high-density command and memory system has been designed and is currently undergoing qualification testing. The digital command storage and processing element will permit storage reprogramming of spacecraft orientation and astronomical experiments on each orbit, even when the satellite is not in contact with the ground, while the core memory element will permit storage of experiment data for subsequent transmission to the ground. . . . the functional design of the satellite command and memory system is discussed in detail. In addition, the power conservation methods, reliability design techniques and environmental performance considerations which influenced the design of this equipment are reviewed.

MOMENTUM CONTROL OF THE OAO SPACECRAFT UTILIZING THE EARTH'S MAGNETIC FIELD
M. Paiken, et al., International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 32, 43 p., 16 refs., A63-25666.

. . . preliminary design of an advanced control technique which is incorporated in the Orbiting Astronomical Observatory (OAO) . . . momenta of inertia wheels, which provide the basic control torques, are regulated by torques created by the interaction of current-carrying coils with the Earth's magnetic field. . . .

THE ORBITING ASTRONOMICAL OBSERVATORIES
J. B. Rogerson, Jr., Space Science Reviews, vol. 2, Nov. 1963, p. 621-652, 8 refs., A64-14780.

. . . detailed description. . . designed to have at least a 70% probability for one year of useful lifetime in orbit. . .

THE ORBITING ASTRONOMICAL OBSERVATORY AND THE ORBITING SOLAR OBSERVATORY
N. G. Roman, NASA, Washington, D. C., 14 Aug. 1963, 13 p., N63-19369.

THE ENGINEERING DESIGN OF THE ORBITING ASTRONOMICAL OBSERVATORY
W. H. Scott, Jr., In: Scientific Satellites. Advances in the Astronautical Sciences, Vol. 12, NASA, American Association for the Advancement of Science, and American Astronautical Society, Symposium on Scientific Satellites-Mission and Design, Philadelphia, Pa., Dec. 27, 1962, Edited by Irving E. Jeter, North Hollywood, Calif., Western Periodicals Co., 1963, p. 235/255. A63-21532.

. . . accurately stabilized unmanned platform for astronomical observations. . . can handle optical systems up to 48-in. diam. . . . control, communications and ground operations, data processing, and power supply.

TRANSCRIPT OF THE PHOTOVOLTAIC SPECIALISTS CONFERENCE. VOLUME II. REPORT ON SYSTEMS EXPERIENCE, APPLICATIONS, AND DESIGN, 11 APRIL 1963 AT THE STATLER HILTON HOTEL, WASHINGTON, D. C.
Power Information Center, U. of Pennsylvania, Philadelphia, Rept. no. PIC SQL209 3.1, Vol. 2, July 1963, lv., AD 412 463.

. . . Design of OAO Solar Cell Arrays;

4B.864: Project OGO

Principal Publications:

THE ORBITING GEOPHYSICAL OBSERVATORY - NEW TOOL FOR SPACE RESEARCH
G. H. Ludwig, Astronautics, vol. 7, May 1962, p. 24/27.

THE ORBITING GEOPHYSICAL OBSERVATORIES
W. E. Scull, et al., Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2287/2296.

TELEMETRY DATA PROCESSING FOR THE ECCENTRIC ORBITING GEOPHYSICAL OBSERVATORY SATELLITE
R. Coates, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TM X-51259; NASA X-545-63-212, Oct. 1963, 21 p., refs., N64-11812.

. . . PCM telemetry data rates of 1000, 8000, or 66,000 bits/sec, selectable by ground command. . . data storage for low-speed

data (1000 bits/sec) plus about 40 percent ground station coverage of each orbit for data acquisition at any of the bit rates. . . anticipates receiving an average of 6000 bits/sec for a period of 6 months, or a total of about 10^{11} bits. The high-speed data processing system for the high volume of data consists of two processing lines plus a large-scale digital computer. The processing lines convert the analog recordings of the PCM telemetry signals to digital magnetic tapes in computer format. The computer then performs quality control and decommutation of the data into separate digital tapes for each experimenter.

THE ORBITING GEOPHYSICAL OBSERVATORY COMMUNICATION AND DATA HANDLING SYSTEMS

P. F. Glaser, Proc. Nat. Telem. Conf., vol. 2, no. 3-3, May 1963.

THE ENGINEERING DESIGN OF THE ORBITING GEOPHYSICAL OBSERVATORIES

G. J. Gleghorn, In: Scientific Satellites. Advances in the Astronautical Sciences, Vol. 12, NASA, American Association for the Advancement of Science, and American Astronautical Society, Symposium on Scientific Satellites-Mission and Design, Philadelphia, Pa., Dec. 27, 1962, Edited by Irving E. Jeter, North Hollywood, Calif., Western Periodicals Co., 1963, p. 149/174, A63-21528.

. . . active thermal-control system, a wideband telemetry system with both real-time and data-storage capability. . . silicon solar-cell power supply. . . .

THE ORBITING GEOPHYSICAL OBSERVATORIES

G. H. Ludwig, National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md., NASA RP-130, Repr. from Space Sci. Rev. (Dordrecht), v. 2, 1963, p. 175/218, refs., N64-15554.

. . . designed to conduct large numbers of diverse experiments. . . Power, thermal control, and data-handling subsystems provide for the proper operation of the experiments and telemetry of the data. Ground stations receive these data, which are then processed into a form suitable for use by the experimenters . . . designed to make available a standard spacecraft and support equipment that can be used repeatedly to carry large numbers of easily integrated experiments in a wide variety of orbits.

COSMIC RAY EXPERIMENTS FOR EXPLORER XII AND THE ORBITING GEOPHYSICAL OBSERVATORY

G. H. Ludwig, et al., In: Space Research III; Proceedings of the Third International Space Science Symposium. Washington, D. C., May 2-8, 1962. Edited by Wolgang Priester, Amsterdam, North Holland Publishing Co.; New York, Interscience Publishers Division, John Wiley and Sons, Inc., 1963, p. 1129/1143, A63-20022.

THE DESIGN OF THE ATTITUDE CONTROL SYSTEM FOR THE ORBITING GEOPHYSICAL OBSERVATORY

D. D. Otten, Space Technology Labs., Inc., Redondo Beach, Calif., 14 Dec. 1962, 30 p., refs., Presented at the 14th Intern. Astronautical Congr., Paris, 25 Sept. - 1 Oct. 1963, IAC Paper 31; Rept. 2313-6006-MU000, N64-11893.

. . . maintains one body axis of the satellite in alignment with local vertical. In addition, the angular orientation of the satellite body about local vertical is controlled, along with a single-degree-of-freedom solar array, to maintain the solar cells perpendicular to the sun's rays. Further, a package (OPEP) free to rotate with respect to the body about local vertical is kept at all times aligned in the orbit plane. . .

ATTITUDE CONTROL FOR AN ORBITING OBSERVATORY: OGO

D. D. Otten, Control Engineering, vol. 10, Dec. 1963, p. 81/85, A64-10864.

Discussion of the challenging task of designing a seemingly simple attitude-positioning control system for a scientific satellite, from hard, irreducible specifications. . . positioning must be accurate and nearly continuous for a design life of one year. . . .

THE ORBITING GEOPHYSICAL OBSERVATORY TEST PROGRAM

M. C. Peterson, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 362/373.

. . . electrical and mechanical checkout procedures and equipment used in its qualification and acceptance testing. The Integrated Systems Test approach incorporating semi-automatic test programming and spacecraft evaluation is described after disclosure of previous test cycles and the test program objectives. . . .

THE MISSION OF THE ORBITING GEOPHYSICAL OBSERVATORIES
W. E. Scull, In: Scientific Satellites. Advances in the Astronautical Sciences, Vol. 12, NASA, American Association for the Advancement of Science, and American Astronautical Society, Symposium on Scientific Satellites-Mission and Design, Philadelphia, Pa., Dec. 27, 1962, Edited by Irving E. Jeter, North Hollywood, Calif., Western Periodicals Co., 1963, p. 127/148, A63-21527.

THE OGO SATELLITES
I. Stambler, Space/Aeronautics, vol. 39, Feb. 1963, p. 70/77, A63-12124.

Description of the design of the OGO (Orbiting Geophysical Observatory) satellites, which are intended to provide data on the intensity and behavior of charged particles in the Earth's atmosphere, on the Earth's magnetic field, and on other atmospheric phenomena. . . .

4B.866: Project ORBIS

Principal Publications:

ORBIS: AN IONOSPHERIC TRAPPING EXPERIMENT
J. P. Mullen, et al., Rec. Nat. Commun. Symp., vol. 9, Oct. 1963, p. 297/301.

. . . consists of synoptic observations of an orbiting two-frequency beacon. The purpose of the experiment is to investigate ionospheric ducting by ground reception of the signals. Qualitative analysis and ray tracings are used to describe the pertinent mechanism. Toward the end of 1963, the ORBIS experiment will be launched. ORBIS, the mnemonic for Orbiting Radio Beacon Ionospheric Satellite, is the first attempt to perform a synoptic study of near critical frequencies transmitted from within the ionosphere. . . . riding "piggyback" on an established and scheduled experimental vehicle. . . The ORBIS payload consists of two beacons, each of one watt nominal output, transmitting continuously on frequencies of 5.002 and 10.004 respectively. In addition, a few milliwatts will be "leaked" on 15.006 for tracking purposes.

4B.868: Project OSO

Principal Publications:

THE HARVARD SOLAR SATELLITE PROJECT
W. Liller, J. Quant. Spectrosc. Radiat. Transfer., vol. 2 (1962), p. 519/526, 7 refs., N63-18354.

. . . instrumentation for an Orbiting Solar Observatory which is scheduled to be launched in 1963. Planned is a scanning spectrometer which will operate in the wavelength range from 500 to 1500 A. . . . a command system will allow an operator on the earth to stop the spectral scan at any desired wavelength.

ONE APPROACH TO THE ENGINEERING DESIGN OF THE ADVANCED ORBITING SOLAR OBSERVATORY
A. J. Cervenka, In: Scientific Satellites, Advances in the Astronautical Sciences, vol. 12, NASA, American Association for the Advancement of Science, and American Astronautical Society, Symposium on Scientific Satellites-Mission and Design, Philadelphia, Pa., Dec. 27, 1962, Edited by Irving E. Jeter, North Hollywood, Calif., Western Periodicals Co., 1963, p. 187/215, A63-21530.

. . . systems and subsystems design problems . . . spacecraft stabilization and control . . . tracking and data handling, experiment data capacity . . . communications and data handling subsystem, command assembly, wideband and narrow-band telemetry assembly, timing and synchronization assembly, and power supply.

THE ORBITING SOLAR OBSERVATORY SPACECRAFT
F. P. Dolder, et al., In: Space Research III; Proceedings of the Third International Space Science Symposium, Washington, D. C., May 2-8, 1962, Edited by Wolfgang Priester, Amsterdam, North-Holland Publishing Co., New York, Interscience Publishers Division, John Wiley and Sons, Inc., 1963, p. 1207/-1215, A63-20030.

Brief description of the main features of the OSO-1. . . . The spacecraft has onboard data recording capability that can store 90 min. of data, which are played back over the transmission system of the vehicle in 5 min. upon ground command. The pointing system has directed the instruments at the Sun with an accuracy of approximately 2 min. in azimuth angle and 2.5 min. in elevation. The temperature inside the satellite has stabilized to 5°C, and excellent radio transmission has been received.

SCIENTIFIC RESULTS OF OSO-1
J. C. Lindsay, American Institute of Aeronautics and Astronautics, Canadian Aeronautics and Space Institute, and Royal Aeronautical Society, Anglo-American Conference, 9th, Cambridge, Mass., Oct. 16-18, 1963, and Montreal, Canada, Oct. 21-24, 1963, Paper 63-470, 34 p., 18 refs., A63-24944, N64-11799.

Review of some of the results obtained from observations of the Sun by the Orbiting Solar Observatory . . . for a period corresponding to approximately three solar rotations on an almost continuous basis, and on a real-time over-the-ground-stations basis for approximately one year. Design characteristics and instrumentation of the spacecraft are briefly described. . . .

THE MISSION OF THE ADVANCED ORBITING SOLAR OBSERVATORY
J. C. Lindsay, In: Scientific Satellites, Advances in the Astronautical Sciences, vol. 12, NASA, American Association for the Advancement of Science, and American Astronautical Society, Symposium on Scientific Satellites-Mission and Design, Philadelphia, Pa., Dec. 27, 1962, Edited by Irving E. Jeter, North Hollywood, Calif., Western Periodicals Co., 1963, p. 175/186, A63-21529.

OSO 2 INSTRUMENTS WILL SCAN SOLAR DISK
B. Miller, Aviation Week and Space Technology, vol. 80, Jan. 13, 1964, p. 52/53+, A64-14106.

. . . The purpose of this elaborate and expanded instrumentation is to measure electromagnetic radiation in the ultraviolet, X-ray and gamma ray regions of the spectrum and to study time variations of these emissions. . . .

THERMAL ANALYSIS OF THE AFCRL SCANNING SPECTROMETER FOR THE S-57 ORBITING SOLAR OBSERVATORY SATELLITE (OSO-C)
L. L. Olbrys, Comstock and Westcott, Inc., Cambridge, Mass., Scientific rept. no. 1, AFCRL 63 700, 12 July 1963, 1v., AD 422 480.

. . . will be mounted externally to the . . . S-57 . . . The analysis was performed by dividing the spectrometer into a number of discrete zones and obtaining an instantaneous heat balance equation for each zpne . . . simple differential equation defining the mean temperature . . . day phase . . . night phase . . . comparison . . . results obtained using an IBM-7090 computer . . . number of orbits required for the stabilization temperature to occur . . .

THE ORBITING ASTRONOMICAL OBSERVATORY AND THE ORBITING SOLAR OBSERVATORY
N. G. Roman, NASA, Washinton, D. C., 14 Aug. 1963, 13 p., N63-19369.

S-17 OSO COMMUNICATIONS SYSTEM
P. F. Scheele, et al., Proc. Nat Telem. Conf., no. 6-1, May 1963.

. . . communications and data handling system designed for the Orbiting Solar Observatory spacecraft. . . . the first OSO (S-16) . . . utilized an FM/FM telemeter. . . . design . . . of the second OSO or S-17 program . . . indicated that some type of time multiplexing telemeter would yield a much more efficient method for ground and airborne handling of both experiment and spacecraft housekeeping data than that provided by an FM/FM telemeter. . . .

4B.872: Project RCS

Principal Publications:

RESEARCH DIRECTED TOWARD THE INVESTIGATION OF SUITABILITY OF THE GLOTRAC TYPE G TRANSPONDER FOR USE IN THE RANGE CALIBRATION SATELLITE PART A
R. Braun, General Dynamics/Astronautics, San Diego, Calif., Final Engineering rept., pt. A., AFCRL 62 240, pt. A., 1 Dec. 1963, 165 p., AD 433 038.

. . . determining what modifications in the GLOTRAC Type G Transponder are required to make the transponder suitable for operation in the Range Calibration Satellite (RCS). . . .

4B.874: Projects with S Numbers

Principal Publications:

THE IONOSPHERE BEACON SATELLITE, S-45
M. J. Aucremanne (comp. and ed.), National Aeronautics and Space Administration, Washington, D. C., NASA Tech. note D-695, Jan. 1961, 28 p., AD 252 876.

Experiments prepared by the four major contractors to NASA in connection with the Ionosphere Beacon Satellite are described. Sufficient description of the satellite is presented so that experimenters throughout the world may use the Beacon Satellite to conduct their own studies of the ionosphere.

S-45 WILL BE STUDIED AROUND THE GLOBE
J. Holmes, Missiles and Rockets, vol. 8, no. 14, April 1961, p. 16/17.

Five major scientific groups will cooperate with NASA when second try is made in late spring to launch ionosphere craft.

S-48 TO SOUND HIGH IONOSPHERE
Missiles and Rockets, vol. 8, no. 26, June 1961, p. 12/13.

Fixed-frequency satellite will measure density of electrons; Canada's S-27 to use swept frequency.

RELIABILITY ASSURANCE PROGRAM FOR THE S-3 SATELLITE SERIES
J. L. Holeman, Proc. Nat. Telem. Conf., no. 2-5, May 1962.

S-6 SATELLITE TO PROBE EARTH'S ATMOSPHERE
E. H. Kolcum, Aviation Week and Space Technology, vol. 76, no. 1, Jan. 1962, p. 56/57.

SATELLITE TO STUDY "SPACE WEATHER"
National Aeronautics and Space Administration, Washington, D. C., News Release No. 62-206, 30 Sept. 1962, 18 p., N64-11198.

. . . description is presented of the S-3a Explorer satellite and the Delta launch vehicle. The objective of the satellite is to describe completely the trapped corpuscular radiation, solar particle, cosmic radiation, and the solar winds, and to correlate the particle phenomena with magnetic field observation.

SATELLITE ATTITUDE DETERMINATION: DIGITAL SENSING AND ON-BOARD PROCESSING
J. S. Albus, et al., IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 53/63.

. . . discusses in general the attitude determination problem for spin stabilized satellites using a digital aspect sensor system, and describes in some detail attitude determination systems . . . to be flown on the Atmospheric Structures Satellite (S-6), . . .

THE NASA TOPSIDE SOUNDER PROGRAM
L. J. Blumle, et al., In: Scientific Satellites, Advances in the Astronautical Sciences, vol. 12, NASA, American Association for the Advancement of Science, and American Astronautical Society, Symposium on Scientific Satellites-Mission and Design, Philadelphia, Pa., Dec. 27, 1962, Edited by Irving E. Jeter, North Hollywood, Calif., Western Periodicals Co., 1963, p. 65/95, 35 refs., A63-21525.

. . . fixed-frequency topside-sounder satellite S-48 . . . design . . . is compared with that of the Alouette . . . The different data-analysis techniques of the two satellites are discussed.

S-6 - AN AERONOMY SATELLITE
R. Horowitz, In: Scientific Satellites, Advances in the Astronautical Sciences, vol. 12, NASA, American Association for the Advancement of Science, and American Astronautical Society, Symposium on Scientific Satellites-Mission and Design, Edited by Irving E. Jeter, North Hollywood, Calif., Western Periodicals Co., 1963, p. 19/39, A63-21523, N63-23414.

Review of the mission and design considerations . . . including . . . primary power supply, . . . telemetry, ground support, and command system. . . .

FIRST RESULTS IN NASA TOPSIDE SOUNDER SATELLITE PROGRAM
J. E. Jackson, et al., In: Advances in the Astronautical Sciences, vol. XI, American Astronautical Society, Annual Meeting, 8th, Washington, D. C., Jan. 16-18, 1962, Proceedings, Edited by Horace Jacobs, North Hollywood, Calif., Western Periodicals Co., 1963, p. 61/85, A64-11446.

Presentation of the preliminary results of the NASA S-27/S-48 Topside Sounder Satellite Program carried out in order to investigate the ionosphere above the height of maximum ionization, using a two-frequency radio-pulse sounder. Reflections from the topside of the ionosphere were obtained on one or both frequencies during 13 of the 15 minutes that the payload was above the maximum electron-density level in the ionosphere. Unexpected effects were observed as the sounder passed through the levels in the ionosphere where the plasma frequency was equal to the sounding frequency. Some evidence of the presence of ionization irregularities at altitudes between 700 and 950 km was obtained. "Spread F" returns were also obtained in addition to the normal topside echoes.

THE S-66 LASER SATELLITE TRACKING EXPERIMENT
H. H. Plotkin, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TM X-52075; NASA-X-524-63-59, Feb. 13, 1963, 24 p., refs., Presented at 3rd Intern. Conf. on Quantum Electron., Paris, Feb. 13, 1963, N64-10108.

The optical tracking experiment to be conducted with the S-66 satellite, the polar ionospheric beacon, is described. The plan consists of illuminating a special satellite-borne reflector with a pulse from a laser and receiving the reflected light on a tracking telescope, which transmits the data to a digital computer. Experiments have shown that this type of optical tracking is feasible, and that the readout of such a system can be expected to be accurate to 5 seconds of arc under the accelerations expected from satellites.

NASA TO LAUNCH POLAR IONOSPHERE BEACON SATELLITE (S-66)
NASA, Washington, D. C. 4 Aug. 1963, 31 p., N63-19158.

4B.878: Project SAN MARCO

Principal Publications:

SAN MARCO SATELLITE TO PROBE AIR DENSITY
W. C. Wetmore, Aviation Week and Space Technology, vol. 79, Aug. 26, 1963, p. 76/77+, A63-22179.

Brief description of the scientific experimentation to be carried out in the San Marco satellite, a joint venture of Italy's National Research Council and NASA. . . .

4B.882: Project SPUTNIK

Principal Publications:

ANTIPODAL RECEPTION OF SPUTNIK III
O. K. Garriott, et al., Proc. IRE, vol. 46, Dec. 1958, p. 1950.

A NOTE ON SOME SIGNAL CHARACTERISTICS OF SPUTNIK I
J. D. Kraus, et al., Proc. IRE, vol. 46, March 1958, p. 610/611.

DETECTION OF SPUTNIK I AND II BY CW REFLECTION
J. D. Kraus, Proc. IRE, vol. 46, March 1958, p. 611/612.

SPUTNIK I'S LAST DAYS IN ORBIT
J. D. Kraus, et al., Proc. IRE, vol. 46, Sept. 1958, p. 1580/1587.

RECORDINGS OF TRANSMISSIONS FROM THE SATELLITE 1958 Δ 2 AT THE ANTENNA LABORATORY, OHIO STATE UNIVERSITY
T. G. Hame, et al., Proc. IRE, vol. 47, May 1959, p. 991/992.

A TYPE OF VARIATION OF THE SIGNAL STRENGTH FROM 1958 Δ2 (SPUTNIK 3)
L. Liszka, Nature, vol. 183, May 1959, p. 1383/1384.

THE CONTINUED PROGRESS OF SATELLITE 1958-Δ2 (SPUTNIK III)
B. R. May, et al., Nature, vol. 184, Sept. 1959, p. 765/767.

Report of the progress of the satellite since Nov. 1, 1958 and of the methods used for predicting its flight at the Radio Research Station, Slough. Earlier progress has been reviewed by King-Hele (1545-of 1959).

SIGNAL STRENGTH RECORDINGS OF THE SATELLITE 2 (SPUTNIK II) AT COLLEGE, ALASKA
R. Parthasarathy, et al., Proc. IRE, vol. 47, Jan. 1959, p. 78/79.

DESCRIPTION OF THE EXPERIMENTS PERFORMED DURING THE FLIGHT OF THE SECOND RUSSIAN SPACE-SHIP SATELLITE
J. W. Palmer, Royal Aircraft Establishment (Gt. Brit.), Library trans. no. 921 of Pravda, 4-6 Sept. 1960, Sept. 1960, 1v., AD 245 830.

SOME CHARACTERISTICS OF THE SIGNAL RECEIVED FROM 1958 Δ 2
Proc. IRE, vol. 48, no. 12, Dec. 1960, p. 2028/2030.

. . . Over 200 passages of 1958Δ2 (Sputnik II) were observed in the period between June 1958 and April 1959. . . .

OSCILLATORS AND RELATED DEVICES USED IN USSR SATELLITES. A BIBLIOGRAPHY
Library Services Section, Air Information Div., Washington, D. C., AID rept. 60-110, 30 Dec. 1960, 27 p., AD 250 076.

. . . emphasis in compiling the bibliography was placed specifically on the uses of: the stability of oscillator frequency used in USSR satellites, techniques on comparison of standard frequencies radiated by ground transmitters with those of the satellite, use of the beat frequency and Doppler effect in satellite tracking . . . The references cover the period 1957 thru 1960.

SOVIET SATELLITES AND SPACE SHIPS (SELECTED ARTICLES)
S. G. Aleksandrov, et al., Air Force Systems Command, Foreign Technology Div., Wright-Patterson AFB, Ohio, Feb. 23, 1962, 269 p., 154 refs., Transl. from the book "Sovietskiye Sputniki 1 Kosmiches-Kiye Korabli", Moscow, Akad. Nauk SSSR, 1961, 2nd Ed. p. 24/82, 117/124, 144/147, 182/184, 217/242, 256/394, 427/456 (FTD TT 62-121/1+2), N63-18430.

MAGNETOMETRIC EQUIPMENT OF THE THIRD SOVIET ARTIFICIAL EARTH SATELLITE
S. SH. Dolginov, et al., ARS Journal, vol. 31, no. 9, Sept. 1961, p. 1329/1341.

Translated from Artificial Earth Satellites, 1960, no. 4, p. 135/160.

TELEMETRY SIGNALS FROM SPUTNIK III
R. E. Henderson, Electronic Technol., vol. 38. no. 3, March 1961, p. 76/79.

Equipment is described for transcribing telemetry signals from Sputnik III from magnetic tape on to photographic film. The resultant record on 35 mm film is in raster form showing successive keying cycles one under another. Changes in the pattern of pulses can thus be readily detected by eye and, by means of a time scale recorded on the edge of the film, the time they occured can be read off. Sample records are shown. A description is reproduced of the telemetry encoding system used in the satellite and the results of the analysis of two transits are included and briefly discussed. . . .

THE FREE BODY MOTION OF EARTH SATELLITES AND ASSOCIATED RADIO EFFECTS
E. Golton, J. British Interplanetary Society, vol. 18, Sept.-Oct., Nov.-Dec. 1962, p. 437/441, A63-12359.

Analysis of the spin and precession motion of an orbiting satellite, to show their dependence upon the shape of the satellite and on perturbations arising at launch. The results are applied to the motion of Sputnik 3 (1958 Delta 2). The limitations imposed by these motions upon ionospheric studies of emitted radio waves are considered. It is noted that improvement could be obtained by attitude stabilization. One possibility is to use both the gravitational field gradient and the magnetic field of Earth in a passive system.

MEASUREMENT OF MAGNETIC FIELD NEAR EARTH AND MOON
Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio, In its Soviet Satellites and Space Ships (Selected Articles) Feb. 23, 1962, p. 146/151, N63-18445.

. . . A summary of geomagnetic measurements inside and outside the ionosphere of the earth from magnetometer data of the first, second, and third Soviet satellites . . .

ROTATION AND ORIENTATION OF SOVIET SPUTNIK III
V. V. Beletskii, et al., AIAA Journal, Russian Supplement, vol. 1, March 1963, p. 748/758, A63-14507.

Investigation of the principles of determining the parameters of rotation and orientation of the Sputnik III (1958 Delta 2) satellite in accordance with the readings from a magnetometer transducer. A method of solving this problem is proposed, and the results of determining the parameters of rotation and orientation of the satellite from the first to the 109th orbit are described. In addition, the parameters of rotation are computed from data of later orbits.

RADIO WAVE PROPAGATION FROM SPUTNIK III
N. C. Gerson, J. Atmos. and Terrest. Phys., vol. 25, Dec. 1963, p. 609/706, 15 refs., A64-13974.

. . . results of observations of the 20-Mc emissions from Sputnik III satellite recorded during the period of May 16 to June 6, 1958. Propagation modes, effects of ionospheric disturbances, and antipodal propagation are discussed. . . .

PRELIMINARY ORBITAL ELEMENTS OF THE CABIN OF SPUTNIK 4 (1960 Σ 3)
L. A. Isakovich, et al., Royal Aircraft Establishment (Gt. Brit), Jan. 1963, 3 p., tables, Library trans. no. 1025 from Byulleten'Stantsii Opticheskogo Nablyudeniya Isskustvennykh Sputnikov Zemli, vol. 24, p 16/20, 1961, AD 299 878.

4B.884: Project TIROS

Principal Publications:

TIROS—THE SYSTEM AND ITS EVOLUTION
H. J. Butler, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 248/256.

TIROS 1: AN OPERATIONAL EVALUATION OF A NEW METEOROLOGICAL TOOL
A. H. Glaser, Allied Research Associates, Inc., Boston, Mass., 30 June 1960, 126 p., AD 243 149.

. . . A critical review of the operational methods used to retrieve these cloud analyses suggests improvements for future TIROS-type satellites. See also AD 243 222.

SIGNAL PROCESSING IN THE TIROS INSTRUMENTATION SYSTEM
M. H. Mesner, IRE Nat. Symp. Space, no. 4-1, Sept. 1960, p. 1/21.

The various signals. . . are processed in the space-borne satellite and in the remaining portion of the system on the ground. The telemetry channel, video channel, command channel, and the attitude, spin data, and sun angle information transfer channel, comprise the signal chains of the satellite system. . .

A SUMMARY OF MILLSTONE HILL RESULTS FOR THE TIROS-1 SATELLITE LAUNCHING
G. H. Pettengill, Lincoln Lab., Mass. Inst. of Tech., Lexington, 16 May 1960, lv., AD 237 124.

. . . a specially designed transponder was located aboard the third stage of the launching vehicle. . . Telemetry signal measurements, taken by other equipment located at the radar site, provided information on the third stage spin rate and times of ignition and burnout. . .

TIROS I WILL SCAN CLOUD COVER, EARTH TEMPERATURE
Aviation Week, vol. 72, no. 11, March 1960, p. 26/28.

TIROS I METEOROLOGICAL SATELLITE SYSTEM
Astro-Electronic Products Div., Radio Corp. of America, Princeton, N. J., Final operational rept. on Phase 1, 1 Oct. 1960, AD 245 835.

. . . eminently successful. . . . showing . . . the adaptability of various electronic and mechanical components to the space environment. . . the freedom from deterioration of solar cells and their optical coating. It also revealed shortcomings in other components and subsystems, and pointed the direction of their improvement. . . .

INFRARED CIRCUITS IN TIROS SATELLITES
F. Schwarz, Electronics, no. 34, Sept. 1961, p. 43/45.

PART I—This part of a two-part article deals with a 5-channel radiometer that measures parameters dealing with earth's heat balance. Future article will deal with transient-type horizon sensor.

POWER SUPPLY FOR THE TIROS I METEOROLOGICAL SATELLITE
S. H. Winkler, et al., RCA Rev., vol. 22, no. 1, March 1961, p. 131/146.

TIROS I METEOROLOGICAL SATELLITE SYSTEM, VOLUME I. . . VOLUME II. . . VOLUME III
RCA Defense Electronic Products, Princeton, N. J., Final comprehensive rept. on vol. 2, -pn vol. 3, 1 July 1961, 213 p., 241 p., 194 p., AD 262 944, AD 262 945, AD 262 946.

Descriptors . . . Television communication systems, Telemetering data. . . includes detailed discussions of the development, design, test, and operation of portions of the system. . . include. . . the major part of the ground based command and Data-Acquisition Stations. Five identical satellites, and three essentially-similar sets of ground-station equipment were fabricated for the TIROS I project. . .
Television communication systems, Telemetering data,
Television communication systems, Telemetering data.

TIROS I METEOROLOGICAL SATELLITE SYSTEM, PART I
L. J. Allison, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Tiros I Meteorol. Satellite System, 1962, p. 1/112, refs., N64-17907.

. . . The satellite traversed 1,302 orbits before the end of its 3-month functional life, and returned slightly fewer than 23,000 pictures-over 60% having high meteorological-information content.

DOCUMENTATION OF THE TIROS III DATA REDUCTION PROGRAM
L. Fried, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TM X-50729; NASA X-543-62-227, Dec. 18, 1962, 90 p., N63-23038.

. . . (1) detailed breakdown of the program's executive routine, including the generation of the Final Meteorological Radiation Tape (FMRT); (2) subroutines which give calling sequence, purpose and method of solution; (3) sense switch and indicator bit settings; (4) diagnostic counters

used in program; (5) program inputs which include documentation card, radiation tape documentation record, and format of the orbital tape; and (6) flow chart of subroutine "DIRECT".

WEATHER SATELLITES
D. S. Johnson, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 851.

. . . The successful series of TIROS meteorological satellites has provided data of considerable use in operational weather analysis and forecasting as well as in research.

EVALUATION OF TIROS INFRARED DATA
C. Prabhakara, et al., National Aeronautics and Space Administration, Goddard Inst. for Space Studies, New York, New York, 1962, 14 p., refs., N64-10620.

. . . Based on the most recent and reliable data of the vertical distribution of water vapor, carbon dioxide, and ozone, atmospheric models for different latitudes and seasons have been derived. . .

INTERPRETATION OF TIROS II RADIATION MEASUREMENTS
R. Wexler, Allied Research Associates, Inc., Boston, Mass., Final rept., AFCRL 62-638, 31 May 1962, 24 p., incl. illus., tables, 16 refs., AD 277 275.

. . . for TIROS infrared sensors. . .

CATALOGUE OF TIROS V CLOUD PHOTOGRAPHY FOR JULY 1962 (PASSES 168 THRU 601)
National Weather Satellite Center, Washington, D. C., Sept. 1962, 49 p., N63-15873.

TERRESTRIAL FEATURES OF THE UNITED STATES AS VIEWED BY TIROS
J. F. Cronin, Allied Research Associates, Inc., Concord, Mass., ARA T 9219 4; Scientific rept., AFCRL Rept. no. 63 664, 1 July 1963, 35 p., AD 413 082.

The photography of the TIROS meteorological satellite series is providing the first continuous view, from outside the atmosphere, of the earth's surface and its cloud masses. To assist in the problems of identification, due to the similarity of many clouds to certain terrestial features, a map has been compiled portraying the United States as its surface features appear in TIROS photography. . . .

OPERATIONS PLAN 13-63. TELEVISION OBSERVATIONAL SATELLITE (TIROS H)
A. G. Ferris, et al., National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md., NASA TM X-54699; X-535-63-248, Dec. 1963, 41 p., N64-17608.

. . . activities concerned with Project TIROS. . . Included are: responsibilities; project organization; mission implementation; operations and control; field station operations; space communications center operations; and computing center operations.

ZEITSTEUERUNG IM TIROS I (Timing in Tiros I) (In German)
J. Genannt, Flug-Revue, vol. 1, Jan. 1964, p. 23/25, A64-13599.

Discussion of the INCREMAG unit installed in Tiros I, which uses the principle of stepwise magnetization of a core with a roughly rectangular hysteresis loop to divide an 18-kc oscillator frequency to a frequency of 0.5 cps. The transistor circuit and functioning sequence of the device are described.

TOSS: TIROS OPERATIONAL SATELLITE SYSTEM
A. H. Glaser, Astronautics and Aerospace Engineering, vol. 1, April 1963, p. 38/41, A63-15187.

Examination of the Tiros Operational Satellite System (TOSS), a proposal using two Tiros satellites with opposed orbits, to provide picture coverage of much of the Earth's surface on a programmed basis each day. The operating constraints and the perturbing effects which limit the effectiveness of a weather satellite are discussed. The effectiveness of the TOSS coverage is depicted in a set of maps.

TIROS PRE-FLIGHT TESTING AND POST-LAUNCH EVALUATION
E. A. Goldberg, Presented at AIAA Space Flight Testing Conf., Cocoa Beach, Fla., March 18-20, 1963, 21 p., N63-17031.

APT USERS' GUIDE
L. Goldshlak, Allied Research Associates, Inc., Concord, Mass., Scientific Rept. No. 1, ARA-T-9219-1; AFCRL-63-655, June 1963, 51 p., N63-17984.

. . . An automatic picture-taking (APT) subsystem will permit local picture readout at those sites which have appropriate terminal equipment. This guide is intended to serve as an introduction to data-handling procedures at APT acquisition sites. . . .

AUTOMATIC DATA PROCESSING OF WEATHER SATELLITE DATA
W. A. Marggraf, General Dynamics Astronautics, San Diego, California, AFCRL TDR63 243, 31 Jan. 1963, 50 p., AD 404 740.

. . . include ingestion of satellite pictorial data with digitization and digital pictorial display; data location, which includes rectification, automatic mosaicing and mapping transformations; and data analysis, such as

differentiation, slicing, and contouring of the data from pictorial intensity, and cloud amount determination. Data from TIROS III, Orbit 509 frames is used to demonstrate the techniques and results. . .

TIROS OPERATIONS
E. F. Powers, Astronautics and Aerospace Engineering, vol. 1, April 1963, p. 29/31, A63-15201.

Description of the technical responsibilities for control of the Tiros satellites, exercised by the Technical Control Center at the NASA Goddard Space Flight Center. The mission of furnishing operational meteorological data and supporting research and development in the study of the physics of the atmosphere is detailed and analyzed.

TIROS ACHIEVEMENTS
R. M. Rados, Astronautics and Aerospace Engineering, vol. 1, April 1963, p. 28/29, A63-15185.

Assessment of the achievements of the Tiros series (I-VI), with a description of the accomplishments of the individual meteorological satellites. A table of the pertinent information characteristic of each satellite is included. The organizations which contributed to the Tiros satellite program are listed.

THE APPLICATION OF PHOTOGRAPHIC PHOTOMETRY TO ELECTRONIC DISPLAY SYSTEMS
L. C. Sanford, et al., Photographic Science and Engineering, vol. 8, Jan.-Feb. 1964, p. 2/6, A64-14929.

Description of a technique for determining absolute luminance of objects as viewed by an orbiting Tiros satellite. . . assignment of luminance values to the viewed object, as imaged ultimately in photographic film. . . .

TIROS OPERATIONS
A. Schnapf, International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 91, 40 p., A63-25758, N64-12352.

Summary of the data obtained from, and description of the development of, the Tiros meteorological satellite program. Covered are satellite design, the Tiros ground complex, satellite performance, and the meteorological significance of the Tiros satellites.

TIROS METEOROLOGICAL SATELLITE REPORT
A. Schnapf, Radio Corp. of America, New York, N. Y., 1963, 40 p., refs., Presented at the 14th Intern. Astron. Congr., Paris, 25 Sept.-1 Oct. 1963, IAC Paper 91, N64-12004.

. . . Seven TIROS meteorological satellites have been launched and orbited. . . The following subsystems of the TIROS satellites are described: (1) the television camera; (2) infrared observation; (3) programing and control; (4) attitude reference; (5) dynamics control; (6) telemetry and tracking; and (7) power supply. . .

SYSTEM PERFORMANCE OF METEOROLOGICAL SATELLITES
R. A. Stampfl, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TM-X-54565; X-650-63-166, Aug. 1963, 23 p., N64-15859.

. . . seven TIROS satellites that have been launched and operated. . . A discussion is included of TIROS tracking, television, and infrared radiometer subsystems.

TIROS METEOROLOGICAL SATELLITE. A DDC REPORT BIBLIOGRAPHY
E. E. Thompson (Comp.), Defense Documentation Center, Alexandria, Va., Bibliography for Jan. 1960-Nov. 1963, Nov. 1963, 1v., 49 refs., AD 422 848.

. . . 49 documents catalogued by DDC from Jan. 1960 to the present. . . .

A MEDIUM DATA RATE DIGITAL TELEMETRY SYSTEM
M. Townsend, et al., Rec. Nat. Space Electronics Symp., no. 1.4, 1963.

. . . Earth orbiting satellites. . . system with 10^7 bit storage. . . provided by a tape recorder, . . . Hardware applicable to the radiation experiments on the TIROS and Nimbus meteorological satellites has been built. . .

SYNOPTIC INTERPRETATIONS AND HEAT BALANCE DETERMINATION FROM TIROS II RADIATION DATA
R. Wexler, Allied Research Associates, Inc., Concord, Mass., Scientific rept. no. 1, AFCRL 63-247, 4 Jan. 1963, 24 p., AD 299 962.

SYNOPTIC ANALYSIS OF TIROS III RADIATION MEASUREMENTS
R. Wexler, et al., Aracon Geophysics Co., Concord, Mass., Final rept., AFCRL 64 53, 31 Jan. 1964, 41 p., AD 431 181.

. . . during July 1961 are analyzed with respect to radiometer deterioration, limb darkening, cloud cover determination. . .

NEXT TIROS TO CARRY EXPERIMENTAL WEATHER CAMERA
National Aeronautics and Space Administration, Washington, D.C., News Release No. 63-269, 13 Dec. 1963, 15 p., N64-11778.

. . . plans are underway to launch the eighth TIROS meteorological satellite. This satellite will carry an experimental camera subsystem (Automatic Picture Transmission) designed to give meteorologists instantaneous photographs of cloud patterns . . .

SEVENTH TIROS SATELLITE TO BE LAUNCHED
NASA, Washington, D.C., News Release No. 63-132, June 16, 1963, 17 p., N63-17027.

The systems, communications, control, infrared and temperature probes, and launch vehicle, for the seventh TIROS satellite that is scheduled for launch are described. . . .

Related Publications:

TRACKING RADAR FOR TIROS WEATHER SATELLITE
H. E. O'Kelly, Electronics, vol. 33, no. 16, April 1960, p. 57/60.

4B.886: Project TRANSIT

Principal Publications:

THE TRANSIT SATELLITE THERMAL-VACUUM TEST PROGRAM
R. W. Blevins, et al., Applied Physics Lab., John Hopkins U., Silver Spring, Md., July 1960, 31 p., AD 246 417.

INSTALLATION AT FRANKFURT OF A RECEIVING STATION FOR THE TRANSIT PROGRAM, PHASE 1.
J. Eitzenberger, et al., Battelle Institut, Frankfurt/Main (Germany), Final rept. on Phase 1, 31 Aug. 1960, 4 p., illus. tables, AD 287 616.

. . . allows a simultaneous reception of 2 frequencies of a satellite providing useful tracking data or useful ionospheric refraction data. The 2 receivers cover the range between 53 and 262 mc that includes satellite frequencies of 54, 108, 162 and 216 mc, except 324 mc. . . .

THE TRANSIT SYSTEM
R. B. Kershner, IRE Nat. Symp. Space Electronics Telem., no. 7-5, Sept. 1960, p. 1/9.

INVESTIGATION OF HIGH FREQUENCY PROPAGATION IN THE IONOSPHERE USING SATELLITE TRANSMISSIONS
W. J. Ross, Ionosphere Research Lab., Pennsylvania State U., University Park., Quarterly status rept. no. 5, 15 July-15 Oct. 1960, 12 p., AD 244 785.

. . . Dispersive doppler measurements were made on the TRANSIT 2A satellite using a tracking reference oscillator to give greatly improved data . . . The design parameters of the spaced receiver scintillation experiments were investigated using the 54 mc signals from TRANSIT 2A.

EVOLUTION AND TESTING OF A NAVIGATIONAL SATELLITE
M. A. Schreiber, et al., Applied Physics Lab., Johns Hopkins U., Silver Spring, Md., Rept. no. CM-972, May 1960, 49 p., incl. illus., tables, AD 239 699.

. . . evolution of design and testing of the first two Transit satellites is developed. . . . are intended for use in measuring the precision of doppler tracking which, in turn will be employed for navigational test and geodetic determinations. Valuable data . . . satisfactory operation of the electronics during the brief flight of Transit 1A. . . .

DATA ACQUISITION AND EVALUATION PLAN PROJECT TRANSIT 2-A
Space Technology Labs., Inc., Los Angeles, Calif., Rept. no. STL/TR-60-0000-61086, 22 April 1960, 1v., AD 402 187.

Data origination, transmission, and evaluation procedures for the Project TRANSIT 2-A launch . . . various agencies involved, the degree of their participation in this task, and the support they require . . .

DATA ACQUISITION, HANDLING, AND EVALUATION PLAN FOR TRANSIT 3-B
J. E. Calkins, et al., Aerospace Corp., El Sequndo, Calif., Rept. TOR-594-102-10, 20 Jan. 1961, 1v., AD 266 449.

. . . The plans and procedures to be used for the acquisition, transmission and analysis of launching, flight, and first pass data for Project TRANSIT 3-B are presented. The data thus accumulated is required for the evaluation of the TRANSIT 3-B flight test objective.

THERMAL ENGINEERING OF THE TRANSIT SATELLITES
L. D. Eckard, Jr., Applied Physics Lab., Johns Hopkins U., Silver Spring, Md., Rept. no. CM-101-1001, Sept. 1961, 61 p., incl. illus., table, 9 refs., AD 273 555.

. . . Transit 1A through 3B . . . satellite space environment factors affecting external and internal temperatures. Important variables available to the designer for controlling satellite temperatures are discussed, including surface coatings, vehicle shape and orientation, orbital parameters, and launching conditions.

RECEIVING STATION FOR THE TRANSIT PROGRAM PHASE II
J. Eitzenberger, et al., Battelle Institut, Frankfurt/Main, Germany, Final rept., 30 March 1961, 1v., AD 416 255.

. . . designed to measure the Doppler effect of signals of TRANSIT satellites . . . allows simultaneous reception of two frequencies of a satellite . . .

A POSITION DIFFERENCE SYSTEM USING SATELLITE DOPPLER SIGNALS
L. Farkas, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 5, June 1961, p. 455/461.

. . . extends the utilization of the TRANSIT Satellite Navigation System to the case where it is desired to determine the relative position between a known location and an unknown location. . . . The most significant advantage . . . is that biases caused by inaccurate knowledge of the satellite position are nearly eliminated for nearby stations. . . .

MAGNETIC DAMPING OF THE ANGULAR MOTIONS OF EARTH SATELLITES
R. E. Fischell, ARS Journal, vol. 31, no. 9, Sept. 1961, p. 1210/1217.

Multiple, cyclindrical rods of a high permeability magnetic alloy can be employed for damping both oscillatory and spin motions of an orbiting satellite . . . has been used on the TRANSIT 1B and 2A navigational satellites. As a result, all oscillatory motions of these satellites appear to have been damped out, and their spin has been essentially stopped. . . . in the TRANSIT satellites where transmission frequency stabilities are on the order of 0.01 cps in 108 mc, the spin rate had to be reduced below 0.005 rps in order to avoid significant modulation of the doppler transmission . . .

EVALUATION OF TRANSIT SATELLITE RELIABILITY
J. A. McGill, et al., ARINC Research Corp., Washington, D. C., Rept. no. 3; Pub. no. 173-2-252, 26 July 1961, 80 p., AD 272 190.

Reliability evaluations are presented for the TRANSIT NAV-3B system, it s major subsystems, and of the NAV-4A system. . . . Reliability functions were derived and computed for . . . (1) doppler signal task, (2) operational task (doppler signalling plus transmission of ephemeris information), and (3) telemetering task (transmission of engineering-evaluation data). . . . 3 levels of system performance, corresponding to the probability of obtaining at least 1, at least 8, or the entire 16 words from the Memory Subsystem. . . .

PROJECT TRANSIT –EARTH AND AEROSPACE NAVIGATIONAL SATELLITE SYSTEM
J. D. Nicolaides, Aerospace Engineering, vol. 20, no. 2, Feb. 1961, p. 20/21 + 60/65.

Transit navigational satellites now in orbit have demonstrated the basic feasibility of the Doppler technique both for the accurate tracking of satellites and for the precision navigation of submerged submarines, surface ships, and aircraft. The Doppler concept, the Transit system operation, and some primary technical problem areas are discussed. Recent progress toward an early operational system is reviewed. . . . good bibliography.

DESIGN AND DEVELOPMENT OF THE TRANSIT NAVIGATIONAL SATELLITE
M. A. Schreiber, et al., Applied Physics Lab., Johns Hopkins U., Silver Spring, Md., Rept. no. CM-994A, May 1961, 55p., AD271382.

. . . of the first five experimental satellites. . . . A detailed coverage of the requirements and changes in the doppler transmitter, power supplied, and despin mechanisms are presented. The telemeter, command, and data storage sys-

tems are explained along with structural and thermal design changes that were made in the various satellites.

TRANSIT RELIABILITY
R. W. Cole, In Defense Dept. Off. of the Director of Def. Res. and Eng., Washington, D. C., Papers Presented at the Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18-21 June 1962 (1962), p. 333/337, N63-17292.

TRANSIT SYSTEM SLATED TO SERVE AS ROUTINE NAVIGATION AID BY OCTOBER
R. Hawkes, Aviation Week and Space Technology, vol. 76, no. 1, Jan. 1962, p. 57/59.

NAVIGATION SATELLITE PROGRESS
A. B. Moody, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 850.

Some 20 techniques have been suggested for use of artificial earth satellites for navigation of ships and aircraft. A study of these indicates that range, range rate, and angle measurement are promising for general navigation. The range rate method, using the Doppler shift of signals from a stable oscillator in the satellite, is used in the TRANSIT system under development by the Navy. . . .

FACTORS CURRENTLY INFLUENCING RMS ERROR IN DOPPLER DATA
J. R. Wright, Defense Research Lab., U. of Texas, Austin, Rept. no. DRL-477; APL rept. no. CF-2992, 1 Nov. 1962, 19 p., illus. tables., AD 291 958.

Estimations are made of the relative importance of the various factors influencing rms doppler errors in TRANSIT satellite data.

SATELLITE MEASUREMENTS OF RADIO BREAKTHROUGH
E. A. Atkins, et al., Canad. J. Phys. vol. 41, Aug. 1963, p. 1388/1393.

. . . of a signal identified as "breakthrough from the ground" received by Transit 2A . . . appears as a rectified sinusoid with noise superimposed . . . The period of the variation in amplitude is appropriate to the spin rate of the satellite . . . The precise times of observation of breakthrough are supplied.

TRANSIT/ANNA FLIGHT TEST OPERATIONS
J. Dassoulas, Applied Physics Lab., Johns Hopkins U., Silver Spring, Md., Rept. no. 63105 63, 1963, 18 p., AD 407 723.

. . . to monitor and evaluate payload performance during hangar RF checks of electronic, memory, power systems, etc . . .

NAVIGATION USING ARTIFICIAL SATELLITES — THE TRANSIT SYSTEM
W. H. Guier, In: The Use of Artificial Satellites for Geodesy; Proceedings of the First International Symposium on the Use of Artificial Satellites for Geodesy, Washington, D. C., April 26-28, 1962, Edited by G. Veis, Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers Div., John Wiley and Sons, Inc., 1963, p. 261/276, 15 refs., A63-24730.

. . . The Transit system is described, and the principles of navigation using Doppler data are discussed.

TRANSIT SATELLITE PRECISION OSCILLATORS AND THEIR TEMPERATURE CONTROL
J. B. Oakes, et al., Applied Physics Lab., Johns Hopkins U., Silver Spring, Md., Jan. 1963, 84 p., AD 402 890.

. . . stable oscillator which controls the RF signals transmitted from the satellite has undergone continous refinement and improvement. . . .

4B.890: Project UK (ARIEL)

Principal Publications:

THE USE OF PROBING ELECTRODES IN THE STUDY OF THE IONOSPHERE
R. L. F. Boyd, J. Brit. Instn. Radio Engrs., vol. 22, no. 5, Nov. 1961, p. 405/408.

The Langmuir probe and its developments provide a means whereby such important ionospheric quantities as electron concentration and temperature, and ion mass spectrum, concentration and temperature may be measured. . . . The problems involved arise largely because the vehicle is isolated from Earth and because of the varying aspect of the vehicle. . . . involves the use of special techniques which are not needed in the laboratory. The ways in which the problems have been tackled will be discussed and special reference will be made to the instrumentation planned for the first Anglo-U.S. satellite. . . .

COSMIC RAY MEASUREMENTS IN THE U.K. SCOUT I SATELLITE
H. Elliot, et al., J. Brit. Instn. Radio Engrs., no. 22, Sept. 1961, p. 251/256.

THE BATTERY FOR THE INTERNATIONAL IONOSPHERE SATELLITE ARIEL I.
E. R. Stroup, American Rocket Society, Space Power Systems Conference, Santa Monica, Calif., Sept. 25-28, 1962, Paper 2510-62, 20 p., A63-11681.

THE DESIGN OF THE UNITED KINGDOM SCIENTIFIC SATELLITE SOLAR POWER SYSTEM
F. C. Yagerhofer, American Rocket Society, Space Power Systems Conference, Santa Monica, Calif., Sept. 25-28, 1962, Paper 2498-62, 26 p., A63-11619.

Description of the electric power system used in the International Ionospheric Satellite, S-51 (1962 Omicron 1) commonly known as the Ariel satellite. For this cooperative effort, the British supplied the scientific experimental equipment while the Goddard Space Flight Center contributed the payload electronic instrumentation, the power supply, the satellite structure, and the ground-station equipment. The satellite employs a flat solar-cell configuration rather than the conventional shingled-modular type. It utilizes an electrochemical cell as a one-year payload-cutoff timer. Of particular note are the techniques used to obtain proper charge rate into the rechargeable nickel-cadmium batteries, the novel standby battery with automatic switching circuitry, and the precision equipment for static dc-to-dc conversion.

A-R-I-E-L FIRST INTERNATIONAL SATELLITE
NASA, Washington, D.C., NASA FACTS C-62, 1962, 1 p., N63-16600.

ARIEL I, THE FIRST INTERNATIONAL SATELLITE (Project Summary)
R. C. Baumann, Washington, NASA, NASA SP-43, 1963, 84 p., refs., N64-10332.

. . . project summary document has been compiled to record the history of the first international satellite . . . design of the satellite and support equipment . . . list of related documentation containing design information and experimental results . . .

THE ARIEL I SATELLITE
R. C. Baumann, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TM X 51621, X-673-63-75, April 1963, 17 p., N64-16700.

. . . is completely self-contained and, other than a single command function, operates independently of external control. A discussion is presented of the components that go into making this space laboratory; the electronics, the structure, and the associated hardware are described.

FRANCE AND BRITAIN PREPARE TO STRIKE OUT INTO SPACE ON OWN
W. Beller, Missiles and Rockets, vol. 12, June 17, 1963, p. 15/18.

. . . The UK3 satellite will be designed, instrumented and completely tested in Britain before delivery to the U.S. in 1966 for launching. . . .

THE UK3/S53 INTERNATIONAL IONOSPHERIC SATELLITE — BRITAIN'S FIRST SPACECRAFT
J. L. Blonstein, International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 136, 70 p., 17 refs., A63-25544, N64-11944.

. . . scheduled to be launched in 1966 . . . involves the development of five satellites, the first of which will serve for structural and thermal testing, the second will be a development unit, while the third will be built as a fully equipped prototpye; the fourth and fifth will be the flight unit and the spare unit, respectively. . . .

VIBRATION ISOLATION OF SATELLITE TAPE RECORDERS
J. H. Conn, Washington, NASA, NASA TM X-942, Feb. 1964, 12 p., N64-15921.

A standardized method of shock and vibration isolation for satellite tape recorders has been developed . . . This system is now being used in the International Satellite UK-2 and will be used in the Orbiting Solar Observatory (S-57 model) . . .

GROUND SUPPORT EQUIPMENT FOR THE UK-2/S-52 INTERNATIONAL SATELLITE
R. M. Drake, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 374/381.

. . . integration, calibration, and confidence tests of the satellite and the special test equipment needed to perform these tests are discussed. . . .

A PEGASUS COMPUTER PROGRAMME FOR ESTIMATING ERRORS IN THE EPHEMERIS OF A SATELLITE, WITH AN APPLICATION TO ARIEL I
R. H. Gooding, Royal Aircraft Establishment, Farnborough (England), RAE Technical note no. Space 37, July 1963, 24 p., AD 420 396.

. . . errors . . . can be estimated from the covariance matrix of errors in the orbital parameters. The program is used to show that orbital parameters of Ariel I derived from Minitrack data are good enough for the position of Ariel to be computed to within 1 km. . . .

ENVIRONMENTAL TEST PROGRAM FOR ARIEL I
W. H. Hord, Jr., National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md., NASA TN D-2099, Feb. 1964, 69 p., N64-15220.

. . . design qualification tests for the prototype spacecraft and acceptance tests for the two flight spacecraft . . . Several failures in the prototype spacecraft occurred during the test program and resulted in various modifications and replacements.

THE ORBITAL ELEMENTS OF ARIEL I FOR APRIL-AUGUST, 1962 AND A COMPARISON OF R.A.E. AND N.A.S.A. EPHEMERIDES
R. H. Merson, et al., Royal Aircraft Establishment (Gt. Brit.), RAE Tech. note. no. Space 39, July 1963, 17 p., AD 417 785.

. . . for the periods April 28 —July 6 and August 4 —August 19, 1962, from Minitrack observations provided by NASA. . . .

THE ORBITAL ELEMENTS OF ARIEL I FOR APRIL-AUGUST, 1962 AND A COMPARISON OF R.A.E. AND N.A.S.A. EPHEMERIDES
R. H. Merson, et al., Planetary and Space Science, vol. 12, Jan. 1964, p. 21/27, A64-15084.

Analysis of Minitrack observations . . . in order to determine the orbital accuracy attainable with Minitrack data and to provide data for testing the ephemeris program. . . .

A MAGNETIC CORE VOLTAGE-TO-FREQUENCY CONVERTER
S. Paull, IEEE Trans. Space Electronics Telemetry, vol. SET-9, no. 1, March 1963, p. 12/18.

. . . Design experience with this device has been chiefly in connection with . . . the first International Satellite UK-1. . . .

INSTRUMENTATION OF SATELLITE UKI FOR OBTAINING LOW RESOLUTION SOLAR X-RAY SPECTRA
K. A. Pounds, et al., In: Space Research III; Proceedings of the Third International Space Science Symposium, Washington, D. C., May 2-8, 1962, Edited by Wolfgang Priester, Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers Division, John Wiley and Sons, Inc., 1963, p. 1195/1206, 13 refs., A63-20029.

THE ARIEL I SATELLITE PROJECT AND SOME SCIENTIFIC RESULTS
M. O. Robins, American Institute of Aeronautics and Astronautics, Canadian Aeronautics and Space Institute, and Royal Aeronautical Society, Anglo-American Conference, 9th, Cambridge, Mass., Oct. 16-18, 1963 and Montreal, Canada, Oct. 21-24, 1963, Paper 63-468, 15 p., 11 refs., A63-23939.

. . . The design, launch, and operation of the satellite are briefly described. The instruments measured, at altitudes between 400 km and 1,200 km, characteristics of the ionosphere, the flux of solar X-rays . . . the primary cosmic ray energy spectrum.

UK3: BRITAIN'S FIRST HOME-BUILT SATELLITE
Engineering, vol. 195, 28 June 1963, p. 886/888, A63-19717.

. . . to be launched by a NASA Scout rocket about 1967. The primary power will be derived from more than 6000 solar cells. A simplified overall block diagram of the satellite electronic equipment is included.

THE THIRD BRITISH SATELLITE
J. Brit. Instn. Radio Engrs., vol. 26, no. 1, July 1963, p. 66.

The development contract for UK.3, the first all-British satellite, has been awarded to the British Aircraft Corporation's Guided Weapons Division . . . The proposed date for launching UK.3 is 1966, when the satellite will carry five scientific experiments into a circular orbit, 400 miles above the earth. . . .

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON THE IONOSPHERE, LONDON, JULY 1962
London: The Institute of Physics and the Physical Society, 1963, 528 p.

. . . held at Imperial College . . . The proceedings contains 81 articles, divided into 4 sections . . . with an additional section giving preliminary results from the first Anglo-American satellite UK 1.

4B.892: Project VANGUARD

Principal Publications:

AUTOMATIC RECORDING AND REDUCTION FACILITY FOR PROJECT VANGUARD
D. H. Gridley, et al., Third IRE Instrumentation Conf., Nov. 1957.

PROJECT VANGUARD REPORT NO. 24. MINITRACK REPORT NO. 4, THE SATELLITE TELEMETRY RECEIVER SYSTEM
V. R. Simas, Naval Research Lab., Washington, D.C., Interim rept., NRL 5065, 20 Jan. 1958, p. 14, AD 419 874.

. . . The receiver is of the double-conversion type with crystal-controlled local oscillators. Three pre-detection bandwidths are available which provide a means of increasing the output signal-to-noise ratio for these experiments in which the information bandwidth is less than the maximum. Grounded-grid preamplifier circuitry is employed to achieve stability and a low noise figure.

THE SATELLITE VANGUARD II: CLOUD COVER EXPERIMENT
R. A. Hanel, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 245/247.

DETERMINATION OF THE INTERNAL TEMP. IN SATELLITE 1959 ∝
V. R. Simes, et al., NASA TN 357, June 1960, p. 18.

ARMY PARTICIPATION IN PROJECT VANGUARD
W. E. Smitherman, IRE Trans. Mil. Electronics, vol. MIL-4, No. 2/3, April/July 1960, p. 323/327.

REVIEW OF DIRECT MEASUREMENTS OF INTERPLANETARY DUST FROM SATELLITES AND PROBES
W. M. Alexander, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., NASA TM X-54570; X-613-62-25, Presented at the COSPAR Meeting May 1962, Submitted for Publication, N64-17609.

. . . Two satellite experiments, Vanguard III . . . Explorer 1 . . . evidence for dust particle streams . . .

A COMPARISON OF THE SATELLITE ORBIT THEORIES OF KOZAI AND MERSON AND THEIR APPLICATION TO VANGUARD 2
R. H. Merson, Royal Aircraft Establishment, Farnborough, (England), RAE TN SP42, July 1963, 40 p., AD 423 111.

. . . relating to the drag-free motion of an earth satellite . . . formulae are derived for the first-order differences between the orbital elements used in the two theories. With the aid of these formulae, the second-order terms in the two theories are shown to be consistent. The R.A.E. Orbit Improvement Programme for a PEGASUS computer has been used to determine the orbital elements of VANGUARD 2 . . . for the period February-July, 1959 from photo-reduced Baker-Nunn camera observations . . .

Related Publication:

PULSE-FREQUENCY MODULATION
R. W. Rochelle, IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 107/111.

. . . It is shown that PFM with quantized frequencies has the same communication efficiency in the presence of additive white Gaussian noise as a corresponding set of coded binary sequences with an equal number of quantized levels. . . . Vanguard III . . . carrying a combination of pulse-duration modulation and PFM. . . .

VOLUME 4 - PART C

DEEP SPACE APPLICATIONS

The most challenging design problems in space communications are the deep space communications systems. The range is orders of magnitude larger than any communications distance experienced in the past. Communications has to be established over nearly a billion miles to reach the limits of our solar system and Man's dreams may go beyond that to other solar systems. This part of the bibliography reports references to directly communications oriented publications. It also includes reports on related investigations which may be of interest to communications engineers.

This part is organized in nine divisions, with the first two containing references to general publications. Division 4C.2 contains design advice for spacecraft subsystems of deep space communications systems. The relatively small number of such publications is an indication that most authors, to date, have concentrated on descriptions of the communications equipment for special projects, which are reported in other divisions.

Division 4C.3 is devoted to the all important area of deep space ground communications facilities. The fact that in deep space communications the design limitations (power, weight, size) apply primarily to space craft terminals, leads to the necessity for highly sophisticated and very powerful terminals on Earth. This division presents, in 14 subdivisions, a special bibliography of deep space ground terminals. The United States effort in this direction is under the guidance of the Jet Propulsion Laboratory in Pasadena, the source of most of the publications. No information was available to the compilers of this bibliography about Russian deep space terminals.

Division 4C.4 discusses communications aspects of lunar exploration, the national space goal of the immediate future. Communications problems for manned space flight are the subject of part 4D. However, manned lunar exploration presents several new communications problems, some of which are due to the lunar mission requirements and others are due to the presence of astronauts within and outside the spacecraft. The compilers of this bibliography decided, therefore, to place references to project Apollo basically in volume 4D (Manned Space Flight Applications) but to arrange for a special section with references to the corresponding lunar mission oriented publications in this division (4C.450). Liberal use is made of duplicate entries in this instance.

Division 4C.5 is associated with the next step beyond lunar exploration, i.e., exploration of our solar system and its communications requirements. Mars exploration and Venus missions with unmanned spacecrafts are already well under way and many publications can be quoted in the two corresponding sections (4C.54 and 4C.55).

A small division (4C.7) contains most of the still rather speculative reports about stellar communications problems. It is here that we have a section (4C.76) about the fascinating subject of the search for extraterrestrial life with the help of communications techniques.

Division 4C.8 has, again, one subdivision for each special deep space project.

DIVISION 4C.0
GENERAL REFERENCES

4C.000: General References on Deep Space Communications

Included: Extraterrestrial weather; Space research requirements; Extraterrestrial radio communications.

Not Included: Space sciences; Astrophysics.

Cross References: Lunar environment (4C.420); Interplanetary environment (4C.520).

Principal Publications:

COMMUNICATIONS IN SPACE OPERATIONS
C.M. Crain, et al., Rand Rept. P-1394, Feb. 1958.

EXTRATERRESTRIAL RADIO TRACKING AND COMMUNICATION
M.H. Brockman, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Dec. 1959, p. 1/41, AD 233 200.

COMMUNICATION TECHNIQUES FOR SPACE EXPLORATION
E. Rechtin, IRE Trans. Space Electronics Telem., vol. SET-5, no. 3, Sept. 1959, p. 95/98.

PROBLEMS IN SPACE EXPLORATION
R. Jastrow, IRE Trans. Space Electronics Telem., vol. SET-6, no. 1, March 1960, p. 55/58.

DEEP SPACE COMMUNICATIONS
W.D. Merrick, et al., Jet Propulsion Laboratory, Tech. release no. 34-10, no. 29, Jan. 1960, 18 p.

EXTRATERRESTRIAL RADIO TRACKING AND COMMUNICATIONS
M.H. Brockman, et al., Proc. IRE, vol. 48, no. 4, April 1961, p. 644.

THE NATIONAL PROGRAM FOR LUNAR AND PLANETARY EXPLORATION
A.R. Hibbs, J. Geophys. Res., vol. 66, no. 7, July 1961, p. 2003/2012.

. . . Jet Propulsion Laboratory has the responsibility for design and development of spacecraft for the exploration of the moon, the planets, and interplanetary space. . . . This paper describes the Ranger spacecraft . . . the Mariner . . . and the Surveyor . . .

INTEREST IN OUTER SPACE
L.V. Berkner, IRE Interat. Conv. Rec. Pt. 8, vol. 10, March 1962, p. 32/33.

. . . basic problems in exploration of deep space . . .

RESEARCH RESERVE SPACE SCIENCE SEMINAR: SUMMARY OF PRESENTATIONS, SAN FRANCISCO, 20 OCTOBER-2 NOVEMBER 1963
J.T. Hayward, et al., Naval Reserve Research Company 12-5, Berkeley, Calif., 1963, 31 p., refs., Summaries Only, N64-14993, AD 429 096.

Topics discussed during this seminar include . . . astrophysics; space exploration . . . entry and landing . . . unmanned deep space probes . . . space telemetry, communications and tracking.

EXPLORING THE SOLAR SYSTEM WITH SPACE PROBES
A.R. Hibbs, In: Space Science, New York, John Wiley and Sons, Inc., 1963, p. 200/225, 10 refs., A63-13868.

Description of the spacecraft and instrumentation designed for the NASA solar-system exploration program. . . .

AN EVALUATION OF SPACE RESEARCH REQUIREMENTS
R. F. Trapp, American Institute of Aeronautics and Astronautics, Aerospace Medical Association, Manned Space Laboratory Conference, Los Angeles, Calif., 2 May 1963, Paper 63131, 8 p., 10 refs., A63-17478.

EXTRA-TERRESTRIAL WEATHER. A DCC REPORT BIBLIOGRAPHY
Defense Documentation Center, Alexandria, Va., Bibliography for 1953-Dec. 1963, Feb. 1964, lv., 721 refs., AD 430 940.

Descriptors . . . Van Allen radiation belt . . . Solar wind, Meteorological satellites . . . Solar satellites, Venus probes, Mars probes, Lunar probes . . .

DIVISION 4C.1
SYSTEMS ENGINEERING

4C.100: Systems Engineering for Deep Space Communications

Included: Sterilization of equipment (to avoid contamination of other celestial objects); Mechanical scan systems; Time lag problem for control systems operated from Earth; Requirements for visual exploration; Transmitter programming; Noise sources in deep space links; Deep space television in general; Tracking techniques for deep space.

Not Included: Systems engineering in general; Systems management; Astroscience instrumentation; Adaptive communications techniques (2); Controlled power communications links (2); Radio astronomy; Analysis of space communications links in general.

Cross References: Design for special deep space missions (Div. 4C.8); Tracking operations in deep space ground stations (4C.320); Systems engineering for deep space ground complex (4C.310).

Principal Publications:

SPACE VEHICLE TELEVISION
C.P. Sonett, Rec. Nat. Symp. Ext. Range & Space Commun. Washington D.C., Oct. 1958, p. 4/19.

RADIO COMMUNICATION WITH A SPACE PROBE
W.T. Blackband, J. Brit. Interplanetary Soc., vol. 17, Nov./Dec. 1959, p. 159/161.

The various sources of noise with which a radio signal from a space probe must compete are discussed and evaluated. The power requirements for transmitting television pictures from the Moon or Mars are calculated for several possible systems.

RADIO LINKS FOR SPACEFLIGHT
J.H. Unger, Proc. Nat. Telem. Conf., May 1959, p. 360/371.

DEEP SPACE COMMUNICATIONS
W.D. Merrick, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 158/162.

. . . design of the TRACE deep space communications system, the choice of the operating frequency, and the selection of a suitable ground antenna. The configuration of the three different microwave communications system stations — launch, injection, and deep space-employed in the Pioneer III and IV experiments is given, together with a description of the computing and interstation communications system. A brief description of the performance of the TRACE systems, its proposed development, and its future capabilities is also included.

STERILIZATION STUDIES
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 1/2.

. . . contamination of the Moon and planets by terrestrial organisms during initial explorations of the solar system must not occur. . . . might irretrievably destroy the opportunity to obtain data concerning the origin of life and could in an explosive manner upset planetary ecologies. Accordingly, spacecraft which have any likelihood of landing, by intention or accident, will be subject to careful sterilization. . . .

OPTIMIZATION OF SYSTEM PARAMETERS FOR DEEP SPACE COMMUNICATION SYSTEMS
M.E. Breese, et al., IRE Globecom Conv. Rec., Chicago, Ill., 1961, 180/183.

COMMUNICATIONS AT MEGAMILE RANGES
R.C. Hansen, et al., Brit. IRE Canad. Proc., vol. 1, Oct. 1961, p. 17/21.

. . . surveys the design of a deep space communication system. . . . basic constraints and capabilities of a low-noise ground receiving system are covered in detail, including antenna temperature contributions from galactic noise, tropospheric and ionospheric attenuation, and earth radiation through antenna sidelobes. Low-noise preamplifiers, large high-gain antennas, and narrow-band phase-lock receivers are also considered. . . .

DEEP SPACE COMMUNICATIONS
E. Rechtin, Astronautics, vol. 6, no. 4, April 1961, p. 37+.

High-quality communications between earth stations and probes exploring the moon, the nearby planets, and interplanetary space is quite practical . . . does not require breakthroughs or the discovery of new principles. . . .

DEEP SPACE COMMUNICATIONS FEASIBILITY PART 2 - DESIGN CONSIDERATIONS
E. Rechtin, Astronautics, vol. 6, no. 4, May 1961, p. 26+.

TRACKING TECHNIQUES FOR INTERPLANETARY SPACECRAFT
R.P. Mathison, Proc. Nat. Telem. Conf., May 1962, No. 8-2, p. 1/24.

THE REDUCTION OF ENERGY CONSUMPTION IN DEEP SPACE COMMUNICATIONS THROUGH TRANSMITTER PROGRAMMING
N.S. Potter, IRE Trans. Commun. Syst., vol. CS-10, no. 4, Dec. 1962, p. 441/448.

. . . programming of transmitter power output to minimize the energy consumption required to maintain a specified minimal information rate from an astronautical vehicle to a terrestrial receiving system over the trajectory of the vehicle. . . . trajectories . . . include an idealized, rectilinear trajectory, deep-space probe with variable terminal ranges, and solar circular orbits at variable radii in the plane of the ecliptic. . . .

AN ASTRO-SHIP CALLS THE EARCH (SUPER-LONG DISTANCE COMMUNICATIONS WITH A SPACE SHIP)
V.A. Sokolov, et al., Foreign Tech. Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, 27 Aug. 1962, 15 p., incl. illus., Trans. no. FTD-TT-62-721 from Nauka I. Zhizn, no. 2, p. 13/19, 1962, AD 286 611.

PLANETARY SCAN SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-18, July/Nov. 1962, p. 70/72.

A planetary scan system has been developed which is capable of performing three major operations on board a spacecraft; planet searching, planet acquisition, and planet scanning. A block diagram of the system is shown . . .

HEAT STERILIZATION PROBLEMS
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 10.

SPACE ASTRONOMY AND THE SLOW-SCAN VIDICON
L.R. Malling, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TR-32-531, J. Soc. Motion Picture Television Engrs., vol. 72, Nov. 1963, p. 872/875, refs., N64-14846.

Space astronomy is defined. In particular, the requirements for visual exploration of the Moon and Mars are outlined. The slow-scan vidicon is shown to be particularly useful as an astrophotographic instrument for space astronomy. The special instrumentation requirements for a slow-scan vidicon system are described for a Mars mission. Some of the techniques are illustrated with photos taken with a slow-scan vidicon system using as an optical objective the Mt. Wilson 60-inch telescope.

TIME LAG CONSIDERATION IN OPERATOR CONTROL OF LUNAR VEHICLES FROM EARTH
R.A. Newman, In: Technology of Lunar Exploration. Progress in Astronautics And Aeronatucs, vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 589/613, 11 refs., A63-23439.

Discussion of the nature and effect of time lags in the control loop for a roving lunar vehicle controlled from the Earth. A display and control concept intended to compensate for the 1.25 sec transmission delays in each direction of the loop, and for other time lags, is described. This concept uses predictive displays and is based on existing technical capability. It permits the operator to control the vehicle at the predicted point where the control instruction will take effect. The concept makes use of a computer to determine probable future vehicle position.

STERILIZATION STUDIES
L. L. Reed, JPL Space Progr. Summ., vol. 4, no. 37-24, Oct./Nov. 1963, p. 5/7.

Microbiological Analysis Techniques for Spacecraft Sterilization . . . Microbiology of Spaces Controlled to Prevent Contamination . . . Adjuvants for Dry Heat Sterilization, Feasibility Study . . .

Related Publications:

SYSTEM DESIGN CHANGES
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 7/9.

A review of the Ranger system has been conducted to determine marginal, unstable unreliable, or weak designs in order to improve mission reliability and capability. . . .

MARINER TELEVISION SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 67/70.

A Mars flyby mission is proposed in which the Mariner will pass the planet at a velocity of approximately 5 km/sec relative to the planet, and at a nominal miss distance of 25,000 km. A system is . . . designed that can obtain from 8 to 20 photographs with an effective TV resolution of 2.5 km. The mechanization is to include the ability of take two-color data with about a 60% overlap between the two pictures.

RANGER T V SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 18.

. . . consists of three major assemblies: (1) the central box which houses the main electronic components, (2) the camera subassembly with associated bracketry and equipment, and (3) the thermal shield.

PRACTICAL ASPECTS OF DATA PROCESSING AND ENCODING FOR SPACE COMMUNICATIONS
G. E. Mueller, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 471/487.

. . . Communications from spacecraft . . . Surveyor . . . Aeros . . . Ranger . . . OAO . . . Relay . . . Telstar . . . discussing methods for processing and encoding data from spacecraft . . . Four factors must be considered in the process of translating measurements and events at a spacecraft into a form suitable for telemetry transmission; filtering, encoding, the choice of format for this code, and the capability for decoding. . . . each of these will . . . be reviewed . . .

INSTRUMENTATION ASPECTS OF THE MARS MISSION
W. Victor, et al., In: Exploration of Mars, Proceeding 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. 373/388, A64-10116.

. . . communication system that utilizes conventional devices and is capable of maintaining almost continuous, high-quality communication with our proposed Mars-bound explorers from the time of Earth lift-off to Marsh touch-down and return. It is shown that real-time television is possible in either direction - that is, from Earth to Mars and from Mars to Earth - even at the maximum Earth-Mars distance of 400 million km and by utilizing conventional devices. The principal problem appears to be one of engineering these devices so that they possess adequate long-life and reliability to accomplish the mission . . . A communications black-out occurs when the Sun enters the main beam of either the Earth-based or Mars-orbiter antenna, and computational results are included which indicate that this should not be a serious problem if it is planned for during the design of the mission.

DIVISION 4C.2
SPACE CRAFT SUBSYSTEMS

4C.200: Spacecraft Subsystems for Deep Space Communications

Included: Auxiliary power supply subsystems for deep space flight; System checkout of spacecraft for deep space flight.

Not Included: Development reports of power supply systems in general; Spacecraft information processing subsystems (3A).

Cross References: Design reports about special spacecraft systems (Div. 4C.8); Design of lunar spacecraft (Div. 4C.4); Design of spacecraft for planetary exploration (Div. 4C.5).

Principal Publications:

DEEP SPACE COMMUNICATIONS FEASIBILITY PART 2 - DESIGN CONSIDERATIONS
E. Rechtin, Astronautics, vol. 6, no. 4, May 1961, p. 26+.

SPACE PROBE LIMITATIONS ON NUCLEAR-ELECTRIC POWER SUPPLIES
O.W. Welles, American Rocket Society, Space Power Systems Conference, Santa Monica, Calif., Sept. 25-28, 1962, Paper 2527-62, 8 p., 7 refs., A63-11684.

Review of the various relationships between a deep space probe and its nuclear-electric power supply, in order to predict the constraints of the probe on the supply. . . .

SYSTEM CHECKOUT AND FLIGHT TESTING OF UNMANNED LUNAR AND PLANETARY SPACECRAFT
J.F. McGee, American Institute of Aeronautics and Astronautics, Space Flight Testing Conference, Cocoa Beach, Fla., March 18-20, 1963, Paper 63104, 23 p., A63-17057.

. . . overall philosophy and test facilities of the Jet Propulsion Laboratory test program. . .

Related Publications:

COMMUNICATION SYSTEMS ANALYSIS FOR LIGHTWEIGHT ROVING LUNAR VEHICLE
G.L. Dunn, General Electric Co., Santa Barbara, Calif., Rept. no. 61 SPC-4, 2 Nov. 1961, 41 p., incl. illus. tables, 5 refs., AD 273 812.

. . . Efforts were made to determine the transmitter power requirements as a function of data transmission rate for the Prospector moon-to-earth TV link. An analysis is presented based on the utilization of PCM-PS modulation at an RF carrier frequency of 2250 mc. The ground based receiver station utilizes the DSIF equipment. The video input is obtained from the output terminals of an image orthicon camera located aboard the tank.

DIVISION 4C.3
GROUND TERMINAL FOR DEEP SPACE COMMUNICATIONS

Section 4C.30

4C.300: General References on Deep Space Ground Stations

Included: DSIF (deep space instrumentation facility); Participation of DSIF in various operations; Moon bounce tests between Goldstone and Woomera; Deep space communications network.

Not Included: Apollo ground communications network (4D).

Cross References: Special stations of DSIF (Sect. 4C.38).

Principal Publications:

DEEP SPACE INSTRUMENTATION FACILITY
JPL Res. Summ., vol. 1, no. 36-1, Dec./Jan. 1959-1960, p. 1/37.

. . . a system of space probe radio communication stations to be known as the Deep Space Instrumentation Facility (DSIF). . . . to assure continuous radio contact with future space vehicles, three permanent radio stations are spaced around the Earth at intervals of about 120 degrees. . . .

DEEP SPACE INTRUMENTATION FACILITY
JPL Res. Summ., vol. 36, no. 5, Aug./Sept. 1960, p. 32/40.

. . . A. Goldstone Tracking Station, also Woomera and South Africa.

PARTICIPATION IN NASA PROJECT S-30, EXPLORER VIII
JPL Res. Summ. vol. 1, no. 36-6, Oct./Nov. 1960, p. 19.

. . . The Goldstone Tracking Station supplied data for the launch pass and the succeeding three orbital passes. The tracking equipment used at Goldstone consisted of a modified Microlock receiver and a two-turn helical antenna. . . .

PRELIMINARY MOONBOUNCE TESTS
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 35/38.

During the week of December 26 through 30, Moon-bounce communication experiments were conducted between the Goldstone transmitter and receiver sites. These tests, conducted at 960.05 mc, were designed primarily to determine the optimum system for Moonbounce taped and live voice communications between the Goldstone and Woomera Tracking Stations. Single-sideband (SSB) transmission was used throughout the experiments and various receiving system methods were evaluated. Based on the results of these tests, equipment has been purchased for installation at the Woomera Station for a series of communication experiments to be conducted in February 1961. . . .

DSIF IN THE RANGER PROJECT
N.A. Renzetti, Astronautics, Sept. 1961, p. 34/37, and p. 70, N63-19542.

. . . DSIF can maintain continuous communications with the spacecraft by means of three permanent Deep Space Stations located at approximately equal intervals around the world. . . . DSIF will provide tracking information and raw telemetry data . . . will transmit commands to the spacecraft when required. . . .

COMMUNICATIONS WITH LUNAR PROBES
N.A. Renzetti, et al., Jet Propulsion Lab., CIT, Pasadena, Calif., Tech. rept. 32-148, 23 Aug. 1961, 18 p., AD 262 446.

The tracking and communication capabilities of the Deep Space Instrumentation Facility (DSIF) . . . are briefly described. . . . The purpose of the Ranger Project the spacecraft, the communications equipment aboard the spacecraft, and the participation of the SDIF in this project are discussed.

THE JPL DEEP SPACE INSTRUMENTATION FACILITY (DSIF)
D.R. Speece, General Electric Co., Santa Barbara, Calif., Rept. no. 61 SPC-5, 15 Oct. 1961, 34 p., incl. illus. tables, AD 273 813.

EXPLORER X
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 70/71.

With the tracking of Explorer X, the Woomera and Goldstone DSIF stations participated in the first mission in which the DSIF operated as a net. Explorer X carried a rubidium magnetometer similar to the one to be carried by the Ranger spacecraft and had as its prime function the measurement of the earth's magnetic field intensity.

ESTIMATED 1963-1970 CAPABILITY OF THE DEEP SPACE INSTRUMENTATION FACILITY FOR APOLLO PROJECT
E. Rechtin, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Calif., Feb. 1, 1962, 54 p., 8 refs., N63-16724.

. . . providing a precision tracking and communications system for the Apollo Project from 1963 to 1970 . . .

RANGER III OPERATION
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 47/52.

All stations participated successfully in the launch of Ranger III on Jan. 26, 1962. Excellent telemetry was received and the spacecraft responded correctly to commands up to the initiation of the terminal maneuver. Following this command, sent by the Goldstone Echo Station at 17:21 GMT on Jan. 28, a spacecraft failure caused the strength of the transmitted signals to drop rapidly and become erratic. Unsuccessful efforts were made to correct this condition by sending various commands to the spacecraft. Loss of signals was complete by Feb. 1.

THE DSIF PROGRAM
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 35/39.

Three permanent deep space stations and one mobile station (Table 1). . . . To provide continuous coverage of a deep space probe (Fig. 1). Their locations are near Goldstone, California (Figs. 2, 3, and 4), Woomera, Australia (Fig. 5) and Johannesburg, South Africa (Fig. 6). The Mobile Tracking Station (MTS, Fig. 7) is presently located near the permanent station in South Africa.

THE DSIF PROGRAM
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 45/49.

All DSIF stations have 960-Mc phase-lock receivers; all permanent stations utilize parametric amplifiers. The Pioneer Station antenna includes a 960-Mc maser amplifier and a Cassegrain feed. The permanent stations and the MTS have receivers with angle error channels which furnish angle information to the servo drive system to enable the antenna to automatically point to the spacecraft.

DSIF PARTICIPATION IN MARINER II
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 3/6.

With the successful launch of the Mariner 2 Venus probe the DSIF (Table 1) began a program of spacecraft tracking and communications. This program: (1) Provided the tracking data . . . (2) Received, recorded and transmitted to the JPL data analysis center the telemetry data . . . (3) Provided the ability to command the spacecraft. . .

TRACKING OPERATIONS: MARINER 2
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 35/36.

Commands to the spacecraft have been successfully transmitted from both the Johannesburg Station and the Echo Station.

PARTICIPATION IN RANGER 5
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 3/5.

. . . mission was unsuccessful due to a failure, of as yet undetermined origin, in the spacecraft, which limited the amount of data recovered and precluded the possibility of obtaining lunar impact.

TRACKING OPERATIONS
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 45/47.

All DSIF stations are continuing to successfully track and receive telemetry data from Mariner 2.
Ranger 5 was launched on October 18, 1962 . . . The Goldstone Pioneer Station was able to track the spacecraft, using the capsule signal, until October 29, when the signal level fell below the station threshold.

DSIF PARTICIPATION IN MARINER 2
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 4/6.

Telemetry data were provided 24 hr/day until December 17, 3 days after planetary encounter, at which time the requirements for DSIF coverage were relaxed to 10 hr/day (only one station tracking per day).
Command Transmission Prior to Encounter . . . Pre-encounter Operations . . . Preparation for Encounter . . . Encounter Operations . . . Post-encounter Operations . . .

DSIF PARTICIPATION IN MARINER 2
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 49/51.

. . . continued successfully to track and receive telemetry data from Mariner 2 on its flight to Venus. . . . received on a 24-hr/day basis until December 17 (3 days after encounter), when coverage was reduced to 10 hr/day . . .

GOLDSTONE OPERATIONS
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 5/8.

Ranger 6 preparation . . . full readiness scheduled in November.

Related Publications:

MARINER 2 SYSTEMS OPERATIONS AND PERFORMANCE
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 21/38.

Section 4C.31

4C.310: Systems Engineering for Deep Space Ground Systems

Included: Site selection; Site noise; GSDS = Goldstone Duplicate Standard; S-band systems engineering; RFI = Radio Frequency Interference; S-band subsystems integration; Millimeter wave planning for future deep space ground stations; X-band systems integration.

Not Included: RFI theory and practice in general; Microwave engineering; Noise and disturbance in communications channels (1); Apollo unified S-band system (4D).

Cross References: Systems engineering for deep space communications links (4C.100).

Principal Publications:

DEEP SPACE INSTRUMENTATION FACILITY
JPL Space Progr. Summ., vol. 1, no. 37-8, Jan./Feb. 1961, p. 31/38.

. . . Goldstone Tracking Station . . . consists of two steerable 85-foot-diameter parabolic reflector antennas and their associated drive systems, radio tracking and transmitting equipment, and data recording and transmitting equipment.
Block diagrams of all 4 stations.

S-BAND SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 81/82.

The system design effort related to the DSIF S-band conversion program has been completed, and detailed design specifications have been released on all major items of hardware. The contractor is proceeding with development of all inhouse modules and subcontracts have been let for development and/or procurement of the remainder of the system.

SYSTEM CAPABILITIES AND DEVELOPMENT SCHEDULE OF THE DEEP SPACE INSTRUMENTATION FACILITY, 1963-1967
E. Rechtin, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-83; supersedes JPL-TM-33-27, March 2, 1962, 31 p., N63-20963.

S-BAND RF SUBSYSTEMS PROTYPE PROGRAM
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb, 1962, p. 72.

DSIF S-band RF subsystems prototype functional hardware is in the final stages of fabrication and module check-out. . . . the over-all prototype configuration is firm.

X-BAND COMMUNICATIONS COMPONENTS
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 109/111.

1. X-Band Feed.
. . . low noise Cassegrain systems will be designed and installed for the X-band planetary radar experiment.
2. Maser System.
An X-band maser system . . . is being fabricated for JPL by the Hughes Research Laboratories. The principal features of the maser are:
F_o 8450 mc
Gain, 23db with a target of 26 db
Bandwidth, $\geq$ 7 mc
Noise temperatures, $\leq 20^{o}K$
Duty per fill of liquid helium, at least 24 hr.
3. System Temperature Instrumentation.

PROTOTYPE S-BAND SYSTEM INTEGRATION
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 14.

On May 1, 1961, Hallamore Electronics Division was awarded a contract to design, fabricate, test and install a DSIF prototype S-band radio system. . . . objective . . . is to accomplish an RF system frequency translation from L-band to S-band that will eventually be incorporated at each DSIF station. . . . Total equipment delivery is expected on or before June 1, 1962.

STATUS OF S-BAND SUBSYSTEM SPECIFICATIONS
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 18/19.

. . . the equipment is in the initial stages of integration into a functional system. Considerable effort has therefore been devoted to the preparation of functional specifications for the benefit of potential users, although several areas of implementation are still undergoing modification.

GOLDSTONE DUPLICATE STANDARD (GSDS) S-BAND RF SUBSYSTEMS
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 8/16.

The first phase of the task of developing and manufacturing the GSDS RF subsystems at Motorola, Inc., Phoenix, Arizona, is nearing completion. The S-band RF subsystems for the production model are shown in Fig. 6.
S-BAND RF PROTOTYPE TEST PROGRAM
S-BAND COMMUNICATION GROUND SUBSYSTEM
. . . to provide the capability of adequately testing the S-band transponders during the initial and final phases of development.
a. Transmitter . . . principal design characteristics. . .
b. Receiver . . .
c. Ranging Subsystem . . .

SITE SELECTION RADIO FREQUENCY INTERFERENCE INVESTIGATIONS
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 17/19.

. . . attention to the problem of radio frequency interference (RFI). . . . a number of experimental investigations to supplement theoretical predictions are in progress at Goldstone.

SYSTEMS ENGINEERING
JPL Space Progr. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 22/23.

The systems engineering function within the DSIF is concerned with three types of activity . . . DSIF systems engineering . . . DSIF project engineering . . . DSIF systems analysis . . . The status of these activities . . .

S-BAND IMPLEMENTATION FOR DSIF
JPL Space Progr. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 58/61.

. . . traveling wave masers (TWM'S) in closed cycle refrigerators (CCR) as part of the S-band implementation program. . . .

SYSTEMS ENGINEERING
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 12/13.

. . . status . . . activities . . .SURVEYOR. . . . RANGER III. . . . MARINER C (MARS MISSION, 1964). . . .MARINER B. (CENTAUR-BASED ENTRY-CAPSULE MISSION). . . . APOLLO. . . .

S-BAND IMPLEMENTATION FOR DSIF
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 76/81.

. . . Six TWM systems are required; subsystem construction is being done by commercial engineering firms; system integration will be done at JPL. . . . The block diagram for the TWM subassembly is shown . . . An acquisition aid is being developed for the DSIF 85-ft antennas at S-band. . . .

MILLIMETER WAVE WORK
W.V. Rusch, et al., JPL Space Progr. Summ., vol. 4, no. 37-24, Oct./Nov. 1963, p. 135. 136.

Radio communications at millimeter wavelengths show potential for use in space communications systems which require wide bandwidth, high gain, and directivity with small antennas, and the compactness of millimeter wave equipment. . . . much component and subystem work remains to be done before practical low-noise systems, comparable to those operating at centimeter wavelengths, can be achieved.
The objective of the . . . project . . . is to investigate millimeter-wave components and techniques to ascertain the future applicability of this frequency range to space communication and tracking.
b. Millimeter-wave antenna range instrumentation . . . measurement of E-band (60 to 90 Gc) antenna patterns.
c. Radiometer. A 90-Gc radiometer is under construction for experimental propagation and radio astronomy use. . . . tentative block diagram. . .

S-BAND SYSTEMS ENGINEERING
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 12.

An indentured specification list is being compiled using the Deep Space Net System Specification as the top document and will work down through the subsystem functional design and test specifications; module design and test specifications; and the DSIF standard and general specifications.

Related Publications:

SITING
R.M. Dohoo, Defense Research Telecommunications Establishment, Ottawa (Canada) Communications Lab., In its Some Considerations in Satellite Commun. Systems, Jan. 1964, 7 p., refs., N64-18274.

The factors affecting the siting of a ground terminal are considered. . . (1) The site should be as far as possible from radar, navigational, and microwave communications-systems installations. (2) The site should not be close to large centers of population or industry. . . (3) The site should be remote from airfield and busy air routes. (4) The site should be surrounded by hills to reduce the near-horizontal direct signals from sources of interference.

SITE NOISE AND ITS CORRELATION WITH VEHICULAR TRAFFIC DENSITY
A.G. Ellis, Proc. Instn. Radio Engrs. Australia, vol. 24, no. 1, Jan. 1963, p. 45/52.

. . . This paper shows that predictions of greater accuracy are obtained when the site noise is related to the nearby traffic density, and as a result of measurements taken at various sites in Victoria and New South Wales, suggests the law between them. . . .

Section 4C.32

4C.320: Tracking Operations and Equipment in Deep Space Ground Stations

Included: Automatic plotting of tracking data; Doppler radar in deep space terminals; Ranging subsystem; Monostatic planetary radar; Venus radar experiment; TRAC(E) systems; Tracking data handling; Transponder ranging system for helicopter tests; S-band ranging experiment; L-band ground transmit-receive system for helicopter tests; Mercury radar experiment; Lunar radar project.

Not Included: Development and design of deep space tracking systems; Information processors for tracking and radar (3A); Display devices (3A).

Cross References: Information processors in deep space ground stations (4C.360); Communications systems for lunar explorations (Div. 4C.4); Precision doppler subsystem (4C.360).

Principal Publications:

THE JET PROPULSION LABORATORY METHOD OF TRACKING LUNAR PROBES
R.E. Carr, Jet Propulsion Lab., Calif. Inst. of Techn., Pasadena, June 1959, p. 1/15, AD 234 178.

THE ELEMENTS OF A DEEP-SPACE TRACKING SYSTEM. THE TRACKING OF PIONEER IV
H.L. Richter, Jr., et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Aug. 1959, p. 1/13, AD 234 170.

THE TRACKING OF PIONEER IV: THE ELEMENTS OF A DEEP SPACE TRACKING SYSTEM
H.L. Richter, Jr., et al., IRE Trans. Space Electronics Telem., vol. SET-5, no. 4, Dec. 1959, p. 196, Abstract only.

RANGING SUBSYSTEM
JPL Res. Summ. vol. 1, no. 36-3, April/May 1960, p. 42/50.

There were three major parameters to be selected for the ranging system; (1) the code clock frequency, (2) the code length, and (3) the frequency of the coherent higher frequency signal used as a vernier on the code clock. . . . Functional breakdown of system . . . Transmitter coder . . . includes the equipment for generating and manipulating the transmitted code for producing the code-times-clock signal. . . . The receiver coder was designed to be essentially identical to the transmitter coder. . . . The range tally is essentially a device which keeps track of, or tallies, the displacement in time of one sequence with respect to the other. . . .

VHF DOPPLER FOR 2388-MC CW DOPPLER RADAR SYSTEM
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 47/48.

GSDS TRACKING DATA HANDLING
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 50/56.

. . . manufactured for installation at the Goldstone receiver site as part of the Goldstone Duplicate Standard (GSDS). . . . block diagram . . . The format and limits for the data handled are as follows . . . Greenwich Mean Time in nine decimal digits . . . Hour angle . . . with a resolution of 0.002 degree. . . . Declination angle. . . . with a resolution of 0.002 degrees. . . . Doppler frequency. . . . Doppler counting periods of 1, 5, 10, 20, 30, 40, 50 or 60 seconds are available as required. . . . Parameter data. Ten decimal digits in any combination. . . . Data condition. . . . Simultaneous operation of two teletype punches. . . . Teletype commands. . . . Sampling rates. . . . from one sample per second to one sample per 90 minutes. . . . Sampling points. . . .

RANGING SUBSYSTEMS
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 64/70.

. . . The construction of the rest of the ranging equipment has . . . been completed. . .

GOLDSTONE DUPLICATE STANDARD MODIFICATIONS OF THE TRAC(E) SYSTEM
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 33/36.

GOLDSTONE 2388-MC CW DOPPLER RADAR OPERATION WITH RANGING CLOCK MODULATION
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 41/42.

. . . The final tracking system will be capable of measuring two angles, range and range rate simultaneously. . . . early performance data on the clock portion of the ranging subsystem. The experiment was performed utilizing the Echo balloon satellite, and the object of the experiment was to check the performance of the clock portion of ranging subsystem by measuring the doppler shift of the 497.5-kc clock signal.

AUTOMATIC PLOTTING OF TRACKING DATA
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 32/33.

In order to rapidly plot the tracking data which originates at the DSIF Stations during a tracking mission, a Benson Lehner Model J Electroplotter . . . has been ordered. The tracking data is sent using standard five-hole Baudot teletype code punched on seven-hole width paper tape and prints out in the GSDS data handling system format . . .

VENUS RADAR EXPERIMENT
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 68/77.

. . . During the inferior conjunction of 1958, an MIT group, using the radio antenna facilities at Millstone Hill, Massachusetts, attempted to determine the range from Earth to Venus. After 13 months of data reduction, strong circumstantial evidence seemed to indicate that a range had been determined, but at the next conjunction, in 1959, a repeat attempt with better equipment was unsuccessful. . . . The next inferior conjunction of Venus will occur on April 11, 1961. In June 1960, it was proposed that an attempt be made by JPL to reflect a continuous wave signal off the surface of Venus, using the Goldstone radar system originally designed for tracking the Echo satellite . . . specific objectives. . . . Ephemeris calculation for the Venus experiment . . . Signal strength calculations . . . Transmitter and receiver oscillators . . .

THE 2388-mc CW DOPPLER RADAR
M. H. Brockman, et al., JPL Res. Summ., no. 36-8, Feb./March 1961, p. 65/68.

. . . for the 1961 Venus experiment consists of a highly stable 2388-mc, 10-kw transmitter feeding an 85-foot diameter transmitting antenna and a highly sensitive receiving system fed by an 85-foot diameter receiving antenna. The function of the transmitter is to illuminate Venus and provide a Venus-reflected signal to the receiving system which is located some 7 miles from the transmitter. . . . functional block diagram . . . System design parameters . . . Preliminary performance. . . .

RANGING SYSTEM EVALUATION
R. L. Carpenter, JPL Res. Summ., no. 36-13, Dec./Jan. 1961, p. 42/46.

Ranging measurements were made on the Echo and Courier satellites. . . . Part of the size of the residuals previously obtained was due to the fact that the range to the satellite, computed by the orbit determination program was measured from the south footing of the Ha-Dec antenna rather than from a point on or near the dish. Also, in deriving the range from the range numbers, no account was taken of changes in the relative geometry between the antennas due to their motions. In order to include these effects an analysis was undertaken to describe precisely the geometry of the Ha-Dec and Az-El antennas. The results of this analysis are given below.

RADIO TRACKING TECHNIQUES AND PERFORMANCE OF THE UNITED STATES DEEP SPACE INSTRUMENTATION FACILITY
N. A. Renzetti, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL Technical rept. no. 32-87, 24 March 1961, 44 p., AD 264 261.

. . . tracking data provided by this facility consists of two angles and radial velocity, accurately time-labeled. This data is used by computing facilities to determine spacecraft orbits, to determine the appropriate time for the transmission of commands from the DSIF to a spacecraft and to determine the appropriate midcourse maneuver to be performed by the spacecraft. The data received by the DSIF from a spacecraft consists of telemetered information concerning both the spacecraft performance and the measurements of the scientific instrumentation aboard.

MONOSTATIC RADAR
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 60/62.

. . . appears attractive for research and development experiments . . . The informarion output will be range, 2 angles, doppler and integrated doppler (or precision change-in range). The RF portion of the system which is planned for installation with the MOD I-D(1) ranging equipment (RS 36-11, Vol. 1) will be installed at the GSCS in early summer 1962. The prototype 15-kw, 2388-mc klystron and associated equipment, now installed on the Az-El antenna at the Echo site, will be moved to this antenna. The reciever is the TRAC(E) MOD III (SPS37-13) equipped with a parametric amplifier.

S-BAND RANGING EXPERIMENT
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 66/69.

At this time all DSIF stations are equipped to locate and track satellites and space probes by obtaining and recording angles . . . and two-way coherent doppler. . . . For planetary and interplanetary range determinations . . . a more powerful method . . . to be devised, preferably one whose accuracy is not a function of the distance involved. During the past 3 years. . . . testing of several versions of precision ranging by essentially digital means. This report concerns the application of these methods to provide precision ranging for the Ranger RA-6, -7, -8 and -9 lunar probes.

TRANSPONDER RANGING SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 78/83.

TRANSPONDER RANGING SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 83/90.

. . . Stored Program Controller, Mod II . . . The resulting machine is operable and capable of being used to conduct the helicopter experiments . . .Test programs. Ranging acquisition program.

S-BAND MONOSTATIC PLANETARY RADAR
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 37/43.

Radar exploration of the planet Venus is planned during the 1962 opposition . . . The equipment to be used for the 1962 experiment has been designated the Mod II Planetary Radar System and will be operated as a monostatic radar . . .

L-BAND GROUND TRANSMIT-RECEIVE SYSTEM USED IN THE TRANSPONDER HELICOPTER RANGING EXPERIMENTS
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 53/64.

SPACECRAFT TRACKING AND DATA ACQUISITION
R. E. Wye, et al., In: 2nd Manned Space Flight Meeting, New York, American Institute of Aeronautics and Astronautics, 1963, p. 206/212, A63-19009.

. . . effect of various errors on the technique used in determining the trajectory . . . A table lists some tracking-system characteristics, including those for the AN/FPS-16, AN/FPQ-6, VERLORT, IIR, Range-Range Rate, JPL PN Ranging and Azusa MKII. . . .

MARK I RANGING SUBSYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 5/6.

A summary of the basic theory of operation and a brief over-all description were given in SPS 37-20, Vol. III, p. 12/15. In SPS 37-21, Vol. III, p. 6/18, a detailed account was given of the design and operation of four of its functional units . . .

LUNAR RADAR PROJECT
JPL Space Progr. Summ., vol. 3, no. 37-23, July/ Aug. 1963, p. 51/54.

Relationship to Planetary Radar Project . . . Background . . . Program . . . to develop a system and conduct experiments in a manner similar to that of the Planetary Radar Project . . .

MARK I RANGING SUBSYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 9/11.

. . . operational and test control features are described. . . .

RADAR OBSERVATIONS OF MERCURY
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 50/51.

. . . made during its recent conjunction in May. . . . at the Venus site . . . Mercury was illuminated with the 100-kw S-band transmitter working into the 85-ft paraboloidal antenna. Essentially the same low-noise, ephemeris-tuned reciever was used for Mercury as was used for the Venus experiments of the Fall of 1962.

Three different types of signal processing were used, yielding three different kinds of information about Mercury. The same techniques were used with Venus . . . during . . . 1962 . . .

LUNAR RADAR PROJECT
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 51/53.

Mod III transmitting System, 2388 Mc, 100 kw
The klystron noise power is one of the major parameters in designing a monostatic radar for lunar use. The effect of the klystron noise was analyzed in SPS 37-23, Vol. III, p. 52/55. . . . because the klystron has been changed . . . a more extensive test was conducted during this reporting period.

MICROWAVE CONFIGURATION FOR LUNAR SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 53/54.

The microwave configuration of a lunar mode adaptation of the Venus site planetary radar is presented. A general description of the Lunar Radar Project was given in SPS 37-23, Vol. III, p. 51/55. . . .

RANGING AND TRACKING SYSTEM DEVELOPMENT
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 59/76.

1. Monostatic Radar . . .
2. Monostatic Radar System Description . . .
3. Digitally Controlled RF Acquisition . . .

NINE-CHANNEL AUTOCORRELATOR
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 33/38.

A nine-channel autocorrelator is currently being constructed for use with the planetary radar receiver located at the Venus site in Goldstone, California. This instrument is a real-time device for processing the reflected signal from a planetary surface.

Section 4C.33

4C.330: Antenna Installations in Deep Space Ground Stations

Included: Cassegrainian feed systems; Feed assemblies; Optical checkout of large antennas; Antenna temperature tests; Diplexer assemblies; Acquisition aid antenna; Az-El antennas; Ranging systems antennas; Advanced antenna system for DSIF (210 ft paraboloid); Antenna instrumentation; Water rotary joint; Antenna pointing offset control; Boresight calibrations; Tiefort mountain antenna range; MESA antenna range; Automatic antenna pointing system; Ha-Dec antennas.

Not Included: Antenna theory and antenna design.

Cross References: Test facilities in deep space ground stations (4C.390).

Principal Publications:

GOLDSTONE 960-mc ANTENNA TEMPERATURE TESTS
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 56/59.

ANTENNA FEED AND DIPLEXER DEVELOPMENT
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 31/32.

To supplement the DSIF operational capability at L-band frequencies several new feeds and their associated diplexers are being developed for S-band operation. . . .

ANTENNA FEED RESEARCH
P. D. Potter, et al., JPL Res. Summ., no. 36-13, Dec./Jan. 1961, p. 60/61.

. . . tests have been performed to determine the effective noise temperature properties of the Goldstone 960-mc Cassegrain feed system. It was pointed out that a noise temperature contribution of 7°K was observed from a combination of the effects of spillover, quadripod scattering, and reflector losses, whereas the known direct feed spillover of 1.3% could only account for 3°K.

SHAPED BEAM FEED RESEARCH
D. Schuster, et al., JPL Res. Summ., no. 36-8, Feb./March 1961, p. 22/26.

. . . directed toward shaping the primary pattern of the feed to provide better dish illumination and less spillover. . . .

225-260 MC AND 960 MC COMPOSITE FEED ASSEMBLY
Alpha Corp., Richardson, Tex., Final test rept., Rept. no. AER-137, 16 Nov. 1961, 66 p. incl. illus., tables, AD 274 512.

. . . These feeds will be used in the 85-ft. Diameter Tracking Antennas of the DSIF Net. . . . consists of a 960-mc Simultaneous Lobing Tracking Feed and a 225-260 mc listening feed combined into one feed assembly. . . .

ADVANCED ANTENNA SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 77/81.

A new, large aperture, low-noise advanced antenna system (AAS) is planned for installation in the DSIF (SPS 37-9). . . . study of the significant technical problems associated with the design and building of a nominal 240-foot steerable antenna for application to the missions of the DSIF. Foundation Studies. . . .

ANTENNA RANGE
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 82/87.

The Mesa antenna range . . . is a major facility of the JPL telecommunications division . . .

960-MC CASSEGRAIN SYSTEM AT THE PIONEER STATION
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 46/58.

The installation of an experimental Cassegrain feed system has been completed on the 85-foot Ha-Dec antenna . . .

S-BAND TRACKING FEED
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 79/81.

The requirements of the DSIF for antenna feeds can be separated into the following three basic modes of operation: (1) high-power transmitting, (2) angle tracking, and (3) data receiving. At the present L-band frequencies (890 and 960 mc), these modes are provided by two different feeds since the tracking feed cannot handle high-power commands. A single S-band feed, now being developed under subcontract to Hughes Aircraft Company, will provide all three modes of operation.

ADVANCED ANTENNA SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 87/90.

. . . feasibility studies for the AAS were initiated with four companies in January, 1961 . . .

RANGING SYSTEM ANTENNA
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 78/79.

A 30-ft. diameter steerable antenna for ranging system experiments will be erected at the new High-Power Transmitter R&D site. . . .

X-BAND MODIFICATIONS TO ANTENNAS
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 79/80.

The 85-ft diameter Az-El antenna, which is to be moved from the Echo Site to the new High Power Transmitter R&D Site, will be modified for use at X-band frequencies.

ACQUISITION AID ANTENNA
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 83/84.

An L-band acquisition system experiment is to be conducted at the Johannesburg Station during the Ranger RA-3 mission and is designed to evaluate the use of an ancillary antenna for spacecraft acquisition. This system will provide detection and automatic angular acquisition of a spacecraft within the beamwidth of the acquisition antenna. In addition, the experiment is intended to provide information required for the development of an S-band acquisition system.

THE APPLICATION OF THE CASSEGRAINIAN PRINCIPLE TO GROUND ANTENNAS FOR SPACE COMMUNICATIONS
P. Potter, IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 154/158.

SCATTERING FROM AN ARBITRARY SURFACE OF REVOLUTION
W. V. T. Rusch, JPL Space Progr. Summ., vol. 4, no. 37-15, April/May 1962, p. 57.

The diffraction integrals described in RS 36-14 have been programmed for machine computation and are currently being used in the design of optimum subreflector shapes in Cassegrain feed systems for low noise antennas.

HIGH POWER L-BAND FEED
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 63.

CASSEGRAIN SYSTEM, 960 mc
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 99/106.

Antenna temperature and calibration studies.

ADVANCED ANTENNA SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 119/135.

Supporting Studies. 1. Seismic Studies. 2. Steel Brittle Fracture. 3. Servo and Dynamic Tests. 4. Servo Simulator Studies. 5. Wind Measurements at AAS Site. 6. Wind Tunnel Studies.

MODIFICATION TO GTS ANTENNAS
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 20/21.

The preparation of the specifications for structural modifications of the 85-ft Ha-Dec antenna, to improve its communication and tracking capability and enable operational use to X-band frequencies, is now in process based on the results of the design study described in SPS 37-14.

ANTENNA DAMAGE BY HAILSTONES
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 21/25.

S-BAND MONOPULSE CASSEGRAIN SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 25/28.

X-BAND CASSEGRAIN FEED SYSTEMS
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 28/31.

Preliminary design . . . for the Goldstone 85-ft antennas has been started.

ADVANCED ANTENNA SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 49/53.

. . . will give an approximate 10-db performance increase over the 85-ft antennas now used in the DSIF . . .

S-BAND ACQUISITION ANTENNA
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 17/18.

Final measurements on the laboratory prototype S-band acquisition antenna (SAA) have been essentially completed . . . Preliminary results and background were given in SPS 37-15.

ANTENNA DAMAGE BY HAILSTONES
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 29/31.

Based on the results of the hail damage investigations carried out in South Africa (SPS 37-15), a hailstorm simulation facility was developed at JPL to continue the study.

S-BAND MONOPULSE CASSEGRAIN SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 65/69.

. . . The primary objective of this program is to develop a single horn monopulse system with aperture efficiency and noise temperature performance approaching that measured at 960 mc with a listening system (SPS 37-13, Vol. I).

ADVANCED ANTENNA SYSTEM (AAS)
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 71/77.

. . . Blaw-Knox has conducted a comparative analysis of several variations of a basic pedestal-alidade-kingpost-bearing-gear and axis readout configuration. . . . Additional refinements of this design have taken place.

S-BAND DIPLEXERS
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 7/8.

Az El MOVE AND REINSTALLATION
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 9/13.

FEEDS AND FEED SYSTEMS
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 17/18.

. . . an ultra low noise 2388 Mc Cassegrain feed system has been designed for the 1962-63 Venus and Mars radar experiments. . . . The full scale installation on the 85-ft. Az-El antenna has been completed and a preliminary evaluation of the feed system secondary has been carried out.

ADVANCED ANTENNA SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 35/43.

The task contract . . . has been completed. . . . JPL is continuing wind tunnel tests, on-site wind studies, bearing and gear studies and structural analysis using computer programs.

PROTOTYPE S-BAND MONOPULSE CASSEGRAIN SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 65/68.

FEEDS AND FEED SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 24/30.

As described in SPS 37-16 and -17, Vol. III, an ultra-low noise 2388-Mc Cassegrain feed system has been installed and tested for the 1962-63 Venus and Mars radar experiments. . . . tests have been performed to calibrate the aperture efficiency and the zenith noise temperature. . . .

S-BAND MONOPULSE GASSEGRAIN SUBSYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 8/11.

. . . designed for use with the 85-ft diameter equatorial-mounted paraboloidal antenna to provide diplexed transmit-track capability.

FEEDS AND FEED SYSTEMS
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 16/18.

The waveguide system in the planetary radar at the Venus site has been operated at a power of 13 kw continuous wave during a recent series of measurements on the Planet Venus. The power will be increased to about 85 kw with a Varian VA 858 klystron. . . . it was necessary to bench test the microwave feed components at 85 kw.

Az-El ANTENNA POINTING OFFSET CONTROL
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 18/20.

The antenna offset control panel is designed to provide a simple reliable device for introducing angular offsets into the slaved steering commands for the Az-El antenna at the Venus site.

WATER ROTARY JOINT FOR Az-El ANTENNA
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 20/22.

The Az-El antenna at the Venus site is being outfitted to handle an RF transmitter with a continuous wave power output capability of up to 300 kw. This is approximately 30 times the existing transmitter power and requires a major change in the amount of cooling fluid required on the antenna dish.

30-FT. DIAMETER AZIMUTH-ELEVATION ANTENNA
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 32/35.

. . . medium size . . . transportable antenna . . . installed at the Venus site of the Goldstone Tracking Station . . . It is a fully steerable Az-El configuration capable of efficient operation at S- and X-band frequencies. . . .

ADVANCED ANTENNA SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 37/55.

. . . more detailed studies were accomplished by both the AAS project team at JPL and several firms in the antenna industry. . . . These studies and discussions are reported . . .

OPTICAL CHECKOUT OF LARGE ANTENNAS FOR DEEP SPACE PROBES
G. W. Godfrey, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 390/394.

DEFLECTION STUDIES ON 85-FT. ANTENNAS
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 4/6.

S-BAND ACQUISITION ANTENNA
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 15/17.

. . . is completed . . .

PROTOTYPE S-BAND CASSEGRAIN SUBSYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 26/28.

30-FT DIAMETER AZIMUTH-ELEVATION ANTENNA
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 28/31.

ANTENNA INSTRUMENTATION
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 31/34.

A flexible instrumentation set is being constructed to be used for research and development testing of the 85- and 30-ft antennas at Goldstone; it will also be used for testing the AAS in the future. The set will be built in a trailer.

WATER ROTARY JOING FOR Az-El ANTENNA
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 42/44.

The new 100-kw transmitter on the 85-ft azimuth-elevation antenna requires a large cooling water flow (300 gal/min) . . .

TIEFORT MOUNTAIN ANTENNA RANGE
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 52/54.

An experimental long base line antenna measurement range is being established at Goldstone for research and development testing of the Echo and Venus site antennas.

TIEFORT MOUNTAIN ANTENNA RANGE
JPL Space Progr. Summ., vol. 3, no. 37-21, March/April 1963, p. 83/84.

. . . has been completed.

30-FT DIAMETER AZIMUTH-ELEVATION ANTENNA
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 11.

. . . additional tests were conducted.

S-BAND ANTENNA GAIN AND PATTERN CALIBRATIONS
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 11/15.

ANTENNA INSTRUMENTATION
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 15/16.

A transportable instrumentation system is being built for use in research and development testing of the structural and mechanical properties of large ground antennas. It will be used on the 30- and 85-ft antennas this year and, later, on the 210-ft diameter Advanced Antenna System. . . . There is a detailed description of the instrumentation system in SPS 37-20, Vol. III and a short progress report in SPS 37-21, Vol. III.

RADIO ASTRONOMICAL TECHNIQUES FOR GROUND ANTENNA CALIBRATION
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 22/29.

a. Boresight and gain calibrations of DSIF antennas. . . . b. 85-ft Az-El antenna radiometric tests.

WATER ROTARY JOINT FOR AZ-EL ANTENNA
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 29/31.

Progress report on fabrication and assembly phase.

ADVANCED ANTENNA SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 49/56.

Contract with the Rohr Corporation . . . for the final design, fabrication, and erection of the first Advanced Antenna System (AAS) . . . has been executed. . . . Supporting studies . . . are continuing on the hydrostatic bearing and the computer program used in the design of the reflector structure.

COMPUTER CONTROLLED ANTENNA POINTING SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 17/20.

Automatic antenna positioning system . . . at the Goldstone Tracking Station . . . Precomputed drive tapes for tracking during visibility periods were used almost exclusively during the 109 days of Mariner's trip to Venus . . . A study has been launched to define a tape drive system with expanded and more flexible capabilities for use throughout the DSIF and the Advanced Antenna System.

COMPUTER PROGRAMS
JPL Space Progr. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 23/26.

Satellite Rate Program to ascertain whether the angular velocity and acceleration encountered in a ha-dec antenna tracking an Earth satellite in any given orbit will violate the physical limitations placed on the antenna . . . DSIF Tracking Data Analysis . . . SDS 920 computer . . . Benson-Lehner plotter . . . Stereographic Projection Program.

RADIO ASTRONOMICAL TECHNIQUES FOR GROUND ANTENNA CALIBRATION
JPL Space Progr. Summ., vol 3, no. 37-23, July/Aug. 1963, p. 28/34.

Boresight and gain calibrations for DSIF antennas . . . Experimental antenna radiometric tests . . .

RADIATION PATTERN AND ANTENNA EFFICIENCY COMPUTER STUDIES
JPL Space Progr. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 34/38.

Two studies are currently being conducted, using the IBM 7094 computer, to numerically evaluate the scalar far-field radiation pattern integral and aperture efficiency of paraboloid reflector antennas . . .

WATER ROTARY JOINT FOR AZ-EL ANTENNA
JPL Space Progr. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 49/51.

. . . testing and installation on the antenna.

ADVANCED ANTENNA SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 62/72.

(AAS) will be a 210-ft diameter, fully sterrable paraboloid. It is being designed for operational use at the DSIF Stations at the DSIF S-band frequencies (2.1 to 2.3 Gc). . . .

ANTENNA ENGINEERING
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 13/18.

. . . The possibility that solar energy or thermal inputs cause distortion of the antenna structures led to an investigation to determine whether or not thermal or solar energy inputs distort antenna structures to a degree that would significantly affect angle pointing data. . . . These tests and consultations indicate the following: (1) White paints of proper film thickness afford the largest reduction in solar heating . . . (2) Maximum temperature control by any paint coating requires a minimum of two standard top coats. (3) Depending on the body's heat capacity, local, winds . . . (4) Paints having spectral glosses as low as 2% . . . can be obtained . . .

CASSEGRAIN CONES SUBSYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 22.

Since the conversion of the DSIF Net to an S-Band Cassegrain configuration requires the net to be supplied with Cassegrain cones, such cones have been purchased for all stations. These cones are improved versions of the original prototype (Fig. 15) and are described . . .

HYPERBOLA SUBSYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 22/23.

The conversion of the DSIF net to an S-band and Cassegrain configuration requires that the net be supplied with hyperboloidal secondary reflectors having remotely adjustable back-up structures (Fig. 20).

The hyperbola subsystems are improved versions of the prototype systems and are described . . .

GROUND ANTENNAS
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 24/27.

S-Band Antenna Gain and Pattern Calibrations . . . have been performed to calibrate the 85-ft Venus site antenna at 2388 Mc. These tests were performed after the antenna surface was resurfaced and realigned. This measurement indicates an improvement of 0-4 db due to resurfacing, thus yielding a new gain of 54.4 ± 0.15-db probability of error (p.e.).

RADIO ASTRONOMICAL TECHNIQUES FOR GROUND ANTENNA CALIBRATIONS
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 27/33.

ANTENNA INSTRUMENTATION
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 33/43.

A transportable instrumentation system . . . detailed description . . .

WATER ROTARY JOING FOR AZ-EL ANTENNA
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 43/44.

. . . covers the final phase of installation and subsequent testing and operational use of the antenna.

MESA ANTENNA RANGE
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 97/99.

Two additions to the range are being made: an anechoic chamber building and a new 3/4 mi. range for full-scale S-band spacecraft antenna measurements.

ADVANCED ANTENNA SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 101/103.

The Advanced Antenna System (AAS) will be a 210-ft. diameter, fully steerable paraboloid. . . . The Master Summary Schedule of the CFS has been received. . . initial operation of the AAS at Goldstone will be in early 1966.

BORESIGHT CALIBRATIONS FOR DSIF ANTENNAS
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 21/24.

Development is proceeding of practical techniques for using radio star sources to boresight the DSIF ground antennas. . . . measurements were made on the 85-ft Az-El antenna at the Venus site.

ANTENNA INSTRUMENTATION
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 24/25.

ACQUISITION AID FOR DSIF
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 53.

An acquisition aid (SAA) is being developed for the DSIF 85-ft antennas at S-band. . . .

DSIF MICROWAVE SWITCH CONTROL ASSEMBLY
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 53/57.

ADVANCED ANTENNA SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 59/62.

On-site preparations at the Mars site, Goldstone Station, and engineering design for the 210-ft diameter, fully steerable paraboloid continue. Photographs . . .

Related Publications:

THE AUSTRALIAN 210-FOOT REFLECTOR AND ITS RESEARCH PROGRAM
J. G. Bolton, Proc. Instn. Radio Engrs., Australia, vol. 24, no. 2, Feb. 1963, p. 106/112.

. . . the first nine months' observations with the Australian 210-foot telescope. Receiver and feed facilities are described and the general performance of the telescope indicated. . . .

THE AUSTRALIAN 210-FOOT RADIO TELESCOPE
E. G. Bowen, et al., Proc. Instn. Radio Engrs., Australia, vol. 24, no. 2, Feb. 1963, p. 98/105.

The history of the C.S.I.R.O. 210-ft radio telescope project at Parkes . . . principal performance requirements . . . major design problems . . . novel drive and control system . . . preliminary results of performance measurements . . .

Section 4C.34

4C.340: Transmitting Equipment in Deep Space Ground Stations

Included: Goldstone 10-KW transmitter; 3W cavity amplifier; Radar transmitter for DSIF; 100 KW S-band transmitter for DSIF.

Not Included: Transmitter design; High power tube development.

Cross References: Antenna coupling facilities (4C.330).

Principal Publications:

GOLDSTONE 2390/2388-mc 3-WATT CAVITY AMPLIFIER
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 42/43.

. . . a UHF power amplifier between the X15 UHF frequency multiplier and the 10-kw transmitter amplifier. A UHF power amplifier has been developed which can be adjusted to meet the 10-mc bandwidth requirement for wideband PM or the high-gain linear amplification requirement for SSB modulation. . . .

GOLDSTONE 10-kw TRANSMITTER
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 43/46.

. . . The 2390/2388-mc portion of this 10-kw subsystem was installed by Varian Associates at the Goldstone transmitter for use in the Echo 1 communication satellite program . . . This klystron amplifier subsystem was designed to be expandable to an 890/960-mc, 10-kw capability with the addition of another klystron amplifier. . . . required for the Ranger program. This report describes the 890/960-mc 10-kw klystron amplifier installation at the Goldstone site. . . .

THE 2390/2388-MC 10-KW TRANSMITTER
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 56/59.

. . . has been expanded to include a single-sideband (SSB) modulation capability. Initial design provided a phase modulation (PM) capability for the 2388-mc signal and a frequency modulation (FM) capability for the 2390-mc signal. . . . block diagram of the SSB exciter and associated components. . . .

MOD II EXCITER AND TRANSMITTER, 2388 Mc, 10 kw
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 30/32.

. . . described in SPS 37-16, Vol. III, pp. 45/47, have been assembled on the ground and tested at the Goldstone Venus Site. . . . system shown in Fig. 29 . . .

MOD II EXCITER AND TRANSMITTER, 2388 Mc, 10 kw
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 22/23.

. . . was described in SPS 37-16, Vol. III, pp. 45/47, and test data was reported in SPS 37-17, Vol. III, pp. 30/32. Since the last report . . . the transmitter has been mounted and is operating in the antenna structure . . . The transmitting system is presently furnishing 13.2 kw of continuous wave power at 2388 Mc for the 1962 Venus radar experiment . . .

MOD III TRANSMITTER SYSTEM, 2388 Mc, 100 kw
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 23/27.

. . . developed . . . by Varian Associates, Palo Alto. . . . is being installed at the Venus site . . . will augment the present radio tracking station located at the Venus site and will become a basic element of a continuous wave, phase-coherent communication system to be utilized for space communications research and development. It will illuminate an 85-ft diameter steerable Az-El antenna reflector.

MOD III TRANSMITTING SYSTEM, 2388 Mc, 100 KW
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 39/42.

The installation was essentially completed during the period . . . system checkout was started. . . . a number of the problem areas that developed as the system checkout proceeded.

MOD III TRANSMITTING SYSTEM, 2388 Mc, 100 KW
JPL Space Progr. Summ., vol. 3, no. 37-21, March/April 1963, p. 47/49.

. . . one planetary radar experiment has been completed, and the time until the beginning of the next experiment is being used to correct known deficiencies. . . .

MOD III TRANSMITTING SYSTEM, 2388 Mc, 100 KW
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 17.

. . . the transmitter has been operating on the Mercury radar experiment. The operating time during this experiment has been used to accumulate information on those areas in the transmitter requiring correction in order to improve the reliability of the system. . . .

MOD III TRANSMITTING SYSTEM
JPL Space Prog. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 39/44.

The major effort has been devoted to the 100kw amplifier protective circuit and the power supply rectifier tubes. Concurrent with this program has been the documentation of the system. . . . 100kw S-band klystron amplifier . . .

MOD IV PLANETARY RADAR EXCITER
JPL Space Prog. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 44/46.

. . . for use with the 100-kw S-band transmitter . . .

100-kw S-BAND TRANSMITTER
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 44/46.

. . . maintenance, design improvements, and documentation were performed . . . Preliminary reliability studies of silicon rectifiers in megawatt power supply service were made.

MARINER C 100-kw TRANSMITTER — KLYSTRON AMPLIFIER SUBSYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 18/19.

It has been determined that under certain conditions it will be necessary to have a ground transmitter power of 100-kw continuous wave (CW) in the Mariner C operation. At the present time, a complete 100-kw CW transmitting system at 2388 Mc is in operation at the Goldstone Venus site and has been in use since mid-January 1963 in planetary radar experiments. To meet the Mariner C requirements, it was decided to furnish a 100-kw CW klystron amplifier subsystem in the frequency range of 2100 to 2130 Mc designed to be a direct replacement for the 2388-Mc klystron amplifier subsystem. . . . a second 100-kw amplifier . . . functional block diagram . . .

HIGH-POWER 100-kw S-BAND TRANSMITTER
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 31/32.

. . . at the . . . Venus site was described in Ref. 9. It has now been installed for approximately 1 yr and, during this time, the expected number of problems and deficiencies was encountered, Many of these have been corrected, and the transmitter is now operational at a full 100 kw. A continuing program of test and rework is being carried on with the objectives of increasing reliability, simplifying and improving operating controls with an ultimate objective of automatic machine control, developing and testing new techniques, and increasing the output power to the full capability of approximately 500 kw.

MONOSTATIC SATELLITE AND LUNAR RADAR (MSSLR) TRANSMITTER
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 50/51.

A 10-kw S-band transmitter operating at 2.388 Gc will be used for the initial installation in the 30-ft antenna at the Venus site . . . The transmitter system is being built at JPL using the klystron and some other components from the Echo and planetary radar transmitter . . . functional block diagram . . .

Section 4C.35

4C.350: Receiving Installations for Deep Space Ground Terminals

Included: Ruby-cavity maser; Low noise amplifiers; TWM = traveling wave maser; L-band mixer; Solid-state maser; Parametric amplifiers; Planetary radar receivers.

Not Included: Design and theory of low noise amplifiers.

Cross References: Systems noise temperature measurements (4C.390).

Principal Publications:

L-BAND MIXER
JPL Res. Summ., vol. 1, no. 36-5, Aug./ Sept. 1960, p. 54/55.

. . . block diagram for the mixer and 30-mc IF amplifier which is primarily used as a postamplifier for parametric amplifiers . . . The 30-mc IF amplifier has about 60-db gain, 5-mc bandwidth, and under 1-db noise figure . . .

SOLID STATE MASER
JPL Res. Summ., vol. 1, no. 36-6, Oct./ Nov. 1960, p. 51/54.

. . . was installed at the Goldstone receiving antenna on September 29, 1960. . . . performance points out the mechanical ruggedness of the maser . . . performed very well on the antenna. . . . the maser system noise temperature was measured as 39° K. . . .

GSDS 960-mc PARAMETRIC AMPLIFIER
JPL Res. Summ., vol. 1, no. 36-7, Dec./ Jan. 1960, p. 31.

. . . planned to be incorporated into each of the present Deep Space Instrumentation Facility (DSIF) receivers with little or no modification of receiver-antenna-feed-line interface. Each parametric amplifier will be placed between the present antenna feed line and the 960-mc reference channel mixer . . . and will lower the receiver threshold, at a noise bandwidth of 20 cps, to approximately -162 dbm. . . . design features are: (1) Single-port negative-conductance non-degenerate design with attendant fail-safe features; (2) A required noise figure, including input circuitry and circulator of 1.6 db; (3) A nominal gain of 20 db; (4) A 10-mc bandwidth; (5) Capability of S-band frequency, 2295 mc, with replacement of the circulator and varactor cavities; (6) Incorporation of automatic noise figure measurement equipment. . . .

RECEIVER INSTALLATION AT Az-El SITE
JPL Res. Summ., vol. 1, no. 36-7, Dec./ Jan. 1960, p. 34/35.

. . . similar to the R&D receiver developed by JPL. This 960-mc phase-lock loop receiver, built by the Alpha Corporation of Richardson, Texas, is identical to both the receiver at the Woomera Tracking Station and the one being shipped to the South African Station. The receiver has three channels (Fig 39). One channel is a phase-lock loop or reference channel and is used in the reception of telemetered information. The two other channels are used to provide dc error signals for the antenna drive servo-system for automatic tracking of an RF source. . . .

PARAMETRIC AMPLIFIER
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 68.

. . . to provide a reduction of DSIF receiving system noise temperature from the present 1500°K system temperature to a nominal temperature of 200°K. This represents a nominal 8-db improvement in the system signal-to-noise ratio. . . . will be instantaneously switchable from L- to S-band by switching the pump power from one pretuned cavity to the other. The pump frequency is nominally 17 G_C so that a near-degenerate X-band parametric amplifier can also be obtained if desired.

960-mc MASER FOR RANGER RA-3 AND CASSEGRAIN SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-11, July/Aug. 1961, p. 61/64.

TRAVELING WAVE MASER
JPL Space Progr. Summ., vol. 1, no. 37-11, July/Aug. 1961, p. 64.

. . . a suitable ULTIMATE system for the DSIF could incorporate a very low-noise traveling-wave maser (TWM), with more than adequate bandwidth, operating in a closed-cycle refrigerator.

960-MC MASER FOR RANGER RA-3 AND CASSEGRAIN SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 58/60.

Needed to improve the sensitivity of the Goldstone DSIF receiver for participation in the Ranger RA-3, -4, and -5 experiments. . . .

MASER FOR RANGER OPERATIONS
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 72/76.

. . . installed on the 85-ft Ha-Dec antenna at the Pioneer Site . . .

AN OPERATIONAL 960-MC MASER SYSTEM FOR DEEP-SPACE TRACKING MISSIONS
T. Sato, et al., IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 164/170.

. . . A ruby-cavity maser, low-noise antenna, low-loss transmission line connecting the antenna to the maser and associated instrumentation all combine to yield reliable and low-noise performance. Results of tests on this system in preparation for the Ranger RA-3 lunar probe are presented. . . . A minimum system temperature of 47°K has been achieved. . . .

PARAMETRIC AMPLIFIER
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 53/62.

. . . fabrication of four paramp subsystems, three complete spare paramp assemblies and paramp power source assemblies, selected module and component spares, module and component test equipment, and complete manufacturing type documentation. . . . complete in Feb. 1962. . . .

CLOSED CYCLE He SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 107/109.

. . . Has been delivered to JPL by Arthur D. Little, Inc. This system has been tested at JPL and is currently being installed at the Pioneer Site for further testing with the 960-mc maser on the HA-Dec antenna.

X-BAND PARAMETRIC AMPLIFIER
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 32/34.

. . . design objectives: noise temperature, 300-360°K; gain, 20 db; and bandwidth, at least 10 mc. It is a one-port nondegenerate type utilizing a shunt-tee circulator in the signal port. The varactor used is a Type MS 2505 gallium arsenide pill varactor operated with dc bias.

MASER AND INSTRUMENTATION
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 52/53.

Three steps are being taken to provide a cavity-type maser which will be much improved over the 1961 maser. The ruby itself will be locked into position by use of plastic foam . . . The permanent magnet will be provided with a thermostat . . . the pump klystron will be temperature-regulated to within a few degrees.

TRAVELING WAVE MASER FOR DSIF
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 15/17.

The klystron pump package contains a crystal oscillator and a phase lock loop for automatic frequency control.

MASER AND INSTRUMENTATION
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 18/21.

The 2388 Mc maser for the Venus radar experiment consists of two complete single cavity amplifiers in one dewar with a common magnet (2450 gauss) and klystron pump supply. An overall performance of 2.7 Mc bandwidth and 31 db gain (96 Mc gain bandwidth product) is achieved.

S-BAND PARAMETRIC AMPLIFIER
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 27/29.

. . . for the S-band planetary radar . . . serves as the post-amplifier following the 2388 Mc maser amplifier. . . .

2.388 Gc RECEIVER
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 32/33.

Tests of the Mod II Planetary Radar 2.388 Gc Receiver (described in SPS 37-16, Vol. III, p. 43) are in process. The measured and computed values of a, the noise limiting factor of the system, were found to be in agreement . . .

TRAVELING WAVE MASER FOR DSIF
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 21/24.

In the DSIF prototype 2295- and 2388-Mc traveling wave maser (TWM), it was hoped that a single structure could be devised to tune over both frequencies by simple adjustments. This can certainly be done at temperatures of 1.5-2°K, but is quite difficult to achieve at 4.3°K, the operating temperature for the DSIF TWM closed-cycle refrigerator (CCR). It appears necessary to build separate structures . . .

MASER AND INSTRUMENTATION
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 30/32.

The 2388-Mc maser for the Venus radar experiment consists of two complete single-cavity amplifiers in one dewar with a common magnet (2450 gauss) and klystron pump supply (SPS 37-17). The maser installed in the Cassegrain cone on the antenna for the Venus radar experiment is shown . . . The system instrumentation is shown . . . and the associated control racks located in the maser trailer . . .

MASER INSTALLATION AT GOLDSTONE ECHO STATION
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 12/13.

Installation of the L-band maser system (SPS 37-18) was started at the Goldstone Echo site on November 11, 1962 for use with Ranger 6 through 9. . . .

TRAVELING WAVE MASER FOR DSIF
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 15.

. . . being developed as a prototype for future operational use . . .

WR 112 CRYOGENIC LOAD DEVELOPMENT
T. Otoshi, JPL Space Progr. Summ., vol. 4, no. 37-23, Aug./Sept. 1963, p. 224/227.

A WR 112 cryogenic load assembly has been designed for calibrating a 8448-Mc radiometer presently being used in a 210-ft and 85-ft antenna model study program using the 30-ft Venus site antenna system at Goldstone. Two similar load assemblies have been fabricated and tested at ambient and liquid nitrogen temperatures.

LOW-NOISE AMPLIFIERS
C. T. Stelzried, JPL Space Progr. Summ., vol. 4, no. 37-23, Aug./Sept. 1963, p. 203/212.

Performance data of the 8448-Mc nine-cavity maser purchased from Hughes Research Laboratories, Malibu, Calif. is given. The 6-liter Dewar provides 24 hours of operating life without liquid nitrogen cooling. A specially constructed fill tube provides rapid and efficient liquid helium transfer. . . . The equivalent noise temperature of the maser was measured to be about 18°K including the effect of a waveguide window and matching section and was theoretically calculated to be about 6°K at the input of the amplifier structure in the liquid helium bath.

PARAMAGNITNYI USILITEL' DLIA PLANETNOGO RADIOLOKATORA
(A Paramagnetic Amplifier for a Space Probing Radar) (In Russian)
M. E. Zhabotinskii, et al., Radiotekhnika i Elektronika, vol. 9, Jan. 1964, p. 114/117, 5 refs., A64-15788.

. . . The amplifier uses a permanent magnet immersed in liquid helium and ruby as an active material. The pumping generator is automatically tuned by the pumping resonator . . . noise temperature of the receiver being equal to 20 = 10°K. Radar probing of planets Mercury and Venus and radio telegraphic communication through the planet Venus have been successfully carried out.

TRAVELING WAVE MASER FOR DSIF
JPL Space Progr. Summ., vol. 3, no. 37-21, March/April 1963, p. 19/20.

. . . is nearly complete. . . . critical review of the noise performance of traveling wave masers is given. . . .

MASER INSTRUMENTATION, SYSTEM TEMPERATURE
JPL Space Progr. Summ., vol. 3, no. 37-21, March/April 1963, p. 40/41.

Evaluation of the 2388-Mc maser receiving system has shown that the mismatch between the maser amplifier and antenna waveguide plumbing is not enough to contribute significantly to the system noise temperature.

MOD IV PLANETARY RADAR RECEIVER, 2.388 Gc
JPL Space Progr. Summ., vol. 3, no. 37-21, March/April 1963, p. 49/62.

. . . performance evaluation prior to being installed at the Venus site . . .

TWM FOR DSIF
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 10/11.

The development of a prototype S-band traveling wave maser (TWM) for the DSIF has been essentially completed. This report summarizes the performance specifications for the system. . . . It may be concluded that fieldworthy S-band TWM's for the DSIF antennas are feasible.

MOD IV PLANETARY RADAR RECEIVER
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 18/19.

Has been installed in the Control Building (G51) at the Venus site, Goldstone Tracking Station. Installation of the "front-end" components in the antenna will be made following completion of the current Mercury-Venus planetary radar experiment. Measurements of receiver parameters additional to those reported in SPS 37-21, Vol. III, have been made. . . . a. Liquid cooling. . . . b. Bandwidths, coherent reference synthesizer loops. . . . c. Spurious signals on coherent references.

S-BAND IMPLEMENTATION FOR DSIF — TWM FOR DSIF
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 51/53.

The first two units of the traveling wave maser (TWM) subsystem are nearly complete and will be shipped to Goldstone soon. . . .

Related Publications:

LOW-NOISE AMPLIFIERS
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 54/56.

. . . The gain stability, without the use of stabilizing techniques, of the 960-mc mixer and IF amplifier . . . has been measured. Filament and B-plus supply voltages were regulated.

Section 4C.36

4C.360: Auxiliary Subsystems for Deep Space Ground Stations

Included: Ground data handling for deep space links; Rubidium vapor standard; Frequency synthesizer; Standard frequency generation; Coordinate converter; Precision doppler systems; GSDS instrumentation system; Programmed local oscillator; Digital instrumentation system for DSIF; Atomic oscillators; Atomic frequency standards; Special computer programs for auxiliary functions; Display and recording equipment for DSIF; Remote control digital antenna positioning system.

Not Included: Ground information processors (3A); Computer programs (3A).

Cross References: Traveling operations for deep space ground stations (4C.320); GSDS-Goldstone Duplicate Standard (4C.310); Test facilities for deep space ground stations (4C.390); Antenna Pointing systems (4C.330).

Principal Publications:

UHF DOPPLER FOR 2388-MC CW DOPPLER RADAR SYSTEM
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 48/50.

The present VHF doppler subsystem utilizes a doppler shifter signal from the coherent receiver VCO at 29.476875 mc and compares it with a 29.476875 mc reference signal derived from the transmitter. A UHF solid-state doppler subsystem has been developed which provides a doppler output at 75 times the 29.476875-mc reference signal. This will provide a resolution of about 1/15 meter, or one RF cycle at 2212 mc. . . . block diagram from the new UHF doppler arrangement. . . .

COORDINATE CONVERTER COMPUTER STUDIES
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 19/21.

Located at the Goldstone Tracking Station is a coordinate converter computer built by the Computer Control Company (CCC) to JPL specifications and requirements. This computer, used in conjunction with a teletype code converter digital comaprator unit, and a digital-to-analog converter, can provide commands for the Goldstone antennas. . . .

GSDS PRECISION DOPPLER SYSTEM
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 23/24.

Design and fabrication of a broad-band frequency multiplier for use in the data handling precision doppler system has begun. The doppler frequency input to the data handling system consists of a bias frequency of 3.33 kc with a doppler frequency shift of approximately $\pm$1.2 kc superimposed upon it. The bias frequency prevents the doppler frequency measure from going through zero and avoids requiring the system to count a frequency very close to zero and determines the sign of the doppler shift. . . .The broad-band frequency multiplier increases the precision of the doppler measurement by multiplying the input doppler signal by a factor of 30. . . . is a phase-locked oscillator with a frequency divider in the feed-back loop. . . .

GSDS ANGLE ENCODING SYSTEM
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 24/26.

At the present time, the only DSIF station which will have a GSDS angle encoding system is the South African Station. . . . The difference between the South African encoding system and the Goldstone system consists of (a) improvements in the system accuracy from 20 seconds of arc rms to 5 seconds of arc and (b) the lack of a binary coded output from the South African system. . . . sensors serve followup . . . disk assemblies. . . .

GSDS INSTRUMENTATION SYSTEM
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 26/28.

. . . consists of two 7-track magnetic recorders, a 36-channel direct-write ultraviolet oscillograph, an 8-channel hot-stylus recorder, signal conditioning equipment, a patch panel system, and a telemetry subsystem . . .

STABLE OSCILLATOR INVESTIGATION
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 46/50.

. . . Previous reports have presented the results of stability investigations of solid-state voltage-controlled crystal oscillators operating in both the 30-mc and the 5-mc regions. . . . This report presents some preliminary results of the relative frequency stability of crystal-oscillator, cesium-beam and rubidium-gas-cell frequency standards, it also presents some initial results of the improvement in crystal oscillator phase stability that might be expected from locking the oscillator to the rubidium line at a frequency of 6834 mc. . . .

VERY STABLE OSCILLATOR
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 62.

. . . provide sufficiently accurate doppler date for Ranger III, it was necessary to increase the stability of the DSIF-1 and -3 transmitter control oscillators from 10^{-6} to 10^{-8}. . . . Resdel Engineering Company of Pasadena has as a shelf item an oscillator which would provide the required stability . . . six units will be distributed throughout the DSIF . . .

TRANSMITTER FREQUENCY SYNTHESIZER FOR MARINER
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 15/16.

The requirement for an 0.15-m/sec. rms. uncorrelated error for the 960mc doppler system has resulted in an increased effort to reduce the amount of transmitter drift due to crystal drift. As extremely stable transmitter control oscillator consisting of a rubidium vapor frequency standard, a frequency synthesizer, and a 3-cps phase locked loop are now in the process of construction for use in the Mariner Program. . . . Fig. 20 shows a block diagram. . .

RECENT MODIFICATIONS TO COORDINATE CONVERTER
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 16/17.

The coordinate converter has been moved from the Pioneer site and installed at the Echo site. Operation at the new location has been successful for the Ranger 3 and 4 missions. . . . the console was expanded and rearranged to provide greater operator convenience.

FREQUENCY SYNTHESIZER DEVELOPMENT
JPL Spacer Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 19/20.

Time limitations, and unavailable parts made necessary a new approach to construction of the frequency synthesizer described in SPS 37-15. . . . Operation of the new synthesizer (Fig. 27) is as follows: A 30 Mc stable frequency reference (generated from the 1Mc output of a Rubidium frequency standard) is fed . . .

DIGITAL INSTRUMENTATION SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 24/26.

. . . to record information from the DSIF ground equipment, in digital form, on magnetic tape in a format compatible with the IBM computers in use at JPL. Information recorded by the system will be reduced at a later time on the JPL computers.

DATA RECORDING SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 31/33.

. . . designed for laboratory tests and/or research project recording. . . . scans a maximum of eight (8) analog data inputs and provides a permanent record of the data in the form of punched paper tape and/or printed copy.

EVALUATION OF ATOMIC OSCILLATOR PERFORMANCE
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 30.

A series of measurements has been completed on two different types of atomic oscillators: the cesium beam oscillator, or Atomichron, as manufactured by the National Company and the Rubidium Wapor Oscilliator as manufactured by Varian Associates.

MARINER SYNTHESIZER
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 6/8.

The rubidium vapor standard, a primary frequency standard manufactured by Varian Associates, utilizes the resonance of the rubidium atom to stabilize a 5-Mc crystal oscillator. The stability approaches $\pm$ 5 parts in 10^{11} for periods in the order of a few minutes . . . Therefore, the error in doppler frequency measurements is extremely small (in the order of parts of cps).

ANGLE-EPHEMERIS TAPE READER AND PROCESSOR
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 40/42.

ATP, is used in the digital angle-pointing system for the 85-ft Az-El antenna located at the Goldstone Tracking Station Venus site.

DATA ANALYSIS ACTIVITIES AT GOLDSTONE
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Dec. 1962, p. 13/14.

. . . performance of the DSIF Tracking Stations during all missions. . . to provide preflight calibration information for the Orbit Determination Group. . . . has an IBM 1620 . . . computer as a central data processing unit, utilizing the IBM 1622 card read-punch . . . IBM 514 reproducing punch, the IBM 047 and IBM 063 tape-card-tape converters.

ANALYSIS OF PROGRAMMED LOCAL OSCILLATOR INCLUDING CERTAIN SECOND ORDER EFFECTS
R. Winkelstein, JPL Space Progr. Summ., vol. 4, Feb./March 1963, p. 110/112.

. . . to determine the effect on the programmed local oscillator behavior of certain secondary system quantities previously neglected. This oscillator is used to control the frequency of the Venus radar receiver. The analysis is carried out by expanding the basic system Laplace transfer block diagram to include the secondary quantities. System behavior is then noted from the resultant root locus diagram. Reference is made to SPS 37-18, Vol. III, p. 32, which describes the physical equipment and includes an analysis of the basic system.

DIGITAL INSTRUMENTATION SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 6/11.

. . . to record and log analog and digital information from the RF, servo and tracking data recording systems. . . .

GROUND DATA HANDLING
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./Feb. 1963, p. 74/76.

. . . outline and general requirements for processing of Surveyor science data . . . Present status . . . the detailed design of the space science analysis area (SSAA) of January 1, 1964 configuration of the SFOF has been accomplished . . . TV ground data handling . . .

DIGITAL INSTRUMENTATION SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-21, March/April 1963, p. 7/13.

The previous two articles on the digital instrumentation system (SPS 37-16, -20) gave a general description of the complete system. Details of the two general purpose digital computers used in the system will now be given. . . . a Scientific Data Systems (SDS) Model 910, and a SDS Model 920.

MODIFIED SCIENTIFIC-ATLANTA PATTERN RECORDER
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 6/7.

Was performance tested at the Goldstone Echo site and was found quite satisfactory.

REMOTE CONTROL DIGITAL POSITIONING SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 7.

For remote control positioning of the transponder attenuator and polarization of the collimation tower antenna, from the receiver station . . . of the control room. This system is capable of setting the transponder attenuator to an accuracy of $\pm 0.1^{o}$ and polarization of the antenna to an accuracy of $\pm 1.0^{o}$.

COMPUTER PROGRAMS — TRAJECTORY PROGRAM FOR ON-SITE COMPUTERS
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 13/14.

A spacecraft trajectory program has been developed for small, on-site computers (SDS 920, IBM 1620) to relieve the Central Computing Facility of the responsibility of providing predictions and/or antenna drive tapes for the DSIF stations. Although the program will be kept as small as possible, it will be accurate enough to permit the spacecraft to be within the beamwidth of the antenna pattern.

Section 4C.37

4C.370: Interconnecting Ground Network for Deep Space Ground Stations

Included: Surface communications systems; SFOF=space flight operations facility communications; Closed circuit TV for SFOF; Space flight operations complex; OVCS=operational voice communications subsystems.

Not Included: World wide communications systems; Data transmission over telephone facilities (1).

Cross References: Deep space operations center (4C.386).

Principal Publications:

COMMUNICATION SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./ March 1963, p. 53/56.

. . . the SFOF will provide the basic means of connecting the various operational and functional areas within the facility to the external communications media which provide the information links between the many and widely separated stations comprising the over-all Space Flight Operations Complex. . . Teletype Switching Subsystem . . . Operational Voice Communication subsystem . . .Closed Circuit TV Subsystem . . .Supporting Subsystems . . . The overall SFOF Communications System is illustrated in Fig. 5.

GROUND TELECOMMUNICATIONS SUBSYSTEM — RANGERS 6-9
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./Feb. 1963, p. 70.

The ground portion of the telecommunications system for the Ranger 6-9 Program is similar to the Ranger 3-5 series. However, upgrading of the equipment and techniques has been progressing . . . configuration of spacecraft test complex . . . is shown in Fig. 2 . . . The system accepts the composite telemetry signal from the spacecraft and separates and decommutates the channels . . . At the DSIF Stations the decommutated data are also applied to a teletype encoder for transmission to JPL during a flight, and the teletype information is used to evaluate the performance of the flight.

COMMUNICATIONS
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 71/73.

DSIF . . . requires an effective communications network. . . . used for transmitting administrative and technical traffic and consists of telephone links, used during a tracking mission, and teletype links, used both for passing technical traffic and data originating during a tracking mission. Teletype links. Telephone links.

COMMUNICATION SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963, p. 37.

. . . of the SFOF, as reported in SPS 37-20, Vol. VI, is composed of a number of subsystems associated with the different media employed in the SFOF. Each of these subsystems will be reported individually in separate issues of the SPS in order to allow full technical presentation . . . Operational Voice Communications Subsystem (OVCS) . . . communications within the SFOF, and between the SFOF and operational and nonoperational agencies outside the SFOF . . . b. Intercom subsystem . . . c. Telephone subsystem . . . d. Conference subsystem.

COMMUNICATIONS SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-23, July/Sept. 1963, p. 37/38.

This report delineates the function and composition of the SFOF Closed Circuit TV Subsystem. . . (CCTVS) provides a means of direct visual communications within the SFOF. . . . provisions have been made for accepting outside. . . . circuits. Generally the system employs conventional technology: however, certain functional utilizations depart from the usual closed circuit applications.

Section 4C.38

Special Facilities within DSIF (Deep Space Instrumentation Facility)

4C.382: Goldstone Complex (California, U. S. A.)

Principal Publications:

THE GOLDSTONE STATION COMMUNICATIONS AND TRACKING SYSTEM FOR PROJECT ECHO
R. Stevens, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Technical rept. no. 32-59, 1 Dec. 1960, AD 251 505.

. . . design and construction of the Project Echo system, the test phase of the system, the experiments conducted with the Echo satellite, and the experimental results of the project. A recording of messages transmitted and received by the Goldstone station via Moon reflection and via the satellite reflection is included.

GOLDSTONE TRANSMITTER SITE
JPL Res. Summ., vol. 1, no. 36-2, Feb./March 1960, p. 7/8.

Transmitter Antenna Feeds. . . . primary feeds and transmission lines to be supplied . . . for the new 85-foot transmitting antenna . . . circularly polarized feed horn . . . The installation of the collimation tower antennas and transmission lines . . . Transmitter RF Safety Tests . . .

GOLDSTONE STATION
JPL Res. Summ., vol. 1, no. 36-4, April/May 1960, p. 1/13.

Path Loss in 2388-mc RF Calibration Link. . . . Measurements were made of the path loss between the input of a temporary 6-foot-diameter test transmitter antenna at the transmitter site . . . and the output of the 85-foot receiving antenna . . . With both passive links connected, the loss varied between -119.1 and -122.4 db as a function of the polarization of the collimation tower antenna. . . .

GOLDSTONE RECEIVER SITE
JPL Res. Summ., vol. 1, no. 36-4, April/May 1960, p. 13/16.

Tracking Pioneer V. . . . This probe contained a PCM telemeter system which transmitted information via either a 5-watt or 150-watt transmitter sending a 378.21-mc phase-modulated signal. . . . Although the Goldstone tracking station did not have a command function in this operation, it obtained tracking data and recorded the telemetered data signals. . . . on April 1 and 2, 1960 . . . the signal from Pioneer V, at this time, the range . . . was 2,900,000 nautical miles. . . . was tracked for two periods. . . . Kitoon Tracking Exercises. To evaluate the tracking characteristics of the Goldstone Station receiver site antenna, a radio beacon and antenna . . . are suspended from a balloon-type vehicle and are tracked by the receiver site antenna. . . .

GOLDSTONE TRANSMITTER SITE
JPL Res. Summ., vol. 1, no. 36-4, April/May 1960, p. 17/20.

The 2390/2388-mc 10-kw transmitter consists of a 10-kw klystron power amplifier driven by a crystal-controlled exciter. . . . block diagram . . . designed to be expandable to a 890/960-mc 10-kw capability with the addition of another klystron amplifier . . . now being designed. . . . Testing of the 2200-2400-mc feed and waveguide system has now been completed, and the results are presented . . . the secondary antenna patterns for the 2200-2400-mc circularly polarized feed are presented . . .

GSDS DATA HANDLING SYSTEM
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 33/34.

. . . has been installed at the Goldstone Az-El site . . . and a similar system for the Ha-Dec site is scheduled to be delivered by the end of April . . .

WIDE-BAND TELEMETRY INSTALLATION AT AZ-EL SITE
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 35.

GOLDSTONE TRACKING STATION
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 74/79.

Star Tracker, 960-mc Maser, Antenna Structure. Building Program.

NEW HIGH POWER TRANSMITTER SITE
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 77/78.

. . . will be located at the south edge of the Goldstone facility. . . .

MASER INSTALLATION
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 82/83.

. . . intended for initial use in tracking Ranger RA-3, is to be installed on the Ha-Dec antenna at the Pioneer Station of the Goldstone Space Communications Stations. . . .

MODIFICATION TO PIONEER STATION ANTENNA
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 83/84.

Recent modifications to the 85-foot Az-EL antenna of the Echo Station included the installation of counter-weights to decrease the static unbalance of the reflector about the elevation axis (SPS 37-9, 37-10). . . .

DESCRIPTION OF GOLDSTONE SPACE COMMUNICATIONS STATIONS
JPL Space Progr. Summ, vol. 3, no. 37-16, May/June 1962, p. 3/6.

. . . shows not only the location of the Goldstone DSIF Sites, but also a Minitrack installation operated by Goddard Space Flight Center personnel independent of JPL operations.

The Pioneer Station (Fig. 3) and the Echo Station (Fig. 4) are the two oldest DSIF installations at GSCS. . . . The Goldstone Venus Site is presently under construction . . .

NEW 85-FOOT HA-DEC ANTENNA INSTALLED AT ECHO STATION
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 10/12.

EQUIPMENT INSTALLATION IN THE NEW ECHO STATION
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 12/16.

COMMUNICATIONS RESEARCH
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 56/57.

Facilities and Capabilities . . . Goldstone . . . Station . . . new buildings . . . Equipment installations at Goldstone . . . installed at the Goldstone Echo Station.

TRACKING STATION OPERATIONS — GOLDSTONE
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov. /Dec. 1963, p. 5/8.

As a result of the success of the 2.0-Mc bandwidth investigation and modifications to the Echo receiver, the Pioneer receiver was modified in essentially the same way as that performed on the Echo receiver.

4C.383: Woomera Station (Australia)

Principal Publications:

WOOMERA TRACKING STATION
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 59/61.

WOOMERA TRACKING STATION
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 38/39.

WOOMERA TRACKING STATION
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 29/31.

. . . undergoing preoperational checks of the antenna structure and the various tracking station subsystems. . . .

WOOMERA TRACKING STATION SYSTEM EVALUATION
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 80/83.

INTERIM 50-W TRANSMITTER INSTALLATION AT WOOMERA
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 14/15.

. . . will be an interim system enabling the Woomera station to have two-way doppler capability for the two Mariner R flights. The system will be similar to the GSDS systems installed at the Goldstone Echo Station (DSIF 3) and at the Johannesburg station (DSIF 5), except that it will not have command capability or as great a power output.

L-BAND ACQUISITION AID
JPL Space Prog. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 8/11.

Woomera DSIF Station has carried out a program, of evaluating the existing L-band acquisition aid antenna . . . consists of any array of four helices connected in a monopulse configuration. It is carried on the 85-foot diameter dish structure, and coaxial relays are used to select the signals (which are either from the dish or from the acquisition aid). Performance specifications.

WOOMERA
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 8/11.

Participation in Atlas-Centaur 2 Mission . . . Woomera, Australia, had to make concurrent preparations for the Interplanetary Magnetic Probe (IMP) S-74 mission and the Atlas-Centaur 2 (AC-2) mission . . .

4C.384: Johannesburg Station (South Africa)

Principal Publications:

SOUTH AFRICAN STATION
JPL Res. Summ., vol. 1, no. 36-5,
Aug./Sept. 1960, p. 39/40.

. . . plans are proceeding for the construction of a third DSIF station. . . . will complete the network of three permanent deep space tracking and communication stations . . .

SOUTH AFRICAN STATION
JPL Res. Summ., vol. 1, no. 36-6,
Oct./Nov. 1960, p. 31/32.

. . . selection of a site . . .

JOHANNESBURG TRACKING STATION
JPL Space Progr. Summ., vol. 1, no. 37-9,
March/April 1961, p. 84/85.

. . . antenna structure was completed March 25, 1961.

NEW TRANSMITTER SYSTEM AT THE JOHANNESBURG TRACKING STATION
JPL Space Progr. Summ., vol. 3, no. 37-15,
March/April 1962, p. 6/10.

. . . recently installed transmitter . . . is a Goldstone Duplicate Standard . . . (Fig. 4) composed of an exciter and high power final amplifier.

4C.385: Other Stations (Mobile Tracking Stations)

Principal Publications:

MOBILE TRACKING STATIONS — MOBILE CHECKOUT RF VCO
JPL Res. Summ., vol. 1, no. 36-2,
Feb./March 1960, p. 12/14.

The RF voltage-controlled oscillators (VCO) used in the Ranger mobile downrange and launch checkout stations must possess S-curves sufficiently large to track the two-way doppler shift. This corresponds to frequency variations of approximately 1 part in 10^4 for the down-range stations and 7 parts in 10^5 for the launch station. . . . The 31-mc VCO used for tracking the deep space probes, Pioneers III and IV, possessed all the desirable characteristics . . .

MOBILE INJECTION TRACKING STATION
JPL Res. Summ., vol. 1, no. 36-6,
Oct./Nov. 1960, p. 33/40.

. . . The purpose of this station is to receive and record telemetred data and to record and transmit tracking information during the injection phase of spacecraft flights. . . .

MOBILE TRACKING STATION
JPL Space Progr. Summ., vol. 1, no. 37-9,
March/April 1961, p. 86/88.

Assessment of the angle tracking errors of the mobile tracking station was performed at Goldstone during the months of January, February, and March. The tests performed consisted of helicopter-theodolite tests, helicopter-TV tests, Venus tracks, stellar meridian crossing observations, and a determination of the effects of polarization on boresight shift.

4C.386: Deep Space Operations Center (Pasadena, California, U.S.A.)

Principal Publications:

OPERATIONS CENTER
JPL Space Progr. Summ., vol. 1, no. 37-11, July/Aug. 1961, p. 76/78.

In order to rapidly plot the tracking data which originates at the DSIF stations during a tracking mission, a Benson Lehner Electroplotter (Fig. 65) has been ordered.

RANGER 5 FLIGHT SUMMARY
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 3/5.

. . . separated normally, extended its solar panels and high-gain antenna, acquired the Sun and began normal operation on solar power. About 15 min. after Sun acquisition, a failure, probably in the power switching and logic circuitry, caused the spacecraft to transfer from solar to battery power. Normal operation was never resumed.

Following battery depletion, the spacecraft transponder came on several times, indicating that solar power was then available. Telemetry received during these periods indicated that the mid-course maneuver sequence had been completed . . . but tracking indicated that essentially no velocity change had occurred. . . .

SPACE FLIGHT OPERATIONS FACILITY (SFOF)
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 9.

TELECOMMUNICATIONS MONITOR
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 19/24.

. . . to provide constant qualitative real-time, near real-time, and nonreal-time monitoring of data supplied to the Space Flight Operations Facility (SFOF) by the Deep Space Instrumentation Facility. . . .

THE SPACE FLIGHT OPERATIONS FACILITY
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 43/49.

DATA PROCESSING SYSTEM
JPL Space Prog. Summ., vol. 6, no. 37-20, Jan./Mar. 1963, p. 50/53.

. . . designed around a central multi-computer configuration, which allows a high degree of flexibility and gradations of capability to adapt to different mission requirements . . . consists of three major subsystems . . . Telemetry Processing System (TPS) is to convert telemetry data receiving in analog, digital, or composite subcarrier form to IBM compatible magnetic tape . . . Data Control and Display System . . . Computer Programming System.

DISPLAY SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 56/59.

Is composed of three parts: The Mission Status Board, the Technical Area Displays and the Command and Control Displays.

SUPPORT SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 59/67.

Required to support the mission-independent activities . . . in the SFOF . . . Industrial Design . . . Human Factors Development Analysis . . . Personnel System Development . . . Information Coordination.

GROUND TELECOMMUNICATIONS SUBSYSTEM — RANGERS 6-9
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 70.

. . . upgrading of the equipment and techniques has been progressing . . . At the DSIF Stations the decommutated data are also applied to a teletype encoder for transmission to JPL during a flight, and the teletype information is used to evaluate the performance of the flight.

SPACE FLIGHT OPERATIONS SYSTEM (SFOS)
JPL Space Progr. Summ., vol. 6, no. 37-22, May/June 1963, p. 5/7.

Plans for the checkout of the SFOS are currently being formulated. The tests will (1) verify the compatibility between the spacecraft and the facilities required to support the spacecraft after launch, and (2) develop the operational methods and procedures of the Space Flight Operations Complex (SFOC).

SURVEYOR PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-23, July/Sept. 1963, p. 13/15.

There will be two Atlas-Centaur research and development flights preceeding the first Surveyor launch . . .

THE SPACE FLIGHT OPERATIONS FACILITY
JPL Space Progr. Summ., vol. 6, no. 37-23, July/Sept. 1963, p. 35/36.

Will be a centralized command and control facility . . . The new SFOF building is nearing completion . . .

Section 4C.39

4C.390: Test Facilities for Deep Space Ground Stations

Included: RFI tests; High power test laboratory; Noise temperature measurements; Special signal generators; DSIF station checkout equipment; Cooled terminations; Environmental test laboratory; Closed loop rf test system.

Not Included: General technique of electronic measurements.

Cross References: Antenna testing facilities (4C.330).

Principal Publications:

DSIF STATION CHECKOUT EQUIPMENT
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 36/37.

. . . Test transponder system . . . Balloon collimation/boresight system. . .

LIQUID HELIUM COOLED TERMINATION
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 55/56.

. . . 50-ohm coaxial termination is under construction for use as a noise level reference in conjunction with the 960-mc maser amplifier when making sky temperature measurements at the Goldstone receiving site. . . .

GSDS TEST TRANSPONDER CHECKOUT SYSTEM
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 21/22.

NOISE TEMPERATURE MEASUREMENTS
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 83/87.

. . . Evaluation of the 2388-mc feeds for the Goldstone antenna requires an accurate measurement technique for the system equivalent noise temperature . . . block diagram of the system which will be used. . . .

GAIN MEASUREMENTS
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 87/89.

. . . To improve the accuracy of gain determination, a study is being made of experimental methods for direct measurement of far-zone gain and of analytical methods to predict far-zone gain using near-zone measurements. Recently, some measurements were made on the 85-foot diameter antennas at the Goldstone Tracking Station . . .

NOISE TEMPERATURE MEASUREMENTS
D. Schuster, et al., JPL Res. Summ., no. 36-8, Feb./March 1961, p. 26/29.

Evaluation of low-noise feeds for the Goldstone receiving antenna . . . block diagram of the technique used. Calibration is obtained by recording the system noise level with the input switched to the liquid helium cooled termination, and with the noise source fired and not fired. The input is then switched to the antenna, and the antenna temperature is interpolated from the recording. Utilizing this technique, the measured equivalent noise temperature of the antenna with the 2388-mc feed used for the Venus radar experiment was about $14^{\circ}K$. . . .

PHASE MEASUREMENT RANGE
JPL Res. Summ., no. 36-8, Feb./March 1961, p. 29/30.

As part of a primary feed testing program, phase-center measurements have been required on several different feeds intended for use in the Goldstone antennas. To perform the measurements, an antenna phase-center test range has been set up using a Serrodyne single-sideband and carrier mixing system . . .

SPACE SIMULATOR
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 46/47.

A TECHNIQUE FOR THE MEASUREMENT OF THE POWER SPECTRA OF VERY WEAK SIGNALS
R. M. Goldstein, IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 170/173.

. . . designed to distinguish the spectrum of a weak signal which is masked by strong background noise. The method was applied during the Jet Propulsion Laboratory Venus radar experiment to study spectral characteristics of the echo. . . .

DUAL-CHANNEL X-BAND RADIOMETER
P. D. Potter, et al., JPL Res. Summ., no. 36-14, Feb./March 1962, p. 82/86.

As an accurate means for far field antenna gain measurement, the application of radio astronomy techniques has proved very efficacious.

INSTRUMENTATION FOR NOISE TEMPERATURE MEASUREMENT
C. T. Stelzried, JPL Res. Summ., no. 36-14, Feb./March 1962, p. 79/81.

Schemes are under investigation to eliminate the effect of amplifier gain instability. This is not necessarily a cure-all for radiometer ills

because a penalty must be paid in increased thermal jitter, increased circuit complexity, or both.

INSTRUMENTATION FOR NOISE TEMPERATURE MEASUREMENT
C. T. Stelzried, JPL Space Progr. Summ., vol. 4, no. 37-15, April/May 1962, p. 53/54.

. . . The 960-mc Dicke radiometer (described in RS 36-14) assembly has been modified to take advantage of a noise phase coherent mode of operation possible with a degenerate parametric amplifier (Fig. 1).

INSTRUMENTATION FOR NOISE TEMPERATURE MEASUREMENT
C. T. Stelzried, JPL Space Progr. Summ., vol. 4, no. 37-17, Aug./Sept. 1962, p. 99/102.

Black body radiation measurements are being made utilizing the maser and monitor receiver as a "total power" radiometer as shown in the block diagram. . .

INSTRUMENTATION FOR NOISE TEMPERATURE MEASUREMENT
C. T. Stelzried, JPL Res. Summ., no. 36-13, Dec./Jan. 1961, p. 57/59.

The 2388-mc total power radiometer runs unattended, a sequence timer automatically turning on the recorder and waveguide switching controls once an hour.

SPACE SIMULATOR
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 30/34.

CLOSED LOOP RF TEST SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 7/10.

. . . provides a mode of testing which is very desirable both from an operational convenience standpoint and from the standpoint of test precision and accuracy.

HIGH-POWER TEST LABORATORY
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 18/19.

. . . provides facilities for testing L-band transmission line and feed components at high power . . .

2.388-Gc SIGNAL GENERATOR FOR PLANETARY RADAR
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 47/50.

An extremely stable, low phase jitter, solid-state signal generator . . . has been procured for testing and calibrating 2.388-Gc receiving systems. A block diagram . . . is shown . . . used with the collimation-tower antenna and feed for checking the receiving system space transmission characteristics.

ENVIRONMENTAL TEST LABORATORY
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 68.

LABORATORY TESTING OF FLOW CORPORATION DRAG SPHERES
JPL Space Progr. Summ., vol. 3, no. 37-21, March/April 1963, p. 4/7.

PRECISION SIGNAL AND NOISE MIXING SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 43/47.

Determining the performance of a detection system for a data signal in white gaussian noise requires a system which is capable of driving the detector with the sum of the data signal with power S and white gaussian noise with spectral density N_o. This report describes such a system.

HIGH-POWER TEST LABORATORY
JPL Space Progr. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 20/21.

Discussed in SPS 37-18 has been moved to a new facility and expanded to S-band capabilities . . . located at the antenna range at Goldstone. It is a completely independent 10-kw transmitter system with a 20-kv power supply, a heat exchanger and a klystron dolly.

ENVIRONMENTAL TEST LABORATORY
JPL Space Progr. Summ., vol. 6, no. 37-23, July/Sept. 1963, p. 39/42.

ENVIRONMENTAL TEST LABORATORY
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 32/33.

RADIO FREQUENCY INTERFERENCE TESTS
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 25/26.

ENVIRONMENTAL TEST LABORATORY
JPL Space Progr. Summ., vol. 6, no. 37-26, June/Dec. 1963, p. 25/27.

Thermal-Vacuum Testing. Heat Exchangers . . .

DIVISION 4C.4
COMMUNICATIONS SYSTEMS FOR LUNAR MISSIONS

4C.400: General References to Lunar Missions

Included: Lunar exploration projects; Extended lunar exploration; Translunar space communications.

Not Included: Communications systems for manned space flight (4D).

Cross References: Manned lunar missions (4C.450); Project Ranger (4C.850); Project Lunik (USSR) (4C.826); Lunar orbiter mission (4C.823); Project Pioneer (4C.845); Project Surveyor (4C.860).

Principal Publications:

TRACKING AND COMMUNICATION FOR A MOON ROCKET
R. T. Gabler, et al., Rand Corp., Santa Monica, Calif., Rept. P-1021, 22 April 1957, AD 244 730.

Certain phases of the over-all problem of sending an instrument package to the moon to telemeter scientific information are considered specifically the tracking of the vehicle after it is placed on a proper trajectory, and the telemetering of information after it lands. . . . requirements for transponding . . . For telemetering, the same crystal-controlled oscillator and power amplifier used for tracking will be employed, with a command receiver switching to control power and to modulate the power amplifier.

RADIO COMMUNICATION WITH A LUNAR PROBE
W. T. Blackband, Proc. Roy. Soc., no. 253, Dec. 1959, p. 511/515.

COMMUNICATIONS AT LUNAR PLANETARY DISTANCE
R. Briskman, Signal, no. 11, July 1960, p. 34/35 and 38.

THE EXPLORATION OF THE MOON
R. Jastrow, Sci. Amer., vol. 202, no. 5, May 1960, p. 61/69.

BY ROCKET TO THE MOON
V. I. Levantovskiy, Aerospace Technical Intelligence Center, Wright-Patterson Air Force Base, Ohio, April 1960, 236 p., Trans. No. MCL-879m ot, k if Gosudarstvennoye Izdatel'stvo, Fiziko-Matematicheskoy Literatury, Moscow: 395 p., 1960, AD 264 192.

A LUNAR EXPLORATION PROGRAM BASED UPON SATURN-BOOSTED SYSTEMS
Army Ballistic Missile Agency, Redstone Arsenal, Alabama, Rept. no. DV-TR-2-60, 1 Feb. 1960, 292 p. incl. illus., AD 400 663.

Contents: Payload packages for lunar landings and circumlunar flights. Lunar exploration. Power supplies.

COMMUNICATIONS SYSTEMS FOR LUNAR MISSIONS
R. L. Choate, JPL Res. Summ., no. 36-13, Dec./Jan. 1961, p. 46/54.

. . . utilize phase-locked demodulators for providing a PM improvement factor . . . generally applicable for . . . narrow bandwidth telemetry, voice communications, or video communications. This report describes the procedure for designing a communication system for a lunar mission with two different types of modulating signals: (1) narrow bandwidth telemetry, 0 to 5 cps, and (2) voice communications, 0 to 3 kc. The system parameters for these two examples are given . . .

CONFERENCE ON LUNAR EXPLORATION PART B. PROCEEDINGS AUGUST 12-17, 1962
J. V. Evans, et al., Virginia Polytechnic Inst., Blacksburg, Aug. 1962, 202 p., 101 refs., Its. Bulletin, Eng. Expt. Sta. Series no. 152, v. 56, no. 7, May 1963, N63-21362.

. . . radio echo studies of the moon; interpretation of lunar radar data; application of photographic photometry to the geology of the lunar surface; lunar vulcanism; and manned lunar exploration.

NASA PROGRAMS LEADING TO EXPLORATION OF THE MOON
D. B. Holmes, IN: Science, Technology and Management, New York, McGraw-Hill Book Co., Inc., 1963, p. 238/247, A63-16600.

. . . manned space-flight program. . . . technical task of the lunar landing is outlined. . . .

LUNAR EXPLORATION. PROCEEDINGS OF THE CONFERENCE ON LUNAR EXPLORATION, PART C—AUGUST 12-17, 1962
O. W. Nicks, et al., Virginia Polytechnic Inst., Blacksburg, Aug. 1962, 169 p., 52 refs., Rept. from Bull. Eng. Expt. Sta., vol. 56, no. 7, May 1963, N63-21346.

. . . The following topics dealing with lunar exploration were discussed . . . photography of the moon from space probes . . . lunar seismology . . . instrumentation for lunar soft landings and . . . the nature of the lunar surface and major structural features.

LUNAR SPACECRAFT DATA HANDLING
H. M. Reynolds, et al., Proc. Nat. Telem. Conf., vol. 2, no. 7-1, May 1962.

. . . The conceptual design of a proposed spacecraft signal processing and data handling system is presented. Objectives . . .

a. To provide data processing to monitor selected scientific instruments on the surface of the moon.

b. To obtain engineering data on the performance of the spacecraft . . .

c. To telemeter the scientific and engineering data back to earth. . . .

MOON EXPLORATIONS: SPECIAL BIBLIOGRAPHY/INDEX
Nina Holt Bradshaw, et al. (comps.), Technical Information Service, Washington, D. C., May 1963, 258 p., 215 refs., N63-22784.

. . . 215 reports selected from the literature publicized in U. S. Government Research Reports, covering the period from June 1956 through October 1962.

TRANSLUNAR SPACE COMMUNICATIONS
M. G. Chatelain, International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 41, 10 p., A63-25670.

Brief description of the spacecraft functions necessary to accomplish a successful lunar landing mission, and the spacecraft systems which perform these functions. Consideration of the space communications system includes methods for the transmission of telemetry, voice, command signals, and TV . . . Problems arising from the nature of the lunar surface, atmosphere, and size are outlined.

EXTENDED LUNAR EXPLORATION
T. C. Evans, American Astronautical Society, Annual Meeting, 10th, New York, N.Y., May 4-7, 1964, Preprint 64-19, 28 p., A64-17812.

Discussion of the possibility of continued lunar exploration following the initial manned landing. . . . Several systems that might support this work and utilize Saturn and Apollo as subsystems are described. Two of these systems are the Apollo Logistic Support System and the Lunar Exploration system for Apollo.

THE ROLE OF UNMANNED SYSTEMS IN LUNAR EXPLORATION
H. A. Lassen, et al., Astronautics and Aeronautics, vol. 2, March 1964, p. 12-19, 13 refs., A64-14969.

TELEVISION FROM SPACE
F. Leary, Space/Aeronautics, vol. 41, March 1964, p. 70/79, A64-16114.

. . . Vidicons and other pickups and information storage systems are discussed. . . . Techniques are under way for better exploitation of digital television by overcoming objections of complexity and the necessity at present for large bandwidths. . . .

BIBLIOGRAPHY OF LUNAR AND PLANETARY RESEARCH—1962
J. W. Salisbury, et al., Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 63 903, Dec. 1963, 1 vol., AD 428 471.

. . . articles published in 1962 . . . astrobiology, comets, exploration programs and probes, meteorite craters and cratering effects, meteors and meteorites, the moon, origin of the solar system, the planets, and tektites.

ADVANCED LUNAR TRANSPORTATION SYSTEMS
T. R. Salter, American Astronautical Society, Annual Meeting, 10th, New York, N.Y., May 4-7, 1964, Preprint 64-20, 32 p., A64-17804.

. . . mathematical logistics model . . .

RELATIONSHIP BETWEEN THE MANNED AND UNMANNED PROGRAMS
J. F. Shea, IN: Technology of Lunar Exploration, Progress in Astronautics and Aeronautics, vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 971/974, A63-23453.

Brief discussion of the data requirements for the Apollo manned lunar landing program, and of the plans for obtaining these data through the unmanned lunar programs. . . .

ASTRONAUTICS INFORMATION, ENGINEERING EQUIPMENT AND PROCESSES ADAPTABLE TO LUNAR AND PLANETARY EXPLORATION
D. I. Sweitzer (comp.), Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-AI/LS-464, May 1963, 340 p., 2705 refs., N63-21479.

. . . a bibliography is given of catalog citations and abstracts on the subjects of general manipulators, roving vehicles and stationary structures, soil, vegetation, dust and particles, gas and liquid, inspection, testing, and analysis techniques . . . remote automatic, and adaptive control, and human time lag and human factors in control.

TECHNOLOGY OF LUNAR EXPLORATION. PROGRESS IN ASTRONAUTICS AND AERONAUTICS. VOL. 10
Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, 450 p., A63-23417.

Collection of papers concerning the various stages of accomplishment of a lunar mission, involving landing on or orbiting the Moon, and returning to Earth. . . .

PROCEEDINGS OF THE LUNAR AND PLANETARY EXPLORATION COLLOQUIUM. VOLUME III NUMBER 2
North American Aviation, Inc., Downey, Calif., 5 May 1963, 159 p., AD 404 726.

4C.410: Lunar Mission Planning

Included: Lunar satellite motion; Circumlunar trajectories; In-transit rendezvous mode; Orbital rendezvous mode; Rendezvous in lunar satellite oribit; 24 hour circumlunar satellite injection orbit; Circumlunar navigation; Midcourse guidance for lunar missions; Calculation of lunar impact location; Moon-to-Earth trajectories; Selenographic coordinates; Lunar escape theory; Launch windows for lunar missions; Earth-Moon libration points.

Not Included: Fundamentals of flight dynamics; Midcourse guidance systems; Ground computers for space navigation (3A); Space flight computers (3A).

Cross References: Lunar landing mission planning (4C.440); Interplanetary trajectories (4C.510).

Principal Publications:

ACCURACY REQUIREMENTS FOR TRAJECTORIES IN THE EARTH-MOON SYSTEM
H.A. Lieske, Rand Corp., Santa Monica, Calif., Rept. no. P-1022, 19 Feb. 1957, 12 p., incl. illus., tables, AD 244 719.

LUNAR FLIGHT TRAJECTORIES
R.W. Buchheim, Rand Corp., Santa Monica, Calif., Rept. no. P-1268, 30 Jan. 1958, 49 p., incl. illus., tables, 18 refs., AD 244 728.

CIRCUMLUNAR TRAJECTORY STUDIES
H.A. Lieske, Rand Corp., Santa Monica, Calif., Rept. no. P-1441, 25 June 1958, 23 p., incl. illus., tables, AD 244 716.

LUNAR TRAJECTORY STUDIES
H.A. Lieske, Rand Corp., Santa Monica, Calif., Rept. no. P-1293, 26 Feb. 1958, 36 p., incl. illus.,tables, AD 244 727.

CHARACTERISTICS OF THREE PRECISION CIRCUMLUNAR TRAJECTORIES FOR THE YEAR 1968
J. P. Gapcynski, et al., National Aeronautics and Space Administration, Washington, D.C., AD 272 902.

ANALYSIS OF THE ANNOUNCED TRAJECTORY OF THE RUSSIAN EXTRA-TERRESTRIAL VEHICLE, MECHTA I
K.E. Kissell, Air Force Cambridge Research Center, Bedford, Mass., AFCRC TN 59-605, Sept. 1959, 23 p., AD 251 314.

INERTIAL GUIDANCE FOR LUNAR PROBES. VOLUME II. FUNDAMENTALS OF LUNAR PROBE TRAJECTORIES
American Bosch Arma Corp., Garden City, N.Y., Rept. no. DR 220-16, Nov. 1959, 1 v., incl. illus., AD 400 657.

DESIGN OF LUNAR AND INTERPLANETARY ASCENT TRAJECTORIES
V.C. Clarke, Jr., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 26 July 1960, 16 p., AD 246 430.

THE MOTION OF A SATELLITE OF THE MOON
H. Lass, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 28 April 1960, 20 p., AD 237 695.

LUNAR TRAJECTORY STUDIES AND AN APPLICATION TO LUNIK III TRAJECTORY PREDICTION
A. Petty, et al., Space Science Lab., General Electric Co., Philadelphia, Pa., Scientific rept. no. 1, AFCRL TN 60-1132, July 1960, AD 247 577.

A summary is given of technical accomplishments pertaining to three relatively closely connected areas: (1) design of a fast, accurate and efficient computer program for computation of lunary trajectories; (2) an application of the resulting computer program to an error analysis of specific lunar trajectories and to the determination of some actual trajectories (as an example, the trajectory of LUNIK III is considered in detail); and (3) tracking program (determination of initial conditions to be used in the equations of motion).

LUNAR CIRCUMNAVIGATION
H.O. Ruppe, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 163/169.

MOON-TO-EARTH TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-2, Feb./March 1960, p. 40/41.

. . . study . . . how to return to the Earth after landing on the Moon. . . .

SELENOGRAPHIC COORDINATES
JPL Res. Summ., vol. 1, no. 36-2, Feb./March 1960, p. 41/42.

. . . two lunar missions likely to occur in the future are the orbiting of an instrumented spacecraft (satellite) around the Moon and the landing (soft impact) of a spacecraft on the Moon's surface. . . . advantageous to compute the craft's motion in a coordinate system centered at the Moon. . . .

MIDCOURSE GUIDANCE
JPL Res. Summ., vol. 1, no. 36-2, Feb./March 1960, p. 46/47.

. . . studies . . . continuing with reference to Agena injected spacecraft on lunar missions. For these missions, a 66-hour trajectory has been under consideration for several reasons . . .

CIRCUMLUNAR NAVIGATION
JPL Res. Summ., vol. 1, no. 36-2, Feb./March 1960, p. 47.

. . . possibility of recovery within a determinable area. . . .

ORBIT DETERMINATION
JPL Res. Summ., vol. 1, no. 36-3, April/May 1960, p. 60/63.

Radio tracking data is used to determine the orbit of a spacecraft, the direction and magnitude of the correcting impulse for a spacecraft, the direction and magnitude of the correcting impulse for a spacecraft midcourse maneuver, possibly for computing retro or terminal maneuvers, and in interpreting scientific experiments. The radio tracking data is contaminated by random noise from many sources. . . . A digital computer program . . . can be used to determine the injection conditions for that orbit which fits the measured data with the least-square error. . . . Effect of Number of Radio Tracking Measurements. . . . a 51-hour lunar trajectory has been used. The spacecraft is injected into a coasting orbit over the South Atlantic Ocean near Ascension Island, and the spacecraft's closest approach to the surface of the Moon (300 miles) occurs 51 hours after injection. . . . Effects of Uncertainties in Astronomical Unit . . .

CIRCUMLUNAR NAVIGATION
JPL Res. Summ., vol. 1, no. 36-3, April/May 1960, p. 64/66.

. . . a circumlunar vehicle which is recoverable upon return to Earth. . . .

FLIGHT PERFORMANCE ANALYSIS
JPL Res. Summ., vol. 1, no. 36-3, April/May 1960, p. 69/74.

In order to establish the orbit in which the spacecraft has been injected with accuracy compatible with the requirements of the midcourse maneuver, it is desirable to obtain some very early postinjection tracking. . . . Tracking RA-1 and RA-2 . . . Tracking RA-3 . . . Tracking RA-4 . . . Tracking RA-5 . . . Tracking Equipment . . . Land-based equipment . . . Tracking ships . . . Firing Window . . . Accuracy . . .

VARIATION OF LUNAR IMPACT LOCATIONS FOR EARTH-MOON TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 10/12.

MOON-TO-EARTH TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 12/14.

To obtain a gross understanding of Moon-Earth flight, it is useful to approximate the path by a single elliptical conic. The procedure is similar to that of approximating an interplanetary trajectory by a single heliocentric conic which passes through the centers of the launch and target planets. . . .

POWERED FLIGHT STUDIES
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 8/10.

A parametric analysis is being performed to study injection coordinate errors arising from guidance system inaccuracy on lunar and interplanetary trajectories. . . . Effects of accelerometer scale factor errors. . . . Effects of certain gyro errors . . . The IBM-704 computer program necessary to perform the study is now being prepared. . . .

ANNOTATED BIBLIOGRAPHY OF LUNAR PROPERTIES, GEOLOGY, VEHICLES AND BASES. PART II. VEHICLES, TRAJECTORIES, AND LANDINGS
A. A. Beltran, et al., Lockheed Aircraft Corp., Sunnyvale, Calif., Special bibliography no. SB-61-67, Rept. no. 5-53-61-2, Dec. 1961, 296 p., AD 271 033.

Part II of this three part lunar bibliography is concerned with manned and unmanned lunar probes, their purpose, trajectories . . . communications . . . Part I dealt with the physical properties . . . and maps of the moon. Part III will cover fixed and mobile lunar bases . . .

TRAJECTORY ANALYSIS — 24-HOUR CURCUMLUNAR SATELLITE INJECTION ORBIT
V. C. Clarke, et al., JPL Res. Summ., no. 36-13, Dec./Jan. 1961, p. 11/12.

USE OF VIDICON DATA TO INCREASE KNOWLEDGE OF SPACECRAFT TRAJECTORY AND INERTIAL ORIENTATION
J. P. Holmes, JPL Res. Summ., vol. 36-13, Dec./Jan. 1961, p. 9/11.

. . . The apparent movement of the Moon's surface from one vidicon photograph to the next is a function of spacecraft trajectory and inertial orientation. The present study is to determine these functional relationships.

A computer program has been written for the IBM 1620 that can give the location of each vidicon picture center on the lunar surface as a function of spacecraft trajectory and of inertial direction of the vidicon camera optical axis.

CONIC APPROXIMATIONS USED IN CIRCUMLUNAR TRAJECTORIES
W. Kirhofer, JPL Res. Summ., no. 36-11, Aug./Sept. 1961, p. 8/11.

REMOTE PROGRAMMING PROBLEMS FOR SCIENTIFIC EXPERIMENTS ON THE MOON
C. C. Mercier, In: Advances in the Astronautical Sciences, vol. VIII, American Astronautical Society, Annual Meeting, 7th, Proceedings, Dallas, Tex., Jan. 16-18, 1961, New York, Plenum Press, Inc., 1963, p. 549/563, A63-17661.

TRAJECTORY AND GUIDANCE THEORY FOR A LUNAR MISSION
J. S. Miller, Instrumentation Lab., Mass. Inst. of Tech., Cambridge, Volume I (Part I) of Final rept. on Low Thrust Vehicle Guidance Study, Aug. 1961, 132 p., incl. illus., tables, 25 refs., AD 275 453.

LUNAR TRAJECTORY STUDIES
A. Petty, et al., Space Sciences Lab., General Electric Co., Philadelphia, Pa., July 1960-June 1961, Final rept., AFCRL-507, June 1961, 276 p., AD 261 670.

. . . to provide a . . . systematic procedure for determining initial conditions to the differential equations of motion from tracking data, lunar and interplanetary trajectories in n-body space, and satellite ephemeris compilations.

A FIXED-BASE-SIMULATOR STUDY OF THE ABILITY OF A PILOT TO ESTABLISH CLOSE ORBITS AROUND THE MOON
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T. F. Gautschi, et al., JPL, Calif. Inst. of Tech., Pasadena, JPL-TM-33-114, Dec. 3, 1962, 38 p., refs., N63-17214.

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N. T. Bobrovnikoff, The Ohio State University Research Foundation, June 1959, AD 242 177.

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A. W. Straiton, et al., Commun. and Electronics, vol. 79, no. 50, Sept. 1960, p. 436/440.

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Research Laboratory of The University of Texas at Austin, Texas. These supplement monostatic radar measurements made by a number of organizations and a few bistatic measurements which have been noted in news articles and mentioned at technical symposia. . . .

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A. A. Beltran, et al., Lockheed Aircraft Corp., Sunnyvale, Calif., Special bibliography no. SB-61-67; Rept. no. 5-53-61-2, Dec. 1961, p. 296, AD 271 033.

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G. W. Morgenthaler and H. Jacobs (editors), American Astronautical Society, Symposium on Manned Lunar Flight; American Association for the Advancement of Science, Annual Meeting, 128th, Proceedings, Denver, Colo., Dec. 29, 1961, North Hollywood, Calif., Western Periodicals Co., 1963, 302 p., A63-17891.

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JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 57/58.

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E. Franzgrote, JPL Space Progr. Summ., vol. 4, Feb./March 1963, p. 186/190.

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LUNAR RADIATION AT 3.2 MILLIMETERS AND A LUNAR MODEL
C. W. Tolbert, et al., Electrical Engineering Research Lab., U. of Texas, Austin, Rept. no. 7-24, 15 Aug. 1963, 24 p., AD 417 910.

. . . 3.2-mm lunar emission temperatures during lunations. . . 4.3-mm electromagnetic characteristics of earth type pumice and granite are reported. . . interpreted in terms of the physical characteristics of the material at and near the surface of the moon. . . .

THE USE OF NEUTRON ACTIVATION FOR LUNAR AND PLANETARY SURFACE COMPOSITIONAL STUDIES
J. Trombka, et al., JPL Space Progr. Summ., vol. 4, Feb./March 1963, p. 190/192.

LUNAR DIMENSIONS ANNOTATED BIBLIOGRAPHY OF SOVIET-BLOC LITERATURE
Aerospace Information Div., Washington, D. C., AID Rept. B63 100, 30 July 1963, 49 p., AD 412 932.

. . . reflects Soviet developments from 1957 to 1963 in investigating lunar revolution, rotation, libration, and mapping techniques. . . .

Related Publications:

RADAR DOPPLER MEASUREMENTS OF THE CISLUNAR MEDIUM
H. T. Howard, et al., J. Geophys. Res., vol. 69, Feb. 1, 1964, p. 535/539, 8 refs., A64-14174.

. . . studies of the "Doppler excess" frequency, the amount by which the measured Doppler frequency. . . exceeds what it would have been if the propagation medium had been free space. In the present experiment the Doppler excess frequency is almost entirely due to the time rate of change of the electron content in a column between the Earth and the Moon. A limited number of comparisons with Faraday polarization and with other ionospheric measurements reveals that the Doppler excess effects are largely due to changes that take place in the ionosphere, the rest of the cislunar medium being fairly stable.

BACK-SCATTERING PROPERTIES OF MOON AND EARTH AT X BAND
H. Safran, AIAA Journal, vol. 2, Jan. 1964, p. 100/101, A64-13137.

Presentation of the back-scattering cross section per unit area of lunar surface. The knowledge of this functional dependence is necessary for the design of vehicle-borne radars measuring altitude and velocity very accurately for the purpose of navigation over the Moon. Analogous results for the Earth are also given. . . .

4C.430: Lunar Mapping and Surveying

Included: Mineralogical mapping of the lunar surface; Temperature mapping of the lunar surface; Radar measurements of lunar surface; Lunar mapping with television cameras; Soil mechanics of lunar surface; Mapping of the other side of the Moon; Far side photography; Radar probing of the surface of the Moon; Alpha-scattering experiments; Lunar mapping satellites; Lunar surface models; Destructive lunar impact missions; Lunar orbiter missions; Lunar probe telemetry systems; Lunar television systems.

Not Included: Fundamentals of selenography; Telemetry systems design; Design of space television links.

Cross References: Lunar environment (4C.420).

Principal Publications:

LUNAR EXPLORATION BY PHOTOGRAPHY FROM A SPACE VEHICLE
M. E. Davies, RAND Corporation, Paper P-1671, March 1959, p. 268/278, Reprint from Xth International Astronautical Congress, London 1959, Springer-Verlag, Wien, 1960.

A COHERENT MINIMUM-POWER LUNAR PROBE TELEMETRY SYSTEM
B. D. Martin, Jet Propulsion Lab., Pasadena, California, External Publication 610, August, 1959.

HOW GOOD IS LUNIK III PHOTOGRAPHY?
M. E. Davies, The RAND Corporation, Paper P-1892, May 1960, 2 p., Reprint from "Astronautics", May 1960.

LUNAR TV CAMERA MANIPULATOR (Final Report)
F. Grimm, et al., General Mills, Inc., Minneapolis, Minn., Electronics Group, 1960, 166 p., 13 refs., N63-21118.

. . . development of a method for controlling the manipulator temperature within specific limits over a period of 10,000 hours under the extreme conditions of heat and cold encountered on the surface of the moon.

ANALYSIS OF LUNIK III PHOTOGRAPHS
A. H. Katz, The RAND Corporation, Paper P-2250, Feb. 1960, p. 27/44, Proc. Lunar & Planetary Exploration Colloquium, vol. II, No. 2, March 17, 1960.

A STUDY OF PHOTOGRAPHS OF THE FAR SIDE OF THE MOON AND DESCRIPTION OF SINGULAR FEATURES REVEALED ON ITS SURFACE
Y. N. Lipsky, In: The Moon, New York, Academic Press, Inc., 1962, p. 7/23, A63-18373.

. . . interpretation and designation of the features of the far side of the Moon as seen from photographs taken from Lunik 3 (1959 Theta). . . .

THE REVERSE SIDE OF THE MOON
A. A. Mikhailov, In: The Moon, New York, Academic Press, Inc., 1962, p. 3/6, A63-18372.

. . . information. . . from the flight of Lunik 3 (1959 Theta). Briefly outlined is the type of equipment carried by the space vehicle, its method of photographing the lunar surface, and the means of transmitting the data to Earth. . . . The method of compiling the "Atlas of the Far Side of the Moon" is noted. . . .

THE OTHER SIDE OF THE MOON (Translation)
London, Pergamon Press, 1960, 36 p.

. . . describes the third Russian space rocket which was launched on 4th October 1959. . . .

SURVEYING AND MAPPING OF THE MOON FROM AN ORBITER
B. C. Aschenbrenner, IRE Internat. Conv. Rec., vol. 5, March 1961, p. 69/86.

USE OF VIDICON DATA TO INCREASE KNOWLEDGE OF SPACECRAFT TRAJECTORY AND INERTIAL ORIENTATION
J. P. Holmes, JPL Res. Summ., no. 36-13, Dec./Jan. 1961, p. 9/11.

The Ranger RA-3 spacecraft was equipped with a vidicon camera designed to take pictures of the Moon's surface. The impact point can be located by matching the vidicon photographs with lunar photographs taken from the Earth. The apparent movement of the Moon's surface from one vidicon photograph to the next is a function of spacecraft trajectory and inertial orientation. The present study is to determine these functional relationships.

RANGER - TELESCOPE VIDICON CAMERA
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 20/24.

It can be demonstrated that, with a 40-inch equivalent focal length telescope which is perhaps the maximum for the Ranger payload, photographs secured with a 200 TV line scan vidicon at 4000 km distance will just about equal the best resolution secured from earth based telescopes. . . .

SCHEMATIC CHART OF THE FAR SIDE OF THE MOON
I. I. Breido, et al., In: The Moon. New York, Academic Press, Inc., 1962, p. 25/38, A63-18374.

Presentation of a schematic chart which shows the approximate distribution of the brightness of 107 features on the marginal visible side of the Moon, and on its far side, as detected by photographs taken by Lunik 3. . . .

DESIGN TECHNIQUES FOR LOW POWER TELEMETRY
R. L. Choate, Proc. Nat. Telem. Conf., no. 3-1, May 1962, p. 1/14.

. . . the transmitter power required for a lunar mission utilizing a properly designed PM system is 12.5 mw for 5-cps bandwidth information, . . . 10.7 w for voice communications.

PROBABLE STRUCTURE AND NATURE OF THE FORMATIONS ON THE REVERSE SIDE OF THE MOON ACCORDING TO PHOTOMETRIC MEASUREMENTS OF LUNAR PHOTOGRAPHS
A. V. Markov, In: The Moon. New York, Academic Press, Inc., 1962, p. 39/44, A63-18375.

. . . as suggested by photographs taken by Lunik 3. . . Because the photographs are obtained without photometric calibration, they are calibrated by taking into account the brightness of ten details of the hemisphere of the Moon visible from the Earth. . . .

PROJECT LUNA SEE (Correspondence)
L. D. Smullin, et al., Proc. IRE, vol. 50, no. 7, July 1962, p. 1703/1704.

. . . to determine some of the possibilities of optical maser radar we conducted experiments with the Moon as a target. . . .

GUIDANCE AND DATA TRANSMISSION CONSIDERATIONS FOR A LUNAR MAPPING SATELLITE
J. A. Webb, Commun. and Electronics, vol. 81, no. 62, Sept. 1962, p. 225/229.

The lunar mapping satellite will be performing its mission approximately 210,000 nautical miles away from the nearest human control. In this environment, control from the earth becomes limited and tenuous. . . As in the case of the earth satellite, the polar lunar satellite has the only orbit which will permit viewing of the entire lunar surface without changing the plane of the orbit. . . . lowest altitude to probability in the order of 30,000 feet. . . . summary of the equipment. . . 1. Camera subsystem. . . 2. Navigation and Control Subsystem. . . 3. Propulsion Subsystem. . . 4. Data Link Subsystem. . . 5. Electric Power Supply Subsystem. . .

LUNAR ORBITER CAPSULE (Final Phase-out Report)
Radio Corp. of America, Princeton, N. J., Astro-Electronics Div., AED-1762, Dec. 31, 1962, 325 p., refs., N63-22054.

. . . Effects of tradeoffs on subsystems and recommendations of specifications for a specific Lunar Orbiter Capsule (LOC) system. . . Subsystem considered. . . (3) tele-communications subsystem, (4) television subsystem, and (5) power supply.

GEOPHYSICAL PARAMETERS INSTRUMENTATION
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 39/45.

A group of instruments designed to measure simple physical properties both on and beneath the lunar surface from a Surveyor soft-landing spacecraft are termed, "geophysical parameters instrumentation." The subsurface instruments have been incorporated into a logging sonde, whereas the surface instruments are deployed separately on the surface from the spacecraft by means of booms or arms. . . The present summary briefly describes both the methods of measurement and the surface and subsurface prototype instrumentation.

LUNAR-SURFACE-CHARACTERISTICS MEASUREMENT TECHNIQUES
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 73/75.

Spatial sensors and decision testers were considered candidates for obtaining surface data from orbiting spacecraft. Aerojet-General/Azusa conducted a parametric study to determine the tradeoffs involved in communications bandwidth versus these techniques for the specific problem of a lunar orbiting spacecraft.

STRUCTURE OF THE MOON'S SURFACE AND INVESTIGATION OF THE FIRST PHOTOGRAPHS OF ITS FAR SIDE (Translation)
N. P. Barabashov, AIAA Journal, Russian Supplement, vol. 1, March 1963, p. 744/747, 22 refs., A63-14506.

INSTRUMENTATION FOR A MINERALOGICAL SATELLITE
E. A. Burns, et al., International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 94, 26 p., 20 refs., A63-25261.

Description of a proposed mineralogical satellite. . . It is noted that remote IR spectral measurements made of the lunar surface by such a satellite should provide valuable information for mineralogical mapping and temperature mapping, and may also introduce a method to determine its general particulate structure.

THE SCATTERING PROPERTIES OF THE LUNAR SURFACE AT RADIO WAVE LENGTHS

J. V. Evans, et al., In: The Moon, Meteorites, and Comets, Vol. IV - The Solar System, Edited by Barbara M. Middlehurst and Gerard P. Kuiper, Chicago and London, University of Chicago Press, 1963, p. 129/161, 58 refs., A64-12636.

. . . characteristics of signals reflected from the Moon, in the light of the most recent and reliable results. . . the different methods currently employed to obtain information from radar systems concerning the gross surface roughness of the Moon. . . .

THEORY OF RADAR SCATTER FROM ROUGH SURFACES, BISTATIC AND MONOSTATIC, WITH APPLICATION TO LUNAR RADAR RETURN

A. K. Fung, J. Geophys. Res. v. 69, no. 6, 15 March 1964, p. 1063/1073, refs., N64-19499.

Presented is a theoretical expression for the bistatic radar return without neglecting terms involving partial derivatives of the surface. A better method of evaluating the integrals involved is shown in which no approximation needs to be made of the auto-correlation function. The final results are specialized for backscatter cases to permit comparisons with the lunar radar observations . . .

STATISTICAL RADAR ESTIMATE OF THE LUNAR SURFACE ROUGHNESS

H. S. Hayre, J. Franklin Institute, vol. 277, March 1964, p. 197/205, 21 refs., A64-16333.

. . . The result is statistically interpreted to indicate that. . . the average size (along the surface) of the lunar surface irregularities (small scale) may be of the order of 6.82 cm, whereas its average slope may be of the order of one in ten, which correlates well with the results of the acoustic simulation of Moon echoes, and with other results reported so far.

A LUNAR SURFACE MODEL FOR ENGINEERING PURPOSES

V. P. Head, In: Technology of Lunar Exploration., Progress in Astronautics and Aeronautics, Vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 35/81, 24 refs., A63-23419.

Theoretical analysis of the subresolution surface geometry and soil strength of the lunar maria, by using data from various experimental investigations. . . .

NEW TYPE RADAR PROBING SURFACE OF MOON

P. J. Klass, Aviation Week and Space Technology, vol. 78, May 6, 1963, p. 91, A63-18188.

. . . The new equipment, operating at 8.6-mm wavelength and using a 28-ft-diam. precision antenna, achieves a beamwidth of only 4.3 min. of arc, which corresponds to an area roughly 250 miles across on the lunar surface. First radar reflections from the lunar surface, obtained at a frequency of 35,000 Mc, indicate that the surface is fairly rough with respect to the dimensions of the waves employed.

RADIOIZLUCHENIE I PRIRODA LUNY (Radio-Frequency Radiation and the Nature of the Moon) (In Russian)

V. D. Krotikov, et al., Uspekhi Fizicheskikh Nauk, vol. 81, Dec. 1963, p. 589/639, 84 refs., A64-15467.

Discussion of the physical nature and self-radiation of the Moon. . . . theory of lunar radio-frequency radiation as compared to experimental data . . . the thermal flux emitted from the interior of the Moon, and the thermal state of the Moon's interior. . . . broad survey of Soviet and foreign literature. . . .

EXPERIMENTAL TELEVISION PHOTOGRAPHS OF THE MOON IN THE SPECTRAL REGION .8-2.3000 μ (Translation)

N. F. Kuprevich, Soviet Astronomy, vol. 6, May-June 1963, p. 883/885, A63-17314.

. . . The IR photographs are compared to those in the cisual region obtained previously by other investigators.

INVESTIGATION OF THE FAR SIDE OF THE MOON WITH THE AID OF ROCKETS. APPENDIX - SCHEMATIC MAP OF THE FAR SIDE OF THE MOON

Y. N. Lipskii, et al., In: The Moon, Meteorites, and Comets, Vol. IV - The Solar System, Edited by Barbara M. Middlehurst and Gerard P. Kuiper, Chicago and London, University of Chicago Press, 1963, p. 90/122, A64-12634.

. . . lunar observations made with the Soviet Lunik 3. . . instruments carried by the rocket . . . temperature control, and the directional and orientation controls. . . techniques employed to obtain an optimum sequence of photographs of different parts of the surface . . .

INTERPRETATION OF RESULTS FROM SURVEYOR ALPH'-SCATTERING EXPERIMENT

A. A. Loomis, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL TR-32-606, 30 April 1964, 17 p., refs., N64-19790.

. . . The broad categories of igneous rocks and meteorites, which are familiar on earth are the best models for rocks on the moon. . .

RADAR MEASUREMENTS OF THE LUNAR SURFACE
G. H. Pettengill, et al., In: Advances in the Astronautical Sciences, vol. VIII, American Astronautical Society, Annual Meeting, 7th, Proceedings, Dallas, Tex., Jan. 16-18, 1961, New York, Plenum Press, Inc., 1963, p. 564/570, A63-17662.

. . . recent measurements of the radio-echo power scattered by the lunar surface. . . . at 440 Mc. . . it is deduced that only about 5% of the surface is rough to the scale of 68 cm. Measurements of the depolarization of the scattered energy offer verification of the surface properties.

RADAR ANALYSIS OF THE MOON. PHASE II: SURFACE PROPERTIES
J. D. Shaw, et al., Texas Instruments, Inc., Dallas, Final rept., AFCRL 64 74, 16 Jan. 1964, 115 p., AD 432 403.

Utilization of radar in determining specific properties of the lunar surface. . . interpretation of the obtained electromagnetic property values in terms of other properties such as denisty, grain size, mineral content, and chemical composition.

RADIO CHARACTERISTICS OF LUNAR SURFACE MATERIAL
K. M. Siegel, In: 12th International Astronautical Congress, Proceedings, vol. 2, Washington, D. C., Oct. 1-7, 1961, New York and London, Academic Press, Inc., 1963, p. 662/669, 13 refs., A63-21282.

The different theories of radio scattering from the Moon are compared and analyzed. . .

BACKGROUND AND REQUIREMENTS ON RADAR SENSORS FOR SPACECRAFT
R. J. Taylor, et al., AIAA Guidance and Control Conf., MIT, Cambridge, Mass., Aug. 12-14, 1963, AIAA Paper 63-348, N63-20478.

. . . (1) a review of the utility of both earth-based and spaceborne radio-frequency sensors in various segments of a lunar-mission and critical assessment of the degree to which radar requirements have been established (2) a summary of typical characteristics of the earth-based and spacecraft-mounted radar that might be used in a lunar mission, and (3) a possible method for determining radar-sensor requirements utilizing an integrated operations-analysis approach.

LUNAR DIMENSIONS. ANNOTATED BIBLIOGRAPHY OF SOVIET-BLOC LITERATURE, 1957-1963
Aerospace Information Div., Library of Congress, Wash., D. C., AID Rept. B-63-100, 30 July 1963, 58 p., 68 refs., N63-19354.

X-RAY DIFFRACTOMETER
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 76/78.

As stated in SPS 37-15, Vol. VI, the Surveyor X-Ray diffractometer will be used for mineralogical analysis of lunar materials . . . Scope. . . Procurement program. . . New developments. . . Future plans. . .

ALPHA PARTICLE SCATTERING EXPERIMENT
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 78/79.

First proposed. . . by Professor Anthony Turkevich of the Enrico Fermi Institute of Nuclear Studies. . . Scientific objectives. . . Instrument operation and description. . . breadboard evaluation. . . Schedules and procurement. . .

SOIL MECHANICS EXPERIMENT
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 80/82.

Designed to make quantitative measurements related to the load bearing strength and shear strength of the lunar surface immediately adjacent to the Surveyor spacecraft. . . Other soil properties such as structure, composition, and particle size may possibly be deduced by interpretation of the measured parameters.

X-RAY DIFFRACTION STUDIES ON SILICATE ROCK GLASSES
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 96/100.

The identification of glass has been considered a major problem in the interpretation of lunar X-ray diffraction data which will be obtained by a diffractometer on a Surveyor spacecraft. . . experiments were carried out on a suite of synthetic and natural rock glasses.

Related Publications:

RANGER TELEVISION CAMERA SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 51/54.

The primary scientific objective of Ranger high-resolution television missions (SPS 37-16, Vol. VI, p. 3/7, 52, 53) is the acquisition of lunar topographic information of sufficient quality to aid in the design of lunar unmanned vehicles and the initial planning for manned lunar exploration.

MODULATION CONSIDERATIONS FOR THE TRANSMISSION OF REAL-TIME SPACE TELEVISION
J. A. Develet, Jr., Aerospace Corp., Los Angeles, Calif., SSD TDR63 117, 13 May 1963, 13 p., AD 406 315.

OPTICS AND SPACE RESEARCH
E. H. Linfoot, Royal Astronomical Society, Quarterly Journal, vol. 4, Dec. 1963, p. 376/390, 10 refs., A64-15521.

. . . the problem of getting the information in the image back to Earth is a serious one. . .

relation between the quality of the image and the minimum transmission time at prescribed power and bandwidth is considered, . . . The general formulas are applied to discuss the problem of designing a Moon-orbiting telescope to obtain pictures of the lunar surface with a resolution of 1 meter. . . .

SEISMOGRAPH
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 90/93.

. . . Four-component seismometer. . . . Single-axis seismometer. . . a backup instrument for Surveyor Lander Flights 5 through 8.

4C.440: Unmanned Lunar Landing Missions

Included: Non-destructive impact missions; High impact beacon; Soft landing missions; Lunar seismic experiment; Automatic landing site selection; Lunar landing maneuvers; Guidance problems for lunar landing; Terminal guidance for lunar landing; Lunar impact capsule; Lunar facsimile capsule; Lunar capsule development.

Not Included: Terminal guidance equipment development.

Cross References: Manned lunar landing missions (4C.450); Lunar roving vehicles (4C.450); Lunar robots (4C.450).

Principal Publications:

TERMINAL GUIDANCE OF A LUNAR PROBE
C. R. Gates, Jet Propulsion Lab., Calif., Inst. of Tech., Pasadena, External publication no. 506, 14 May 1958, 16 p., AD 262 023.

. . . problem of guiding a lunar probe to a zero-velocity or soft landing the moon is discussed. A self-contained guidance system is proposed and measurement instruments and accuracies, guidance computer transfer functions, and the magnitude and control of impulse required in the terminal maneuver are treated. . . .

ESTIMATED LUNAR SURFACE CHARACTERISTICS FOR LANDING SELECTION
F. H. Brady, et al., Proc. Nat. Aeron. Electronics Conf., vol. 8, May 1960, p. 311/316.

HIGH-IMPACT BEACON
JPL Res. Summ., vol. 1, no. 36-3, April/May 1960, p. 32/34.

. . . initial goal is to develop a beacon package capable of surviving an uncontrolled impact at a velocity of the order of 500 ft/sec against a hard surface. . . . An accelerometer is being developed to indicate peak accelerations of from several hundred to several thousand gravity units. . . .

LUNAR SEISMIC EXPERIMENT
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 1/9.

. . . An early lunar seismic experiment, where weight limitation is severe and impact velocity may be high, will require a rugged short-period seismometer . . .

LUNAR SOFT LANDING ANALYSIS
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 24/27.

. . . Some of the significant areas receiving careful consideration are as follows: Acceleration levels and propellant efficiency. . . . Retro initiation. . . . Impulse variations . . . Nonstandard trajectory . . . Sensors . . . component sybsystems: Radar . . . Optical devices . . . Computer . . .

ANNOTATED BIBLIOGRAPHY OF LUNAR PROPERTIES, GEOLOGY, VEHICLES AND BASES, PART II. VEHICLES, TRAJECTORIES, AND LANDINGS
A. A. Beltran, et al., Lockheed Aircraft Corp., Sunnyvale, Calif., Special bibliography no. SB-61-67; Rept. no. 5-53-61-2, Dec. 1961, 296 p., AD 271 033.

Part II of this three part lunar bibliography is concerned with manned and unmanned lunar probes, their purpose, trajectories . . . communications . . . Part I dealt with the physical properties . . . and maps of the moon. Part III will cover fixed and mobile lunar bases . . .

THE RANGER LUNAR CAPSULE
F. G. Denison, Astronautics, Sept. 1961, p. 32/33 - p. 77/78, N63-19541.

. . . vertical positioning of the sensitive axis of the seismometer permits the use of a modestly directional transmitting antenna to relay scientific and engineering data back to the Deep Space Instrumentation Facility. The seismometer is designed not only to provide a record of moonquakes and meteoric impacts, should they occur, but also to record the continuous, microscopic seismic motions that are believed to exist on the moon.

VELOCITY SENSING FOR SOFT LUNAR LANDING BY CORRELATION BETWEEN SPACE MICROWAVE RECEIVERS
F. R. Dickey, Jr., IRE Internat. Conv. Rec., vol. 5, March 1961, p. 63/68.

LUNAR PROBES AND LANDINGS, AN ANNOTATED BIBLIOGRAPHY
G. R. Evans (comp.), Lockheed Aircraft Corp., Sunnyvale, Calif., Special bibliography no. SB-61-24; Rept. no. LMSD-5-10-61-3, May 1961, 40 p., 105 refs., AD 259 325.

. . . concerned primarily with lunar probes, lunar landings, design configurations, and materials applicable to spaceships. . . . The period covered by the search was generally from January 1959 to the present.

COMMUNICATIONS WITH LUNAR PROBES
N. A Renzetti, et al., Jet Propulsion Laboratory, Calif. Inst. of Tech., JPL Tech. Rept. 32-148, Aug. 1961.

DESIGN OF LUNAR AND INTERPLANETARY ASCENT TRAJECTORIES
V. C. Clarke, Jr., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Technical rept. no. 32-30, rev. 1, 15 March 1962, 16 p., incl. illus., AD 275 047.

DATA COMPRESSION OF TELEVISION PICTURES AND AUTOMATIC LANDING SITE SELECTION
I. Eisenberger, et al., JPL Space Progr. Summ., vol. 4, no. 37-16, June/July 1962, p. 56/57.

. . . problem of data reduction of television pictures, together with an application of the same techniques to automatic landing site selection. The main idea of the method is to obtain a "line drawing" on the photosensitive screen of the vidicon aboard the spacecraft or planetary capsule, instead of a fine-grained photographic-like image. One method of doing this has been proposed in Ref. 20 and involves scanning the surface of the vidicon twice, once with a wide beam and again with a narrow beam.

SURVEYOR SPACECRAFT COMMAND AND DATA HANDLING GSE
J. S. Green, American Rocket Society, Annual Meeting, 17th, and Space Flight Exposition, Los Angeles, Calif., Nov. 13-18, 1962, Paper 2692-62, 22 p., A63-12229.

Development of ground-support equipment to provide remote control for the Surveyor spacecraft, designed for a soft landing on the Moon. A command and data-handling system is described, which has a design flexibility adequate to accommodate both the complexity of the spacecraft and the changes in its design. The operational requirements of the system are discussed in terms of the command, telemetry, and television subsystems. Block diagrams of these systems are presented.

THE EFFECT OF BIAS AXIAL VELOCITIES AND ALTIMETER FUZING ALTITUDE ON RANGER IMPACT SURVIVABILITY
Aeronutronic, Newport Beach, Calif., Technical Report, Publication U-1826, Sept. 15, 1962, 38 p., refs., N64-10336.

LUNAR CAPSULE DEVELOPMENT
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 12/13.

. . . a complete lunar capsule subsystem for Rangers 3, 4 and 5. . . . abstracted from the Aeronutronic document: Twelfth Bimonthly Technical Progress Report, Development of a Lunar Capsule Subsystem, April 1962 . . .

LUNAR CAPSULE DEVELOPMENT
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 19/21.

Aeronutronic Div. of Ford Motor Company . . . has developed a complete lunar capsule subsystem for Rangers 3-5. . . . abstracted from the Aeronutronic document: Thirteenth Bimonthly Technical Progress Report, Development of a Lunar Capsule Subsystem, June 1962.

LUNAR CAPSULE DEVELOPMENT
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 12/14.

LUNAR CAPSULE DEVELOPMENT
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 13/14.

HIGH-IMPACT DATA STORAGE UNIT
W. E. Arens, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 134/137.

. . . a unit for storing data before, during and after impact with repeated readout capabilities . . . This report describes the data storage unit (DSU) developed by EMI, the data storage test unit (DSTU) designed to test the DSU, the impact tests conducted to establish feasibility, the results of these tests, and the conclusions based upon these results. This program definitely demonstrated that a solid state data storage unit can: (1) Survive a lunar or planetary surface rough landing; (2) Store data without error before, during, and after impact.

UNMANNED LUNAR PROBES AND THE MANNED LUNAR MISSION
W. S. Boyle, American Astronautical Society, Annual Meeting, 10th, New York, N. Y., May 4-7, 1964, Preprint 64-5, 15 p., 5 refs., A64-17806.

. . . Data on a typical instrumentation for lunar probes are tabulated, together with data needed to ensure a lunar probe are tabulated, together with data needed to ensure a safe lunar excursion module landing, compared to data returned by lunar probes. . . .

LUNAR LANDING AND RENDEZVOUS RADAR
J. L. Burrows, Space/Aeronautics, vol. 40, Oct. 1963, p. 109, 111 +, A63-24934.

Description of the rendezvous radar system proposed for the Apollo lunar excursion module. Considered are the landing and rendezvous sections of the dual-interrupted CW Doppler radar. . . .

A TERMINAL GUIDANCE TECHNIQUE FOR LUNAR LANDING
S. J. Citron, et al., AIAA Journal, vol. 2, March 1964, p. 503/509, 11 refs., A64-15147.

A HIGH-RESOLUTION SYSTEM FOR LUNAR AND PLANETARY LANDING-SITE SELECTION
J. C. Dawson, et al., Rec. Nat. Spac. Electronics Symp., no. 9.1, 1963.

. . . a radar-computer system that permits selection of a satisfactory vehicle landing site during the terminal descent phase of a lunar or planetary exploration mission. The concept combines a high-resolution radar with a special processor that operates on the signals from parallel narrow-band receivers to provide a means of closely examining the proposed landing area and of selecting a suitable section for touchdown. . . .

GUIDANCE CONCEPTS FOR LUNAR LANDING
P. J. deFries, In: Advances in the Astronautical Sciences, vol. VIII, American Astronautical Society, Annual Meeting, 7th, Proceedings, Dallas, Tex., Jan. 16-18, 1961, New York, Plenum Press, Inc., 1963, p. 425/438, A63-17651.

A DISCUSSION OF THE LUNAR LANDING PROBLEM
F. E. Digesu, AIAA Guidance and Control Conf., MIT, Cambridge, Mass., Aug. 12-14, 1963, AIAA Paper 63-344, 7 p., 7 refs., N63-20492.

A MINIMUM FUEL VERTICAL TOUCHDOWN LUNAR LANDING GUIDANCE TECHNIQUE
B. A. Hall., et al., AIAA Guidance and Control Conf., MIT, Cambridge, Mass., Aug. 12-14, 1963, AIAA Paper 63-345, 18 p., 4 refs., N63-20133.

. . . automatic, easily instrumented, guidance technique . . . suitable for accomplishing a soft, pinpoint, vertical lunar landing with a nearly minimum fuel expenditure. . . .

TERMINAL GUIDANCE AND CONTROL TECHNIQUES FOR A SOFT LUNAR LANDING
B. A. Kriegsman, et al., In: 12th International Astronautical Congress, Proceedings, vol. 1, Washington, D. C., Oct. 1-7, 1961, New York and London, Academic Press, Inc., 1963, p. 392/418, A63-21263.

. . . Two different guidance concepts for the terminal phase are presented. . . . Guidance equations, sensor performance, and fuel requirements are given for both systems . . . application . . . for two different missions. . . . unmanned vehicle on a direct descent trajectory, and a manned vehicle on an approach trajectory from a lunar parking orbit.

LUNAR LANDING AND LONG-RANGE EARTH REENTRY GUIDANCE BY APPLICATION OF PERTURBATION THEORY
H. C. Lessing, et al., In AIAA 2nd Manned Space Flight Meeting (1963), p. 140/150, refs., N63-23221.

LUNAR LANDING BY COMMAND GUIDANCE IN THE PRESENCE OF TRANSMISSIONS TIME-DELAY
H. F. Meissinger, American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Cambridge, Mass., Aug. 12-14, 1963, Paper 63-346, 17 p., A63-20669.

. . . system configuration and the operator's functions of a lunar-landing guidance command system, which is designed to function in the presence of the long transmission times and low TV frame rates encountered in deep space missions. . . .the vehicle uses an autonomous on-board system which provides the ability of soft landing in a preselected nominal target area. The command guidance methods considered involve complex, time-variant, and nonlinear feedback systems and the largely unknown dynamic response of the human operator. Reviewed is a three-dimensional manned simulation study of human operator using various modes of command operation, The simulator used is described in an appendix.

LUNAR ROUGH LANDING CAPSULE DEVELOPMENT PROGRAM
Aeronutronic, Newport Beach, Calif., Final Technical Report, U-2007, 20 Feb. 1963, 249 p., refs., N64-19316.

. . . The seismometer-experiment payload will survive the impact . . . A facsimile picture-taking device, compatible with the payload constraints of the Ranger capsule system, was shown to be feasible.

MANEUVERS NEAR THE MOON
Image, vol. 2, May 1963, p. 6/7, A63-18610.

. . . Lunar Excursion Module (LEM). Emphasized is the simulation of a landing abort launch of the LEM and its intercepting and rejoining the Command Module.

LUNAR FACSIMILE CAPSULE
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 13/14.

. . . The LFC transmits data to reproduce on Earth and complete 360-deg panoramic view of the lunar terrain surrounding the landed capsule . . . The primary objective of the currently authorized LFC development program (Phase I) is to demonstrate the feasibility of the prototype LFC viewing subsystem to survive and function after being subjected to a simulated lunar impact.

LUNAR FACSIMILE CAPSULE
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963, p. 10/12.

. . . general configuration of the LFC is basically that of the Ranger seismometer capsule, with a high-resolution facsimile (HRF) device replacing the seismometer experiment. . . .

LUNAR FACSIMILE CAPSULE
JPL Space Progr. Summ., vol. 6, no. 37-23, July/Sept. 1963, p. 7/10.

Related Publications:

LUNAR SPACECRAFT DATA HANDLING
H. M. Reynolds, et al., Proc. Nat. Telem. Conf., vol. 2, no. 7-1, May 1962.

. . . The conceptual design of a proposed spacecraft signal processing and data handling system is presented. Objectives . . . a. To provide data processing to monitor selected scientific instruments on the surface of the moon. b. To obtain engineering data on the performance of the spacecraft . . . c. To telemeter the scientific and engineering data back to earth. . . .

SPACE COMPUTER REQUIREMENTS
B. A. Swearinger, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 161/167.

The sample mission chosen for analysis was manned lunar trip which included the lunar landing subtask.

BI-STATIC CORRELATION RADAR FOR VELOCITY SENSING IN SPACECRAFT
F. R. Dickey, Jr., et al., American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Cambridge, Mass., Aug. 12-14, 1963, Paper 63-351, 8 p., A63-21605.

. . . on lunar missions. The method measures the direction of the velocity, as well as its magnitude relative to the Moon's surface. . . . The technique can be made operable throughout a far greater range of altitudes than a self-contained radar system . . .

4C.450: Manned Lunar Missions

Included: Communications problems associated with the lunar target of manned missions; Orbital docking in lunar orbit; Lunar roving vehicles; Lunar robots; Lunar surface vehicles; Lunar surface communications; Lunar excursion module.

Not Included: Communications problems associated with manned space missions (4D); Project Apollo (4D).

Cross References: Unmanned lunar landing missions (4C.440); Lunar surface colonization (4C.480).

Principal Publications:

DESIGN OF A POWER SYSTEM FOR A LUNAR MOBILE SURFACE VEHICLE
R. H. Brody, General Electric Co., Santa Barbara, Calif., Rept. no. 61SPC-3, 2 Oct. 1961, 73 p., incl. illus., tables, 14 refs., AD 273 811.

PREDICTION-MARKER COMPUTERS AND DISPLAY SYSTEMS FOR CONTROLLING A LUNAR ROBOT VEHICLE FROM EARTH
D. Cohen, East Coast Conf. Aerospace Navig. Electronics, vol. 8, no. 5.1.1, Oct. 1961, p. 1/9.

COMMUNICATION SYSTEMS ANALYSIS FOR LIGHTWEIGHT ROVING LUNAR VEHICLE
G. L. Dunn, General Electric Co., Santa Barbara, Calif., Rept. no. 61 SPC-4, 2 Nov. 1961, 41 p., incl. illus., tables, 5 refs., AD 273 812.

. . . Efforts were made to determine the transmitter power requirements as a function of data transmission rate for the Prospector moon-to-earth TV link. An analysis is presented based on the utilization of PCM-PS modulation at an RF carrier frequency of 2250 mc. The ground based receiver station utilizes the DSIF equipment. The video input is obtained from the output terminals of an image orthicon camera located aboard the tank.

AN ANALYSIS OF A MANNED LUNAR SYSTEM
N. H. Keezell, Jr., MIT, Cambridge, Mass., June 1961, 37 p., AD 258 046.

. . . It is concluded that, using current technology, a payload of 261,000 lbs. launched with a velocity of 36,000 fps. can place men in orbit around the moon, land them on the moon, and return them to earth . . .

ROVING LUNAR VEHICLES—PART II: ROVING VEHICLE CONTROL POSES PROBLEMS
B. Miller, Aviation Week and Space Technology, vol. 75, no. 15, Oct. 1961, p. 71/79.

. . . prowling about extraterrestrial surfaces hundreds of thousands or millions of miles from their human, earthbound operators pose a number of difficult problems which must be solved before the complicated missions planned for this new type of spacecraft can be achieved. . . . Transmission delay . . . would be sizable and bothersome. . . . on the inner planets, this transmission delay becomes orders of magnitude larger, the problems of control increasingly complex. . . . between the earth and moon. . . . round-trip transmission delay of 2.64 sec.

MANNED LUNAR FLIGHT. ADVANCES IN THE ASTRONAUTICAL SCIENCES, VOLUME 10 (Proceedings of Am. Astronautical Soc. Symp. on Manned Lunar Flight, Denver, Dec. 29, 1961)
G. W. Morgenthaler, et al. (editors), North Hollywood Western Periodicals Co., 1963, 308 p., 166 refs., N63-22841.

LUNAR MISSIONS: GETTING TO THE MOON
K. R. Stehling, Space Aeronautics, vol. 35, no. 1. Jan. 1961, p. 51/53.

ADVANCES IN THE ASTRONAUTICAL SCIENCES, VOL. X-MANNED LUNAR FLIGHT (American Astronautical Society, Symposium on Manned Lunar Flight; American Association for the Advancement of Science, Annual Meeting, 128th, Proceedings, Denver, Colo., Dec. 29, 1961)
G. W. Morgenthaler and H. Jacobs (editors), North Hollywood, Calif., Western Periodicals Co., 1963, 302 p., A63-17891.

Investigation of the major problems of technology and life sciences which must be solved to permit manned lunar flight. Three topics . . . lunar spacecraft . . . physiological factors . . . lunar environment. . . .

RECOVERY OF LUNAR RE-ENTRY VEHICLES AT A PRE-SELECTED LANDING SITE
D. M. Caldwell, Jr., et al., Air Force Flight Test Center, Edwards Air Force Base, Calif., Rept. no. FTC TDR 62-18, Sept. 1962, 19 p., incl. illus., AD 284 277.

A Vehicle returning from the moon at a velocity of about 36,000 fps possesses nearly twice the kinetic energy of one which is in orbit around the earth at 26,000 fps; its recovery is thereby a more difficult task. . . .

REMOTE STEERING OF A LUNAR SURFACE VEHICLE
G. M. Jordan, et al., Navigation, vol. 10, Autumn 1963, p. 230/241, A64-10454.

Analysis and selection of an optimum steering system for the remote control of a mobile lunar surface vehicle. Combinations of three steering configurations and three types of controllers are considered as possible steering systems. The generalized system concept is developed, and an analog-computer simulation is described. . . .

MAN/MOON/MACHINE RELIABILITY RELATIONSHIPS
E. P. McDowell, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 220.

Abstract Only. . . . man's first efforts to travel beyond the immediate vicinity of earth will be in the direction of the moon . . . it is likely that he will be interested in the probability of successful return. Can we, or should we, guarantee 99.99% probability of success, 99%, 90%, or perhaps only 50%. . . . we must first examine the present and foreseeable state-of-the-art in equipment design. . . .

APPROXIMATE CALCULATIONS FOR A MANNED LUNAR LANDING MISSION
F. M. McMullen, Massachusetts Inst. of Tech., Cambridge, Master's thesis, June 1962, 79 p., incl. illus., tables, 30 refs., AD 278 111.

Approximate calculations are obtained for some of the problems of a manned trip to the moon with a lunar landing, return and entry into the earth's atmosphere using a lifting vehicle. . . .

SELECTION OF POWER SYSTEMS FOR LUNAR ROVING VEHICLES
J. R. May, American Rocket Society, Space Power Systems Conference, Santa Monica, Calif., Sept. 25-28, 1962, Paper 2523-62, 18 p., A63-11722.

. . . shown that a completely integrated power-generation, thermal-control, and propulsion system can be provided for lunar operation. . . .

TIME LAG CONSIDERATION IN OPERATOR CONTROL OF LUNAR VEHICLES FROM EARTH
R. A. Newman, In: Technology of Lunar Exploration. Progress in Astronautics and Aeronautics, vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence. New York and London, Academic Press, Inc., 1963, p. 589/613. 11 refs., A63-23439.

. . . The concept makes use of a computer to determine probable future vehicle position.

POWER SUPPLIES FOR MOBILE LUNAR VEHICLES
R. G. Roble, et al., American Rocket Society, Space Power Systems Conference, Santa Monica, Calif., Sept. 25-28, 1962, Paper 2525-62, 7 p., 12 refs., A63-11724.

SPECIFICATION FOR A LUNAR SURFACE VEHICLE DESIGNED TO SUPPORT AN EARLY APOLLO MISSION
A. Baker, Rec. Nat. Space Electronics Symp., no. 6.2, 1963.

. . . paper considers three major subsystem areas in detail - Communications, Power Sources, and Environmental Control. . . .

OPTIMUM FREQUENCIES FOR LUNAR SURFACE COMMUNICATIONS
M. Chomet, et al., IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 25/31.

THE POTENTIAL OF VARIOUS APPROACHES FOR MANNED LUNAR LANDING MISSIONS AS MEASURED BY LAUNCH WEIGHT REQUIREMENTS

N. F. Dow, General Electric Co., Philadelphia, Pa., Space Sciences Lab., Nov. 1963, 41 p., N64-11203.

. . . A review is made of various techniques (direct, earth orbit, rendezvous, lunar orbit rendezvous, libration point rendezvous) for accomplishing the manned, lunar landing mission . . .

LUNAR EXPLORATION VEHICLES AND EQUIPMENT

J. E. Froehlich, et al., In: Advances in the Astronautical Sciences, Vol. X-Manned Lunar Flight, American Astronautical Society, Symposium on Manned Lunar Flight; American Association for the Advancement of Science, Annual Meeting, 128th, Proceedings, Denver, Colo., Dec. 29, 1961, North Hollywood, Calif., Western Periodicals Co., 1963, p. 279/302, A63-17904.

. . . means of locomotion . . . walkers, hoppers, and hover rockets . . . life support, communications . . . surface navigation systems . . . Several likely moonmobile configurations are described.

THE MANNED LUNAR MISSION

R. R. Gilruth, et al., In: Technology of Lunar Exploration, Progress in Astronautics and Aeronautics, Vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 281/290, A63-23428.

. . . Comparisons are made of the Apollo and Mercury space vehicles and spacecraft. . . .

ABORT CONSIDERATIONS FOR MANNED LUNAR MISSIONS

T. J. Kelly, et al., In: Technology of Lunar Exploration, Progress in Astronautics and Aeronautics, Vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 451/482, A63-23435.

. . . for the lunar orbit and descent phase of a manned lunar mission. . . . Velocity increment and time-to-return for several direct and indirect abort sequences are established . . .

TECHNICAL DEVELOPMENT STATUS OF THE PROJECT APOLLOR LUNAR EXCURSION MODULE

T. J. Kelly, American Astronautical Society, Annual Meeting, 10th, New York, N. Y., May 4-7, 1964, Preprint 64-16, 69 p., A64-17810.

TRAJECTORY AND GUIDANCE CONSIDERATIONS FOR LUNAR RETURN MISSIONS

T. A. Magness, et al., In: Technology of Lunar Exploration. Progress in Astronautics and Aeronautics, Vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 659/686, A63-23442.

. . . from the lunar surface to Earth. . . .

SIMULATION OF MANNED LUNAR LANDING

E. Markson, et al., In: Technology of Lunar Exploration, Progress in Astronautics and Aeronautics, Vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 561/588, A63-23438.

Description of a predictive type of guidance system for a man-in-the-loop lunar landing which uses a novel solution to three-dimensional particle motion for repeated predictions of trajectory end conditions. . . .

LUNAR MISSIONS: LAUNCH TO RENDEZVOUS

A. B. Mickelwait, In: Technology of Lunar Exploration, Progress in Astronautics and Aeronautics, Vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 139/165, A63-23422.

. . . General Summary . . .

RENDEZVOUS AND ORBITAL DOCKING: A BIBLIOGRAPHY

J. F. Price, et al., Space Technology Labs., Inc., Redondo Beach, Calif., Research Bibliography 47; Rept. 9990-6385-KU-000, April 1963, 139 p., 369 refs., N63-22776.

A partially annotated bibliography is presented on rendezvous and orbital-docking studies, covering manned and unmanned rendezvous, as well as satellite interception.

RELATIONSHIP BETWEEN THE MANNED AND UNMANNED PROGRAMS
J. F. Shea, In: Technology of Lunar Exploration, Progress in Astronautics and Aeronautics, Vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 971/974, A63-23453.

Brief discussion of the data requirements for the Apollo manned lunar landing program, and of the plans for obtaining these data through the unmanned lunar programs. . . .

FUTURE LUNAR MISSIONS. REVIEW OF SOVIET AND SOVIET-BLOC LITERATURE
Aerospace Information Div., Washington, D. C., AID P64 1, 8 Jan. 1964, 246 p., AD 431 728.

. . . In most cases the materials quoted are from the 1961 to 1963 period . . .

INITIAL CONCEPT OF LUNAR EXPLORATION SYSTEMS FOR APOLLO, VOLUME V-SUMMARY DIGEST
National Aeronautics and Space Administration, Washington, D. C., March 1964, 34 p., N64-15969.

. . . utilization of a modular approach . . . flexibility in scope (2 to 18 men), duration (3 months to 2 or more years), and type of mission activity; feasibility of development for the 1970 to 1974 time period . . .

Related Publications:

THE APOLLO GUIDANCE COMPUTER
R. L. Alonso, et al., Rec. Nat. Space Electronics Symp., no. 6.1, 1963.

. . . binary, fifteen digit (bit) "general purpose" computer employing parallel word transfer and single address instructions. . . .

MANNED SPACE FLIGHT
E. Clark, et al., Aviation Week and Space Technol. v. 79, no. 4, July 22, 1963, 131 p., N63-22118.

. . . special issue . . . devoted to U. S. civilian and military manned spaceflight and to Soviet spaceflight . . .

COMMUNICATIONS AND TRACKING ON THE APOLLOR LUNAR EXPLORATION MISSION
S. W. Fordyce, Rec. Nat. Space Electronics Symp., no. 6.3, 1963.

. . . current plans for the communications and tracking links for the Apollo lunar mission. . . . the rationale behind the selection of the Apollo communications and tracking systems.

ASTRONAUTICS INFORMATION, RECOMMENDATIONS FOR UTILIZATION OF LUNAR RESOURCES SEMINAR PROCEEDINGS: A REPORT OF THE WORKING GROUP ON EXTRATERRESTRIAL RESOURCES, MARCH 8, 1963
G. W. S. Johnson (editor), Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, June 28, 1963, 70 p., 58 refs., N63-21643.

4C.480: Future Lunar Missions

Included: Manned lunar base; Synchronous lunar satellites; Communications satellites around the moon; Lunar exploration vehicles (for longer missions); Lunar logistics systems; Lunar colonization; Lunar point-to-point communications; Lunar based antennas; Lunar based surveillance system; Lunar industrial complex; Lunar shelter concepts; Moon-base; Lunatron concept.

Cross References: Lunar surface communications (4C.450); Communications with roving lunar surface vehicles (4C.450); Lunar roving vehicles (for short missions (4C.450).

Principal Publications:

MOON BASE
T.C. Helvey, New York, John F, Rider Inc., 1960, 72 p.

. . . Simulator of approximate lunar environment; Plastic lunar crew shell; Equipment for the maintenance of the earth; Environment within the base; Crew equipment for lunar surface . . . Human Factors. . . .

DESIGN CONSIDERATIONS FOR A LUNAR INDUSTRIAL COMPLEX
W.C. Athas, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 426/433.

SOME CONSIDERATIONS FOR A LUNAR BASED SURVEILLANCE SYSTEM
R.H. Brody, General Electric Co., Santa Barbara, Calif., Rept. no. 61 SPC-10, 28 Feb. 1962, 44 p., incl. illus., 11 refs., AD 273 815.

. . . television surveillance system for a lunar mobile vehicle . . . a review of illumination characteristics of the lunar surface . . . selection of a suitable pickup tube . . . some possible system configurations. Problems involved in lunar night operation are emphasized.

ON THE UTILITY OF THE MOON IN SPACE TRANSPORTATION: THE LUNATRON CONCEPT
W.J. Escher, In Am. Inst. of Aeron. and Astronautics Eng. Problems of Manned Interplanetary Exploration, Oct. 1963, p. 102/112, refs., N64-10045.

. . . Lunatron is a coined name for the lunar-surface-based electromagnetically powered rail-launch concept. Since it is a non-jet-reaction device, its characteritics and capabilities contrast sharply with rocket systems . . .

LUNAR EXPLORATION VEHICLES AND EQUIPMENT
J.E. Froehlich, et al., In: Advances in the Astronautical Sciences, vol. X - Manned Lunar Flight, North Hollywood Calif., Western Periodicals Co., 1963, American Astronatucal Society, Symposium on Manned Lunar Flight; American Association for the Advancement of Science, Annual Meeting, 128th, Proceedings, Denver, Colo., Dec. 29, 1961, p. 279/302, A63-17904.

. . . means of locomotion . . . walkers, hoppers, and hover rockets . . . life support, communications . . . surface navigation systems . . . Several likely moonmobile configurations are described.

LUNAR LOGISTIC SYSTEM PAYLOAD PERFORMANCE STUDY, VOLUME III: DEVELOPMENT PROGRAMS AND ESTIMATED SCHEDULES AND COSTS
R.E. Horner, Northrop Corp., Hawthorne, Calif., Final Report, NSL-63-4, Jan. 1963, 42 p., N64-15901.

. . . development program for a roving base payload and for four typical function units are described. . . .

ASTRONAUTICS INFORMATION. RECOMMENDATIONS FOR UTILIZATION OF LUNAR RESOURCES SEMINAR PROCEEDINGS: A REPORT OF THE WORKING GROUP ON EXTRA-TERRESTRIAL RESOURCES
G. W. Johnson (editor), Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, June 28, 1963, 70 p., 58 refs., N63-21643.

. . . The feasibility and usefulness of the employment of extra-terrestrial resources with the objective of reducing dependence of lunar and planetary exploration on terrestrial supplies is discussed . . .

THE LUNAR BASE: A BIBLIOGRAPHY
L.R. Magnolia, et al., Space Technology Labs., Inc., Redondo Beach, Calif., Research Bibliography 48; Rept. 9990-6450-KU-000, Aug. 1963, 96 p., 240 refs., N63-22777, AD 413 433.

. . . An annotated bibliography is presented of articles dealing with the operation of manned lunar bases.

LUNAR SHELTER CONCEPTS
K.H. Merkel, et al., Cincinnati Univ., Coll. of Design, Architecture and Art, Ohio, 1963, 237 p., AD 422 274.

. . . to meet the harsh envoronment of the moon . . . ability of the personnel to fabricate and erect the shelter on the moon in a minimum of time must be considered. . . .

THE MANNED LUNAR BASE
G.A. Smith, In North American Aviation, Inc., Proc. of the (13th) Lunar and Planetary Exploration Colloq., vol. 3, no. 3, Nov. 1963, p. 3/9, N64-13702.

. . . for scientific exploration of the moon . . . Studies . . . including transportation, communication, and power necessary to maintain such a base . . .

LUNAR BASES
I. Stambler, Space/Aeronautics, vol. 40, Dec. 1963, p. 60/67, A64-12902.

Discussion of "LESA," the lunar exploration system for Apollo . . . Alphonsus is stated to be the most promising base site on the Moon, although not the only one. . . .

USE OF EXTRATERRESTRAIL RESORUCES FOR MARS BASING
E.A. Steinhoff, RAND Corp., Santa Monica, Calif., P2746, May 1963, 19 p., AD 405 811.

The establishment of exploratory bases on the Moon and Mars will lead to complex logistics if all supplies have to be provided by the Earth. . . .

LUNAR BASED ANTENNAS
M.A. Stephens, Rec. Nat. Space Electronics Symp., no. 7.3, 1963.

. . . concerned with the problems involved in locating and maintaining antennas on the lunar surface for direct communications with earth stations. . . . environment and the effect of this environment on antenna selection, construction and performance. . . .

NASA STUDYING LUNAR BASE FEASIBILITY
I. Stone, Aviation Week and Space Technology, vol. 79, July 1, 1963, p. 71/73, A63-18731.

. . . Tentative subsystem concepts for major subsystems envision the lunar base as having a basic module serving as a shelter to house several men. . . .

DES SATELITES SYNCHRONES DE LA LUNE SERAIENT-ILS STABLES ET UTILES? (Would Synchronous Lunar Satellites Be Stable And Useful?) (In French)
S. Travers, Technique et Science Aeronautiques et Spatiales, Sept.-Oct. 1963, p. 373/376, A64-16346.

General study of the feasibility and utility of lunar satellites interstation communication on the Moon. In view of the absence of a lunar ionosphere, radio wave communication systems are confined to ine-of-sight transmission. . . .

LUNAR POINT-TO-POINT COMMUNICATION
L.E. Vogler, In: Technology of Lunar Exploration, Progress In Astronautics And Aeronautics, vol. 10, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 533/559, 25 refs., A63-23437.

. . . on the surface of the Moon; ground wave propagation is assumed over a lunar model consisting of a smooth sphere of homogeneous material with no surrounding atmosphere . . . Antenna considerations and noise effects. . . .

INITIAL CONCEPT OF LUNAR EXPLORATION SYSTEMS FOR APOLLO, VOLUME I: SUMMARY
National Aeronautics and Space Administration, Washington, D.C., Final Report, March 1964, 176 p., refs., N64-17721.

. . . to provide a conceptual design of a modular lunar-base system for Project Apollo lunar explorations . . . topics . . . are the physical environment, lunar-base system requirements, base-design integration, lunar-base construction concepts, lunar-base operations concepts, logistic-support concepts, typical lunar-base operations plans, and subsystem analysis and module configurations.

Related Publications:

PRELIMINARY INVESTIGATION OF LUNAR SURFACE COMMUNICATIONS
J.P. Ferrara, et al., In: Advances in the Astronautical Sciences, Vol. X - Manned Lunar Flight, American Astronautical Society, Symposium on Manned Lunar Flight; American Association for the Advancement of Science, Annual Meeting, 128th, Proceedings, Denver, Colo., Dec. 29, 1961, North Hollywood, Calif., Western Periodicals Co., 1963, p. 251/264, A63-17902.

. . . utilization of medium radio frequencies for beyond-line-of-sight transmission on the surface of the Moon. . . . effects of cosmic noise, receiver parameters, and the field intensities are combined in a plot of maximum range vs frequency for a given transmitter power.

DIVISION 4C.5
COMMUNICATIONS SYSTEMS FOR PLANETARY MISSIONS

4C.500: General References to Planetary Communications

Included: Interplanetary logistics; Interplanetary communications; Lasers for communications over interplanetary distances; Recoverable interplanetary space probes; Retransmitting satellites for planetary communications; Interplanetary navigation; EMPIRE dual planet fly-by mission.

Not Included: Laser communications (3B).

Cross References: Project Mariner (4C.830); Project IMP (4C.820); Mars probe (USSR) (4C.842); Project Voyager (4C.870); Russian Venus probe (4C.882).

Principal Publications:

COMMUNICATIONS AND NAVIGATION TECHNIQUES OF INTERPLANETARY TRAVEL
P.A. Castruccio, IRE Trans. Aeron. Navigational Electronics, vol. ANE-4, Dec. 1957.

PARAMETERS AND TECHNIQUES APPLICABLE TO ULTRA-LONG-RANGE COMMUNICATION WITH SOLAR SYSTEM PROBES
J.J. Downing, Nat. Telem. Conf., May 1959, p. 331/342.

AN INTERPLANETARY COMMUNICATION SYSTEM
G.E. Mueller, et al., IRE WESCON Conv., Rec., Pt. 5, vol. 3, 1959, p. 68/80.

AN INTERPLANETARY COMMUNICATION SYSTEM
G.E. Mueller, et al., IRE Trans. Space Electronics Telemetry, vol. SET-5, no. 4, Dec. 1959, p. 196/204.

TRACKING OBJECTS WITHIN THE SOLAR SYSTEM USING ONLY DOPPLER MEASUREMENTS
R.R. Newton, Applied Physics Lab., Johns Hopkins U., Silver Spring, Md., Reprint series rept. 539, 27 Aug. 1959, 10 p., AD 261 095.

A RECOVERABLE INTERPLANETARY SPACE PROBE
M.I. Skolnik, et al., Lincoln Lab., MIT, Group Report 31-148, vol. III, July 1959, AD 248 159.

A COMMUNICATION SYSTEM FOR A SMALL INTERPLANETARY VEHICLE
M.I. Skolnik, Nat. Symp. Space Electronics Telem., no. 1.4, Sept. 1959, p. 1/14.

OPTIMUM FREQUENCY DETECTION OF INTERPLANETARY COMMUNICATION
S. Chandra, J. Brit Interplanetary Soc., no. 17, July 1960, p. 362/365.

INTERPLANETARY NAVIGATION
G.M. Clemence, Proc. IRE, vol. 48, no. 4, April 1960, p. 497/499.

THE EXPLORATION OF THE SOLAR SYSTEM
F. Godwin, Nature, vol. 187, no. 4740, Sept. 1960, p. 811.

MAXIMUM UTILIZATION OF NARROW-BAND DATA LINKS FOR INTERPLANETARY COMMUNICATIONS
W.F. Sampson, Proc. IRE, vol. 48, April 1960, p. 589/593.

INTERPLANETARY COMMUNICATIONS SYSTEM DEVELOPMENT
R.G. Stephenson, AIEE Speical Publication T-126, Conference on Space Technology, 1960.

A RECOVERABLE INTERPLANETARY SPACE PROBE. VOLUME I. GENERAL DISCUSSION
Instrumentation Lab., MIT, Cambridge, 1960, AD 248 157.

. . . The vehicle contains an automatic navigation and attitude control system using a digital computer and electromechanical-optical accessories, a micro rocket system for making navigational corrections, a long-range communication system for transmitting useful intelligence, and a reentry vehicle with associated radio and light beacon aids for the physical recovery of the payload. The over-all vehicle weight is approximately 340 pounds.

RETRANSMITTING SATELLITE FOR SPACE EXPLORATION
Missiles & Rockets, vol. 9, no. 13, Sept. 1961, p. 39.

. . . further radio communications with other planets it will be necessary to establish a satellite which will occupy an unchanging position relative to Earth and Mercury and install on it a restransmitting station. . . . article in the journal Automation, Telemechanics and Communications entitled "Radio Electronics and the Conquest of the Cosmos" . . .

COMMUNICATION SYSTEM DESIGN FOR INTERPLANETARY DISTANCES
R.G. Stephenson, Proc. XIth Internatl. Astron. Congr. (Stockholm), vol. I, April 1961, p. 714.

Communications systems which can send and receive messages across hundreds of millions of miles. . . . This paper . . . describes the Pioneer V system design parameters. . . . The communication principles of Pioneer V are then applied to more sophisticated systems; it is shown that voice and even slow television transmission is feasible between earth and its neighboring planets. . . .

DEEP SPACE EXPLORATION AND THE PROBABILITY OF SUCCESS
D.G. Bourke, Proc. Nat. Telem. Conf., vol. 2, no. 8-5, May 1962.

. . . reviews some characteristics which significantly affect the success probability of a probe into deep space . . . attempts to measure the extent of the reliability need in meaningful quantities by using these characteristics as arguments in predictions for representative missions of the future.

OPTICAL MASER SYSTEMS FOR INTERPLANETARY COMMUNICATIONS
V.J. Corcoran, et al., Rec. Nat. Commun. Symp., vol. 8, no. 10, Oct. 1962, p. 14/20, 18 refs.

The requirements for the use of optical masers for voice communications over interplanetary distances are calculated. . . . difficulties in realizing an actual optical space communications system are determined. The areas of research and development necessary to obtain a possible system are delineated. . . .

EXPLORATION OF THE NEARER PLANETS
G. de Vaucoulers, Texas U., Austin, in USIA Voice of Amer. Forum Ser. on Space Sci. (Lecture 15), Jan. 8 - May 21, 1962, p. 221/237, N63-23449.

. . . a rational program of unmanned experimentation of increasing sophistication leading eventually to manned planetary exploration is outlined . . .

TRANSMISSION PROGRAMMING FOR ENERGY CONSERVATION IN SPACE COMMUNICATIONS
N.S. Potter, IRE Internat. Conv. Rec., Pt. 8, vol. 10, March 1962, p. 123/130.

. . . analytic and quantitative study . . .of the programming of transmitter power output to minimize the energy consumption required to maintain a specified minimal information rate from an astronautical vehicle to a terrestrial receiving system over the trajectory of the former. . . .

THE REDUCTION OF ENERGY CONSUMPTION IN DEEP SPACE COMMUNICATIONS THROUGH TRANSMITTER PROGRAMMING
N.S. Potter, IRE Trans. Commun. Syst. vol. CS-10, Dec. 1962, p. 441/448, A63-15051.

Study of the programming of transmitter power output to minimize the energy consumption required to maintain a specified minimal information rate from a space vehicle to a ground receiving system over the trajectory of the vehicle. The representative categories of astronautical probes considered are (1) an idealized rectilinear-trajectory, deep-space probe with variable terminal ranges, and (2) solar circular orbits at variable radii in the plane of the ecliptic. Methods of variational calculus are used to determine a lower bound to the energy consumption if the totality of information output is specified. Applicable contours are provided which display the relative energy consumptions involved in the optimal and approximating power radiation programs, and the transmitter-receiver separations, at the time that switching of the transmitter power level is to be accomplished for both categories of trajectories.

COMMUNICATION WITH DEEP SPACE VEHICLES
F.M. Riddle, Proc. Nat. Telem. Conf., no. 8-1, May 1962, p. 1/11.

INTERPLANETARY RADIO COMMUNICATION
G. Rulea, Foreign Tech. Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, 9 Aug. 1962, 4 p., Trans. no. FTD-TT-62-786 from Stienta si Tehnica, 13:3, p. 17/18, March 1961, AD 284 135.

DESIGN OF A LASER DEEP SPACE COMMUNICATION SYSTEM
K.L. Brinkman, et al., Rec. Nat. Space Electronics Symp., no. 7.1, 1963.

. . . utilizing a laser transmitter and an optical receiver. . . . designed for two-way transmission of information over interplanetary distances for a 1965-70 time period. Abstract only. . .

THE EMPIRE DUAL PLANET FLYBY MISSION
F. P. Dixon, Aeronutronic, Newport Beach, Calif., 1963, 46 p., refs., N64-10907.

Mission analyses and spacecraft syntheses are reported for various methods of accomplishing a manned mission with close approach to both Venus and Mars and return to the Earth in the 1970-72 period . . . using a nuclear engine for interplanetary injection from Earth orbit, taking up to 631 days, and providing for Earth return with a lifting reentry vehicle. Accelerated developments required to support such a mission are specified.

HABITABLE PLANETS FOR MAN
S. Dole, RAND Corp., Santa Monica, Calif., Rept. no. R414PR, March 1964, 170 p., AD 437 264.

APPLICATION OF VLF TO INTERPLANETARY COMMUNICATIONS
J. Farber, et al., Rec. Nat. Space Electronics Symp., no. 7.5, 1963.

. . . The presence of galactic and extra-terrestrial noise in the plane of the ecliptic has been a predominant factor in favoring the microwave band for both deep space communications and interplanetary communications. . . . adoption of S-band and the most favorable telemetry band for NASA's deep space probes. . . . lies within the radio window of the earth's atmosphere (100MC - 10,000MC) and represents a satisfactory compromise between antenna aperture size, antenna gain, power and receiver sensitivity at ranges out to VENUS and MARS and MERCURY. . . . As a result of recent measurements . . . there is mounting evidence to support the fact that attenuation bands centered in the VLF part of the spectrum exist around the planets and the sun by virtue of their ionized atmosphere. . . . resulting in extremely low noise levels at VLF in interplanetary space. . . .

PROSPECTS FOR EARLY MANNED INTERPLANETARY FLIGHTS
R.W. Gillespie, et al., Astronautics and Aerospace Engineering, vol. 1, Aug. 1963, p. 16/21, A63-20265.

Consideration of gross requirements for . . . flyby and capture missions in order to determine the effects of the variation in launch year, trip duration, propulsion systems, and entry modes on the performance of the missions. . . .

INTERPLANETARY LOGISTICS
L.S. Mills, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 706/713.

The success of future manned interplanetary space ventures will depend heavily upon reliable in-flight maintenance despite the spectacular progress in spacecraft component and system reliability. The design of efficient on-board checkout equipment and the development of relatively simple automatic maintenance techniques are requisities for the security of the long-range flights now planned. . . .

INTERPLANETARY AND INTERSTELLAR EXPLORATION
O.W. Nicks, Spaceflight, vol. 6, May 1964, p. 80/87, A64-18028.

Review of present knowledge of solid objects in space, with special reference to exploration of the solar system, with some comments on objects composing the rest of the universe . . . Journey time for various interplanetary missions and methods of accomplishing them, both present and future, are discussed. Speculation is made on various aspects of interstellar exploration.

THE SCIENTIFIC OBJECTIVES OF DEEP SPACE INVESTIATIONS: INTERPLANETARY SPACE BEYOND 1 AU
D. L. Roberts, IIT Research Inst., Chicago, Ill., Astro Sciences Center, 4 Feb. 1963, 56 p., refs., N64-19571.

. . . solar wind . . . interplanetary magnetic field, cosmic rays . . . distribution of interplanetary matter . . . to describe what is and what is not known about the interplanetary medium, and to point out what further information is urgently needed and can be obtained from space probes.

A SYSTEMATIC APPROACH TO THE STUDY OF NONSTOP INTERPLANETARY ROUND TRIPS
S. Ross, In: Advances in the Astronatucal Sciences, vol. 13, American Astronautical Society, Annual Meeting, 9th, Los Angeles, Calif., Jan. 15-17, 1963, Edited by Eric Burgess, North Hollywood, Calif., Western Periodicals Co., 1963, p. 104/164, 13 refs., A63-23391.

. . . All likely mission areas in the 1970-1980 period are presented, along with detailed studies of some interesting trips. . . .

BIBLIOGRAPHY OF LUNAR AND PLANETARY RESEARCH - 1962
J.W. Salisbury, et al., Air Force Cambridge Research Labs., Bedford, Mass., AFCRL 63 903, Dec. 1963, lv., AD 428 471.

. . . articles published in 1962 . . . astrobiology, comets, exploration programs and probes, meteorite craters and cratering effects, meteors and meteorites, the moon, origin of the solar system, the planets, and tektites.

INTER-PLANETARY MISSION COMMUNICATION SYSTEMS
R.S. Sawyer, Rec. Nat. Space Electronics Symp., no. 7.6, 1963.

. . . The four major functions of communication and tracking systems for interplanetary missions: tracking, data acquisition and transmission, voice communication, and television have been discussed. . . .

ASTRONAUTICS INFORMATION, ENGINEERING EQUIPMENT AND PROCESSES ADAPTABLE TO LUNAR AND PLANETARY EXPLORATION
D. I. Sweitzer (comp.), Jet Propulsion Lab., Calif. Inst. Of Tech., Pasadena, JPL-AI/LS-464, May 1963, 340 p., 2705 refs., N63-21479.

. . . a bibliography is given of catalog citations and abstracts on the subjects of general manipulators, roving vehicles and stationary structures,

soil, vegetation, dust and particles, gas and liquid, inspection, testing, and analysis techniques . . . remote automatic, and adaptive control, and human time lags and human factors in control.

PROCEEDINGS OF THE LUNAR AND PLANETARY EXPLORATION COLLOQUIUM. VOLUME III NUMBER 2
North American Aviation, Inc., Downey Calif., 5 May 1963, 159 p., AD 404 726.

RESULTS OF THE MARINER II SPACEFLIGHT TO VENUS
Intern. Geophys. Bull., no. 73, July 1963, p. 1/9, N63-19090.

Preliminary scientific findings . . . in interplanetary space and in the vicinity of Venus . . . (1) interplanetary environment, (2) environs of Venus, (3) surface and atmospheric conditions, and (4) Venus' mass and other data obtainable from tracking information.

Related Publications:

THE APPLICATION OF RADIO INTERFEROMETRY TO EXTRATERRESTRIAL METEOROLOGY
M.J. Golay, IRE Trans. on Space Electronics Telem., vol. SET-5, no. 4, Dec. 1959, p. 186/193.

ADVANCED MANNED SPACE SYSTEMS
T.D. Smith, et al., Medical and Biological Problems of Space Flight, Proceedings of a Conference held in Nassau, The Bahamas, Nov. 1961, Edited by Geoffrey H. Bourne, New York and London, Academic Press, 1963, p. 47/62, A63-19994.

Brief description of the reusable interplanetary transport approach (RITA), a nuclear rocket-propelled space vehicle designed for safe, reliable, low-cost space transportation.

THE SCALE OF THE SOLAR SYSTEM
Nature, vol. 190, no. 15, May 1961, p. 592.

. . . radar distance measurement of Venus . . . equipment operated at 440 Mc/s, with aerial gain of 37.5 dB and a peak power of 2.5 mW. The signals were pulsed for 0.5, 2.0 or 4.0 msec. Received energy was integrated over different range intervals for a duration equal to the echo time so as to remove false echoes. Mean echo intensity was equivalent to a received power level of 163 dB below 1 mW, and corresponded to ~ 12% scatter from the planetary surface. . . .

PLANETARY INTERFEROMETER
H.T. Bull, JPL Space Progr. Summ., vol. 4, no. 37-23, Aug./Sept. 1963, p. 254/257.

A breadboard infrared interferometer has been constructed at Manchester University in England to do planetary interferometer spectroscopy on Mars and Venus, and to further the state of the art to support spacecraft interferometer design. The spectral range of the instrument is from 2 to 13 μ and it is desired to perform spectroscopy having a resolution better than 10 cm^{-1} through this region.

INPUT SIGNAL REPRODUCTION BY A PHOTOGRAPHIC SYSTEM USING A FLYING SPOT SCANNER
A.W. Spitzak, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 209/216.

A picture of an area on a distant planet which had hitherto not been viewed in high detail serves a useful purpose to many scientific disciplines. . . . An instrument to present pictures here on Earth is thus desired on most early planet exploration. . . . Early planet-exploring missions will probably always be burdened with low communication rates and low instrument weight and power consumption. . . . because . . . the optimum picture-taking time may be only one or three days, some form of storage is necessary. . . . standard TV system with a high-volume storage tape recorder is one method . . . A second method is to use photographic film which would act as its own data storage system. To investigate the feasibility . . . Three immediate problem areas: (1) Film choice . . . (2) Processing and developing film . . . (3) Conversion schemes for attaining electrical signals from the film transmission variations.

4C.510: Planetary Missions Planning

Included: Interplanetary trajectories; Round trip trajectories to Mars and Venus; Interplanetary navigation; Satellite orbits around planets; Interplanetary terminal trajectories; Out-of-the ecliptic trajectories; Solar trajectories; Planetary capture; Interplanetary injection guidance; Interplanetary transfer orbits; Astroballistic trajectories; Interplanetary ascent trajectories; Mechanics of interplanetary space travel; Three-dimensional interplanetary trajectories; Planetary terminal guidance; Midcourse guidance in interplanetary missions.

Not Included: Fundamentals of astro-mechanics.

Cross References: Lunar trajectories (4C.410); Midcourse guidance in lunar missions (4C.410).

Principal Publications:

INTERPLANETARY COMMUNICATION AND NAVIGATION
P. A. Castruccio, Westinghouse Engineer, vol. 18, May 1958, p. 88/93.

THE EFFECT OF GUIDANCE ERRORS ON ASTROBALLISTIC TRAJECTORIES
D. B. DeBra, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 242/248.

The effect of guidance errors in position, velocity and time are considered for free flight trajectories. The effect is considered for three central force fields, separately and combined to approximate the effect on an interplanetary probe in which a planet is the desired target. Guidance optima are shown to exist for certain trajectories and a Mars probe is considered as an example. . . .

THREE-DIMENSIONAL INTERPLANETARY TRAJECTORIES
A. B. Mickelwait, et al., IRE Trans. Mil. Electronics, vol. MIL-3, no. 4, Oct. 1959, p. 149/159.

TERMINAL GUIDANCE: SELF-CONTAINED GUIDANCE
JPL Res. Summ., vol. 1, no. 36-1, Dec./Jan. 1959, p. 51/52.

. . . fundamental operating principle of the self-contained planetary terminal guidance system. . . mode of operation consists of taking a series of position measurements by means of celestial sightings involving two stars and the planet sought, and making velocity corrections in accordance with these measurements. . . .

DETERMINATION OF MISS COEFFICIENTS FROM CHANGES IN ORBITAL ELEMENTS
JPL Res. Summ., vol. 1, no. 36-1, Dec./Jan. 1959/1960, p. 53.

. . . In determining the parameters for a guidance computer it is necessary to consider large changes from the nominal velocity and space coordinates of the vehicle such that there is no longer a linear relation between these coordinate changes and the miss components near the target. In order to find suitable coordinates at injection which are nearly linearly related to the miss components. . . the conic elements near injection are being investigated. . . .

INTERPLANETARY TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-1, Dec./Jan. 1959/1960, p. 53/55.

Several reference trajectories for Mars and Venus firings in 1962 have been computed. Some pertinent parameters of 155-day and 169.5-day Mars trajectories are given. . . Also given in this table are parameters of a 114-day Venus probe. . . .

LOW-THRUST TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-1, Dec./Jan. 1959/1960, p. 55/57.

. . . These trajectories are characterized by acceleration levels typically of 10^{-2} g or less—such as would result from an electrical or ion propulsion system. The geometrical and kinematic features of these trajectories both in escaping from a satellite orbit and in interplanetary transfer paths are presently being studied primarily from a guidance point of view. . . .

DESIGN OF LUNAR AND INTERPLANETARY ASCENT TRAJECTORIES
V. C. Clarke, Jr., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 26 July 1960, 16 p., AD 246 430.

SOME CONSIDERATIONS AFFECTING THE DESIGN OF MIDCOURSE NAVIGATION SYSTEMS FOR INTERPLANETARY SPACE VEHICLES
G. Gulbenkian, Proc. Nat. Aero. Electronics Conf., vol. 8, May 1960, p. 361/368.

INTERPLANETARY NAVIGATION SYSTEM
T. P. Haney, East Coast Conf. Aerospace Navig. Electronics, vol. 7, no. 4.1.5, Oct. 1960, p. 1/7.

DEVELOPMENT OF A COMPUTER SUBROUTINE FOR PLANETARY AND LUNAR POSITIONS
H. F. Michielsen, et al., Lockheed Aircraft Corp., Sunnyvale, Calif., WADD TR 60-118, Aug. 1960, lv., AD 247 127.

INTERPLANETARY NAVIGATION
A. B. Mickelwait, et al., Sci. Amer., vol. 202, no. 3, March 1960, p. 64/73.

APPLICATION OF INERTIAL TECHNIQUES TO INTERPLANETARY NAVIGATION
M. J. Minneman, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 373/379.

ORBIT DETERMINATION
JPL Res. Summ., vol. 1, no. 36-2, Feb./March 1960, p. 42/44.

. . . results for interplanetary trajectories are described. . . .

INTERPLANETARY INJECTION GUIDANCE
JPL Res. Summ., vol. 1, no. 36-2, Feb./March 1960, p. 44/46.

. . . In the analysis of injection guidance systems for space missions, it is desirable to consider a correlated velocity vector Vc as the velocity vector which would be required by the spacecraft along the powered portion of the trajectory. . . .

SELF-CONTAINED TERMINAL GUIDANCE
JPL Res. Summ., vol. 1, no. 36-3, April/May 1960, p. 63/64.

For many missions toward Mars and Venus, the precision of the planetary approach must be considerably more refined than can presently be attained through the use of midcourse guidance. . .

EXTRAECLIPTIC LOW-THRUST TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 14/18.

The measurement of cosmic rays, solar corpuscular radiation, and the interplanetary magnetic field outside the plane of the ecliptic is of special scientific interest. . . . Heretofore, these phenomena have been measured almost exclusively in or near Earth's orbital plane. One way of placing an instrument package in an extraecliptic heliocentric coasting orbit is by means of a low-thrust (ionic propulsion) power-limited rocket. . . .

MARS AND VENUS TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 14.

. . . The four defining parameters are. . . the launch date, the right ascension and declination of the outgoing asymptote of the hyperbola, and the hyperbolic excess speed. . . .

INTERPLANETARY TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-3, April/May 1960, p. 58/60.

Choice of defining parameters. Several distinct sets of parameters may be used to define an interplanetary trajectory. . . . a trajectory may be defined by the elements of the heliocentric transfer conic, or the elements of the geocentric escape conic, or the geocentric injection conditions, or the direction and magnitude of the near-Earth hyperbolic-excess velocity vector. Of these, the latter set is the most general involving the specification of only four parameters, whereas the others involve specifying at least six parameters each. . . .

LOW-THRUST TRAJECTORY STUDIES
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 12/13.

. . . used these equations under conditions not satisfying the requirements. . . . Two distinct elementary derivatives of these equations have been developed for arbitrary perturbation forces, and the equations are therefore valid generally. . . .

HELIOCENTRIC CONIC PROGRAM
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 11/12.

Simulation of a revised interplanetary heliocentric conic program on the IBM 704 has recently been completed. The purpose of this program is to computer approximate transfer ellipses between any arbitrary launch planet and any target planet in the solar system. To obtain a solution, it is only necessary to specify the launch date and flight time. . . .

POWERED FLIGHT STUDIES
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 8/10.

A parametric analysis is being performed to study injection coordinate errors arising from guidance system inaccuracy on lunar and interplanetary trajectories. . . . Effects of accelerometer scale factor errors. . . . Effects of certain gyro errors. . . The IBM-704 computer program necessary to perform the study is now being prepared. . . .

DESIGN SPECIFICATIONS FOR PRE-INJECTION STANDARD TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 11/12.

OUT-OF-ECLIPTIC TRAJECTORIES
V. C. Clarke, JPL Res. Summ., vol. 1, no. 36-9, April/May 1961, p. 10/12.

A study is nearing completion of a special class of trajectories in which a space probe is launched from Earth in a direction perpendicular to the ecliptic plane flies above (or below) the plane for a period up to 6 months, and finally returns to Earth. . . .

OUT-OF-THE ECLIPTIC TRAJECTORIES
V. C. Clarke, JPL Res. Summ., vol. 1, no. 36-10, June/July 1961, p. 3/5.

An illustration of the speed profiles for various hyperbolic-excess speeds is shown. . . The independent variable in this figure is time of flight from injection.

INTERPLANETARY TRAJECTORIES
V. C. Clarke, JPL Res. Summ., no. 36-8, Feb./March 1961, p. 1/2.

INTERPLANETARY TRAJECTORIES
V. C. Clarke, JPL Res. Summ., vol. 1, no. 36-9, April/May 1961, p. 10.

. . . a computer study is in progress to determine the characteristics of ballistic interplanetary trajectories from Earth to Mars, Venus, Mercury, and Jupiter. . . .

NONLINEAR TRAJECTORY ERROR ANALYSIS
H. Gordon, JPL Res. Summ., no. 36-11, Aug./Sept. 1961, p. 12/14.

The analysis of a standard trajectory for a deep space mission must include an investigation of the effects of injection errors in order to evaluate the pre- and post-injection guidance requirements. This is usually carried out by using linear perturbation theory. . . . purpose of the study described here is to determine the extent and nature of the errors introduced by using linear perturbation theory.

POWERED FLIGHT STUDIES: A STUDY OF GUIDANCE SYSTEM ERRORS
H. S. Gordon, JPL Res. Summ., no. 36-8, Feb./March 1961, p. 7/10.

COMPUTATION OF DIFFERENTIAL CORRECTION FOR TIME OF FLIGHT
J. O. Maloy, JPL Res. Summ., no. 36-8, Feb./March 1961, p. 4/5.

It is now well understood that the guidance analysis for both impact and flyby trajectories is facilitated by use of the impact parameter (the perpendicular distance from the center of the target body to the incoming asymptote) as a measure of the position dispersion normal to the line of motion. . . .

LOW-THRUST TRAJECTORY OPTIMIZATION
W. G. Melbourne, JPL Res. Summ., no. 36-8, Feb./March 1961, p. 6/7.

. . . performed in order to assess the payload capabilities of power-limited advanced propulsion vehicles for the various interplanetary missions under consideration for the coming decade. . . .

TIME RELATIONSHIPS FOR INTERPLANETARY TRAJECTORIES
W. M. Pauson, ARS Journal, vol. 31, no. 9, Sept. 1961, p. 1281/1285.

HYPERBOLIC ORBIT PERTURBATION STUDY
C. G. Sauer, JPL Res. Summ., vol. 1, no. 36-9, April/May 1961, p. 14/15.

Of particular interest in the design of lunar and interplanetary escape trajectories are the effects of the oblateness of the Earth on the escape hyperbola. In addition to the usual hyperbolic elements, it is also desirable to observe the effects of the oblateness on the magnitude and direction of the hyperbolic excess velocity vector. . . .

MEASURING FLIGHT TIME VARIATIONS FOR LUNAR AND INTERPLANETARY TRAJECTORIES
T. H. Thornton, JPL Res. Summ., no. 36-13, Dec./Jan. 1961, p. 12/15.

. . . compares three methods used to define time of flight variation for lunar and interplanetary trajectories and investigates the linearity of each. . . . variations in (1) time to closest approach for a massy target, (2) linearized time of flight, and (3) time to closest approach for a massless target.

PROBLEMS OF THE MECHANICS OF INTERPLANETARY SPACE TRAVEL
C. A. Traenkle, Aeronautical Res. Lab., Off. of Aerospace Res., Wright-Patterson AFB, Ohio, ARL-141, Nov. 1961, 33 p., AD 269 197.

. . . 3 classes of impulsive thrust trajectories of space vehicles are analyzed with respect to their characteristic parameters of velocity sum, rocket performance and travel time: A number of representative future space missions are compared with respect to rocket motor requirements and travel time.

MARINER 2 FLIGHT TO VENUS
F. L. Barnes, Astronautics, vol. 7, Dec. 1962, p. 66/72, A63-11738.

Trajectory analysis of the Mariner 2 (1962 Alpha Rho 1) flight to Venus. An outline is given of the preflight analysis of the mission, including preflight injection-guidance and midcourse-maneuver considerations. Details of the actual midcourse maneuver executed by Mariner 2 are also included.

LOW ENERGY SOLAR TRAJECTORIES
W. E. Bollman, JPL Res. Summ., no. 36-14, Feb./March 1962, p. 7/9.

In interplanetary space exploration, a type of trajectory may be needed wherein the spacecraft reaches a radial distance from the Sun which is as different from the Earth-Sun distance as it is possible to attain with available launch vehicles.

PROBABILITY OF PLANETARY CAPTURE
C. E. Kohlhase, JPL Res. Summ., no. 36-14, Feb./March 1962, p. 13/16.

. . . We must either produce a sterile spacecraft or we must insure a low probability of planetary capture (impact) for an unsterile spacecraft. It appears, however, that component reliability may be severely jeopardized by the application of any rigid heat sterilization program. . .

If the injection and midcourse guidance systems should function as currently designed, then the results listed in the accompanying tables are representative of capture probabilities.

TRACKING TECHNIQUES FOR INTERPLANETARY SPACECRAFT
R. P. Mathison, Proc. Nat. Telem. Conf., no. 8-2, May 1962, p. 1/24.

ESCAPE AND CAPTURE PHASES OF AN INTERPLANETARY TRAJECTORY FOR POWER-LIMITED VEHICLES
W. G. Melbourne, et al., JPL Space Progr. Summ., vol. 4, no. 37-19, Dec./Jan. 1962, p. 1/2.

EFFECT OF CUTOFF LATITUDE ON CUTOFF CONDITIONS FOR TRANSFER ORBITS TO VENUS
L. N. Rowell, et al., RAND Corp., Santa Monica, Calif., Memo. no. RM-3038-PR, May 1962, 33 p., incl. illus., tables, 2 refs., AD 276 083.

DETERMINATION OF INTERPLANETARY TRANSFER ORBITS FOR SPECIFIED DATE OF DEPARTURE
H. B. Schechter, RAND Corp., Santa Monica, Calif., Memo. no. RM-2621-PR, May 1962, 45 p., incl. illus., 3 refs., AD 276 082.

HELIOCENTRIC TRACKING SENSITIVITY IN VENUS TRAJECTORIES
T. T. Soong, JPL Space Progr. Summ., vol. 4, no. 37-16, June/July 1962, p. 1/2.

SPACECRAFT ENTRY AND LANDING IN PLANETARY ATMOSPHERES
M. Tucker, In: Advances in Space Science and Technology, Vol. IV, New York, Academic Press, Inc., 1962, p. 139/201, 64 refs., A63-17570.

THE EFFECT OF PLANET ROTATION ON SPACE DOPPLER NAVIGATOR DATA
F. R. Zboril, Rec. Nat. Symp. Space Electronics Telemetry, no. 5.4, Oct. 1962.

. . . study. . . initiated in Lockheed's Spacecraft organization to determine the requirements of space probes for Doppler navigators in a planetary terminal phase. Pulse Doppler radar permits the measurement of range rate and its change with respect to time. From such measurements some important data can be computed such as the vehicle's height above the planet, the magnitude and direction of the velocity vector with respect to the planet's spin axis. . . . application in orbiting vehicles, entering or departing space capsules and in space weapon systems. . . .

GENERALIZED INTERPLANETARY TRAJECTORY STUDY. SUPPLEMENT 1. OPERATIONAL PROCEDURE FOR THE INTERPLANETARY TRAJECTORY PROGRAM
Space Sciences Lab., General Electric Co., Philadelphia, Pa., Final rept., WADD TR 60-502, pt. 2, suppl. 1, Aug. 1962, 65 p., incl. tables, AD 286 884.

An IBM 7090 computer program is described and an operational procedure for the interplanetary trajectory program is given. . . .

GENERALIZED INTERPLANETARY TRAJECTORY STUDY, PART II
Space Sciences Lab., General Electric Co., Philadelphia, Pa., Final rept., WADD TR 60-502, pt. 2, Aug. 1962, 104 p., incl. illus., tables, 17 refs., AD 288 074.

An IBM 7890 computer program is described to determine burnout velocity components for interplanetary vehicles. . . .

NEARLY CIRCULAR PERIODIC ORBITS ABOUT AN OBLATE PLANET
R. B. Barrar, System Development Corp., Santa Monica, Calif., Rept. no. SP-1067/002/00, 28 Feb. 1963, 11 p., AD 298 712.

THE ENGINEERING DESIGN OF INTERPLANETARY BALLISTIC TRAJECTORIES
W. E. Bollman, American Institute of Aeronautics and Astronautics, Astrodynamics Conference, New Haven, Conn., Aug. 19-21, 1963, Paper 63-414, 14 p., A63-21728, N63-20497.

Discussion of the design methods, empirical rules, and the associated constraints, for the selection of interplanetary ballistic trajectories. . . . Also discussed are. . . (6) communications . . . As an example of the methods discussed, the selection of the launch interval, the arrival dates, and the aiming point of Venus are outlined for Mariner I and II (1962 Alpha Rho 1).

THE THEORY OF MID-COURSE GUIDANCE IN INTERPLANETARY MISSIONS
H. S. Braham, In: Guidance and Control of Aerospace Vehicles, Edited by Cornelius T. Leondes, New York, McGraw-Hill Book Co., Inc., 1963, p. 508/532, A63-25922.

. . . mid-course orbit correction of lunar and interplanetary missions. . . . (1) determination of the orbital parameters, using either ground-based or self-contained sensors to provide data, and ground-based or self-contained computation; (2) computation of the necessary mid-course correction according to

some functional relation between the orbit parameters and required velocity correction, and transmittal of this command to the vehicle; and (3) control of the mid-course correction, by using accelerometers and a stabilized reference for controlling vehicle attitude. . . .

EARTH-VENUS TRAJECTORIES, 1968-69, VOLUME 4, PART A
V. C. Clarke, Jr., et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-99, Vol. 4, Pt. A, Aug. 1, 1963, 791 p., refs., N64-10310.

EARTH-VENUS TRAJECTORIES, 1970 VOLUME 5, PART A
V. C. Clarke, Jr., et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-99, Vol. 5, Pt. A, 16 Sept. 1963, 790 p., refs., N64-15794.

The results of machine computations of the three-dimensional ballistic interplanetary trajectories are presented . . . The trajectories are calculated in two distinct parts: (1) the heliocentric transfer ellipse, and (2) the launch-planet-centered escape trajectories . . .

EARTH-VENUS TRAJECTORIES, 1965-66, VOLUME 2, PART C
V. C. Clarke, Jr., et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-99, Vol. 2, Pt. C, June 1, 1963, 788 p., 9 refs., N63-21647.

EARTH-VENUS TRAJECTORIES, 1970 VOLUME 5, PART C
V. C. Clarke, Jr., et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-99, Vol. 5, Pt. C, 15 Oct. 1963, 790 p., refs., N64-15795.

. . . This volume contains 9,210 trajectories for the year 1970 . . .

THE EMPIRE DUAL PLANET FLYBY MISSION
F. P. Dixon, Aeronutronic, Newport Beach, Calif., 1963, 46 p., refs., N64-10907.

Mission analyses and spacecraft syntheses are reported for various methods of accomplishing a manned mission with close approach to both Venus and Mars and return to the Earth in the 1970-72 period . . . using a nuclear engine for interplanetary injection from Earth orbit, taking up to 631 days, and providing for Earth return with a lifting reentry vehicle. Accelerated developments required to support such a mission are specified.

OPTIMIZATION OF CORRECTIVE SEQUENCES FOR INTERPLANETARY TERMINAL TRAJECTORIES
J. E. Funk, et al., Air Force Inst. of Tech., Wright Patterson AFB, Ohio, Rept. no. GA/PHYS/63 5.6, Aug. 1963, 345 p., AD 419 068.

ROUND-TRIP TRAJECTORIES TO MARS AND VENUS
G. S. Gedeon, In: Advances in the Astronautical Sciences, Vol. XI, American Astronautical Society, Annual Meeting, 8th, Washington, D.C., Jan. 16/18, 1963, Proceedings, Edited by Horace Jacobs, North Hollywood, Calif., Western Periodicals Co., 1963, p. 588/627, A64-11467.

Study of two types of round-trip trajectories: (1) "swing-around" trajectories, requiring no additional propulsion near the observation planet; and (2) "orbiting round-trip" trajectories, requiring propulsion to enter into a planetocentric orbit and to leave it after a specified waiting period. . . .

A STUDY OF HIGH PRECISION GEOCENTRIC AND INTERPLANETARY ORBITS
S. Herrick, California U., Los Angeles, Rept. for 2 Feb. 1959 - 30 April 1963, Rept. no. 63 56, 30 Sept. 1963, 20 p., AD 427 653.

EVOLUTION OF THE ORBITS OF ARTIFICIAL SATELLITES OF PLANETS AS AFFECTED BY GRAVITATIONAL PERTURBATION FROM EXTERNAL BODIES (Translation)
M. L. Lidov, AIAA Journal, Russian Supplement, vol. 1, Aug. 1963, p. 1985/2002, 10 refs., A63-20527.

. . . Approximate formulas are drived for the variation in orbital elements for one revolution of the satellite, for several revolutions, and for the period of revolution of the perturbing body. . . . concluded that although the error in the approximate method is appreciable (of the order of several per cent), the method is sufficiently accurate for research purposes and for the preliminary computation of a class of satellite orbits broad enough to be useful in actual practice.

SOME EXACT ANALYTICAL SOLUTIONS OF PLANETARY ENTRY
W. H. Loh, AIAA Journal, vol. 1, April 1963, p. 836/842, 11 refs., A63-15879.

Presentation of exact solutions for variable L/D entries, especially useful for proper entry into Jupiter where entry deceleration is most critical. It is shown that when minor terms of the exact solutions are neglected, the solutions reduce precisely to those approximate solutions developed previously by Loh.

PROBLEMS IN THE DESIGN OF UNMANNED SPACECRAFT FOR PLANETARY AND INTERPLANETARY EXPLORATION
J. R. Miles, Institute of the Aerospace Sciences, Annual Meeting, 31st, New York, N.Y., Jan. 21/23, 1963, Paper 63-36, 18 p., A63-14597.

. . . Topics covered include: (1) biological sterlization and its effects upon spacecraft hardware; (2) midcourse maneuvers; (3) capsule ejection, entry, landing, and deployment; (4) power requirements and thermal control; and (5) communications.

THE DETERMINATION AND CHARACTERISTICS OF BALLISTIC INTERPLANETARY TRAJECTORIES UNDER THE INFLUENCE OF MULTIPLE PLANETARY ATTRACTIONS
M. A. Minovitch, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TR-32-464, 31 Oct., 1963, 69 p., refs., N64-13275.

The determination of free-fall trajectories to several planets is essentially the well-known unresolved n-body problem. Thus, in order to calculate these trajectories, certain simplifying assumptions must be made. This report is based upon one fundamental assumption. At any instant, one, and only one, gravitating body influences the vehicle's motion . . .

SUMMARY OF ONE WAY BALLISTIC TRAJECTORY DATA: EARTH TO SOLAR SYSTEM TARGETS
F. Narin, et al., IIT Research Inst., Chicago, Ill., Astro Sciences Center, Rept. T-4R, 1964, 67 p., refs., N64-19572.

A survey of one-way ballistic trajectories (conic sections, impulsive thrusting, one graviting body at a time) to major targets and positions within the solar system was made using the ASC/IITRI conic section trajectory system on the IBM-7090 computer . . .

INTERPLANETARY NAVIGATION
E. F. Oliver, Navigation, vol. 10, Winter 1963-1964, p. 373/378, 6 refs., A64-14802.

. . . in view of the future space flights to other planets . . . major differences between terrestrial and interplanetary navigation . . . Several plotting systems . . . electronic, inertial, and optical instrumentation, or any combination of the three, will constitute the navigational equipment. Finally, a hypothetical mission to make a heliocentric transfer to the orbit of the planet Mars and then replenish an observation station on the Martian satellite Probos is described.

SPACE FLIGHT HANDBOOKS. VOLUME 3: PLANETARY FLIGHT HANDBOOK
S. Ross, et al., Lockheed Missiles and Space Co., Palo Alto, Calif., Washington, NASA, NASA SP-35, Pt. 1, 1963, 280 p., refs., N64-14175.

. . . a series of maps, graphs, and tables that will be of use to the preliminary-deisgn analyst in scheduling round-trip interplanetary missions to Mars and Venus in the time period 1965-1999. . . departure and arrival speeds for trips to these planets, a listing of useful constants and planetary ephemerides, tables of important occurences, and a number of auxiliary graphs . . .

INTERPLANETARE FLUGBAHNEN KLEINER SCHUBBESCHLEUNIGUNG MIT KONSTANTEM SCHUB (Interplanetary Trajectory of Low Constant Thrust Acceleration) (In German)
E. Rossger, et al., Technische U., Berlin (W. Germany), Rept. 26, Oct. 1963, 156 p., refs., N64-13473.

. . . Some of the advantages of low constant-thrust propulsion over impulse propulsion are discussed, possible propulsion principles are illustrated, and an analysis is made of the weight ratio of spacecraft with a separate energy-generating system . . .

BEISPHIELE DES EINSATZES VON ANALOGRECHNERN ZUR FLUGBAHNOPTIMA-LISIERUNG - OPTIMALE INTERPLANETARE UBERGANS-BAHNEN MIT VARIABLEM SCHUB (Examples of the Application of Analog Computers to Flight Path Optimization - Optimum Interplanetary Transfer Trajectories with Variable Thrust) (In German)
E. Rossger, et al., International Symposium on Analogue and Digital Techniques Applied to Aeronautics, Liege, Belgium, Sept. 9/12, 1963, Paper, p. 1/10., A64-14036.

. . . applied to an optimum 90-day Mars mission.

A SUMMARY OF THE TRAJECTORY ANALYSIS AND PROPULSION REQUIREMENTS FOR ADVANCED PROPULSION SPACECRAFT
C. Sauer, et al., JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 1/4.

. . . The first studies employed the so-called variable thrust program which had no constraints other than power-limited constraint. For the Mercury and Mars mission, both circular and eccentric orgits were used, the remaining planets including the Earth employed circular orbits in all cases. . . .

LINEAR CONTROL THEORY APPLIED TO INTERPLANETARY GUIDANCE
F. Tung, IEEE Trans. Automatic Control, vol. AC-9, Jan. 1964, p. 82/89, 10 refs., A64-15917.

. . . It is shown that the optimal control signal is a linear function of only those components of the predicted miss whose terminal convariance is specified. A one-dimensional model which approximates the terminal phase of an interplanetary trip is considered in detail. Computer results are given showing the comparison of this solution with

the minimum effort theory developed recently by Breakwell and Striebel on the requirement for the expected amount of velocity corrections. . . .

EARTH-VENUS TRAJECTORIES, 1965-66, VOLUME 2, PART A
Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-99, Vol. 2, Pt. A, N63-21980.

. . . results of extensive machine computations of three-dimensional ballistic interplanetary trajectories . . . calculated in two distinct parts: (1) the heliocentric transfer ellipse, and (2) the launch-planet-centered escape trajectories. Following these trajectories, differential corrections or error coefficients and guidance and tracking parameters are given.

SPACE FLIGHT HANDBOOKS. VOLUME 3: PLANETARY FLIGHT HANDBOOK
Lockheed Missiles and Space Co., Palo Alto, Calif., Washington, NASA, NASA SP-35, Pt. 3, 1963, 530 p., N64-14177.

Information is presented concerning trajectories for returning from the planets Venus and Mars during the period 1960-2000 . . .

Related Publications:

A SYSTEM OF COORDINATES FOR SPACE
C. M. Jones, East Coast Conf. Aeron. Navig. Electronics, vol. 5, Oct. 1958, p. 97/102.

. . . specifies a reference plane, a point of reference, and a reference for measuring longitude, for satellite, cislunar, solar, and interstellar space. Distances are measured in light-seconds and velocity by its ratio to the speed of light . . .

A SELF-CONTAINED INTERPLANETARY NAVIGATOR
H. B. Haake, et al., IRE Trans. Aerospace Navig. Electronics, vol. ANE-8, no. 1, March 1961, p. 28/41.

. . . using a positional perturbation guidance equation to compute velocity corrections. . . .

A NUMERICAL TECHNIQUE FOR THE INTEGRATION OF A GENERAL BIVARIATE GAUSSIAN DISTRIBUTION OVER AN OFFSET CIRCLE
H. J. Gordon, JPL Space Progr. Summ., vol. 4, no. 37-24, Oct./Nov. 1963, p. 1/4.

. . . design of an interplanetary trajectory . . .

4C.520: Interplanetary Environment

Included: Planetary atmospheres; Planetary sources of noise; Interplanetary space; Interplanetary plasma; Solar modulations.

Not Included: Astrophysics.

Cross References: Lunar environment (4C.420).

Principal Publications:

A BRIEF DESCRIPTION OF THE NATURAL ENVIRONMENT OF INTERPLANETARY SPACE
J. H. Shaw, Proc. Nat. Aeron. Electronics Conf., vol. 8, May. 1960, p. 302/310.

INTERPLANETARY ENVIRONMENTAL SIMULATION PROBLEMS
K. E. Tempelmeyer, Proc. Nat. Aeron. Electronics Conf., vol. 8, May 1960, p. 328/338.

ASTRONAUTICS INFORMATION, RADIOMETRY AND PHOTOMETRY OF THE MOON AND PLANETS
E. Barber, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Lit. search 345, Sept. 1961, 88 p., AD 264 330.

Material is presented on photometry, spectrophotometry, colorimetry, and other methods of studying the surfaces and atmospheres of the planets in the visual, ultraviolet, and infrared regions. The material is divided into nine sections covering the major planets, the Moon, and lunar eclipses.

PRELIMINARY INVESTIGATION OF INTERPLANETARY LUNAR AND NEAR PLANET ENVIRONMENTS AND METHODS OF SIMULATION
C. D. Jones, et al., Ohio State U. Research Foundation, Columbus, ASD TR 61-267, July 1961, 216 p., AD 268 719.

Summaries of the natural enviroments of Mars, Venus, the Moon and interplanetary space are presented. . . . thermal radiation, cosmic atomic and subatomic radiation, meteoroid particles, vibration, shock, acceleration, and low pressure . . . Additional simulation technques associated with temperature, heat flux and atmospheric composition are discussed.

DIRECT OBSERVATIONS OF THE INTERPLANETARY PLASMA
C. Dilworth, et al., J. Phys. Soc. Japan, v. 17, Suppl. A-11, 1962, p. 553/560, 5 refs., N63-18368.

. . . preliminary results obtainde with the earth satellite Explorer X (1961 kappa) are presented . . . experiments included two types of magnetometers (Goddard Space Flight Center) and a plasma probe (Massachusetts Institute of Technology) . . .

STUDY OF VARIATIONS AND SOLAR MODULATIONS
E. V. Ismael, San Andres U., La Paz (Bolivia), Final technical rept., AFOSR 62 15, Oct. 1962, 1v., AD 419 521.

THE RADIO SPECTRUM FROM 10 Gc to 300 Gc IN AEROSPACE COMMUNICATIONS, VOLUME IV, ABSORPTION IN PLANETARY ATMOSPHERES AND SOURCES OF NOISE
A. Evans, et al., RCA Victor Co., Ltd. (Canada), Research rept. no. 6-400-4; 7-401-2, ASD TR 61-589; vol. 4, Aug. 1962, 174 p., incl. illus., tables, 28 refs., AD 294 452.

. . . absorption of electromagnetic waves in the atmospheres of the earth and other planets and noise in the 10-300 kmc frequency range. The theory of resonant absorption in gases is considered and the various factors affecting the width of the absorption bands discussed. . . . Experimental measurements . . . rain and fog . . . atmospheres of other planets . . . Theoretical aspects of noise temperature are presented. In particular the limitation of the Rayleigh-Jeans law at these frequencies is pointed out of the validity of the concept of effective antenna temperature discussed. The various sources of noise and their relative importance are outlined.

PRELIMINARY RESULTS FROM MARINER-II SOLAR PLASMA EXPERIMENT
M. Neugebauer, et al., JPL, Calif. Inst. of Tech., Pasadena, JPL-TM-33-111, Nov. 15, 1962, 11 p., 11 refs., N63-17226.

EXPLORATION OF SPACE WITH SCIENTIFIC PROBES
O. W. Nicks, National Aeronautics and Space Administration, Washington, D. C. NASA TM X-50312, 1962, 19 p., Presented at the 8th Tri-Service Conf. on Electromagnetic Compatibility, Chicago, Oct. 30, 1962, N63-21911.

. . . Interplanetary experiments of the Mariner 2 Venus probe are discussed . . . Thus far, measurements from the ion chamber have indicated an average radiation level corresponding to about 1.1 milliroentgen per hour . . . the flux of interplanetary dust particles is at least one thousand times less in interplanetary space than in the near vicinity of the earth. Preliminary data from Mariner indicate abrupt changes in the velocity and intensity of solar solar winds and correlated effects on the magnetic fields in space . . .

FLIGHT ENVIRONMENT DESIGN PARAMETERS FOR MARS AND VENUS
R. H. Zimmerman, et al., Ohio State U. Research Foundation, Columbus, Final technical rept., pt. 2, on Preliminary Investigation of Interplanetary, Lunar, and Near Planet Environments, ASD TDR 62-805, Sept. 1962, 154 p., incl. illus., tables. refs., AD 288 538.

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. . . .

SOME THOUGHTS ON GUIDANCE SYSTEMS
W. H. Pickering, Astronautics and Aeronautics, vol. 2, Jan. 1964, p. 70/73, A64-12083.

Discussion of guidance-system design problems. . . . guidance problem with space vehicles . . . to sense location and position of Mariner II to 36-million miles; Earth-based computing center maintained under controlled conditions; and the midcourse propulsion system for adjusting the trajectory of the spacecraft Mariner II.

THE MISSION OF MARINER II: PRELIMINARY OBSERVATIONS
J. A. Van Allen, et al., JPL, Calif. Inst. of Tech., Pasadena, TR32-383, Science, v. 139, no. 3549, Jan. 4, 1963, 10 p., 22 refs., N63-16386.

Data . . . on the solar plasma experiment, the Iowa experiment, the cosmic dust experiment, the interplanetary magnetic fields experiment, high-energy-radiation experiment, and the electromagnetic radiation from Venus experiment compiled from data received from the mission of the Mariner II interplanetary space vehicle. . . .

THE INTERPLANETARY MAGNETIC FIELD AS MEASURED BY EXPLORER X, PIONEER V, AND MARINER II
J. B. Weddell, North American Aviation, Inc., Downey, Calif., Space and Information Systems Div., SID-63-380, April 1963, 69 p., 8 refs., N63-21907.

. . . The components of the magnetic field in each of two inertial coordinate systems have been calculated . . . It was possible to separate local and transient perturbations of the field from a field which varies relatively slowly with position and time. The Mariner II results suggest that the interplanetary field is the extension of dipolar fields at active solar regions, rather than of the general solar magnetic field. A set of maps of the slowly varying field was constructed in each of the sets of coordinates described . . .

Related Publications:

DIAMETERS OF MARS AND VENUS
R. L. Wildey, JPL Res. Summ., vol. 1, no. 36-10, June/July 1961, p. 13/14.

. . . the accuracy of the best available data for the diameters of Mars and Venus has been critically studied and is summarized here.

4C.530: Equipment Design for Planetary Missions

Included: Planetary telemetry systems; Planetary landing missions in general; Planetary entry problem; Terminal missions for planetary landing; Planetary atmospheric entry; Planetary bases; Manned interplanetary missions.

Cross References: Design of Mariner spacecraft electronics (4C.830); Voyager project (4C.870).

Principal Publications:

INTERPLANETARY TELEMETERING
R. H. Dimond, Proc. IRE, vol. 48, April 1960, p. 679/685.

MAXIMUM UTILIZATION OF NARROW-BAND DATA LINKS FOR INTERPLANETARY COMMUNICATIONS
W. F. Sampson, Proc. IRE, vol. 48, April 1960, p. 589/593.

ATMOSPHERIC ENTRY
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 19/23.

During the terminal portion of an interplanetary voyage, the space vehicle approaches the attracting planet along a hyperbolic trajectory. In order to land safely at the destination, considerable energy must be removed from this final phase. . . . as most of the interesting planets are surrounded by atmosphere, the discussion will concern problems that accompany an atmospheric transit. . . . Ballistic Type of Entry . . . Assumptions . . . Equations of motion . . . Deceleration during entry . . . Entry with gas-dynamic Lift . . .

PLANETARY ENTRY SIMULATION PROGRAM
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 18/19.

The Systems Analysis Section of JPL will perform the overall system evaluations in the area of entry into a planetary atmosphere. Other Laboratory sections will conduct the necessary analyses to define and describe in detail the entry maneuver for specific missions and to specify any parameters required for computation of the entry trajectory. . . .

TERMINAL MISSION PERFORMANCE STUDIES
C. E. Kohlhase, JPL Res. Summ., vol. 1, no. 36-9, April/May 1961, p. 15/20.

One of the most important factors in determining the selection of a particular terminal mission is the realizable payload which, of course, depends upon the terminal maneuver propellant and heat-shield requirements. Terminal maneuvers are defined as any maneuvers that result in the spacecraft being captured (either as a satellite or landing) by the destination body. . . . The purpose of this study is to determine the range of final-to-initial-mass ratios that may be achieved for several different terminal missions to the Moon, Mars, and Venus. . . .

EXPERIMENTAL PLANETARY ENTRY RESEARCH FOR MARS AND VENUS - 1962
T. K. Pugmire, Space Sciences Lab., General Electric Co., Philadelphia, Pa., TIS rept. no. R62SD84, Oct. 1962, 196 p., incl. illus., tables, 40 refs., AD 400 326.

. . . coordinated between theoretical and experimental studies . . . The Maritan and Venusian model atmospheres utilized, followed those given in a preliminary engineering estimate.

THE MARINER (VENUS γ1962) FLIGHT TELECOMMUNICATIONS SYSTEM
J. N. Bryden, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 498/508.

. . . provided 2-way doppler, automatic angle tracking, command, and telemetry functions. Two-way doppler is achieved by the spacecraft transponder receiver, which receives at a frequency of 89- Mc and, when a lock, transmits the telemetry carrier signal at exactly 96/89ths of this frequency giving a transmitted frequency of 960 Mc. . . . The command and telemetry systems make use of identical modulation and detection methods. Each employs two subcarriers, related in frequency by a ratio of 2/1. The data subcarrier frequency is biphase modulated according to the state of the binary data information, and the synchronization subcarrier is biphase modulated by cyclic pseudo-random code. . . .

ENERGY CONSIDERATIONS FOR PRECISION LANDING FROM HYPERORBITAL APPROACH TRAJECTORIES
R. E. Fortier, In: Advances in the Astronautical Sciences, vol. 13, American Astronautical Society, Annual Meeting, 9th, Los Angeles, Calif., Jan. 15-17, 1963, Edited by Eric Burgess, North Hollywood, Calif., Western Periodicals Co., 1963, p. 320/356, A63-23399.

. . . precision touchdown at a preselected landing site on an oblate rotating planet. A hyperorbital approach trajectory, allowing a limited class of re-entry errors, is considered during the approach phase. . . .

RESEARCH IN THE ENTRY PROBLEMS OF INTERPLANETARY EXPLORATION
P. H. Rose, 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 G. W. Morgenthaler, North Hollywood, Western Periodicals Co., 1963, p. 195/216, 38 refs., A64-10109.

Brief discussion of the entry problems peculiar to interplanetary travel. The desirability of high velocity entry into planetary atmospheres is noted . . . 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. . . .

INTER-PLANETARY MISSION COMMUNICATION SYSTEMS
R. S. Sawyer, Rec. Nat. Space Electronics Symp., no. 7.6, 1963.

. . . The four major functions of communication and tracking systems for interplanetary missions: tracking, data acquisition and transmission, voice communication, and television have been discussed. . . .

MARINER II - AN EXAMPLE OF AN ATTITUDE STABILIZED SPACE VEHICLE
D. Schneiderman, International Astronautical Federation, International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 130, 20 p., 11 refs., A63-25675.

. . . general considerations that led to the design concepts incorporated into a planetary spacecraft. The highly successful Mariner II spacecraft . . . is discussed as an example. . . .

USE OF EXTRATERRESTRIAL RESOURCES FOR MARS BASING
E. A. Steinhoff, RAND Corp., Santa Monica, Calif., May 1963, 19 p., AD 405 811.

The establishemnt of exploratory bases on the Moon and Mars will lead to complex logistics if all supplies have to be provided by the Earth. Use of regeneration to recover water and oxygen and hydrophonic gardening to grow food can reduce the logistics requirements.

THE DETERMINATION OF EXTREME ENTRY ANGLES INTO A PLANETARY ATMOSPHERE
J. Warga, et al., American Institute of Aeronautics and Astronautics, Summer Meeting, Los Angeles, Calif., June 17-20, 1963, Paper 63-152, 11 p., A63-18658.

ENGINEERING PROBLEMS OF MANNED INTERPLANETARY EXPLORATION
American Institute of Aeronautics and Astronautics, New York, N. Y., Oct. 1963, 162 p., refs., Papers presented at Am. Inst. Aeron. and Astronautics Conf., Palo Alto, Calif., Sept. 30-Oct. 1, 1963, N64-10040.

Related Publications:

PHILOSOPHY OF JPL SPACE COMMUNICATIONS AND TRACKING SYSTEMS
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 51/53.

. . . The JPL radio telemetry effort began in 1956 . . . resulted in the FM-FM system of telemetry which is now a national standard. The JPL radio guidance effort began in 1950 . . . In 1958 the first TRAC(E) system TRacking and Communications . . . was designed and later became the United States' first true deep space communications and tracking system . . . The basic philosophy of the JPL Space Communications and Tracking Systems will change when the total radiated power is predominantly used for communications rather than tracking . . . The ratio of the information bandwidth to the tracking bandwidth is plotted qualitatively as a function of time in Figure 54 for four different types of vehicles. . . .

WIDE-BAND TELEMETRY INSTALLATION AT AZ-EL SITE
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan. 1960, p. 35.

The GSDS versions of the wide-band telemetry modules described in RS 36-5 have recently been installed . . . in the FSDS 960-mc receiver at the Goldstone transmitter site. . . . system tests were conducted using a 960-mc test transmitter whose output was phase modulated using an audio signal generator. Peak modulation indices/of 0.5, 1.0, 1.5, and 2.0 radians were used; the modulation frequency was varied through the range of 50 cps to 15 kc for the stagger-tuned mode, and through the range of 50 cps to 10 kc for the synchronously-tuned mode. . . .

NON-THERMAL NOISE MEASUREMENTS NEAR PLANETS
R. F. Mlodnosky, et al., IN: Societe Royale des Sciences de Liege, Memoires, Cinquieme Serie, Tome 7, 1963, Physics of Planets; Proceedings of the Eleventh International Astrophysical Symposium. Liege, Belgium, July 9-12, 1962, University of Liege and USAF, Institut d'Astrophysique, Liege, Belgium, 1963, p. 220/223, A63-25345.

. . . 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. . . .

PRELIMINARY DESIGN OF MARS BASING
P. H. Bliss, RAND Corp., Santa Monica, Calif., May 1963, 18 p., AD 405 556.

VOYAGER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963, p. 25/26.

Design studies . . . are in progress. . . . A study has been made of the propulsion requirements for the landing capsule of an orbiter/lander mission. . . . The telecommunications requirements for the Mars 1969 opportunity may logically be divided into three categories: . . . (1) Functions between Earth and the parent spacecraft, or orbiter. . . . (2) Functions between the orbiter and capsule . . . (3) Functions between the landed capsule and Earth.

4C.540: Mars Exploration

Included: Midcourse maneuver for Mars missions; Television subsystem for Mars mission; Mars microscope; Model Mars atmosphere; Radar observations results (of Mars); Mars launch trajectories; Martial landing missions; Instrumentation for Mars missions; Martian colonly; Surface properties of Mars; Martian ionosphere; Topside sound for Mars; Martian meteorology.

Not Included: Fundamentals of astrophysics and celestial mechanics.

Cross References: Planetary radar equipment (4C.320); Planetary trajectories (4C.510); Project Mariner (4C.830); Project Voyager (4C.870); Russian Mars probe (4C.842).

Principal Publications:

PRELIMINARY CONSIDERATIONS OF THE INSTRUMENTATION OF A PHOTOGRAPHIC RECONNAISSANCE OF MARS
J.H. Laning, Jr., et al., MIT Instrumentation Lab Report, no. R-174, May 1958.

THE EFFECT OF GUIDANCE ERRORS ON ASTROBALLISTIC TRAJECTORIES
D.B. DeBra, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 3, June 1959, p. 242/248.

The effect of guidance errors in position, velocity and time are considered for free flight trajectories. The effect is considered for three central force fields, separately and combined to approximate the effect on an interplanetary probe in which a planet is the desired target. Guidance optima are shown to exist for certain trajectories and a Mars probe is considered as an example. . . .

COMMUNICATION SYSTEM FOR A MARS RECONNAISSANCE VEHICLE
M. I. Skolnik, et al., Lincoln Lab., Mass. Inst. of Tech., Lexington, Group rept. no. 31-148, 14 May 1959, 35 p., AD 239 073.

. . . prime function . . . receive data from the vehicle on a periodic basis concerning its status and any other scientific data that may be of interest. The total time of flight of the vehicle is a little over three years. . . . consists of two parts: a telemetering subsystem whose function is to transmit a short message from the vehicle to the earth at intervals of about once per week, and a transponder subsystem used in conjunction with a ground-based radar to locate and track the vehicle just before re-entry and predict its point of impact. The transponder subsystem can also be used to provide a signal to release the re-entry vehicle from the rest of the space vehicle.

VEHICLES FOR EXPLORATION ON MARS
T.F. Cartaino, Rand Corp., Santa Monica, Calif., 30 April 1960, 27 p., AD 245 345.

ON THE ORBITAL PERTURBATIONS OF MARTIAN SATELLITES
L.F. Koehler, IRE Trans. Symp. Space, no. 5-4, Sept. 1960, p. 1/7.

INTERPLANETARY TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-2, Feb./March 1960, p. 37/40.

. . . typical Mars and Venus trajectories for 1964 launching dates. . . .

COMPUTATION OF MIDCOURSE MANEUVER FROM TRACKING DATA
JPL Res. Summ., vol. 1, no. 36-4, June/July 1960, p. 21/22.

After injection into orbit, the Ranger spacecraft will cruise in a Sun-Earth oriented attitude which is maintained until one of the predetermined maneuver points is reached.

MARS TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 4/5.

. . . Trajectories to Mars in 1964. . . .

FLIGHT DATA ANALYSIS
P.H. Feitis, et al., JPL Res. Summ., no. 36-11, Aug./Sept. 1961, p. 4/5.

Determination of density profile of Mars atmosphere from Mariner B capsule flight data. A computer program which simulates the rotational as well as the translatory motion of a passive capsule during entry into a planetary atmosphere has been obtained from Ames Research Center.

A STUDY OF MANNED NUCLEAR-ROCKET MISSIONS TO MARS
S.C. Himmel, et al., Aerospace Engineering, vol. 20, no. 7, July 1961, p. 18/19 + 51/58.

. . . effects of mission duration, radiation environment of space, and the use of atmospheric braking are evaluated. . . .

LOW-THRUST TRAJECTORY OPTIMIZATION
W.G. Melbourne, JPL Res. Summ., no. 36-11, Aug./Sept. 1961, p. 5/7.

. . . extending the variable thrust program . . . to three-dimensional rendezvous trajectories to Mars.

MARS MICROSCOPE
G.A. Soffen, JPL Res. Summ., no. 36-13, Dec./Jan. 1961, p. 1/3.

. . . the microscope must be sent in conjunction with an image detecting system and a device for conversion into a telemetry signal. A more advanced instrument might be designed to discriminate and telemeter only data of interest.

The present laboratory effort is directed toward examining these problem areas: (1) acquisition, treatment, and handling of the sample; (2) selection of the optical-vidicon systems; and (3) objective methods of data discrimination and interpretation.

DIAMETERS OF MARS AND VENUS
R. L. Wildey, JPL Res. Summ., vol. 1, no. 36-10, June/July 1961, p. 13/14.

. . . the accuracy of the best available data for the diameters of Mars and Venus has been critically studied and is summarized here.

DETERMINATION OF NUCLEAR-ROCKET POWER LEVELS FOR UNMANNED MARS VEHICLES STARTING FROM ORBIT ABOUT EARTH
R. H. Cavicchi, et al., National Aeronautics and Space Administration, Washington, D. C., NASA Technical note D-474, Jan. 1962, 40 p., 8 refs., AD 270 081.

A STUDY OF GUIDANCE SENSITIVITY FOR VARIOUS LOW-THRUST TRANSFERS FROM EARTH TO MARS
A. L. Friedlander, National Aeronautics and Space Administration, NASA Technical note D-1183, Feb. 1962, 40 p., AD 270 925.

INVESTIGATION OF ADVANCED ANTENNA TECHNIQUES FOR SPACE VEHICLE DOPPLER VELOCITY SENSORS
F. J. Goebels, Jr., et al., Hughes Aircraft Co., Culver City, Calif., Final engineering rept., May 1961-May 1962, ASD TDR 62-713, May 1962, 75 p., incl. illus., tables., AD 282 427.

. . . an investigation of large, pressure erectable, pliant film antennas for radiometric (passive) doppler velocity sensing for navigation between planets. . . .

PROBABILITY OF PLANETARY CAPTURE
C. E. Kohlhase, JPL Res. Summ., vol. 36-14, Feb./March 1962, p. 13/16.

. . . planetary capture (impact) . . .

If the injection and midcourse guidance systems should function as currently designed, then the results listed in the accompanying tables are representative of capture probabilities.

ATMOSPHERE AND SURFACE PROPERTIES OF MARS AND VENUS
E. J. Öpik, In: Progress in the Astronautical Sciences, vol. I, Amsterdam, North-Holland Publishing Co., 1962, p. 261/342, 97 refs., A63-17235.

ENGINEERING MODEL ATMOSPHERE OF MARS
G. F. Shilling, RAND Corp., Santa Monica, Calif., 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, N63-19314.

A PHOTOGRAPHIC HISTORY OF MARS 1905-1961
E. C. Slipher, Lowell Observatory, Flagstaff, Ariz., 1962, 168 p., illus., AD 298 548.

MARTIAN MISSION. A BIBLIOGRAPHY
North American Aviation, Inc., Downey, Calif., Rept. no. SID 62 1062, 21 Aug. 1962, 38 p., AD 421 510.

A survey is made of the literature on space guidance techniques for the navigation of interplanetary space craft on a Martian mission. Landing techniques and take offs from Mars have also been included. . . .

TELEVISION SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 59/66.

A photogramorphological survey of the Mars surface is to be made by two TV cameras mounted on the planetary horizontal platform (PHP) of Mariner, one for the purpose of obtaining high-resolution photographs of the Martial surface (Camera A), and another having a wider field of view of obtaining colorimetric information from the planet and its atmosphere . . . A block diagram of the TV subsystem. . . .

TELEVISION SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 59/69.

. . . The entire subsystem will be logically controlled and synchronous with a 1-Mc clock. Total mission storage of 100 pictures is to be provided with the selection of which picture to store, controlled by a preset program. The TV data data is to be telemetered to Earth at a minimum bit rate of 21 bits/sec requiring about 13 hr to transmit one complete picture.

FIZICHESKIYE USLOVIYA NA MARSE (Physical Conditions on Mars) (In Russian)
N. P. Barabashov, NASA, Washington, D. C., NASA TT-F-165, August 1963, 15 p., Transl. into English from Vestnik Akad. Nauk SSSR, Moscow, no. 10, 1962, p. 18/25, N63-19862.

A LIFE COLONY FOR MARTIAN EXPLORATION
F. H. Bellamy, et al., Spaceflight, vol. 5, March 1963, p. 38/45, A63-19723.

Outline of considerations pertinent to the construction of a colony on Mars, based on extrapolation of the present state-of-the-art. . . . choice of site, food, oxygen and water . . . supplies . . . transportation . . . and communications.

PRELIMINARY DESIGN OF MARS BASING
P. H. Bliss, RAND Corp., Santa Monica, Calif., May 1963, 18 p., AD 405 556.

. . . design and construction problems for a Martian base. An immediate, prefabricated inflatable shelter is proposed for the first crew that lands on Mars which will serve for headquarters while additional base construction is performed.

GUIDANCE PHENOMENA FOR A MARS MISSION
J. V. Breakwell, et al., 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. 252/273, A64-10111.

SYMPOSIUM SYNOPSIS: THE WHEN AND WHAT OF THE MARS TRIP
W. G. Clohessy, et al., 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. 599/617, A64-10131.

. . . The bioastronautic and communications aspects of the such a program are among the areas covered.

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) (In French)
A. Dollfus, Academie des Sciences, Paris, Comptes Rendus, vol. 256, no. 14, 1 April 1963, p. 3012/3015, A63-17408.

MISSION ANALYSIS OF FAST MANNED FLIGHTS TO VENUS AND MARS
K. A. Ehricke, In: Advances in the Astronautical Sciences, vol. 13, American Astronautical Society, Annual Meeting, 9th, Los Angeles Calif., Jan. 15-17, 1963, Edited by Eric Burgess, North Hollywood, Calif., Western Periodicals Co., 1963, p. 470/546, A63-23872.

Study of several interplanetary mission profiles for manned flights to Mars and Venus, including a flyby mission, a capture mission, and a landing mission. . . . Interplanetary mission maps are constructed. . . . Criteria for mission window selection are presented. . . .

FROM MERCURY TO MARS
M. A. Faget, et al., Astronautics and Aerospace Engineering, vol. 1, Feb. 1963, p. 24/28, A63-13324.

. . . NASA manned spacecraft program which includes as approved developments the Mercury one-man spacecraft, the Gemini two-man rendezvous spacecraft, the Apollo lunar-landing mission, and space-station operations. . . . Some considerations are also discussed which are to shape the design of the Mars-exploration mission, and which should influence research and development efforts in the interim. The Mars-exploration mission is emphasized as the most advanced mission on which conjecture is timely.

EQUATIONS FOR THE DENSITY DISTRIBUTION OF AND MOTION WITHIN THE JPL MODEL MARS ATMOSPHERES
P. H. Feitis, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 4/7.

STUDY OF TOPSIDE SOUNDER FOR MARS AND VENUS IONOSPHERES FROM MARINER SPACECRAFT
T. Flattau, et al., Cutler-Hammer, Deer Park, N.Y., Final Report, Rept. 1844-1, Oct. 1963, 118 p., refs., N64-10903.

. . . This report analyzes the problems and solutions in sounding the topside of the ionospheres of Mars and Venus from a passing spacecraft . . . 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 . . . 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.

A SYSTEMATIC APPROACH TO THE STUDY OF STOPOVER INTERPLANETARY ROUND TRIPS
R. W. Gillespie, In: Advances in the Astronautical Sciences, vol. 13, American Astronautical Society, Annual Meeting, 9th, Los Angeles, Calif., Jan. 15-17, 1963, Edited by Eric Burgess, North Hollywood, Calif., Western Periodicals Co., 1963, p. 165/176, A63-23392.

. . . list of trajectory data for stopover round trips to Mars and Venus between 1960 and 1999, including speeds, directions, and departure and arrival dates. All data are calculated for the inclined, eccentric orbits. Use of the data to design rockets and plan expenditions is explained. . . .

EXPERIMENTS FROM A SMALL PROBE WHICH ENTERS THE ATMOSPHERE OF MARS
R. A. Hanel, et al., Washington, NASA, NASA TN D-1899, Dec. 1963, 23 p., refs., N64-11234.

. . . 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 REQUIREMENTS FOR EFFICIENT MARS LAUNCH TRAJECTORIES
L. F. Helgostam, American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, New York, N.Y., Jan. 20-22, 1964, Preprint 64-15, 9 p., A64-12923.

MARSFLIGHT II SPACE CABIN SIMULATOR
R.A. Ibison, Medical and Biological Problems of Space Flight, Proceedings of a Conference held in Nassau, the Bahamas, November 1961, Edited by Geoffrey H. Bourne, New York and London, Academic Press, 1963, p. 63/84, 31 refs., A63-19995.

LAUNCH FACILITY REQUIREMENTS FOR MARS/NOVA VEHICLE
H. F. Keyser, 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. 132/150, A64-10106.

Study of facilities proposed to support Mars missions using the NOVA launch vehicle. Factors involved in determining the number of sites of launch pads at the Merritt Island, Florida launch area are discussed.

RADIOLOKATSIIA PLANETARY MARS V SOVETSKOM SOIUZE (USSR Radar Probing of the Planet Mars) (In Russian)
V.A. Kotel'nikov, et al., Akademiia Nauk SSSR, Doklady, vol. 151, Aug. 1, 1963, p. 811/814, A63-25429.

. . . Data concerning the transmission and reception of the radar signals, at a frequency of 700 Mc, are described. Presented are described. Presented are the spectrum of the received signal at a filter band of 4 cps, and graphs showing the stored energy of the reflected signal.

MANNED MARS MISSIONS
B. Kovit, Space/Aeronautics, vol. 40, Nov. 1963, p. 65/71, A64-10690.

MARS NONSTOP ROUND-TRIP TRAJECTORIES
R.W. Kuidens, AIAA Journal, vol. 2, Feb. 1964, p. 368/370, A64-14398.

. . . 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. . . .

TELEVISION CAMERA FOR A GEOLOGICAL SURVEY OF THE PLANET MARS
L.R. Malling, In: International Symposium on Space Technology and Science, Tokyo, Japan, August 27-31, 1962, 4th, Proceedings, Edited by Tamiya Nomura, Tokyo, Japan and Ruthland, Vt., Japan Publications Trading Co., 1963, p. 549/557, 5 refs., A64-15034.

Description of a proposed television camera system for the photographic survey of Mars . . . electrostatically operated Vidicon camera tubes are used. Ruggedized electrostatic tubes are available that will withstand sterilization temperatures of over 125°C . . . both cameras take pictures continuously and alternately following planetary acquisition. With a stored picture readout time of 10 seconds, and with interleaved camera operation, several pictures may be taken per minute . . . When this tube is combined with a suitable information encoder, a capability is then established for transmitting pictures over a narrow-band communication system back to Earth over planetary distances.

THE ATMOSPHERE OF MARS
D.H. Menzel, Harvard Coll. Observatory, Cambridge, Mass., 1963, 4 p., Repr. from Mem. Soc. Roy. Sci., Leige., ser. 5, v. 7, special issue, NASA CR-50016: Its Repr. 614, N63-17152.

A THEORETICAL STUDY OF THE MARTIAN IONOSPHERE
R.B. Norton, National Bureau of Standards, Boulder, Colo., Central Radio Propagation Lab., 1963, 16 p., refs., Presented at the Am. Astronautical Soc. Symp. on the Exploration of Mars, N64-14270.

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 . . . On Mars there may be layers that absorb radio waves more strongly than the normal terrestrial D region.

SURVEY OF VELOCITY REQUIREMENTS AND REENTRY FLIGHT MECHANICS FOR MANNED MARS MISSIONS
E.B. Pritchard, American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, New York, N.Y., Jan. 20-22, 1964, Preprint 64-13, 12 p., 15 refs., A64-12750.

DATA FOR VEHICLE DESIGN FOR EARTH ORBIT TO MARS ORBIT AND RETURN
H.O. Ruppe, 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. 151/173, 71 refs., A64-10107.

Estimation of the payload and speed requirements for a manned Mars-exploration mission using a nuclear heat-exchanger-type propulsion system. . . .

THE USE OF RADAR TECHNIQUES TO SELECT A MARTIAN LANDING SITE

K.M. Siegel, 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. 396/403, A64-10118.

A set of experiments to determine the geometrical character and material composition of the Martian surface is described. These experiments depend upon both passive and active electromagnetic radiation measurements. Bistatic and monostatic, multi-wavelength, high resolution radar mapping experiments are strongly recommended.

NONCONVENTIONAL COMMUNICATION DEVICES FOR THE MARS MISSION?

K.M. Siegel, et al., 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. 389/395, A64-10117.

. . . advantages . . . of . . . systems operating at wavelengths other than microwave- e.g., optical and millimeter, are weighed against the disadvantages. It is concluded that some small relative advantage can probably be gained in the millimeter range. No foreseeable advantage exists in the optical range. Therefore, it appears that improvements in space communication techniques are most likely to be found within the microwave region.

MARINER DESIGN MODIFIED FOR MARS FLYBY

I. Stone, Aviation Week and Space Technology, vol. 78, May 6, 1963, p. 50/51+, A63-18185.

. . . Described are (1) the guidance and control system; (2) the scientific instrumentation; (3) TV, IR, and scan telemetry; and (4) launch trajectory considerations.

INSTRUMENTATION ASPECTS OF THE MARS MISSION

W. Victor, et al., 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. 373/388, A64-10116.

. . . It is shown that real-time television is possible in either direction — that is, from Earth to Mars and from Mars to Earth —even at the maximum Earth-Mars distance of 400 million km and by utilizing conventional devices. . . . A communications black-out occurs when the Sun enters the main beam of either the Earth-based or the Mars-orbiter antenna, and computational results are included which indicate that this should not be a serious problem if it is planned for during the design of the mission.

TELECOMMUNICATION ASPECTS OF A MANNED MARS MISSION

W.K. Victor, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TR-32-501, 20 Aug. 1963, 16 p., N64-14845.

. . . principal problem appears to be one of engineering these devices so that they possess adequate long life and reliability to accomplish the mission . . . Temporary loss of communications will occur at semisynodic periods of approximately 13 months when the planets are in opposition or in conjunction.

FLIGHT REGIMES IN THE ATMOSPHERES OF VENUS AND MARS

P. P. Wegener, Rand Corp., Santa Monica, Calif., Memo RM 3388 PR, July 1963, 49 p., AD 411 951.

. . . 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.

MINIMUM EARTH MARS TRANSFER TIME FOR A MARS RENDEZVOUS MISSION

D. B. Williams, Michigan U., Ann Arbor, June 1963, 1 v., AD 416 357.

RADAR OBSERVATIONS OF MARS

JPL Space Progr. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 38/39.

. . . during the several weeks from January 31, 1963 to March 2, 1963, with essentially the same radar which was used previously (SPS 37-19, Vol. III, p. 23/27, 37/20, Vol. III, p. 39/42, 37/31, Vol. III, p. 47/49) and the system noise temperature has been lowered to 37°K (SPS 37-17, Vol. III, p. 18/21, 37/20, Vol. III, p. 38/39, 37-21, Vol. III, p. 40/41). Two types of experiments were performed. One was the measurement, using radiometer techniques, of the total power contained in the echo. The other was an analysis of this power using the autocorrelation approach, into its frequency spectrum. . . .

EXPLORATION OF MARS

Advances in the Astronautical Sciences, vol. 15, Proceedings of the American Astronautical Society Symposium on the Exploration of Mars, Denver, Colo., June 6, 7, 1963, Edited by George W. Morgenthaler, North Hollywood, Western Periodicals Co., 1963, 617 p., A64-10098.

Collection of papers concerning various aspects of manned Mars missions. The areas covered include propulsion, guidance, and orbit concepts for the Mars trip, vehicle designs, Earth return and re-entry, bio-astronautic considerations, communications and auxiliary power supply, and planetary exploration. . . .

SPACE FLIGHT HANDBOOKS, VOLUME 3: PLANETARY FLIGHT HANDBOOK
Lockheed Missiles and Space Co., Palo Alto, Calif., Washington NASA, NASA SP-35, Pt. 2, 1963, 522 p., N64-14176.

Tabulations are given of trajectory data for scheduling flights to Venus and Mars during the period 1960-2000. Data are presented for single-plane transfers and for broken-plane transfers that employ a midcourse plane-change. The data at the target planet are held fixed while the trip duration is varied in 10-day increments from zero days to the length of that planet's synodic period with the Earth . . .

A STUDY OF THE METEOROLOGY OF MARS AND VENUS
Geophysics Corp. of America, Bedford, Mass., Quarterly Progress Rept. No. 3, 6 July - 5 Oct. 1963, 1963, 35 p., 4 refs., N64-13066.

. . . Atmospheric tides in the Martian atmosphere were discussed. Techniques for constructing thermodynamic diagrams for the Martian atmosphere were developed . . . Meteorological studies of Venus focused on two problems, both of which are related to planetary and atmospheric temperatures. . . .

VENUS-MARS CAPSULE STUDY, VOLUME I (REVISED)
General Electric Co., Evendale, Ohio, Missile and Space Div., March 1, 1963, 598 p., refs., N63-20816.

. . . 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 . . . transmit data to the Earth as to the Characteristics of the Venusian atmosphere . . .

FLIGHT TO MARS
Flight International, vol. 83, Jan. 3, 1963, p. 26/29, A63-11785.

Description of the Soviet spacecraft Mars I (1962 Beta Nu I), launched Nov. 1, 1962. The construction, scientific equipment, and radio systems are treated in detail. . . . A detailed diagram and a photograph are included.

Related Publications:

MARINER B CAPSULE PROPULSION STUDY
R. Sehgal, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-86, 1 June 1962, 36 p., refs., N64-10902.

. . . advantages of propelling the Mariner B capsule from the spacecraft on a flyby trajectory, as opposed to merely dropping it from the spacecraft on an impact trajectory and then diverting the spacecraft bus . . .

MARINER MARS 1964 DESIGN
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 43/46.

Mission . . . Test and Evaluation Program . . . Configuration of Mariner Mars . . .

MARINER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 27/34.

Trajectory Considerations . . . Spacecraft Assembly and Test Operations . . . RF Coupler Tests . . . RF Interference . . . 1. Spacecraft Transporting Equipment . . . 2. Power Subsystem . . . 3. Gas Actuator . . . 4. Long-Range Earth Sensor 5. Mid-Course Propulsion System.

VEHICLE DESIGN FOR MARS LANDING AND RETURN TO MARS ORBIT
D. M. Hammock, et al., 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, A64-10108.

MARINER C PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 13/22.

The over-all objective of the Mariner C Project is to perform a successful mission to Mars during the 1964 period of availability. . . .

4C.550: Venus Exploration

Included: Manned missions to Venus; Fly-by missions to Venus; Microwave observations of Venus; Tracking techniques of Venus probes; Venus environment; Results of Venus radar contacts; Venus atmosphere; Earth-Venus trajectories; Venus meteorology; Black body radiation of Venus; Radar astronomy of Venus.

Cross References: Ground facilities for deep space tracking (4C.320); Project Mariner (4C.830); Russian Venus Probe (4C.882).

Principal Publications:

NATURAL ENVIRONMENT OF THE PLANET VENUS
J. H. Shaw, et al., The Ohio State University Research Foundation, February 1959, AD 242 176.

. . . Attempts have been made to estimate the probable environment in cases where it cannot be definitely established.

MICROWAVE ABSORPTION AND EMISSION IN THE ATMOSPHERE OF VENUS (Correspondence)
A. H. Barrett, J. Geophys. Res., vol. 65, June 1960, p. 1835/1838.

ANALYSIS OF TRAJECTORY PARAMETERS FOR PROBE AND ROUND-TRIP MISSIONS TO VENUS
J. F. Dugan, Jr., et al., National Aeronautics and Space Administration, Washington, D. C., Nov. 1960, 46 p., AD 246 111.

A MICROWAVE RADIOMETER EXPERIMENT FOR THE PLANET VENUS
D. E. Jones, Proc. Nat. Electronics Conf., vol. 16, Oct. 1960, p. 489/493.

. . . to determine the source of the centimeter radiation, and to scan the planet geographically at several wavelengths to study the surface and atmosphere of the planet, by sending a microwave radiometer to Venus on a space probe. . . .

VENUS TRAJECTORIES
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 10/11.

. . . Firing dates to Venus for minimum energy trajectories occur approximately every 19 months. . . .

TRAJECTORIES TO VENUS IN 1962
JPL Res. Summ., vol. 1, no. 36-7, Dec./Jan., 1960, p. 9/11.

RADAR MEASUREMENTS OF THE PLANET VENUS
L. R. Malling, et al., Brit. IRE Canad. Proc., vol. 1, Oct. 1961, p. 21.

. . . Jet Propulsion Laboratory established contact with the planet Venus using a planetary radar system from 10th March to 10th May 1961. . . . A super-sensitive receiving system was employed with a 10 kW transmitter operating at 2388 Mc/s. . . .

FIRST FLIGHT TO VENUS
Z. Jakubski, Space Technology Lab., Inc., Los Angeles, Calif., Rept. no. STL-TR 61-511019, Trans. from Pravda, no. 57 (15547), 26 Feb. 1961, AD 264 168.

ADDITION OF RANGE IN ORBIT DETERMINATION OF VENUS PROBE
J. D. Anderson, JPL Res. Summ., vol. 1, no. 36-10, June/July 1961, p. 5/8.

A preliminary investigation of the use of an additional block of range data in the orbit determination of a Venus probe has been completed. This block of data could be defined by a time tag, the time of the first range point for example, and by an interval of time over which data is obtained at some prespecified rate. . . . if only one block of range data defined as above is available, it would be possible to determine the optimum time point with respect to mission objectives at which the range block should be taken.

AN ANALYSIS OF THE NARROW-BAND SPECTRA OF VENUS
R. L. Carpenter, JPL Res. Summ., no. 36-14, Feb./March 1962, p. 56/59.

Since the publication of Radar Exploration of Venus (Ref. 18), efforts have been continued to reduce the large amount of data obtained with the narrow-band spectrum analyzer. The reduction consisted of computing the spectra of the radar return for each day's operation and then measuring their bandwidth and relative signal-to-noise ratio. The results of this reduction are presented and interpreted in terms of the rotation period of Venus.

. . . Description of Experiment . . . Measurement of Bandwidth and Signal Level . . . Changes in the Relative Signal Level and Bandwidth . . . Direction and Period of Rotation . . . Conclusions . . .

RESULTS OF RADAR CONTACT WITH VENUS IN 1961 (Translation)
V. A. Kotel'nikov, et al., Radio Engineering and Electronic Physics, vol. 11, Nov. 1962, p. 1722/1733, 14 refs., A63-20082.

Analysis of the spectra of signals reflected from Venus. The sum of both the narrowband and wideband components are analyzed. The

magnitude of the astronomical unit is re-evaluated and the coefficient of reflection of Venus is determined. . . .width of the narrow-band component was less than 4 cps, and its intensity did not vary significantly over the days of observation . . . the coefficient of reflection of Venus, determined from the narrowband component, was 8% . . . the wideband component of the signal corresponded to a broadening of the lines to 400 cycles and more; it varied widely from day to day . . .

ATMOSPHERE AND SURFACE PROPERTIES OF MARS AND VENUS
E. J. Öpik, IN: Progress in the Astronautical Sciences, vol. I, Amsterdam, North-Holland Pub. Co., 1962, p. 261/342, 97 refs, A63-17235.

EFFECT OF CUTOFF LATITUDE ON CUT-OFF CONDITIONS FOR TRANSFER ORBITS TO VENUS
L. N. Rowell, et al., RAND Corp., Santa Monica, Calif., Memo. no. RM-3038-PR, May 1962, 33 p., incl. illus., tables, 2 refs., AD 276 083.

NEW CO_2 BAND IN VENUS SPECTROGRAMS
H. Spinrad, JPL Res. Summ., no. 36-14, Feb./March 1962, p. 5.

During a detailed examination of Venus spectrograms in the Mount Wilson Observatory plate files, a band of CO_2 with a head at λ7158 has been discovered. This band had been observed . . . on laboratory spectra taken under conditions of high pressure and a very long path length.

DIAMETERS OF MARS AND VENUS
R. L. Wildey, JPL Res. Summ., vol. 1, no. 36-10, June/July 1961, p. 13/14.

DSIF PARTICIPATION IN MARINER II
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Aug. 1962, p. 3/6.

With the successful launch of the Mariner 2 Venus probe the DSIF (Table 1) began a program of spacecraft tracking and communications. This program: (1) Provided the tracking data . . . (2) Received, recorded and transmitted to the JPL data analysis center the telemetry data. . . (3) Provided the ability to command the spacecraft. . .

MARINER VENUS 1964 TRAJECTORIES AND DESIGN
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 36/43.

MARINER-2 MICROWAVE OBSERVATIONS OF VENUS
A. H. Barrett, et al., Sky and Telescope, vol. 25, April 1963, p. 192/195, A63-26098.

Description of the techniques and equipment used in the observations of Venus by Mariner 2 . . . Various microwave radiometer measurements are discussed. Preliminary results indicate a Venus surface temperature of approximately 700°K, a value in keeping with previous radio measurements. . . .

VENUS: A SUMMARY OF PRESENT KNOWLEDGE
M. H. Briggs, et al., JPL, Calif. Inst. of Tech., Pasadena, 1963, 39 p., 107 refs., N63-19961.

VENUS: A SUMMARY OF PRESENT KNOWLEDGE
M. H. Briggs, J. Brit. Interplanetary Soc., vol. 19, March/April 1963, p. 45/52, 112 refs, A63-20440.

PRELIMINARY RESULTS OF THE 1962 RADAR ASTRONOMY STUDY OF VENUS
R. L. Carpenter, et al., JPL Space Progr. Summ., vol. 4, Feb./March 1963, p. 182/184.

Continuous wave spectra were obtained by transmitting a 13-kw 2388-Mc signal toward Venus and computing the spectrum of the received echo. . . . shows the spectrum . . . computed on the IBM 7094 computer from approximately an hour of recorded data. The spectrum has a resolution of 1 cps or a radial velocity resolution of about 6.3 cm/sec. . . .

EARTH-VENUS TRAJECTORIES, 1965-66
V. C. Clarke, Jr., et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-99, vol. 2, pt. B, May 15, 1963, 790 p., 9 refs., N63-23029.

. . . for flight times from Octover 20 to November 28, 1965 . . .

EARTH-VENUS TRAJECTORIES, 1967, VOLUME 3, PART A
V. C. Clarke, Jr., et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-99, vol. 3, pt. A, June 15, 1963, 790 p., 9 refs., N63-21337.

. . . results of extensive machine computations of three-dimensional ballistic interplanetary trajectories . . .

EARTH-VENUS TRAJECTORIES, 1970, VOLUME 5, PART B
V. C. Clarke, Jr., et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-99, vol. 5, pt. B, 1 Oct. 1963, 792 p., refs., N64-14893.

EARTH-VENUS TRAJECTORIES, 1968-69, VOLUME 4, PART A
V. C. Clarke, Jr., et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-99, vol. 4, pt. A, Aug. 1, 1963, 791 p., refs., N64-10310.

. . . for the launch date interval of November 16 to December 25, 1968, are presented in tabular form . . .

EARTH-VENUS TRAJECTORIES, 1968-1969, VOLUME 4, PART B
V. C. Clarke, Jr., et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-99, vol. 4, pt. B, Aug. 15, 1963, 789 p., refs., N64-10099.

. . . for the launch date interval of December 26, 1968, to February 3, 1969 . . .

MISSION ANALYSIS OF FAST MANNED FLIGHTS TO VENUS AND MARS
K. A. Ehricke, In: Advances in the Astronautical Sciences, vol. 13, American Astronautical Society, Annual Meeting, 9th, Los Angeles, Calif., Jan 15-17, 1963, Edited by Eric Burgess, North Hollywood, Calif., Western Periodicals Co., 1963, p. 470/546, A63-23872.

. . . Criteria for mission window selection are presented. . . .

MARINER II: PRELIMINARY REPORTS ON MEASUREMENTS OF VENUS
L. A. Frank, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TR-32-429, Science, vol. 139, no. 3559, March 8, 1963, p. 905/910, refs., N63-16423.

MARINER II: PRELIMINARY REPORTS ON MEASUREMENTS OF VENUS. CHARGED PARTICLES
L. A. Frank, et al., Science, vol. 139, March 8, 1963, p. 905/907, A63-13082.

A SYSTEMATIC APPROACH TO THE STUDY OF STOPOVER INTERPLANETARY ROUND TRIPS
R. W. Gillespie, In: Advances in the Astronautical Sciences, vol. 13, American Astronautical Society, Annual Meeting, 9th, Los Angeles, Calif., Jan. 15-17, 1963, Edited by Eric Burgess, North Hollywood, Calif., Western Periodicals Co., 1963, p. 165/176, A63-23392.

ROTATION OF VENUS: PERIOD ESTIMATED FROM RADAR MEASUREMENTS
R. M. Goldstein, et al., Science, vol. 139, March 8, 1963, p. 910/911, A63-13086.

. . . results of a radar probe of Venus. . . .

PHOTOCHEMICAL PROBLEMS OF THE VENUS ATMOSPHERE
P. Harteck, et al., Rensselaer Polytechnic Inst., Troy, N.Y., Washington, NASA, NASA TN D-1984, June 1963, 42 p., 46 refs., N63-17208.

NUMERICAL INVESTIGATION OF THE DISTRIBUTING INFLUENCE OF THE SUN ON A VENUS SATELLITE
J. M. J. Kooy, et al., Astronautica Acta, vol. 9, no. 2, 1963, p. 59/80, A63-24544.

. . . artificial Venus satellite. Different orbital motions are investigated, with different average distances from the planet and different eccentricities and inclinations as to the orbit plane of Venus around the Sun. . . .

RADIOLOKATSIONNYE NABLIUDENIIA VENERY V SOVETSKOM SOIUZE V 1962 GODU (Radar Observations of Venus in the Soviet Union in 1962) (In Russian)
V. A. Kotel'nikov, et al., Akademiia Nauk SSSR, Doklady, vol. 151, July 21, 1963, p. 532/535, A63-23922.

Presentation of some results of Venus radar probes . . . Presented are graphs showing: (1) the signal spectrum obtained at a filter pass band of 1 cps, (2) the distribution of FM signals reflected by Venus at filter pass bands of 1 and 4 cps, (3) the variation in distance between the Earth and Venus relative to the calculated value, and (4) the reflected-signal envelope.

THE ELECTRICAL CHARACTERISTICS OF THE ATMOSPHERE AND SURFACE OF VENUS FROM RADAR OBSERVATIONS
D. O. Muhleman, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TR-32-423, Rept. from Icarus, vol. I, no. 5/6, May 1963, p. 401/411, 26 refs., N63-21480.

. . . made at wavelengths of 12.5 cm and 68 cm. during several months around the 1961 inferior conjunction. . . 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 . . . interpreted to indicate that there are no large bodies of waste on the Venusian surface.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM
R. Novick, Columbia Radiation Lab., New York, Quarterly prog. rept. no. 4, 16 Sept.-15 Dec. 1963, Rept. no. CU12 63, 15 Dec. 1963, 77 p., AD 430 797.

. . . Double-resonance and level-crossing studies of the excited states of the chromium atom are continuing. . . . Theoretical studies are continuing on laser quencing of metastable atoms. . . . Studies of the microwave properties of model planetary atmospheres are continuing and a model of the Venusian atmosphere was constructed which is consistent with all available data.

VENUS AND THE MARINER
E. J. Opik, Irish Astron J. (Armagh), vol. 6, no. 2, June 1963, p. 59/67, refs., N64-10343.

. . . Observations relating to the surface conditions on Venus, which were obtained radiometrically (by radiation measurements, not by radio) during the Mariner II 35 minutes of fly-by, are discussed . . .

VENUS
C. Sagan, International Science and Technology, March 1963, p. 86/92, 94, A63-13109.

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. . . .

PHOTOGRAPHIC APPEARANCE OF VENUS AT THE TIME MARINER 2 ENCOUNTER
B. A. Smith, J. Geophys. Res., vol. 68, July 15, 1963, p. 4363/4365, A63-20157.

MARINER II: PRELIMINARY REPORTS ON MEASUREMENTS OF VENUS. MAGNETIC FIELD
E. J. Smith, Science, vol. 139, March 8, 1963, p. 909/910, A63-13085.

. . . The data give no indication of a Venusian magnetic field. This implies, by comparison with spacecraft measurements near Earth and with theoretical models, that the magnetic dipole moment of Venus is at most 1/10 to 1/20 of the Earth.

A SEARCH FOR WATER VAPOR AND TRACE CONSTITUENTS IN THE VENUS ATMOSPHERE
H. Spinrad, JPL Space Progr. Summ., vol. 4, Feb./March 1963, p. 177/180.

APPLICATION OF DELAY-LOCK RADAR TECHNIQUES TO DEEP SPACE TASKS
R. B. Ward, Lockheed Aircraft Corp., Sunnyvale, Calif., Technical Report on Communications, Rept. no. 6 90 63 68, Oct. 1963, 58 p., AD 424 005.

. . . discusses the use of delay-lock radar techniques for deep-space tracking and communications tasks . . . a Mars or Venus space probe of the Voyager type is used as a typical mission . . . results of delay-lock radar development to date . . . description of the digital delay-lock discriminator . . . An integrated delay-lock two-way tracking-communications system suitable for the assumed mission is described . . . The anticipated performance indicates considerable improvement over present capabilities.

FLIGHT REGIMES IN THE ATMOSPHERES OF VENUS AND MARS
P. P. Wegener, Rand Corp., Santa Monica, Calif., Memo RM 3388 PR, July 1963, 49 p., AD 411 951.

. . . uncertainties in aerodynamic flight conditions encompass orders of magnitude, particularly at high altitudes.

MARINER: MISSION TO VENUS
H. J. Wheelock (comp.), Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 1963, 125 p., Also McGraw-Hill Book Co., Inc., N63-21488.

. . . The historic mission of Mariner II to the near-vicinity of Venus and beyond has enabled scientists to revise many of their concepts of interplanetary space and the planet Venus.

BLACK BODY RADIATION
JPL Space Progr. Summ., vol. 3, no. 37-20, Jan./Feb. 1963, p. 34/36.

. . . measured temperature was just above the short term threshold of the radiometer system.

MARINER 2 FLIGHT OPERATIONS
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 21/22.

A SEARCH FOR WATER VAPOR AND TRACE CONSTITUENTS IN THE VENUS ATMOSPHERE
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 113/116.

PRELIMINARY RESULTS OF THE 1962 RADAR ASTRONOMY STUDY OF VENUS
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 116/120.

Continuous wave spectra were obtained by transmitting a 13-kw, 2388-Mc signal toward Venus and computing the spectrum of the received echo. An 85-ft parabolic antenna at Goldstone was used alternately for transmission and reception by switching between the two modes in accordance with the signal's round-trip time . . . The transmitted signal was less than one cycle wide, and any broadening of the echo is due to the relative velocity of different parts of the planet . . . Fig. 12 shows the spectrum obtained on November 10, 1962. It was computed on the IBM 7094 computer from approximately an hour of record data . . . Of particular interest is the detail on the lower left side of the spectrum.

A STUDY OF THE METEOROLOGY OF MARS AND VENUS
Geophysics Corp. of America, Bedford, Mass., Quarterly Progress Report No. 3, 6 July-5 Oct. 1963, 1963, 35 p., 4 refs., N64-13066.

. . . Atmospheric tides in the Martian atmosphere were discussed. . . . Meteorological studies of Venus . . .

SPACE FLIGHT HANDBOOKS, VOLUME 3: PLANETARY FLIGHT HANDBOOK
Lockheed Missiles and Space Co., Palo Alto, Calif., NASA Washington, NASA SP-35, Pt. 2, 1963, 522 p., N64-14176.

Tabulations are given of trajectory data for scheduling flights to Venus and Mars during the period 1960-2000. Data are presented for single-plane transfers and for broken-plane transfers that employ a midcourse plane-change. The data at the target planet are held fixed while the trip duration is varied in 10-day increments from zero days to the length of that planet's synodic period with the Earth . . .

VENUS-MARS CAPSULE STUDY, VOLUME I (REVISED)
General Electric Co., Evendale, Ohio, Missile and Space Div., March 1, 1963, 598 p., refs., N63-20816.

. . . 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 . . . transmit data to the Earth as to the Characteristics of the Venusian atmosphere . . .

EARTH-VENUS TRAJECTORIES, 1965-66, VOLUME 2, PART A
Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-99, vol. 2, Pt. A, N63-21980.

. . . Following these trajectories, differential corrections or error coefficients and guidance and tracking parameters are given.

APPROACH TO VENUS
Spaceflight, vol. 5, Jan. 1963, p. 2/7, A63-11809.

Outline of the objectives of the spacecraft Mariner 2 (1962 Alpha Rho 1) for the Venus fly-by mission. The six scientific experiments carried by it are discussed.

4C.580: Other Missions in Our Solar System

Included: Missions to the asteroids; Cometary missions; Review of electric propulsion of interplanetary spacecraft; Missions to Mercury; Jovian environment; Radiations from Jupiter; Environment of other planets; Jupiter probe; Missions to Pluto; Missions to Saturn; Solar probes; Comet probes.

Not Included: Fundamentals of electric propulsion; Electric propulsion for space flight in general (3B).

Cross References: Mars exploration (4C.540); Venus exploration (4C.550).

Principal Publications:

BASIC REQUIREMENTS FOR THE EXPLORATION OF JUPITER AND ITS MOONS
W. H. Straly, et al., Army Ballistic Missile Agency, Huntsville, Ala., Rept. no. DSP-TR-1-60, 4 March 1960, 57 p., incl. illus., tables, AD 235 563.

. . . basis for the investigation of the requirements necessary for exploration. Communications and data transmission, guidance and control, auxiliary power sources, and flight environment are examined in the light of energy requirements, trajectories, orbital navigation, large transfer times, vehicle capabilities, mission objectives, and payload characteristics.

REMARKS ON A COMET PROBE
H. C. Corben, IN: Space Age Astronomy, New York, Academic Press, Inc., 1962, p. 380/382, A63-14372.

Survey of predicted comet perihelion passages for the next 10 years. Included is a table of launch dates and probe performance specifications for the interception of comet Encke in mid-July 1964. Suggested instrumentation for the probes is noted.

A PRELIMINARY STUDY OF A SOLAR-PROBE MISSION
D. W. Dugan, National Aeronautics and Space Administration, Washington, D.C., Tech. note D-783, April 1961, 58 p., AD 254 734.

. . . it is believed that approaches to the Sun as close as about 4 or 5 million miles do not present insuperable difficulties insofar as heating and communications are concerned . . .

THE EXISTENCE OF PERIODIC VARIATIONS IN THE OBSERVATIONS OF JOVIAN ECLIPSES
M. Ruderfer, IRE Internat. Conv. Rec., vol. 5, March 1961, p. 139/146.

LOW ENERGY SOLAR TRAJECTORIES
W. E. Bollman, JPL Res. Summ., no. 36-14, Feb./March 1962, p. 7/9.

In interplanetary space exploration, a type of trajectory may be needed wherein the spacecraft reaches a radial distance from the Sun which is as different from the Earth-Sun distance as it is possible to attain with available launch vehicles.

THE POSSIBLE ROLE OF FIELD-ALIGNED DUCTS IN THE ESCAPE OF DECAMETER RADIATION FROM JUPITER
T. D. Carr, Florida U., Gainesville, 1962, 13 p., 16 refs., For Presentation at the Meeting on the Planet Jupiter held at NASA, Goddard Inst. for Space Studies, N.Y., Oct. 16-17, 1962, N63-19531.

A duct model for the production and escape of the Jovian decameter radiation is presented. The model accounts for observed phenomena in the process of emission of the electromagnetic

radiation and the propagation effects which occur during the escape of the radiation from the upper atmosphere of Jupiter. The paper is not concerned with the details of the emission process, but assumes that the emitters are located at the ionospheric altitudes in or near the auroral zones. . . .

A FEASIBILITY STUDY OF SOLAR PROBES
C. F. Hall, et al., Presented at the IAS 30th Annual Meeting, New York, Jan 22-24, 1962, IAS Paper 62-21, IAS, N63-16268.

THE ENVIRONMENT OF THE PLANETS
W. W. Kellogg, Space Exploration Lecture Series, Calif. U., Oct. 1-4, 1962, and at Moffett Field, Anaheim, Los Angeles, and San Diego, Oct. 1962, 13 p., 5 refs., P-2640, N63-19338.

SOLAR CELLS DESIGNED FOR OPERATION IN THE INNER REGIONS OF THE SOLAR SYSTEM
M. F. Lamorte, American Rocket Society, Space Power Systems Conference, Santa Monica, Calif., Sept. 25-28, 1962, Paper 2568-62, 5 p., A63-11803.

ELECTRIC THRUST DEVICE REQUIREMENTS FOR INTERPLANETARY SPACECRAFT
J. H. Molitor, et al., IRE Trans. Space Electronics Telemetry, vol. SET-8, no. 2, June 1962, p. 183/187.

. . . The state of the art of electric thrust devices is discussed, and it is concluded that, with expected advances, ion motors can meet all of the requirements of interplanetary missions, with magnetohydrodynamic motors a promising backup. . . .

ABSOLUTE MAGNITUDES OF 1954-1960 COMETS
S. K. Vsekhsviatskii, Soviet Astronomy, vol. 6, May-June 1963, p. 849/854, A63-17306.

A SURVEY OF MISSIONS TO THE ASTEROIDS
A. L. Friedlander, et al., IIT Research Inst., Chicago, Ill., Astro Sciences Center, Rept. M-3, 1963, 109 p., refs., N64-19566.

. . . missions to the asteroid belt, and to asteroids whose orbits bring them in close proximity to the earth. Experimental techniques for elucidating the scientific questions associated with the asteroids have been examined, and suitable experimental packages for the various missions are outlined . . . guidance requirements . . . have been examined . . .

DECAMETER RADIATION FROM JUPITER
J. L. Hirshfield, et al., Yale U., New Haven, Conn., 1963, 6 p., Reprint from Nature 198:4875, p. 20/22, 6 April 1963, AD 413 013.

The observed correlation between solar flare activity and intense radio bursts from Jupiter in the 5-38 Mc/s region has prompted several suggestions as to the origins of this radiation. . . .

TRAJECTORY CHARACTERISTICS FOR A COMETARY MISSION
R. A. Park, et al., American Institute of Aeronautics and Astronautics, Astrodynamics Conference, New Haven, Conn., Aug. 19-21, 1963, Paper 63-413, 23 p., A63-21727.

. . . problems involved in carrying out a comet intercept mission. The properties of 31 short-term comets are summarized in a table to determine the feasibility of a mission to any of them during the next 15 yr. . . .

THE ANOMALOUS INCLINATION OF THE JOVIAN AMMONIA LINES
H. Spinrad, JPL Space Progr. Summ., vol. 4, Feb./March 1963, p. 180/181.

RADAR OBSERVATIONS OF MERCURY
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 50/51.

. . . made during its recent conjunction in May. . . . at the Venus site . . . Mercury was illuminated with the 100-kw S-band transmitter working into the 85-ft paraboloidal antenna. Essentially the same low-noise, ephemeris-tuned receiver was used for Mercury as was used for the Venus experiments of the Fall of 1962.

THE ANOMALOUS INCLINATION OF THE JOVIAN AMMONIA LINES
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 116.

. . . A satisfactory explanation for the anomalous ammonia-line tilt has not yet been proposed.

PHYSICS OF PLANETS. PROCEEDINGS OF THE ELEVENTH INTERNATIONAL ASTROPHYSICAL SYMPOSIUM
Liege U., Belgium, AFCRL 63 457, 1963, 603 p., AD 405 842.

. . . sponsored by the University of Liege and by the Cambridge Research Laboratories of the Office of Aerospace Research, United States Air Force, through its European Office.

COMET INTERCEPT STUDY. FINAL REPORT
Space Technology Labs., Inc., Redondo Beach, Calif., Rept. no. 8668-602-RU-000, March 28, 1963, 250 p., 61 refs., N63-16229.

. . . feasibility of a comet intercept mission in the near future . . . Thirty-one comets were evaluated as intercept targets with regard to injection energies required at suitable launch periods, the distance of the earth at intercept, the transit and flight times, and the guidance requirements. . . .

Related Publications:

TECHNIQUES FOR THE INVESTIGATION OF SOLAR RADIO BURSTS AT METRE WAVELENGTHS
K. V. Sheridan, Proc. Instn. Radio Engrs., Australia, vol. 24, no. 2, Feb. 1963, p. 174/184.

The Sun emits a wide variety of radiation in the radio spectrum of which a prominent part consists of metre wavelength bursts of wide dyna ic range originating in the hot ionized solar corona. . . . a solar radio research station to study these radio bursts with a variety of instruments including spectrographs, interferometers and polarimeters. . . .

DIVISION 4C.7
FUTURE DEEP SPACE COMMUNICATIONS TASKS

4C.720: Missions to Other Solar Systems

Included: Interstellar environment; Interstellar missions; Interstellar communications; Relativistic interstellar spacecraft.

Not Included: Fundamentals of astronomy.

Cross References: Comet probes (4C.580).

Principal Publications:

INTERSTELLAR COMMUNICATION
B. M. Oliver, 1962 IRE Internat. Conv. Rec., Pt. 8, vol. 10, p. 34/39, A63-12483.

Brief discussion of the problems of interstellar, communication. It is pointed out that the ultimate range of a communication system is determined by three factors: (1) the energy radiated per symbol; (2) the directive gain of the antennas; and (3) the cosmic and thermal noise. The two likely regions of communication are believed to be the IR and the optical part of the spectrum, and a much quieter section in the microwave region. The acquisition problem involves the difficulties encountered in the time dimension. Possibilities of communication languages are considered.

DIRECT CONTACT AMONG GALACTIC CIVILIZATIONS BY RELATIVISTIC INTERSTELLAR SPACEFLIGHT
C. Sagan, Plant Space Sci., vol. 11, 1963, p. 485/498, Presented at the Am. Rocket Soc. 17th Ann. Meeting, Los Angeles, Nov. 15, 1962, N63-20930.

. . . Some of the technical problems in the construction of starships capable of relativistic velocities are discussed . . .

FEASIBILITY OF INTERSTELLAR TRAVEL
D. F. Spencer, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Technical rept. no. 32-233, 15 March 1962, 17 p. incl. illus., tables, 8 refs., AD 274 312.

INTERPLANETARY AND INTERSTELLAR EXPLORATION
O. W. Nicks, Spaceflight, vol. 6, May 1964, p. 80/87, A64-18028.

Review of present knowledge of solid objects in space, with special reference to exploration of the solar system, with some comments on objects composing the rest of the universe . . . Journey time for various interplanetary missions and methods of accomplishing them, both present and future, are discussed. Speculation is made on various aspects of interstellar exploration.

RADIOASTRONOMY AND COMMUNICATION THROUGH SPACE
E. Purcell, IN: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 121/143, A64-10223.

Review of radioastronomical developments in the last several years . . . problems of selecting the best frequency for sending signals and of recognizing received signals, and the advisability of setting up listening posts.

INTERSTELLAR COMMUNICATION
A. G. W. Cameron (editor), New York and Amsterdam, W. A. Benjamin, Inc., 1963, 320 p., A64-10210.
An anthology of 32 papers, all of which are reprints, dealing with the large range of questions and problems of interstellar communication. The papers are individually abstracted and indexed in this issue.

4C.760: Exploration of Extraterrestrial Life

Included: Intelligent radio signals from other planetary systems; Searching for signals from interstellar communities; Stellar signals program; Detection of intelligent signals from space; IR extraterrestrial life detectors; Estimates of the density of intelligent life outside our solar system; Habitable planets; Superior galactic communities; Signals from outer civilizations; Project OZMA; Coherence in interstellar signals; Radio signals from other planets; Extraterrestrial biology; Space microbiology.

Not Included: Fundamentals of biology; Fundamentals of linguistics.

Cross References: Planetary communications within our solar system (4C.580); Mars exploration (4C.540).

Principal Publications:

SEARCHING FOR INTERSTELLAR COMMUNICATIONS
G. Cocconi, et al., Nature, vol. 184, Sept. 1959, p. 844/846.

Discussion of the possible frequency, transmitted power and form of signals originating in an interstellar communication system.

SPECULATIONS ON COMMUNICATIONS WITH OTHER PLANET CIVILIZATIONS
D. W. Atchley, Jr., QST, vol. 64, no. 3, March 1960, p. 71/75.

A block diagram and description of the Project OZMA Radiometer and a reference to possible radio-amateur participation.

COMMUNICATIONS FROM SUPERIOR GALACTIC COMMUNITIES
R. N. Bracewell, Nature, May 1960, p. 670.

. . . Another philosophical discussion on the possibility of intelligent communities. A plot of stars being able to support intelligence versus distance is given. Based on that the total number of communities superior to ours is plotted. If there are many, and they live long, there is a chance of getting in contact with us. If there are few, it is concluded the life time is short and only a very few may have such a long life time as ours. Then the chance of contact is very low.

HOW CAN WE DETECT RADIO TRANSMISSIONS FROM DISTANT PLANETARY SYSTEMS?
F. D. Drake, Sky & Telescope, no. 19, Jan. 1960, p. 140/143.

LIFE OUTSIDE THE SOLAR SYSTEM
S. S. Huang, Sci. Amer., vol. 202, no. 4, April 1960, p. 55/63.

STUDIES IN EXTRATERRESTRIAL BIOLOGY
JPL Res. Summ., vol. 1, no. 36-6, Oct./Nov. 1960, p. 2/3.

. . . Studies on surviving microbiological forms in arid climes. . . . Studies on the preservation of extracellular enzymes in solid samples. . . . Studies of the origin of organic residues . . .

NOTE ON THE PROBABLE CHARACTER OF INTELLIGENT RADIO SIGNALS FROM OTHER PLANETARY SYSTEMS (Correspondence)
M. J. E. Golay, Proc. IRE, vol. 49, May 1961, p. 959.

UBER DIE MOGLICHKEIT DES NACHRICHTENEMPFANGES VON FREMDEN PLANETENSYSTEMEN (On the Possibility to Receive Messages from Other Planetary Systems) (In German)
Rohrbeck, Nachrichtenempfang, vol. 11, no. 6, June 1961, p. 280.

DETECTION OF INTELLIGENT SIGNALS FROM SPACE
J. A. Webb, Nat. Commun. Symp. Rec., vol. 7, Oct. 1961, p. 10/15.

. . . Stars nearest to the solar system are tabulated in accordance with distance, relative mass, and other parameters. . . . although our nearest stellar neighbor is some 4.3 light years away, if this distance is extended by 3 or 4 to 1, a fairly large number of stars can be examined. . . . a minimum noise window exists in the 1 kmc to 10 kmc frequency region, and that this frequency band probably offers the greatest potential for interstellar snooping . . . unlikely that intelligent beings in other stellar systems are constantly broadcasting . . .

STELLAR SIGNALS PROGRAM
A. Boni, Proc. XIth Internatl. Astron. Congr., Stockholm, vol. I, April 1961, p., 714.

RADIO SIGNALS FROM OTHER PLANETS (Correspondence)
R. N. Bracewell, Proc. IRE, vol. 50, Feb. 1962, p. 214.

ON A NEW SECURITY PROBLEM (Correspondence)
P. R. Geffe, Proc. IRE, vol. 50, no. 10, Oct. 1962, p. 2126.

CHEVLOVEK PRONIKAET V KOSMOS (Man Penetrates Into the Cosmos)
M. G. Kroshkin, Foreign Tech. Div., Air Force Systems Command, Wright-Patterson AFB, Ohio, 27 March 1963, 162 p., Trans. no. FTD-TT-62-1854 from Voyennoye Izdatel'stvo Ministerstva Oborony Soyuza SSR (Moskva), p. 1/60, 1962, AD 402 475.

. . . The question of whether or not there is life on other stellar worlds and whether communications can be established with intelligent beings of these worlds is considered. . . .

ON THE POSSIBILITIES OF THE EXISTENCE OF EXTRATERRESTRIAL INTELLIGENCE. APPENDIX—MATHEMATICAL DEFINITION OF THINKING FUNCTIONS
R. A. MacGowan, In: Advances in Space Science and Technology, vol. IV, New York, Academic Press, Inc., 1962, p. 39/110, 66 refs., A63-17564.

Examination of theories of planetary systems formation, evolution of life, the thinking process,

and the development of intelligent mechanical automata, in an effort to estimate realistic probabilities concerning the existence and characteristics of extraterrestrial intelligent automata.

INTERSTELLAR COMMUNICATION
B. M. Oliver, IRE Internat. Conv. Rec., Pt. 8, vol. 10, March 1962, p. 34/39.

Speculation as to the existence of extraterrestrial life is . . . old . . . knowledge about our solar system has shown it to be barren of intelligent life except (debatably) for Earth itself . . . estimates of the density of intelligent life elsewhere in the universe, on planetary systems around other stars. . . .

ADVANCES IN SPACE SCIENCE AND TECHNOLOGY. VOL. IV
F. I. Ordway, III, New York, Academic Press, 1962, 431 p., A63-17566.

. . . discussion of the possibility of the existence of intelligent beings other than man. . . . manned artificial satellites and space stations are surveyed . . . operational and other details of such modern craft as the X-15, Dynasoar, Mercury, and Vostok.

MEANS TO DEVELOP SPACE MICROBIOLOGY
N. Zhukov-Verezhnikov, et al., Foreign Tech. Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, 15 May 1962, 8 p., AD 277 649.

. . . Its purpose is to study microscopic forms of life on the planets and other celestial bodies and also to use microorganisms for studying the conditions of life in space. . . .

INTERSTELLAR COMMUNICATION AND HUMAN EVOLUTION
R. Ascher, et al., In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 306/308, A64-10240.

Proposal of initial steps for increasing the reasonableness of guesses about the probability of existence of extraterrestrial technical civilizations, and about the possibility of contacting them.

RADIO SIGNALS FROM OTHER PLANETS
R. N. Bracewell, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 199/200, A64-10230.

. . . There are . . . reasons for not using 1,420 Mc or other microwave frequencies, if the distance to the nearest community more advanced than our own is 100 light-years rather than the 10 light-years investigated by Project Ozma.

COMMUNICATIONS FROM SUPERIOR GALACTIC COMMUNITIES
R. N. Bracewell, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 243/248, A64-10235.

Consideration of the possibility of establishing contact with galactic communities more advanced than ours. . . . It is suggested that we might better devote our efforts to scrutinize our solar system for signs of probes sent here by our more advanced neighbors.

STELLAR LIFE ZONES
A. G. W. Cameron, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 107/110, A64-10220.

Discussion of the invalidity for the solar system of Huang's assumption that the probability of finding a planet in any position near a star is proportional either to the element of area on the orbital plane, or to the element of volume in space. The conclusion is reached that all single stars in space (except those with very low heavy-element contents) have a life zone containing an average of about 1.4 planets of undetermined size. . . .

FUTURE RESEARCH ON INTERSTELLAR COMMUNICATION
A. G. W. Cameron, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 309/315, A64-10241.

. . . For civilizations on planets near the very faint stars, which have been proposed as likely to exist, the laser may be the obvious way of communicating, since the signal-to-noise ratio of their optical transmissions should be orders of magnitude better than that calculated for the Sun by Schwartz and Townes.

SEARCHING FOR INTERSTELLAR COMMUNICATIONS
G. Cocconi, et al., In: Interstellar Communications, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 160/164, A64-10225.

. . . optimum channel of interstellar communication, power demands of the source, signal location and bandwidth . . . nature of the signal and possible sources. . . . the presence of interstellar signals is entirely consistent with all we know and that, if signals are present, the means of detecting them is now at hand. It is noted that a discriminating search for signals deserves a considerable effort.

HOW CAN WE DETECT RADIO TRANSMISSIONS FROM DISTANT PLANETARY SYSTEMS?
F. D. Drake, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 165/175, A64-10226.

. . . for detecting intelligent radio transmissions which may emanate from the vicinities of, at best, 25% of the stars and, at worst, perhaps one star in a million . . . the search should be confined to the band between 1,000 and 10,000 Mc, and that frequencies around 1,420 Mc may offer the best chance for success. Specifications are given for a receiver designed to detect interstellar radio signals at the surface of the Earth.

PROJECT OZMA
F. D. Drake, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 176/177, A64-10227.

. . . the first systematic, high-sensitivity search for manifestations of extraterrestrial intelligent life. . . . Preliminary observations discovered no signals of extraterrestrial origin, but radio frequencies still appear to offer the greatest hope for success.

COHERENCE IN INTERSTELLAR SIGNALS
M. J. E. Golay, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 192/198, A64-10229.

. . . there may be four likely spectral regions within which a search should be made for coherent signals, before any intelligent messages can be received; at half or at twice the hydrogen frequency, and with or without correction for nebular drift. . . .

THE SIZES OF HABITABLE PLANETS
S. Huang, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 102/106, A64-10219.

Discussion of the conditions for habitability and size of planets. The tentative conclusion is reached that a habitable planet most likely will have a radius lying between 1,000 and 20,000 km. . . .

PROBLEM OF TRANSMISSION IN INTERSTELLAR COMMUNICATION
S. Huang, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 201/206, A64-10231.

. . . suggested that our transmitting station should be used solely, at least for the next hundred years or so, for making responses to some intelligent messages from interstellar space that have been detected.

COMMENTS CONCERNING "ON A NEW SECURITY PROBLEM" (Correspondence)
D. J. McAuley, et al., Proc. IEEE, vol. 51, no. 8, Aug. 1963, p. 1158/1159.

INTERSTELLAR COMMUNICATIONS
P. Morrison, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 249/271, A64-10236.

Discussion of communication with interstellar societies more advanced than ours. It is suggested that signal beams be mounted at home, beams of a simple and unmistakable kind, directed preferentially toward those points where we think listeners may sooner or later arise. . . . The frequency suggested is the major spectral line in the radio band, the 20-cm emissions from neutral hydrogen atoms.

OUTLOOK REGARDING INTERSTELLAR COMMUNICATION
P. Morrison, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 316/317, A64-10242.

The first success can be looked to within the year 1964-1966, when a Mars soft-landed instrument probe should be able to settle the issue of whether life exists on that planet. If the answer is yes, the next stage is to see whether or not that form of life has independent origin from that of the Earth. . . . Analogous work directed at the other uncertain factors, from searches for stellar companions to historical investigations of the drive to technical competency, ought to replace the speculative nature of current investigations of the field.

INTERSTELLAR COMMUNICATION
B. M. Oliver, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 294/305, 14 refs., A64-10239.

During this century, while the expectation of finding intelligent extraterrestrial like has vanished for the rest of our solar system, it has grown enormously for other stellar systems. It is stated that, if we can signal out to 1,000 light-years for an extremely long time, our chances of contact are, perhaps, 50%. The microwave region still seems the best at the present state of the art. It is suggested that we send a repeated series of messages which constitute a course of instruction—facts about our civilization, or

language, or science, and ourselves. The other race can then respond with a much more sophisticated initial message, perhaps one which would indicate some more efficient means of communication.

EXTRATERRESTRIAL INTELLIGENT LIFE AND INTERSTELLAR COMMUNICATION: AN INFORMAL DISCUSSION

J. P. T. Pearman, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 287/293, A64-10238.

. . . Straightforward detection of "intelligent" transmissions seems to hold more promise than establishing two-way communication. . . . the use of lasers does not appear to be advantageous over interstellar distances, and, in the radio spectrum, the region from 10 to 30 kMc seems to be preferable for maximizing the signal-to-noise ratio. . . .

INTERSTELLAR AND INTERPLANETARY COMMUNICATION BY OPTICAL MASERS

R. N. Schwartz, et al., In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 223/231, 10 refs., A64-10233.

. . . the possibility of developing maser oscillators and other apparatus in or near the optical region which will allow the beaming of detectable light signals between planets of two stars separated by a number of light-years. The chance that broadcasts from another society approximately as advanced as we are could be detected by present telescopes and spectrographs is discussed, together with appropriate techniques now available for detection. . . .

IS COMMUNICATION POSSIBLE WITH INTELLIGENT BEINGS ON OTHER PLANETS

I. S. Shklovskii, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 5/16, A64-10211.

. . . possibility of establishing contact with intelligent beings on other planetary systems. Considered are the origin and development of life on planets surrounding the stars, similar to that on Earth, together with the nature of the communication channel, the distance that the signal will reach, and the method of overcoming interference.

THE SEARCH FOR SIGNALS FROM OTHER CIVILIZATIONS

S. von Hoerner, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 272/286, A64-10237.

. . . It is . . . assumed that a state of mind not too different from our own will have developed at many places but will have only a limited longevity. It is suggested that use be made of exactly twice the frequency of the 21-cm line. . . . The design is recommended of a receiving system which can be used for ordinary astronomy as well, since, because of the size and sensitivity needed for its prime task, it will be extremely powerful . . .

DETECTION OF INTELLIGENT SIGNALS FROM SPACE

J. A. Webb, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 178/191, A64-10228.

Discussion of the possibility of interstellar radio contact, and analysis of the detection techniques to be used. It is concluded that, whereas it would be generally unlikely that a 100-ft radio telescope, operating at 10^{o}K, could detect a civilization comparable to that on Earth at a range of 10 light-years, the possibility is certainly worth looking for, and a "lucky break" just might occur. . . . For example, our nearest stellar neighbor is 4.29 light-years away, but there are 55 stars within 16.6 light-years. . . .

THE GENERAL LIMITS OF SPACE TRAVEL

S. von Hoerner, In: Interstellar Communication, Edited by A. G. W. Cameron, New York and Amsterdam, W. A. Benjamin, Inc., 1963, p. 144/159, A64-10224.

. . . The conclusion drawn is that space travel, even in the most distant future, will be confined completely to our own planetary system, and a similar conclusion will hold for any other civilization, no matter how advanced it may be. The only means of communication between different civilizations thus seems to be electromagnetic signals.

DIVISION 4C.8
SPECIAL DEEP SPACE EXPLORATION PROJECTS

4C.820: Project IMP (Interplanetary Monitoring Platform)

Principal Publications:

SATELLITE ATTITUDE DETERMINATION: DIGITAL SENSING AND ON-BOARD PROCESSING
J. S. Albus, et al., IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 53/63.

. . . the Interplanetary Monitoring Probe (IMP). . . .

NSAS TO LAUNCH INTERPLANETARY EXPLORER SATELLITE
National Aeronautics and Space Administration, Washington, D.C., Nov. 10, 1963, p. 27, N63-23821.

. . . The first of a series of seven Interplanetary Monitoring Platform (IMP) satellites is to be launched . . .

4C.823: Project Lunar Orbiter

Principal Publications:

LUNAR ORBITER CAPSULE, FINAL PHASE-OUT REPORT
Radio Corp. of America, Princeton, N. J., Astro-Electronics Div., Dec. 31, 1962, 325 p., refs., N63-22054.

. . . Effects of tradeoffs on subsystems and recommendations of specifications for a specific Lunar Orbiter Capsule (LOC) system . . . Subsystem considered . . . (3) tele-communications subsystem, (4) television subsystem, and (5) power supply.

TELEVISION FROM SPACE
F. Leary, Space/Aeronautics, vol. 41, March 1964, p. 70/79, A64-16114.

. . . The Lunar Orbiter's proposed system will probably be similar to Columbia Broadcasting System Laboratories' Photoscan, using analog transmission. Techniques are under way for better exploitation of digital television by overcoming objections of complexity and the necessity at present for large bandwidths. . . .

LUNAR ORBITER - ITS MISSION AND CAPABILITY
I. Taback, American Astronautical Society, Annual Meeting, 10th, New York , N.Y., May 4/7, 1964, Preprint 64-7, 33 p., A64-17813.

. . . objectives of the Lunar Orbiter and of the measurements which are planned. . . .

4C.826: Project Lunik (USSR)

Principal Publications:

LUNAR EXPLORATION BY PHOTOGRAPHY FROM A SPACE VEHICLE
M. E. Davies, RAND Corporation, Paper P-1671, March 1959, p. 268/278, Xth International Astronautical Congress, London 1959, Springer-Verlag, Wien, 1960.

ANALYSIS OF THE ANNOUNCED TRAJECTORY OF THE RUSSIAN EXTRATERRESTRIAL VEHICLE, MECHTA I
K. E. Kissell, Air Force Cambridge Research Center, Bedford, Mass., Sept. 1959, 23 p., AD 251 314.

THE LAUNCHING OF A COSMIC ROCKET TOWARDS THE MOON
Priroda, Jan. 1959, p. 1/4.

A short account of the day-to-day progress of the cosmic rocket from January 2/5, 1959. In the first 62 hours it travelled to a distance of 597,000 km passing the moon and entering an orbit around the sun between those of the earth and Mars.

BY ROCKET TO THE MOON
V. I. Levantovskiy, Aerospace Technical Intelligence Center, Wright Patterson Air Force Base, Ohio, April 1960, 236 p., Trans. No. MCL-879m ot, k if Gosudarstvennoye Izdatel'stov Fiziko-Matematicheskoy Literatury, Moscow: 305 p., 1960, AD 264 192.

SCHEMATIC CHART OF THE FAR SIDE OF THE MOON
I. I. Breido, et al., In: The Moon. New York, Academic Press, Inc., 1962, p. 25/38, A63-18374.

HOW GOOD IS LUNIK III PHOTOGRAPHY?
M. E. Davies, The RAND Corporation, Paper P-1892, May 1960, 2 p., Reprint from "Astronautics", May 1960.

ANALYSIS OF LUNIK III PHOTOGRAPHS
A. H. Katz, The RAND Corporation, Paper P-2250, Feb. 1960, p. 27/44, Proceedings of Lunar & Planetary Exploration Colloquium, vol. II, No. 2, March 17, 1960.

A STUDY OF PHOTOGRAPHS OF THE FAR SIDE OF THE MOON AND DESCRIPTION OF SINGULAR FEATURES REVEALED ON ITS SURFACE
Y. N. Lipsky, In: The Moon, New York, Academic Press, Inc., 1962, p. 7/23, A63-18373.

. . . interpretation and designation of the features of the far side of the Moon as seen from photographs taken from Lunik 3 (1959 Theta). . . .

PROBABLE STRUCTURE AND NATURE OF THE FORMATIONS ON THE REVERSE SIDE OF THE MOON ACCORDING TO PHOTOMETRIC MEASUREMENTS OF LUNAR PHOTOGRAPHS
A. V. Markov, In: The Moon, New York, Academic Press, Inc., 1962, p. 39/44, A63-18375.

THE REVERSE SIDE OF THE MOON
A. A. Mikhailov, In: The Moon, New York, Academic Press, Inc., 1962, p. 3/6, A63-18372.

. . . from the flight of Lunik 3 (1959 Theta). Briefly outlined is the type of equipment carried by the space vehicle, its method of photographing the lunar surface, and the means of transmitting the data to Earth. . . .

LUNAR TRAJECTORY STUDIES AND AN APPLICATION TO LUNIK III TRAJECTORY PREDICTION
A. Petty, et al., Space Science Lab., General Electric Co., Philadelphia, Pa., Scientific rept. no. 1, AFCRL TN 60-1132, July 1960, AD 247 577.

A summary is given of technical accomplishments pertaining to three relatively closely connected areas: (1) design of a fast, accurate and efficient computer program for computation of lunar trajectories; (2) an application of the resulting computer program to an error analysis of specific lunar trajectories and to the determination of some actual trajectories (as an example, the trajectory of LUNIK III is considered in detail); and (3) tracking program (determination of initial conditions to be used in the equations of motion).

THE OTHER SIDE OF THE MOON (Translated from Russian)
J. B. Sykes, London, Pergamon Press, 1960, 36 p.

. . . describes the third Russian space rocket which was launched on 4th October 1959. There are reproductions of photographs which were made from the automatic interplanetary station, particularly those photographing the side of the Moon not visible from Earth, also diagramatic illustrations of the satellite in orbit. . . .

SOVIET SATELLITES AND SPACE SHIPS (SELECTED ARTICLES)
S. G. Aleksandrov, et al., Air Force Systems Command, Foreign Technology Div., Wright Patterson AFB, Ohio, Feb. 23, 1962, 269 p., 154 refs., Transl. from the book "Sovietskiye Sputniki 1 Kosmicheskiye Korabli", Moscow, Akad. Nauk SSR, 1961, 2nd Ed., p. 24/82, 117/124, 144/147, 182/184, 217/242, 256/394, 427/456 (FTD TT 62-121/1+2), N63-18430.

INVESTIGATION OF THE FAR SIDE OF THE MOON WITH THE AID OF ROCKETS. Appendix - SCHEMATIC MAP OF THE FAR SIDE OF THE MOON
Y. N. Lipskii, et al., In: The Moon, Meteorites, and Comets, Vol. IV - The Solar System, Edited by Barbara M. Middlehurst and Gerard P. Kuiper, Chicago and London, University of Chicago Press, 1963, p. 90/122, A64-12634.

. . . the Soviet Lunik 3 . . . instruments carried by the rocket . . . temperature control, and the directional and orientation controls . . . techniques employed to obtain an optimum sequence of photographs . . . details of the lunar features observed on the far side of the Moon. . . .

SOME CONVENIENT FORMULAE FOR THE TRAJECTORY OF THE SPACE PROBE APPLIED TO LUNIK I.
G. B. Longden, Royal Aircraft Establidhment, Farnborough (England), RAE TN SPACE 40, July 1963, 50 p., AD 423 032.

A missile flying on a hyperbolic orbit, trajectory formulae which proved most convenient in ballistic missile experience is discussed. . . . illustrated by using some of the facts published about Lunik I to deduce the approximate trajectory in the earth and the moon.

THE IMPACT OF LUNIK II ON THE MOON
P. Moore, J. Brit. Astron. Assoc., vol. 71, no. 5, 1961, p. 218.

SOVIET SPACE EXPLORATION
V. Sharonov, Industr. Res., vol. 5, Sept. 1963, p. 59/67, A64-10879.

. . . investigations of the Moon, the composition of interplanetary space, space radiation . . .

4C.830: Project Mariner

Principal Publications:

FLIGHT DATA ANALYSIS
P. H. Feitis, et al., JPL Res. Summ., no. 36-11, Aug./Sept. 1961, p. 4/5.

Determination of density profile of Mars atmosphere from Mariner B capsule flight data. A computer program which simulates the rotational as well as the translatory motion of a passive capsule during entry into a planetary atmosphere has been obtained from Ames Research Center.

THE MARINER PLANETARY COMMUNICATION SYSTEM DESIGN
B. D. Martin, Jet Propulsion Lab., Calif. Inst. of Tech., Technical rept. 32-85, rev. 1, 15 May 1961, 62 p., AD 256 945.

. . . a discussion of the design constraints imposed upon the communication system by the mission and launch dates. Interplanetary space communications state-of-the-art is then discussed, leading to a prediction of the available system bit-rate capacity for this and future missions. The general over-all design of the communication system to be employed on the Mariner mission is presented . . . use of near-optimum binary data transmission techniques.

MARINER
JPL Space Progr. Summ., vol. 1, no. 37-8, Jan./Feb. 1961, p. 23/30.

MARINER A
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 30/34.

Systems
1. Flight Sequence . . .

MARINER A
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 34/35.

Magnetic Spectrometer

SPACECRAFT ANTENNAS AND RF COMPONENTS
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 35/36.

. . . three separate antenna systems, a high-gain parabolic antenna, a command antenna, and an omnidirectional telemetry antenna. . . .

MARINER A
JPL Space Progr. Summ., vol. 1, no. 37-9, March/ April 1961, p. 36/39.

Electrical Power

MARINER A
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 39/40.

Mid-course guidance analysis. . . . The covariance matrix of injection guidance errors has been utilized in determining the trajectory dispersion in the plane perpendicular to the incoming asymptote at Venus.

MARINER A
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 40/43.

. . . spacecraft is 964 pounds. . . . Mariner A and Centaur interface design. . .

MARINER A — TELECOMMUNICATIONS
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 43/45.

. . . three separate antenna systems: . . .

MARINER A — COMMUNICATIONS SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-11, July/Aug. 1961, p. 25/32.

The over-all configurationof the Mariner A communications system is given in SPS 37-6, Page 69. A description of the modulation and demodulation philosophy and system is given in SPS 37-9. The detailed mechanization of the telemetry encoder is discussed in this issue. The function of the Mariner A flight data encoder (Fig. 20) is to accept approximately 90 analog and digital signals from the spacecraft. In addition, the encoder will receive and keep a cumulative count of an unspecified number of uncorrelated event pulses from the spacecraft.

MARINER A — ELECTRICAL POWER
JPL Space Progr. Summ., vol. 1, no. 37-11, July/Aug. 1961, p. 32/35.

MARINER R — SOLAR PLASMA ANALYZER
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 25/27.

MARINER R
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 25/32.

. . . design of the system test complex for Mariner R has been completed . . .

MARINER R — ANTENNAS, RF COMPONENTS, AND COUPLERS
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 27/29.

The Mariner R antenna system consists of a Ranger I-type high gain antenna modified to circular polarization, a Ranger I-type omnidirectional antenna used for short distance telemetry, and the Mariner A-type solar panel mounted command antennas. The Mariner A

command antennas were described in SPS 37-10, Vol. 1. . . . including a Ranger I rotary joint for the high gain antenna, an 890-mc filter, and a 7-db directional coupler for the command antenna system.

MARINER B — BIOLOGICAL INSTRUMENTATION
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 33.

Multivator is the name given to an instrument concept which will perform a wide variety of biological analyses. . . .

MARINER B — TELEVISION EXPERIMENT
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 33/35.

. . . From a scientific point of view, the most fundamental parameter to be considered is resolution. . . .Every incremental improvement of resolution beyond 5 km is significant in attempting to understand Martian morphology, until a resolution of about 100 m is reached. . . .The detectors . . . will be 400-line vidicon tubes. Encoding will be by pulse code modulation using 6 bits per picture element or just under 10^6 bits per piture. Storage of 100 pictures is contemplated.

MARINER B — SECONDARY POWER
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 35/39.

PLANETARY SCAN SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 19/22.

. . . ultraviolet (UV) spectrometer and the radiometer. . .will scan the planet Venus in one plane described by the spacecraft trajectory around the planet and in another plane described by the rotation of these instruments about the scan axis. . .

MARINER R
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 23/28.

. . . The Mariner R preliminary design was initiated in early September using this new design weight. It now was possible to include the weight of a mid-course propulsion system to increase the probability of getting close enough to the planet. . . .

SPACECRAFT ANTENNAS
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 30/31.

The Mariner R antenna system consists of a Ranger RA-1 type high-gain antenna modified to circular polarization, an RA-1 type omnidirectional antenna used for short-distance telemetry, and the Mariner A type solar panel mounted command antennas. The Mariner A command antennas were described in SPS 37-10, Vol. 1.

SECONDARY POWER
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 32/35.

. . . Mariner R system will have a raw power capability of 200 watts. . . . Electrical Inverters. . . . The power profile (Fig. 25) shows the raw power required by the 2400- and 400-cps systems, and the battery load requirements . . .

A DATA CONDITIONING SYSTEM FOR THE MARINER SPACECRAFT
R. C. Baron, et al., Rec. Nat. Symp. Space Electronics Telemetry, no. 7.2, Oct. 1962.

. . . to gather information from scientific instruments aboard the spacecraft, to prepare this data for transmission to Earth, and to generate special instrumentation control and calibration signals. The . . . Scientific Data Conditioning System (SDCS) is a high density, low power, solid-state electronic system. . . .

III. THE MARINER PLANETARY COMMUNICATION SYSTEM DESIGN
B. D. Martin, Proc. Nat. Telem. Conf., vol. 2, no. 8-3, 1962.

. . . will be used on the first Mariner spacecraft, a Venus probe, to be launched during the summer of this year. While the basic design philosophy and implementation techniques remain essentially the same, the major system difference between that reported here and that used in the Mariner is the deletion of the S-band transponder system. . . .

MARINER B CAPSULE PROPULSION STUDY
R. Sehgal, et al., Jet Propulsion Lab., Calif. Inst. Of Tech., Pasadena, JPL-TM-33-86, 1 June 1962, 36 p., refs., N64-10902.

. . . advantages of propelling the Mariner B capsule from the spacecraft on a flyby trajectory, as opposed to merely dropping it from the spacecraft on an impact trajectory and then diverting the spacecraft bus . . .

MARINER R — SECONDARY POWER
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 29/31.

. . . is similar to the Ranger spacecraft design . . .

MARINER R — SOLAR PLASMA ANALYZER
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 14/16.

Problems experienced in the electrometer during assembly were: 1. Quadrature in the carrier signal . . . 2. Low gain in the ac amplifier section. 3. Low frequency ripple on the electrometer output.

MARINER R PROJECT
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 14/33.

. . . replacement for the Mariner A project which was cancelled during Sept. 1961 due to unavailability of Centaur launch vehicle. . . .

MARINER R — PARTICLE FLUX DETECTOR
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 16/18.

MARINER R — SCIENTIFIC INSTRUMENTS GSE
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 18/20.

The scientific instruments ground support equipment (GSE) consists of five consoles. . . . two consoles and the Flexowriter are used for testing the data conditioning system (DCS).

MARINER R — RF COUPLERS
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 21/22.

The basic differences between the Mariner R and the Ranger I and II spacecraft Agena B RF coupler interfaces are:

1. The Mariner R high gain antenna is circularly polarized instead of linear.
2. The Mariner R uses separate command antennas mounted on one of the solar panels instead of diplexing both 890 and 960 mc through the omni-antenna as in Rangers I and II.

MARINER R — SECONDARY POWER
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 22/25.

MARINER R — FLIGHT EQUIPMENT
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 25/26.

The Mariner R power system less solar panels is presently installed in the spacecraft which is being subject to system tests at the spacecraft assembly facility.

MARINER R — SECONDARY POWER GSE
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 26/30.

MARINER B — TELEVISION SUBSYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 35/38.

. . . A block diagram of the TV subsystem is shown in Fig. 3. . . . presently no tubes available that completely meet Mariner B requirements. . . .

PLASMA PROBE
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 38/40.

. . . utilization of techniques achieved in the development of the Surveyor plasma probe will afford higher resolution measurements of a broader particle energy spectrum than obtainable with the Ranger instrument.

MARINER B — ANTENNAS, RF COMPONENTS, AND COUPLERS
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 40/41.

SECONDARY POWER
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 41/44.

Mariner B . . .

MARINER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 21/32.

Missions . . . Status . . . Spacecraft Description . . . (Figs. 1 and 2) has a conical configuration that bears a strong genetic resemblance to the Ranger Series. . . . Scientific Experiments . . . Solar Plasma Detector . . . Central Computer and Sequencer . . . Mid-Course Propulsion System . . . Ground Support Equipment . . . Central Computer and Sequencer GSE . . . Attitude Control GSE.

TELEVISION SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 59/66.

. . . two TV cameras mounted on the planetary horizontal platform (PHP) of Maniner, one for the purpose of obtaining high-resolution photographs of the Martial surface (Camera A), and another having a wider field of view of obtaining colorimetric information from the planet and its atmosphere . . . A block diagram of the TV subsystem . . .

ULTRAVIOLET SPECTROMETER
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 66/69.

For the Mariner Venus (1965) mission . . . Test Results of Model 9-15 UV Spectrometer . . .

SOLAR PLASMA ANALYZER
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 77/79.

. . . for the Mariner Venus (1962) flyby mission . . .

PARTICLE FLUX DETECTOR
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 79/81.

The ionization chamber. . . measures the total ionization rate per unit volume of gas produced by radiation . . . A GM tube particle flux detector has been developed for use with the ionization chamber on the Mariner Venus (1962) spacecraft. . . .

PLASMA PROBE
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 81/83.

. . . for use on the advanced Mariner spacecraft. . . . utilization of techniques achieved in the development of the Surveyor plasma probe . . .

MARINER PROJECT
JPL Space Progr. Summ., vol. 6, no 37-16, May/July 1962, p. 27/34.

. . . completed a series of system and envirionmental tests . . .

SCIENTIFIC SYSTEM FOR THE ADVANCED MARINER
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 34/41.

The scientific instruments can be divided into three groups according to their location on the spacecraft: (1) the bus (main spacecraft structure), (2) the capsule, or (3) the planetary horizontal platform.

TELEVISION SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 59/69.

. . . Each camera is to be a shuttered system utilizing a "slow-scan" vidicon . . . Total mission storage of 100 pictures is to be provided with the selection of which picture to store, controlled by a preset program. The TV data is to be telemetered to Earth at a minimum bit rate of 21 bits/sec requiring about 13 hr. to transmit one complete picture.

PLASMA INSTRUMENT
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 69/71.

. . . the advanced design Mariner plasma instrument . . .

SOLAR PLASMA ANALYZER
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 75/76.

DISF PARTICIPATION IN MARINER II
JPL Space Progr. Summ., vol. 3, no. 37-17, July/Sept. 1962, p. 3/6.

With the successful launch of the Mariner 2 Venus probe the DSIF (Table 1) began a program of spacecraft tracking and communications. This program: (1) Provided the tracking data . . . (2) Received, recorded and transmitted to the JPL data analysis center the telemetry data . . . (3) Provided the ability to command the spacecraft. . .

TELEVISION SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962.

Shutter Development . . . Mariner television camera . . . Flag-type shutter . . . Rotary blade shutter . . . Mariner Mars TV camera with Digital Control.

MARINER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 21/28.

Mariner 2 (Fig. 1) is presently on an encounter trajectory to Venus and all subsystems are operating normally . . .

MARINER (1962) COMMAND SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 29/31.

Provides the capability to initiate any of 12 independent events aboard the spacecraft and the capability to transmit the 18-bit mid-course maneuver parameters to the spacecraft central computer and sequencer. The basic elements of the command link are presented in Fig. 7 . . . Circuit design . . . Package design . . .

MID-COURSE PROPULSION SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 31/32.

Mariner 1 . . . Mariner 2 . . .

TRACKING OPERATIONS: MARINER 2
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 35/36.

Commands to the spacecraft have been successfully transmitted from both the Johannesburg Station and the Echo Station.

EFFECT OF SPACECRAFT MAGNETIC FIELD ON MARINER MAGNETOMETER MEASUREMENTS
JPL Space Progr. Summ., vol. 6, no. 37-18, July/Nov. 1962, p. 75/76.

. . . presented a serious problem to the task of measuring the weak field intensities of interplanetary space. . . .

SOLAR PLASMA INSTRUMENT
JPL Space Progr. Summ., vol. 6, no. 37-18, July/Nov. 1962, p. 76/78.

. . . completed 54 days of highly productive and informative energy spectrum analysis . . . performance summary for the device over this period.

MARINER 2 SYSTEMS OPERATIONS AND PERFORMANCE
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 21/38.

. . . launch . . . on August 27. . . .

MARINER VENUS 1964 DESIGN
JPL Space Progr. Summ., vol 6, no. 37-18, Sept./Nov. 1962, p. 38.

TRACKING OPERATIONS
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 45/47.

All DSIF stations are continuing to successfully track and receive telemetry data from Mariner 2.

Ranger 5 was launched on October 18, 1962 . . . The Goldstone Pioneer Station was able to track the spacecraft, using the capsule signal, unitl October 29, when the signal level fell below the station threshold.

MARINER TELEVISION SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 67/70.

A Mars flyby mission is proposed in which the Mariner will pass the planet at a velocity of approximately 5 km/sec relative to the planet, and at a nominal miss distance of 25,000 km. A system is . . . designed that can obtain from 8 to 20 photographs with an effective TV resolution of 2.5 km. The mechanization is to include the ability to take two-color data with about a 60% overlap between the two pictures.

DSIF PARTICIPATION IN MARINER 2
JPL Space Progr. Summ., vol. 3, no. 37-19, Nov./Jan. 1962, p. 4/6.

Telemetry data were provided 24 hr/day until December 17, 3 days after planetary encounter, at which time the requirements for DSIF coverage were relaxed to 10 hr/day (only one station tracking per day).

MARINER 2 FLIGHT OPERATIONS
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 23/36.

MARINER VENUS 1964 TRAJECTORIES AND DESIGN
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 36/43.

MARINER MARS 1964 DESIGN
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 43/46.

DSIF PARTICIPATION IN MARINER 2
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 49/51.

. . . continued successfully to track and receive telemetry data from Mariner 2 on its flight to Venus. . . . received on a 24-hr/day basis until December 17 (3 days after encounter), when coverage was reduced to 10-hr/day . . .

GROUND SUPPORT EQUIPMENT
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 63/65.

MARINER MARS 1964 LOGICALLY CONTROLLED SHUTTER-AND-FILTER WHEEL
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 81/82.

SOLAR PLASMA EXPERIMENT
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 91/95.

Data recieved from the Mariner 2 . . . show that there was always a measurably large plasma flow from the direction of the Sun. . . .

MARINER 2 SOLAR PLASMA ANALYZER
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 95/96.

. . . has completed 112 days of in-flight operation in Mode II, the spacecraft cruise mode, and 7 hrs. in Mode III, the encounter mode . . .

THE EVALUATION OF CERTAIN PHYSICAL CONSTANTS FROM THE RADIO TRACKING OF MARINER II
J. D. Anderson, et al., American Institute of Aeronautics and Astronautics, Astrodynamics Conference, New Haven, Conn., Aug. 19-21, 1963, Paper 63-424, 10 p., A63-21734.

Description of the mathematical techniques used to obtain physical-constant information from the Mariner II. . . . data from the viewpoint of the parameter estimation procedure, the calculation of the residuals, and the variational coefficients for orbital parameters and physical constants. . . .

MARINER R RELIABILITY MODEL FORMULATION AND QUALITATIVE ASSESSMENT
J. D. Andrew, et al., Planning Research Corp., Los Angeles, Calif., PRC R-266, Aug. 24, 1962, 125 p., refs., N63-22053.

. . .investigation of the Mariner R spacecraft as configured for a Venus-approach mission . . .

MICROWAVE RADIOMETER DEVELOPMENT FOR MARINER VENUS 1964
F. T. Barath, JPL Space Progr. Summ., vol. 4, no. 37-23, Aug./Sept. 1963, p. 258/264.

. . . radiometer operates simultaneously at 33-mm (9-Gc) and 8.5 mm (35-Gc) wavelengths. Both channels are of the Dicke type, the first channel being a tuned radio frequency (TRF) and the second a crystal video system.

MARINER-2 MICROWAVE OBSERVATIONS OF VENUS
A. H. Barrett, et al., Sky and Telescope, vol. 25, April 1963, p. 192/195, A63-26098.

Description of the techniques and equipment used in the observations of Venus by Mariner 2

. . . Various microwave radiometer measurements are discussed. Preliminary results indicate a Venus surface temperature of approximately 700°K, a value in keeping with previous radio measurements. . . .

THE MARINER (VENUS ϒ1962) FLIGHT TELECOMMUNICATIONS SYSTEM
J. N. Bryden, Proc. Internat. Telem. Conf., vol. 1, Sept. 1963, p. 498/508.

. . . provided 2-way doppler, automatic angle tracking, command, and telemetry functions. Two-way doppler is achieved by the spacecraft transponder receiver, which receives at a frequency of 89- Mc and, when in lock, transmits the telemetry carrier signal at exactly 96/89ths of this frequency giving a transmitted frequency of 960 Mc. . . . The command and telemetry systems make use of identical modulation and detection methods. Each employs two subcarriers, related in frequency by a ratio of 2/1. The data subcarrier frequency is biphase modulated according to the state of the binary data information, and the synchronization subcarrier is biphase modulated by cyclic pseudo-random code. . . .

MARINER (VENUS '62) FLIGHT TELECOMMUNICATIONS SYSTEM
J. N. Bryden, JPL Tech. Rept. 32-377, Jan. 1963, 20 p., N63-14466.

THE MARINER 2 INFRARED RADIOMETER EXPERIMENT
S. C. Chase, et al., J. Geophys., vol. 68, Nov. 15, 1963, p. 6157/6169, 12 refs., N64-15964.

COMMUNICATING WITH FUTURE DEEP-SPACE PROBES
W. E. Dahl, Electronics, vol. 36, May 3, 1963, p. 28/30, 32, A63-18054.

Description of the manner in which the Mariner II . . . spacecraft communication system functioned to receive commands and transmit telemetry during the 109-day flight. . . .

MARINER II - ATTITUDE CONTROL SYSTEM
R. G. Forney, International Astronautical Federation , International Astronautical Congress, 14th, Paris, France, Sept. 25-Oct. 1, 1963, Paper 131, 52 p., A63-25674.

THE VOYAGE OF MARINER II
J. N. James, Sci. Amer., vol. 209, July 1963, p. 70/84, A63-20308.

. . . major results of the flight are summarized in table form.

MARINER SPACECRAFT PACKAGING
J. Jodele, Jet Propulsion Lab., Calif. Inst. of Tech. Pasadena, JPL TR-32-451, July 1, 1963, 20 p., N63-22165.

. . . (conventional components on printed wiring boards) . . . found to be reliable, relatively easy to design on a short time scale and easy to fabricate and modify.

FINAL REPORT ON MARINER 2 TEMPERATURE CONTROL
D. W. Lewis, et al., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-140, July 1, 1963, 30 p., N64-10338.

. . . chronological history of the thermal aspects of the Mariner 2 flight is given, including telemetry data for monitored components. . . .

POST-DETECTION ELECTRONICS FOR A COMPARATIVE RADIOMETER SYSTEM
H. R. Mertz, JPL Space Progr. Summ., vol. 4, Feb./March 1963, p. 164/169.

. . . Mariner 1962. . .

THE MARINER 2 DATA PROCESSING SYSTEM
D. B. Sparks, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 1963, 13 p., AD 407 761.

. . . and procedures used in the processing of tracking and telemetry data are presented with accompanying data flow charts . . .

THE MARINER II DATA PROCESSING SYSTEM
D. B. Sparks, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 1963, 13 p., Presented at AIAA Space Flight Testing Conf., Cocoa Beach, Fla., 18-20 March 1963, N63-17521.

MARINER DESIGN MODIFIED FOR MARS FLYBY
I. Stone, Aviation Week and Space Technology, vol. 78, May 6, 1963, p. 50/51+, A63-18185.

Discussion of the Mariner C Mars-flyby spacecraft . . . scheduled for launching in November 1964. . . .

MARINER B TELECOMMUNICATION SYSTEM RELIABILITY STUDY
M. K. Tam, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TM-33-146, 15 Aug. 1963, 129 p., refs., N64-15780.

. . . A comprehensive comparison between the results of the Mariner A and The Mariner B reliability studies is presented.

THE MISSION OF MARINER II: PRELIMINARY OBSERVATIONS
K. A. Van Allen, et al., JPL, Calif. Inst. of Tech., Pasadena, TR32-383, Science, v. 139, no. 3549, Jan. 4, 1963, 10 p., 22 refs., N63-16386.

MARINER: MISSION TO VENUS
H. J. Wheelock (comp.), Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 1963, 125 p., Also: New York, McGraw-Hill Book Co., Inc., N63-21488.

. . . The historic mission of Mariner II to the near-vicinity of Venus and beyond has enabled scientists to revise many of their concepts of interplanetary space and the planet Venus.

THE MARINER R PROJECT: VOLUME 2: SUPPLEMENTARY DOCUMENTATION
Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Progress Report, Sept. 1, 1962, Jan. 3, 1963, JPL-TR-32-422, vol. 2, 1 July 1963, 269 p., N64-13180.

. . . containing . . . lists covering the flight hardware and ground support equipment for Mariner R 1962 and Mariner 1964 . . . listing of components designated as flight equipment for Mariner R 1964, prior to the cancellation of the Mariner R Project . . . summary of Mariner R-3 design-evaluations tests . . . summary of failure reports for Mariners 1, 2, and R-3.

MARINER II REPORTS
NASA, Washington, D. C. Office of Educational Programs and Services, NASA FACTS B-4-63, 1963, 1 p., N63-16563.

MARINER II COMPLETES ORBIT OF SUN
NASA, Washington, D. C., Aug. 1, 1963, 3 p., N63-18874.

TRANSCRIPT OF THE PHOTOVOLTAIC SPECIALISTS CONFERENCE. VOLUME II. REPORT ON SYSTEMS EXPERIENCE. APPLICATIONS, AND DESIGN, 11 APRIL 1963 AT THE STATLER HILTON HOTEL, WASHINGTON, D. C.
Power Information Center, U. of Pennsylvania, Philadelphia, Rept. no. PIC SOL209 3.1, Vol. 2, July 1963, 1v., AD 412 463.

. . . Mariner II Solar Panel Design and Flight Performance . . . Design of OAO Solar Cell Arrays; Orbiting Manned Laboratory Power Systems . . .

AUTOMATIC-DATA SYSTEMS FOR SYSTEMS TEST APPLICATION
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 68/70.

. . . Initial application of the data systems is planned for the Mariner Mars 1964 Project . . . system block diagram . . .

MARINER MARS 1964 PHOTOGRAPHIC SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 104/108.

. . . The transmission bit-rate is to be 8.33 bits-per-sec with a bit-error rate not to exceed one error in 300 bits. A 200 scan line raster is to be used with resolution capability of 200 picture elements per line . . . The TV data will be stored and transmitted in digital pulse code modulation form. A conversion of 6-bits-per-picture element will be used resulting in 240,000 bits-per-picture.

MARINER MARS 1964 TELEVISION SUBSYSTEM OPTICAL SUBASSEMBLY
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 112/113.

EVALUATION OF THE SLOW-SCAN VIDICON
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 108/111.

. . . For the Mariner Mars 1964 camera . . . the vertical scan rate is 24 sec . . . tests performed have been confined to scan rates and operating potentials within the capabilities of the Mariner Mars 1964 TV subsystem.

MARINER MARS 1964 DESIGN
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 27/34.

Description . . . was presented in SPS 37-19, Vol. VI. There have been no gross changes to the spacecraft configuration . . .

MARINER 2 SUBSYSTEM PERFORMANCE
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 22/27.

Accuracy of Midcourse Maneuver Execution . . . Power Subsystem . . . Long Range Earth Sensor . . .

MARINER 2 FLIGHT OPERATIONS
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 21/22.

Passed by the planet Venus on December 14, 1962 . . . All subsystems aboard the spacecraft performed satisfactorily.

TV CAMERA SHUTTER
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963.

MARINER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963, p. 17/24.

The primary purpose of the Mariner Mars 1964 mission is to permit a biology-oriented scientific investigation of the planet Mars during the 1964 opportunity. . . . A digital computer program which will simulate spacecraft missions is being developed for the IBM 7094 computer. . . .

MARINER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-23, July/Sept. 1963, p. 17/26.

. . . Mariner Mars 1964 TV system test was conducted using breadboard counterparts of the spacecraft equipment. . . . Spacecraft Design. . .

CENTRAL COMPUTER AND SEQUENCER OPERATIONAL SUPPORT EQUIPMENT
JPL Space Progr. Summ., vol. 6, no. 37-23, July/Sept, 1963, p. 42/43.

SOLAR PANEL SIMULATOR
JPL Space Progr. Summ., vol. 6, no. 37-23, July/ Sept. 1963, p. 43.

TV OPERATIONAL SUPPORT EQUIPMENT
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 35/39.

Operational support equipment . . . Mariner C spacecraft television system. The OSE is also required to strip the TV data from the data automation system format.

SCIENTIFIC INSTRUMENTS SUBSYSTEM TEST COMPLEX
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 33/35.

A test complex (Fig. 5) has been assembled for operation verification of the Mariner C (Mars mission 1964) . . .

OPERATIONAL SUPPORT EQUIPMENT JUNCTION BOX
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 46/47.

. . . junction box has been developed for the Mariner C scientific OSE which is completely removable from the OSE console. . . .

MARINER C SCIENTIFIC INSTRUMENTATION SCIENCE SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 71/77.

. . . The instruments and their ancillaries designed to accomplish these purposes are listed and briefly described in Table 2 and Fig. 12.

A COMPUTER-CONTROLLED CHECKOUT SYSTEM FOR SCIENTIFIC INSTRUMENTS
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 47/49.

The Mariner C operational support equipment (OSE) is designed for both manual OSE operation and computer-controlled testing. The computer system is illustrated in Fig. 21. This system consists of a Digital Equipment Corp., (DEC) PDP-4B computer and a peripheral console. The PDP-4B is a single-address, parallel, binary machine operating with an 18-bit word length. Standard features include stored program operation, a random access magnetic-core memory, a complete order code, and indirect addressing.

MARINER C - SCIENCE DATA AUTOMATION SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 77/87.

The DAS is divided into two electrically and physically separable units: the real-time (RT) DAS and the non-real-time (NRT) DAS. . . . A block diagram of the DAS is shown in Fig. 14.

MARINER C PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 13/22.

The over-all objective of the Mariner C Project is to perform a successful mission to Mars during the 1964 period of availability. . . .

MECHANIZATION OF THE NONREALTIME DATA AUTOMATION SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-25, July/Dec. 1963, p. 53/56.

. . . Science Data Automation System (NRT DAS) . . . complete DAS is described in Ref. 1. This report reviews the design constraints and hardware trade-offs involved in the design of the NRT system.

MARINER C100-KW TRANSMITTER - KLYSTRON AMPLIFIER SUBSYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 18/19.

. . . To meet the Mariner C requirements, it was decided to furnish a 100-kc CW klystron amplifier subsystem in the frequency range of 2100 to 2130 Mc designed to be a direct replacement for the 2388-Mc klystron amplifier subsystem. . . . a second 100-kw amplifier would be provided . . . with the provisions for rapid transfer . . . functional block diagram . . .

ANALYSIS OF ANOMALIES IN MARINER 2 DATA
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 58/59.

EFFICIENCY OF VIDEO DATA UTILIZATION IN A SPACE TV CAMERA SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 47/50.

. . . For a planetary experiment where data are not to be transmitted in real time, a continuous flow of transmitted data may be maintained by suitable control of the tape machine . . . A well established clamp technique for establishing a black-reference potential will be described for the camera output-amplifier of the Mariner C system.

MARINER TELEVISION SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 41/43.

MARINER C TV DEVELOPMENT SUPPORT EQUIPMENT
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 42/46.

Three sets of development support equipment (DSE) are being developed and fabricated to support the test, calibration and evaluation of the Mariner C TV subsystem. Every effort is being made to ensure that the three equipments are identical to provide consistent test data no matter which equipment is used, whether at JPL or AMR.

MARINER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 11/18.

Mariner C mission(Mariner Mars 1964 Project) is to conduct close-up (flyby) scientific . . . The proof test model (PTM) spacecraft is assembled . . .

OPERATIONAL SUPPORT EQUIPMENT
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 27/28.

Mariner C central Computer and Sequencer Simulator . . .

SPACE SCIENCES OPERATIONAL SUPPORT EQUIPMENT
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 32/38.

Description of some of the equipment being used in the checkout of the Mariner C science subsystem . . . Count rate accumulator and ion chamber interval counter. . . . Real Time data translator. . . . Standard isolation box.

MARINER C ATTITUDE-CONTROL OPERATIONAL SUPPORT EQUIPMENT
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 32/38.

Among the new capabilities that have been incorporated in the Mariner C attitude-control operational support equipment (OSE) to monitor new sybsystems are the solar vane monitors and the gyro rebalance loop.

PLANETARY SIMULATION FOR MARINER C PLANETARY SCAN SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 56/58.

The design and construction of a planetary simulator for the Mariner C planetary scan subsystem has been completed. The device is used to evaluate the instrument in both bench and environmental testing.

Related Publications:

MAGNETIC TAPE RECORDERS
W. E. Arens, JPL Space Progr. Summ., vol. 4, no. 37-24, Oct./Nov. 1963, p. 175/183.
Mariner B Magnetic Tape Recorders . . . Mariner C Magnetic Tape Recorder . . .

DEMODULATION AND DETECTION EFFICIENCY OF AN UNCODED, COHERENT, BIORTHOGONAL DIGITAL CHANNEL IN GAUSSIAN NOISE
G. L. Fultz, JPL Space Progr. Summ., vol. 4, no. 37-21, April/May 1963, p. 204/210.

. . . From the results of the . . . discussion, the data demodulation and detection efficiency of the Mariner 2 demodulator was questioned and subsequently analyzed. . . .

TIME CONSTANT REQUIRED FOR MATCHED FILTER
C. E. Gilchriest, JPL Space Progr. Summ., vol. 4, no. 37-21, April/May 1963, p. 210/212.

Telemetering and command systems for the Mariner require matched filters which are perfect integrators. . . . analysis considers both the noise and the signal and shows that a time constant of the order of 1 to 3 bit lengths is adequate.

VENUS AND THE MARINER
E. J. Opik, Irish Astron J. (Armagh), vol. 6, no. 2, June 1963, p. 59/67, refs, N64-10343.

. . . Observations relating to surface conditions on Venus, which were obtained radiometrically (by radiation measurements, not by radio) during the Mariner II 35 minutes of fly-by, are discussed . . .

4C.842: Project Mars Probe (USSR)

Principal Publications:

NO GAINS WITHOUT PAINS, MARS I
Z. Dobrichovsky, Foreign Tech. Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, 20 Feb. 1963, 6 p., incl. illus., Trans. no. FTD-TT-63-131 from Veda Technika Mladezi, No. 26, p. 915/917, 1962, AD 299 855.

SOVIET INTERPLANETARY ROCKET TO MARS
V. Gubarev, Joint Publications Research Service, Washington, D.C., JPRS: 16523, 5 Dec. 1962, 15 p., AD 400 400.

THE FIRST FLIGHT TO THE PLANET MARS
J.W. Palmer, Royal Aircraft Establishment (Gt. Brit), Jan. 1963, 10 p., illus., (Library Trans. no. 1026 from Pravda, 15 Dec. 1962), AD 299 876.

. . . automatic interplanetary station "Mars I" launched from the Soviet Union on 1st November 1962. The layout and equipment of the vehicle are described with photographs and diagrams . . .

NA PUTI K MARSU (En Route to the Planet Mars) (In Russian)
A. Sergeev, Grazhdanskaia Aviatsiia, Feb. 1963, p. 4, A63-16606.

. . . techniques used in the launching of the Soviet "Mars I" automatic space station toward Mars on November 1, 1962. . . .

ON THE WAY TO THE PLANET MARS. "MARS I"
Fl. Zaganescu, Joint Publications Research Service, Washington, D.C., In its Transl. from Stiint. si. Tech., Sci. and Technol., Bucharest, vol. 14, no. 9 and no. 11, Sept.-Nov. 1962, Air Transport and Space Sci., 4 April 1963, p. 11/19, N64-10776.

Preparations for the launching of the MARS I space probe and the equipment carried on the probe. . . The main purpose for launching the approximately one-ton space laboratory was to carry out long-range studies in cosmic space, to establish interplanetary space radio-communications, to photograph Mars, and to transmit the photographs by radio.

4C.845: Project Pioneer

Principal Publications:

PIONEER SPACE PROBE
R.R. Bennett, Proc. Nat. Electronics Conf., vol. 14, Oct. 1958, p. 1068/1074.

. . . schedule for this program . . . background . . . significant special experiments . . . Project Able . . .

RUSSIAN NEWS BRIEFS: "MARS I" IN FLIGHT
Electro-Optical Systems, Inc., Pasadena, Calif., May 24, 1963, 3 p., Transl. from Pravda, Moscow, May 17, 1963, N63-17248.

SOVIET SCIENCE IN THE NEWS. THE FIRST FLIGHT TOWARD THE PLANET MARS
Electro-Optical Systems, Inc., Pasadena, Calif., Rept. no. 1, 15 Dec. 1962, 19 p., AD 435 566.

EQUIPMENT ON BOARD SOVIET INTERPLANETARY SHIP (STATION) MARS I
Foreign Tech. Div., Air Force Systems Command, Wright-Patterson AFB, Ohio, FTD TT 63 638, 16 July 1963, 2 p., AD 415 078.

ON THE WAY TO MARS
Foreign Tech. Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, 3 Jan. 1963, 5 p., incl. illus., Trans. no. FTD-TT-62-1921 from Russian Newspaper, Izvestiya, p. 4, 16 Dec. 1962, AD 295 767.

FORWARD TO MARS
Air Force Systems Command, Wright-Patterson AFB, Ohio, Foreign Technology Div., 28 Jan. 1963, 5 p., Transl. into English from Izv., Moscow, no. 15, 1962, p. 1/4, FTD-TT-63-94/1+2+4, AD 400 548, N64-13158.

On November 12, 1962, a routine communication session was held with the automatic interplanetary station Mars I. . . . Station Mars I was 3,650,000 kilometers away from Earth at the instant of the communications session . . .

MARS AND MARS-I
Foreign Tech. Div., Air Force Systems Command, Wright-Patterson AFB, Ohio, FTD TT 63 395, 2 Oct. 1963, 3 p., AD 424 877.

The Soviet astronomer, Prof. V. Saronov, believes that photos obtained from the interplanetary station Mars-1 will show whether the planet Mars has mountains, what the composition of the atmosphere of this planet is, and what the substance of polar caps and so-called canals are.

TRACKING PIONEER IV BEYOND THE MOON
R.E. Anderson, et al., IRE Nat. Conv. Rec., pt. 5, 1959, p. 152/157.

THE GOLDSTONE TRACKING STATION
M. Eimer, et al., Nat. Symp. Space Electronics Telem., no. 6.5, Sept. 1959.

Tracking & Data Handling for the Pioneer III and Pioneer IV Firing.

THE ELEMENTS OF A DEEP-SPACE TRACKING SYSTEM. THE TRACKING OF PIONEER IV
H. L. Richter, Jr., Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Aug. 1959, 13 p., AD 234 170.

THE TRACKING OF PIONEER IV. THE ELEMENTS OF A DEEP SPACE TRACKING SYSTEM
H. L. Richter, et al., IRE Trans. Space Electronics Telemetry, vol. SET-5, no. 4, Dec. 1959, p. 196.

PROCESSING AND PRESENTATION OF DATA FROM OUTER SPACE I. PIONEER PROBE
J. M. Seehof, et al., Proc. Nat. Telem. Conf., May 1959, p. 232/246.

RADIATION MEASUREMENTS TO 658, 300 KM, WITH PIONEER IV
J. A. Van Allen, et al., Nature, vol. 184, no. 25, July 1959, p. 219/224.

1958 NASA/USAF SPACE PROBES (ABLE-1) FINAL REPORT VOLUME 1. SUMMARY
Space Technology Labs. for NASA, NASA Memo 5-25-29W June 1959, 90 p.

1958 NASA/USAF SPACE PROBES (ABLE-1) FINAL REPORT VOLUME 2. PAYLOAD AND EXPERIMENTS
Space Technology Labs. for NASA, NASA Memo 5-25-59W, June 1959, 200 p.

1958 NASA/USAF SPACE PROBES (ABLE-1) FINAL REPORT VOLUME 3. VEHICLES, TRAJECTORIES, AND FLIGHT HISTORIES
Space Technology Labs. for NASA, NASA Memo 5-25-29W, June 1959, 230 p.

TEMPERATURE CONTROL SYSTEM FOR THE ATLAS ABLE-4 LUNAR SATELLITE
R. M. Acker, et al., Space Technology Lab., Inc., Los Angeles, Calif., 31 March 1960, 18 p., AD 269 302.

. . . to control the mean internal temperature . . . within the range of 45 to 70 degrees F . . . development of an active, lightweight closed loop temperature control system.

TRACKING EXPERIMENTS WITH PIONEER IV
T. A. Barr, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 355/359.

SIGNAL PROCESSING FOR SPACE VEHICLE EXPERIMENTS
P. J. Coleman, Jr., IRE Nat. Symp. Space, no. 4-3, Sept. 1960, p. 1/28.

Brief descriptions of several experiments carried aboard the space probes, Pioneer I, II and V, and the earth satellite, Explorer VI, are presented. . . . two basic telemetry systems were employed. . . . an FM-PM system and the second was a pulse coded, bi-phase modulated system. These systems are described briefly . . .

PIONEER III AND IV SPACE PROBES
H. Curtis, et al., IRE Trans. Mil. Electronics, vol. MIL-4, no. 2/3, April/July 1960, p. 123/129.

. . . a description of the flight hardware, and a synopsis of the results of the experiments.

A FUNCTIONAL DESCRIPTION OF PIONEER V
P. F. Glaser, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 361/366.

. . . to explore space out to the maximum range of present communication facilities, in the range of 50 to 60 million miles. . . . launched on March 11, 1960 . . . the lightest of the three payloads in the recent Able series . . . carries no propulsion equipment and therefore a greater proportion of its weight can be devoted to instrumentation. . . . sensing and measuring equipment for the scientific experiments, the Telebit unit, a doppler transponder consisting of a command receiver and transmitter, a solar cell power conversion system . . .

THE PIONEER V COMMUNICATION AND TRACKING SYSTEM
P. F. Glaser, Proc. Nat. Commun. Symp., vol. 6, Oct. 1960, p. 38/43.

THE DATA SYSTEMS FOR EXPLORER VI AND PIONEER V
E. W. Greenstadt, Trans. IRE Space Electronics Telemetry, vol. SET-6, Sept./Dec. 1960, p. 112/119.

TRACKING THE MOON PROBES
A. R. Hibbs, et al., COSPAR First Internat. Space Science Symp. - at Nice, France, 1960.

RADIATION INSTRUMENTATION ELECTRONICS FOR THE PIONEERS III AND IV SPACE PROBES
C. S. Josias, Proc. IRE, vol. 48, no. 4, April 1960, p. 735/743.

MILLSTONE OPERATIONS RELATED TO THE PIONEER V SPACE PROBE
R. R. Silva, Lincoln Lab., Mass. Inst. of Tech., Lexington, 23 June 1960, 9 p., illus., Rept. no. 30G-0007, AD 239345.

. . . The Pioneer V space probe . . . Millstone tracking station was very successful in obtaining angular, doppler and telemetry data from Pioneer V. Automatic antenna tracking enabled very accurate angular data to be obtained during the launch phase and several subsequent transmission periods during the first and fourth days thereafter. . . .

UNIVERSITY OF CHICAGO PROPORTIONAL COUNTER TELESCOPE EXPERIMENT FOR EXPLORER VI AND PIONEER V
Laboratories for Applied Sciences, U. of Chicago, Ill., Subcontract to Space Tech. Labs., Inc., Los Angeles, Calif., Rept. STL/TR-60-0000-0166, Final rept., 25 June 1960, 20 p., AD 269 307.

GOLDSTONE RECEIVER SITE
JPL Res. Summ., vol. 1, no. 36-4, April/May 1960, p. 13/16.

Tracking Pioneer V. . . . This probe contained a PCM telemeter system which transmitted information via either a 5-watt or 150-watt transmitter sending a 378.21-mc phase-modulated signal. . . . Although the Goldstone tracking station did not have a command function in this operation, it obtained tracking data and recorded the telemetered data signals. . . . on April 1 and 2, 1960 . . . the signal from Pioneer V, at this time, the range . . . was 2,900,000 nautical miles. . . . was tracked for two periods. . . . Kitoon Tracking Exercises. To evaluate the tracking characteristics of the Goldstone Station receiver site antenna, a radio beacon and antenna . . . are suspended from a balloon-type vehicle and are tracked by the receiver site antenna. . . .

INTERPLANETARY SPACECRAFT COMMUNICATIONS SYSTEMS
P. F. Glaser, In: Advances in the Astronautical Sciences, vol. VIII, American Astronautical Society, Annual Meeting, 7th, Proceedings, Dallas, Tex., Jan. 16-18, 1961, New York, Plenum Press, Inc., 1963, p. 16-24, A63-17621.

. . . Pioneer V . . . communications system . . . Detailed performance measurements . . . solar flare activity during the lifetime of Pioneer V is evaluated. . . .

THE SCIENTIFIC RESULTS OF THE PIONEER V SPACE PROBE
J.W. Lindner, In: Advances in the Astronautical Sciences, vol. VIII, American Astronautical Society, Annual Meeting, 7th, Proceedings, Dallas, Tex., Jan. 16-18, 1961, New York, Plenum Press, Inc., 1963, p. 56/69, 16 refs., A63-17625.

. . . magnetic field measurements, radiation measurements . . . astronomical unit, obtained for distances up to 40 million km from the Earth. . . .

PROJECT ABLE-4
A. J. McMahon, Space Technology Labs., Los Angeles, Calif., Final mission rept., vol. 2, Rept. no. STL/TR-60-V002-02092, May 1961, 146 p., AD 259 094.

Pioneer V, 1960 Alpha, was successfully launched on 11 March 1960. It escaped the earth and was established in a solar orbit . . . This space probe was equipped with a cosmic ray telescope, an ion chamber and geiger tube, a search coil magnetometer and a micrometeorite detector. Digital data from these experiments were telemetered to the Hawaii and Manchester ground stations until 26 June 1960 when Pioneer V was 22,462,000 nautical miles from the earth.

REDUCTION AND ANALYSIS OF EXPLORER VI AND PIONEER V DATA, VOLUME I
A. Rosen, et al., Space Technology Labs., Inc., Redondo Beach, Calif., Rept. 8626-6006-RU000, 30 Nov. 1962, 199 p., refs., N64-17677.

. . . discussed: (1) the structure composition and dynamics of the Radiation Belt during August and September 1959; (2) Explorer VI Satellite observations of the geomagnetic field during magnetic storms; (3) Pioneer V data reduction and analyses; (4) an investigation of signal fading on Explorer VI and Pioneer V transmissions; and (5) satellite signal fluctuation caused by ionospheric irregularity.

THE PIONEER IV LUNAR PROBE: A MINIMUM-POWER FM/PM SYSTEM DESIGN
B. D. Martin, JPL, Calif. Inst. of Tech., Padadena, Calif., Tech. rept. no. 32-215, 15 March 1962, 76 p., incl. illus., tables, refs., AD 274 664.

. . . A discussion of the phase-coherent (phase-lock) technique is presented . . . The use of a carrier-tracking loop as a phase demodulator is examined, and expressions for the usable carrier and subcarrier sideband powers are developed. A useful channel design equation is then described . . .

DOLLING UP A SPACE PROBE
A. B. Mickelwait, et al., Electronics, vol. 37, March 23, 1964, p. 80/84, A64-16061.

. . . Description of Pioneer 6, the most magnetic-field-free deep space probe, first of a new series of scientific satellites to be launched during the International Year of the Quiet Sun, in mid-1965. . . .

THE NEW PIONEER SATELLITES
I. Stambler, Space/Aeronautics, vol. 40, Nov. 1963, p. 58/64, A64-10689.

Discussion of important new data on interplanetary space to be expected from launchings both toward and away from the Sun. . . . The new Pioneer's data transmission system is being designed for a capacity of 64 commands, but this may be increased to 128 commands.

Related Publications:

THE DISTANT GEOMAGNETIC FIELD, 5. LONG-PERIOD OSCILLATIONS
C. P. Sonett, J. Geophys. Res., vol. 68, no. 24, 15 Dec. 1963, p. 6371/6376, N64-13028.

. . . Long period magnetic oscillations (≥ 100 seconds) seen on the Pioneer I flight are discussed. The indication is that these oscillations are comparable in scale to the magnetosphere and are primarily radial, that is, they are contained in geomagnetic meridian planes . . .

4C.848: Project Prospector

COMMUNICATION SYSTEMS ANALYSIS FOR LIGHTWEIGHT ROVING LUNAR VEHICLE
G. L. Dunn, General Electric Co., Santa Barbara, Calif., Rept. no. 61 SPC-4, 2 Nov. 1961, 41 p., incl. illus., tables, 5 refs., AD 273 812.

. . . Efforts were made to determine the transmitter power requirements as a function of data transmission rate for the Prospector moon-to-earth TV link. An analysis is presented based on the utilization of PCM-PS modulation at an RF carrier frequency of 2250 mc. The ground based receiver station utilizes the DSIF equipment. The video input is obtained from the output terminals of an image orthicon camera located aboard the tank.

4C.850: Project Ranger

Principal Publications:

SPACE-VEHICLE ATTITUDE CONTROL
N. Sirri, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 2 Oct. 1960, 37 p., AD 243 163.

. . . one being developed by the Jet Propulsion Laboratory of the California Institute of Technology for its Ranger space craft . . .

B. RANGER SPACECRAFT COMMUNICATIONS
JPL Research Summ., vol. 36, no. 5, Aug./Sept. 1960, p. 62/66.

COMMUNICATIONS SYSTEM COMPONENTS
JPL Res. Summ., vol. 1, no. 36-2, Feb./March 1960, p. 15/22.

The communications system for the first Ranger spacecraft will consist of a 250-mw transmitter and a 3-watt transponder. The 250-mw transmitter will telemeter spacecraft engineering and scientific measurements and may be used to provide tracking data with respect to two angles and one-way doppler. . . .

RANGER COMMUNICATIONS
JPL Res. Summ., vol. 1, no. 36-3, April/May 1960, p. 24/26.

RANGER -1 AND SPACECRAFT RA-1
JPL Res. Summ., vol. 1, no. 36-3, April/May 1960, p. 55/58.

The Atlas-Agena Ranger-1 trajectory has been designed to produce a highly elliptical orbit, since such an orbit best satisfies the requirements of the attitude control, scientific mission, and communication subsystems. . . .

RANGER-3 TRAJECTORY
JPL Res. Summ., vol. 1, no. 36-3, April/May 1960, p. 58.

. . . During the spacecraft's first pass over the Goldstone meridian, a midcourse maneuver will be made. . . .

FLIGHT PERFORMANCE ANALYSIS
JPL Res. Summ., vol. 1, no. 36-3, April/May 1960, p. 69/74.

. . . desirable to obtain some very early postinjection tracking. . . .

CAVITY TEMPERATURE COMPENSATION
JPL Res. Summ., vol. 1, 36-4, June/July 1960, p. 87/89.

The spacecraft UHF transmitters for Ranger RA-1 employ only one type of cavity amplifier. This unit is used both as a 0.25-watt and as a 3-watt amplifier. . . .

RANGER SPACECRAFT COMMUNICATIONS
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 62/64.

The Ranger two-way communications system contains an 890/960-mc transponder consisting of a narrow-band double superheterodyne, automatic phase tracking receiver operating at 890.046 mc and an integrally related transmitter operating at 960.050 mc. . . . Transponder . . . Design parameters . . . Improved transponder . . .

ANTENNA TRANSFER SWITCH
JPL Res. Summ., vol. 1, no. 36-5, Aug./Sept. 1960, p. 64/65.

The Ranger communication system incorporates two antenna types. . . . the problem of switching resolves to the effective and efficient transfer of the 3-watt transmitter power from one antenna system to the other. . . .

THE RANGER SPACECRAFT
J. D. Burke, Astronautics, Sept. 1961, p. 23/26, N63-19537.

. . . redundant systems were provided for critical operations such as power supply and radio transmission. . . .

DATA PROCESSING FOR NEAR REAL TIME ENGINEERING EVALUATION OF RA-1 AND -2
A. E. Dickinson, JPL Res. Summ., vol. 1, no. 36-9, April/May 1961, p. 20.

. . . Spacecraft Data Analysis Team (SDAT) . . . Some aspects of providing the RA-1 and -2 SDAT with the telemetry data required to perform this function are discussed here. . . .

PREPARING RANGER FOR OPERATIONS
F. Duerr, Astronautics, Sept. 1961, p. 28/29+, N63-19539.

. . . sequence of the final checkout precedures at Cape Canaveral . . .

THE RANGER BOOSTER
H. T. Luskin, Astronautics, Sept. 1961, p. 30/31+, N63-19540.

. . . Atlas-D/Agena-B . . .

DSIF IN THE RANGER PROJECT
N. A. Renzetti, Astronautics, Sept. 1961, p. 34/37+, N63-19542.

. . . DSIF can maintain continuous communications with the spacecraft by means of three permanent Deep Space Stations located at approximately equal intervals around the world. . . . DSIF will provide tracking information and raw telemetry data . . . will transmit commands to the spacecraft when required. . . .

COMMUNICATIONS WITH LUNAR PROBES
N. A. Renzetti, et al., Jet Propulson Lab., CIT, Pasadena, Calif., Tech. rept. 32-148, 23 Aug. 1961, 18 p., AD 262 446.

. . . communications equipment aboard the space-craft, and the participation of the SDIF in this project are discussed.

SCIENTIFIC EXPERIMENTS FOR RANGER 1 AND 2
Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 3 Jan. 1961, 28 p., AD 252 041.

. . . radiation detectors . . .

EARLY RANGER EXPERIMENTS
Astronautics, Sept. 1961, p. 26/27, N63-19538.

An individual description of each of the eight scientific experiments designed for early Ranger spaceflights . . .

THE RANGER PROGRAM
JPL, Calif. Inst. of Tech., Pasadena, JPL-TR-32-141, Rept. of 7 papers from Astronautics, Sept. 1961, 27 p., N63-19535.

SCIENTIFIC EXPERIMENT FOR RANGER 3, 4, AND 5
Jet Propulsion Lab., CIT, Pasadena, Calif., Technical rept 32-199, 5 Dec. 1961, 25 p., AD 269 878.

. . . include a vidicon camera to obtain close-up pictures of the Moon's surface . . . A gamma ray experiment . . . an altimeter . . . A seismometer will be landed to obtain data regarding the inner structure of the Moon and the magnitude and depth of any thermal activity.

RANGER
JPL Space Progr. Summ., vol. 1, no. 37-8, Jan./Feb. 1961, p. 3/18.

Telecommunications, 1. Antenna System. . . 2. Data Encoder: The basic system for encoding telemetering data in a form suitable for modulation of the RF carrier for Ranger RA-3, -4, and -5 spacecraft is a PAM/FM or time-division-multiplex/FM subcarrier method. 3. Rate limiter. 4. Timing System . . .

RANGER
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 4/11.

RANGER TELECOMMUNICATIONS
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 11.

Antennas and RF Components . . .

RANGER - ELECTRICAL POWER
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 12/16.

RANGER - SCIENTIFIC INSTRUMENTS
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 16/20.

RANGER - TELESCOPE VIDICON CAMERA
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 20/24.

. . . with a 40-inch equivalent focal length telescope. . . photographs secured with a 200 TV line scan vidicon at 4000 km distance . . . present vidicon telescope system will transmit from 4000-km down to 24-km altitude . . .

RANGER - GAMMA-RAY SPECTROMETER EXPERIMENT
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 24/25.

RANGER
JPL Space Progr. Summ., vol. 1, no. 37-10, May/ June 1961, p. 3/4.

RA-1 spacecraft . . . problems encountered during spacecraft checkout . . .

RANGER
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 4/10.

Spacecraft Integration. Systems Integration. System Analysis.

RANGER - TELECOMMUNICATIONS
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 10/12.

Data Encoder The basic system . . . is a PAM/FM or time division multiplex/FM subcarrier method . . . many data points are periodically sampled, and the sampled data then frequency modulates an oscillator. The outputs of several FM oscillators, each being modulated with sampled data, are linearly mixed, and the composite signal then modulates the transponder.

RANGER - TELECOMMUNICATIONS
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 12/18.

Omnidirectional Antenna. . . .

ELECTRICAL POWER
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 18/25.

RANGER - SCIENTIFIC INSTRUMENTS
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 26/27.

. . . Ranger RA-1 flight friction assembly . . .

RANGER PROGRAM
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 64/67.

Status.

RANGER - SOLAR CORPUSCULAR RADIATION ELECTROSTATIC ANALYZERS
JPL Space Progr. Summ., vol. 1, no. 37-11, July/Aug. 1961, p. 5/9.

RANGER PROJECT - VIDICON EXPERIMENT
JPL Space Progr. Summ., vol. 1, no. 37-11, July/Aug. 1961, p. 9/11.

RANGER - SPACECRAFT ANTENNAS
JPL Space Progr. Summ., vol. 1, no. 37-11, July/Aug. 1961, p. 11/14.

SECONDARY POWER
JPL Space Progr. Summ., vol. 1, no. 37-11, July/Aug. 1961, p. 14/18.

RANGER RA-1
JPL Space Progr. Summ., vol. 1, no. 37-11, July/Aug. 1961, p. 39/47.

. . . launching occured on August 23, 1961. The planned highly elliptical trajectory was not achieved, . . . tracking stations were able to successfully track Ranger RA-1 . . . telemetry data was also recorded. All tracking and data recording operations ceased on August 29 when signals were no longer received from the spacecraft.

SPACECRAFT ANTENNAS
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 4/10.

RANGER RA-1: FLIGHT PERFORMANCE
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 11/12.

RANGER RA-2
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 12/13.

. . . two distinct problem areas have been recognized during visual inspection of the hardware. . . . cracked subminature glass diodes . . . leaky Cerafil capacitors . . .

RANGERS RA-3, -4, AND -5
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 13/15.

. . . system testing, proof testing, and flight hardware delivery. . . . A block diagram of the RA-3 power system is presented in SPS 37-9, Vol. 1. . . .

RANGER
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 3/4.

Ranger II was launched on November 18 . . . The 2nd burn did not occur. . . . left in a low Earth orbit . . . Data was received from Ranger II at all DSIF stations during its brief flight, which probably terminated after 6 orbits.

RANGER - ANTENNAS AND RF COMPONENTS
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 9/11.

Omnidirectional antennas. . . .

SYSTEM FLIGHT ANALYSES: RANGER I
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 11/16.

. . . Ranger I communications system is shown in Figure 7. During operation, it has several normal functions which are detected through the telemetering and ground system. They are: (1) transponder lock, (2) power up, (3) antenna switchover, (4) commands, and (5) beacon modulation.

RANGER II REPORT
JPL Space Progr. Summ., vol. 1, no. 37-13, Nov./Dec. 1961, p. 43/46.

. . . launching occurred on November 18, 1961 . . . . Some tracking data was obtained by the Mobile Tracking Station located in South Africa.

BRIEF DESCRIPTION OF RANGER LUNAR SEISMOGRAPH
F. E. Lehner, Proc. IRE, vol. 50, no. 11, Nov. 1962, p. 2297.

RANGER VIDICON TV CAMERA USES ELECTROSTATIC DEFLECTION
J. F. Mason, Electronics, vol. 35, no. 8, Feb. 1962, p. 26/27.

THE EFFECT OF BIAS AXIAL VELOCITIES AND ALTIMETER FUZING ALTITUDE ON RANGER IMPACT SURVIVABILITY
Aeronutronic, Newport Beach, Calif., Technical Report, Publication U-1826, Sept. 15, 1962, 38 p., refs., N64-10336.

RANGER PROJECT
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 3/11.

Ranger III was launched on Jan. 26, 1962. . . . spacecraft was injected into an orbit with too high an energy for it to intercept the moon. . . . DSIF provided tracking and telemetry coverage continuously for 5 days . . .

RANGER III OPERATION
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 47/52.

PARTICIPATION IN RANGER 4
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 3/4.

. . . launched . . . on April 23 . . . Although the spacecraft was injected into a lunar-impact trajectory, no data were obtained from any of the experiments nor could any performance of ground commands be obtained.

RANGER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 3/12.

Ranger 1 and 2 Flight Operations . . .

GROUND SUPPORT EQUIPMENT
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 17/19.

Earth Sensor GSE . . . to check out the Ranger Earth sensor at AMR . . .
Data Encoder GSE

THE RANGER 6, 7, 8, 9 SPACECRAFT
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 3/7.

Description . . . Flight Sequence . . . TV Subsystem Development . . .

FLIGHT ANALYSES
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 8/11.

Ranger 3 . . . on January 26, 1962 . . . Ranger 4 . . . on April 23, 1962 . . .

SYSTEM DESIGN CHANGES
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 7/9.

. . . general product improvement program . . . modifications have been incorporated into the Ranger 5 design (and subsequent Rangers) to preclude the same type failure. . . .

RANGER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 3/7.

. . . Ranger 5 spacecraft is undergoing prelaunch preparations at AMR . . .

PARTICIPATION IN RANGER 5
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 3/5.

. . . mission was unsucessful due to a failure . . . in the spacecraft . . .

MID-COURSE PROPULSION SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 10/12.

RANGE 5 FLIGHT SUMMARY
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 3/5.

. . . launched . . . on October 18, 1962 . . . a failure probably in the power switching and logic circuitry, caused the spacecraft to transfer from solar to battery power. Normal operation was never resumed. . . . Telemetry received during these periods indicated that the mid-course maneuver sequence had been completed . . .

RANGER TELEVISION CAMERA SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 51/54.

The primary scientific objective of Ranger high-resolution television missions (SPS 37-16, Vol. VI, pp 3/7, 52, 53) is the acquisition of lunar topographic information of sufficient quality to aid in the design of lunar unmanned vehicles and the initial planning for manned lunar exploration.

TRACKING OPERATIONS
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 45/47.

All DSIF stations are continuing to successfully track and receive telemetry data from Mariner 2. . . .

TV SUBSYSTEM DEVELOPMENT
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 15/16.

RANGER EARTH SENSOR
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 12.

TEST OPERATIONS
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 5/9.

. . . Ranger 6 . . . Ranger 7 Assembly and Subsystem Testing . . . Space Simulation Testing - Ranger 7, 8, 9 . . . Ranger Test and Evaluation Plan . . .

RANGER TV SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 67/72.

Ranger 5 Ground Data Handling - The primary receiving station for Ranger 5 television data was the Echo Station at Goldstone, Calif. . . . consisted . . . of a specially modified Ampex FR-600 tape recorder, ground support equipment racks containing all necessary program and sync logic, scan converters and video monitors, and special 35-mm kinescope film recorders. Video Performance Through Telemetry - A test tape . . . which consisted of three sections. The first section contained Channel 1, Channel B-2, and an unmodulated Channel V carrier of 3.6 kc. The second section of tape was used for telemetry signal-to-noise calibrations and contained the same signals as the first section with the exception that the Channel V signal was modulated from band-edge to band-edge with a 100-cps square wave. The final section of tape contained the Mode IV signals with a test pattern modulation of Channel V.

RANGER TV SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 18.

RANGER 5 FLIGHT EVALUATION
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 3/8.

. . . launched . . . October 18, 1962 . . . the attempted midcourse maneuver was not successful . . .

RANGER 6-9 ASSEMBLY AND TEST OPERATIONS
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 8/14.

RANGE PROJECT STATUS
J. D. Burke, In: Technology of Lunar Exploration. Progress in Astronautics and Aeronautics, Vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 855/875, A63-23449.

TRAJECTORY DESIGN FOR RANGER AND MARINER MISSIONS
V. C. Clarke, Jr., AIAA Astrodynamics Conf., Yale U., New Haven, Conn., Aug. 19-21, 1963, AIAA Paper 63-408, N63-20761.

. . . for lunar and interplanetary missions . . . the trajectory selection process for the Ranger 3, 4, and 5 missions is described to exemplify the interrelationships between spacecraft design, mission objectives, and trajectory design . . . The constraining factors discussed for the Ranger mission include flight time, launch date, launch time, landing location on the moon, and retrovelocity increment.

PHOTOGRAPHY OF THE MOON FROM SPACE PROBES
M. Eimer, Jet Propulsion Labs., JPL Tech. Rept. 32-347, Jan. 1963, 21 p.

. . . description of Ranger 3 telescope.

MIDCOURSE GUIDANCE USING RADIO TECHNIQUES
C. R. Gates, et al., In: Technology of Lunar Exploration. Progress in Astronautics and Aeronautics. Vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 265/278, A63-23427.

. . . An analysis of the midcourse guidance system of the Ranger 3 . . . demonstrates the feasibility of the three major elements of the guidance system . . .

RANGER PREFLIGHT SCIENCE ANALYSIS AND THE LUNAR PHOTOMETRIC MODEL
A. G. Herriman, et al., Jet Propulsion Labs., JPL Tech. Rept. 32-384, Jan. 1963, 38 p., N63-13449.

RANGER TV SUBSYSTEM
B. P. Miller, American Astronautical Society, Annual Meeting, 10th, New York, N.Y., May 4-7, 1964, Preprint 64-6, 33 p., A64-17958.

Description of a Ranger TV subsystem developed to obtain pictures of the surface of the Moon during the terminal phase of a lunar impact trajectory in support of the Apollo program . . . design characteristics are . . . described, covering the camera group, communications group, telemetry, command and control group, power group, and thermal design. Finally, a summary of the Ranger 6 . . . mission is given.

SPACE FLIGHT OPERATIONS PLAN RANGER 6
P. J. Rygh (comp.), Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, 3 Sept. 1963, 178 p., N64-14744.

. . . Operational facilities and support equipment are described and the flow of data between facilities is outlined to show the operations scheduled to complete the mission . . .

THE MOON PROBES
I. Stambler, Space/Aeronautics, vol. 41, March 1964, p. 52/61, A64-16112.

Review of present and future status of the unmanned lunar probe program. The history and description of equipment of the Ranger 6 . . . probe are given in detail.

NASA TO LAUNCH SIXTH RANGER
National Aeronautics and Space Administration, Washington, D. C., New Release No. 64-16, 26 Jan. 1964, 55 p., N64-13938.

. . . will be launched on a lunar photographic mission by an Atlas-Agena vehicle from Cape Kennedy, Florida, no earlier than January 30. Although this is the sixth Ranger mission, the spacecraft will be called Ranger A to conform with a recent NASA change in spacecraft designations. If the launch is successful, the spacecraft will be named Ranger VI . . . description . . . power supply, midcourse motor, communications, stabilization system, television system . . . mission description . . . Deep Space Network . . .

RANGER DESIGN REVIEW
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 4/9.

SPACECRAFT TESTING
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 10/12.

COMMAND SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963, p. 1/2.

The Ranger command subsystem is divided into two types of equipment; flight and ground. . . . indicated in Fig. 1. . . . use of an 18-bit binary command word. Each bit is 1 sec long. . . . two types of commands . . . real-time command . . . stored command. . . . format and examples of both types . . . in Fig. 2.

TV SUBSYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963, p. 12/13.

GOLDSTONE OPERATIONS
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 5/8.

. . . Updating of equipment has been completed . . .

CENTRAL COMPUTER AND SEQUENCER OPERATIONAL SUPPORT EQUIPMENT
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 33.

. . . developed for use in the Ranger Block III spacecraft test program. . . .
Blockhouse (launch test set).
Systems test set.
Automatic subsystem checkout.
Fig. 4 shows a complete set of equipment as used in the laboratory or in the spacecraft assembly area.

RANGER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-24, Sept./Nov. 1963, p. 1/5.

. . . diodes used for the central computer and sequencer (CC&S) and Earth sensor electronics of the spacecraft were highly contaminated . . .

INVESTIGATION OF MICROPOLISH OXIDES FOR RECORDING RANGER BLOCK III DATA
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 50/51.

RANGER ATTITUDE-CONTROL OPERATIONAL SUPPORT EQUIPMENT
JPL Space Progr. Summ., vol. 6, no. 37-25, June/Dec. 1963, p. 28/30.

. . . systems test set . . . launch complex set . . . laboratory test set . . .

Related Publications:

THE RANGER LUNAR CAPSULE
F. G. Denison, Astronautics, Sept. 1961, p. 32/33+, N63-19541.

VIDICON DATA HANDLING
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 3/4.

. . . It should be possible to store three complete pictures of the RA-3 type in the computer at one time.

RANGER LUNAR CAPSULE ANTENNA
W. G. Scott, 1962 WESCON Conv. Rec., vol. 6, 1962, 7 p., A63-12981.

Discussion of the development of a curved turnstile antenna, with wide-angle circular polarization performance, for the instrumented capsule to be landed on the Moon by the Ranger spacecraft. . . .

LUNAR CAPSULE DEVELOPMENT
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 12/14.

LUNAR ROUGH LANDING CAPSULE DEVELOPMENT PROGRAM
Aeronutronic, Newport Beach, Calif., Final Technical Report, 20 Feb. 1963, 249 p., refs., N64-19316.

LUNAR FACSIMILE CAPSULE
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963, p. 10/12.

. . . general configuration of the LFC is basically that of the Ranger seismometer capsule, with a high-resolution facsimile (HRF) device replacing the seismometer experiment. . . .

4C.860: Project Surveyor

Principal Publications:

SURVEYOR TO COLLECT WIDE RANGE OF DATA
F. G. McGuire, Missiles and Rockets, vol. 8, no. 10, March 1961, p. 33/34.

Four television cameras and Hughes-developed soil drill are among variety of scientific instruments designed to conduct four experiments.

SURVEYOR
JPL Space Progr. Summ., vol. 1, no. 37-9, March/April 1961, p. 26/27.

A letter contract for initiating the Surveyor spacecraft development was executed with the Hughes Aircraft Company. . . To continue Surveyor systems analysis and trajectory studies. . .

SURVEYOR GEOPHYSICAL INSTRUMENT, VOLUME I: SURFACE GEOPHYSICAL INSTRUMENT-PROTOTYPE NO. I
R. E. Canup, et al., Texaco Experiment, Inc., Richmond, Va., Interim Report, May 1, 1962, 229 p., refs., N64-10097.

. . . The instruments included are designed to measure temperature, thermal diffusivity, magnetic susceptibility, density, penetrability, and acoustic velocity of the lunar surface. . .

SURVEYOR PROJECT STATUS
W. E. Giberson, In: Technology of Lunar Exploration. Progress in Astronautics and Aeronautics. Vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 877/904, A63-23450.

SURVEYOR PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 15/17.

The primary objectives of Surveyor are to successfully accomplish the soft landing of a number of scientific instrument payloads on the lunar surface (seven missions, 1963, 1964, and 1965): to provide for a minimum of 30 days (90 days desired) of scientific observations and measurements on the lunar surface with a modest quantity of reliable and sensitive scientific instruments: and to telemeter the scientific and engineering data to Earth for retrieval, reduction, and timely dissemination.

X-RAY DIFFRACTOMETER
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 47/48.

. . . for mineralogical analysis of lunar materials. . . . for use on Surveyor. . .

PETROGRAPHIC MICROSCOPE
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 48/50.

. . . for remote observation of crushed rock samples in transmitted light. . .

SURVEYOR SEISMOGRAPH SYSTEM
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 50/53.

. . . basic system consists of a three-component long-period seismometer (Fig. 8), a short-period vertical seismometer (Fig. 9), feedback control circuitry, a leveling system, and a calibration system.

SIGMA PLASMA DETECTOR
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 73/77.

. . . Surveyor. . . will examine the solar wind and Moon interaction and is a second generation version of the solar plasma detector flown on Rangers 1 and 2. . . .

SURVEYOR PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 23/24.

GEOPHYSICAL PARAMETERS INSTRUMENTATION
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 39/45.

. . . group of instruments designed to measure simple physical properties both on and beneath the lunar surface from a Surveyor soft-landing spacecraft. . . present summary briefly describes both the methods of measurement and the surface and subsurface prototype instrumentation.

SURVEYOR PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962.

The Surveyor A-21 spacecraft design (Fig. 1) has been frozen, except for the scientific instrument complement. . .

SURVEYOR PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-18, Sept./Nov. 1962, p. 17/19.

. . . scientific payload for the 2100-lb configuration has been defined; the two-camera panning television subsystem (SPS 37-17, Vol. VI, p. 18/19) was approved for inclusion. Other payload elements include a soil properties measuring device. . . a micrometeorite-ejecta detector, and a soil-analysis group consisting of: (1) surface sampler. . . (2) sample processor, (3) X-ray diffractometer . . . and (4) an alpha-particle-scattering measuring device.

SURVEYOR SCIENTIFIC INSTRUMENTS STATUS SUMMARY
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 75/78.

SURVEYOR PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-19, Nov./Jan. 1962, p. 19/22.

Spacecraft Development

SURVEYOR LANDER MISSION AND CAPABILITIES
M. Beilock, American Astronautical Society, Annual Meeting, 10th, New York, N. Y., May 4-7, 1964, Preprint 64-8, 42 p., A64-17817.

SURVEYOR SPACECRAFT SYSTEM. TOUCHDOWN DYNAMICS STUDY
R. E. Deitrick, et al., Hughes Aircraft Co., Culver City, Calif. Aerospace Group, Jan. 1963, 277 p., refs., N64-13014.

ELECTRONIC PACKAGING TECHNIQUES FOR SURVEYOR LUNAR SPACECRAFT
A. E. Hawley, et al., IEEE Trans. Product Engineering and Production, vol. PEP-7, Sept. 1963, p. 38/46, A63-24202.

ELECTRONIC PACKAGING TECHNIQUES FOR SURVEYOR LUNAR SPACECRAFT
A. E. Hawley, et al., IEEE Internat. Conv. Rec., Pt. 6, vol. 11, March 1963, p. 157/165.

INTERPRETATION OF RESULTS FROM SURVEYOR ALPHA-SCATTERING EXPERIMENT
A. A. Loomis, Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, JPL-TR-32-606, 30 April 1964, 17 p., refs., N64-19790.

Rocks on the moon's surface may differ from rocks below because of contamination by meteoritic infall, sputtering, and extensive mixing by impact. The broad categories of igneous rocks and meteorites, which are familiar on earth are the best models for rocks on the moon. . .

CENTAUR/SURVEYOR DIRECT ASCENT LUNAR CONIC TRAJECTORIES, 1964-1967
R. Richard, JPL, Calif. Inst. of Tech., Pasadena, JPL-EPD-155, May 13, 1963, 349 p., N63-19940.

A NOVEL CIRCULARLY POLARIZED PLANAR ARRAY FOR SURVEYOR
A. F. Seaton, et al., IEEE Internat. Conv. Rec., Pt. 1, vol. 11, March 1963, p. 2/9.

SURVEYOR: OUR FIRST LUNAR LABORATORY
I. Stambler, Space/Aeronautics, vol. 40., July 1963, p. 70/77, A63-18911.

. . . systems-subsystems, and instrumentation. . . Television will survey the landing area. . . Briefly discussed are the thermal-control, data-handling, communications, and power systems. The ground network for Surveyor is the command and data-handling console (CDC), which has three subsystems and is basically a modulating and demodulating system. Five modes for keying and punching commands into CDC are described.

SURVEYOR PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 15/20.

. . . a change in mission mode from parking-orbit to direct-ascent trajectories has been approved. . . for early Surveyor flights . . . decided to fly engineering payloads instead of scientific payloads on the first four Surveyor spacecraft . . .

SURVEYOR SCIENTIFIC INSTRUMENTS
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 71/74.

GROUND DATA HANDLING
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 74/76.

Introduction and summary of past efforts. . . Present status. . . TV ground data handling. . .

X-RAY DIFFRACTOMETER
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 76/78.

. . . will be used for mineralogical analysis of lunar materials. . .

ALPHA PARTICLE SCATTERING EXPERIMENT FOR SURVEYOR
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 78/79.

. . . Instrument operation and description . . . breadboard evaluation. . .

SOIL MECHANICS EXPERIMENT
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 80/82.

GAS CHROMATOGRAPH
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 82/90.

. . . part of the Surveyor scientific mission to provide an analysis of the volatile constituents in the lunar crust material. . . . prototype model P-2. . . was delivered to JPL on December 8, 1962.

SEISMOGRAPH
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 90/93.

. . . Four-component seismometer. . . . Single-axis seismometer. . . a backup instrument for Surveyor Lander Flights 5 through 8.

X-RAY SPECTROMETER
JPL Space Progr. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 94/96.

The objective of the Surveyor X-ray spectrometer experiment is to provide data to determine the elemental composition of materials taken from the lunar surface and subsurface.

SURVEYOR PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963, p. 14/16.

The first four Surveyor missions are designated as test missions . . . the payload has been defined (Fig. 1). The next three Surveyor missions, designated as operational missions, will carry the scientific experiments listed in Table 1.

4C.870: Project Voyager

Principal Publications:

VOYAGER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-15, March/May 1962, p. 3/12.

Sophisticated orbiters and landing experiments beginning in 1966 or 1967 using Saturn vehicles. . .

VOYAGER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-16, May/July 1962, p. 43.

VOYAGER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-17, July/Sept. 1962, p. 33/34.

A study of Voyager propulsion system requirements for Mars and Venus orbiters has been completed. Early estimates of the propulsion system mass and configuration are required for preliminary design of the spacecraft . . .

VOYAGER PROJECT
JPL Space Prog. Summ., vol. 6, no. 37-20, Jan./March 1963, p. 35.

4C.882: Project Venus Probe (USSR)

Principal Publications:

ANALYSIS OF THE ANNOUNCED TRAJECTORY OF THE RUSSIAN EXTRA-TERRESTRIAL VEHICLE, MECHTA I
K. E. Kissell, Air Force Cambridge Research Center, Bedford, Mass., AFCRC TN 59-60 5, Sept. 1959, 23 p., AD 251 314.

FIRST FLIGHT TO VENUS
Z. Jakubski, Space Technology Labs., Inc., Los Angeles, Calif., Rept. no. STL-TR, Trans. from Pravda, No. 57 (15547), 61-511019, AD 264 168.

SURVEYOR PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-23, July/Sept. 1963, p. 13/15.

SYSTEMS ENGINEERING
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 12/13.

. . . status. . . activities. . .
SURVEYOR. A test plan was prepared for compatibility testing. . . An additional test plan is under preparation for the purpose of testing the T-21, Surveyor spacecraft, with a full GSDS S-band system at Goldstone. The proposals for the Surveyor Roving Vehicle Project were reviewed for compatibility with the DSIF. . . .

Currently in the planning phase. . . use on the Saturn class of boost vehicle. . . Trajectory studies. . .

VOYAGER PROJECT
JPL Space Progr. Summ., vol. 6, no. 37-22, May/July 1963, p. 25/26.

. . . telecommunications requirements for the Mars 1969 opportunity may logically be divided into three categories: . . . (1) Functions between Earth and the parent spacecraft, or orbiter. . . . (2) Functions between the orbiter and capsule. . . (3) Functions between the landed capsule and Earth.

Related Publications:

APPLICATION OF DELAY-LOCK RADAR TECHNIQUES TO DEEP SPACE TASKS
R. B. Ward, Lockheed Aircraft Corp., Sunnyvale, Calif., Rept. no. 6 90 63 68, Oct. 1963, 58 p., AD 424 005.

. . . discusses the use of delay-lock radar techniques for deep-space tracking and communications tasks. . . a Mars or Venus space probe of the Voyager type is used as a typical mission. . .

SOVIET SATELLITES AND SPACE SHIPS (SELECTED ARTICLES)
S. G. Aleksandrov, et al., Air Force Systems Command, Foreign Technology Div., Wright-Patterson AFB, Ohio, Feb. 23, 1962, 269 p., 154 refs., Transl. from the book "Sovietskiye Sputnik 1 Kosmicheskiye Korabli" Moscow, Akad. Nauk SSSR, 1961, 2nd Ed., p. 24/82, 117/124, 144/147, 182/184, 217/242, 256/394, 427/456 (FTD TT 62-121/1+2), N63-18430.

VOLUME 4 - PART D

MANNED SPACEFLIGHT APPLICATIONS

The last class of space communications systems to be referenced in this bibliography has some special requirements which are not required for the other three classes. The presence of a human crew in the spacecraft imposes the need for voice communications and, in many uses, for television observation within the command module. Outside the spacecraft it is expected that crew members will have to communicate by radio intercommunications links, since there may be no atmosphere to support sound waves. An additional requirement is the installation of bio-medical telemetry to supervise the physiological functions of the astronauts. Reference of publications in these special areas are included in divisions 4D. 2 and 4D. 3. One subdivision (4D. 250) is devoted to a novel communications approach which may ultimately find application in other classes of space communications systems, but which originated in connection with the manned space flight project Apollo. This is the so-called unified S-band system which combines ranging code signals, telemetry signals and voice and television over the same carrier channel, thus saving space and weight which otherwise would go for separate equipment. This system also permits a great simplification for the ground station and increased efficiency in the use of auxiliary subsystems.

Other divisions deal with the special environment for manned space flight (4D. 1) with ground facilities (4D. 4) and with testing and training facilities (4D. 9).

Division 4D. 8 contains, similarly as in the previous parts, references to special projects. In this connection it may be pointed out that the project Apollo is discussed in this division, though it could well be classified as a deep space project. The compilers felt that the communications requirements for the service of the astronauts have, for this project, a stronger influence on the design of the communications systems than the requirements due to the deep space character of the mission. This situation may change for future manned missions of longer duration. A subdivision in part 4C has been established for references to deep space oriented publications about manned flight communications systems (See 4C. 450).

DIVISION 4D. 0
GENERAL REFERENCES

4D. 000: General References to Manned Space Flight Communications

Included: Manned space flight (summaries); Manned interplanetary flight (outlook); Recovery of manned spacecraft.

Not Included: Astronauts' problems in space.

Cross References: Training for manned space flight (4D. 900); Communications problems for manned lunar missions (4C. 450).

Principal Publications:

THE DEVELOPMENT OF MANNED SPACE VEHICLES
J. P. Kuettner, et al., Medical and Biological Problems of Space Flight; Proceedings of a Conference held in Nassau, the Bahamas, Nov. 1961, Edited by Geoffrey H. Bourne, New York and London, Academic Press, 1963, p. 1/45, A63-19993.

General history . . . Mercury . . . Gemini . . . Apollo . . . Vostok . . . Discussed and tabulated are characteristic data of propulsion systems for various missions, including satellite correction and transfer, and Jupiter, Saturn, and deep space probes.

NASA SPACE FLIGHT PROGRAMS - 4. MANNED SPACE FLIGHT
G. M. Low, Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 31/38.

ADVANCED MANNED SPACE SYSTEMS
T. D. Smith, et al., Medical and Biological Problems of Space Flight, Proceedings of a Conference held in Nassau, The Bahamas, Nov. 1961, Edited by Geoffrey H. Bourne, New York and London, Academic Press, 1963, p. 47/62, A63-19994.

Brief description of the reusable interplanetary transport approach (RITA), a nuclear rocket-propelled space vehicle designed for safe, reliable, low-cost space transportation.

DEVELOPMENT OF MANNED ARTIFICIAL SATELLITES AND SPACE STATIONS
S. J. Gerathewohl, In: Advances in Space Science and Techology, Vol. IV, New York Academic Press, Inc., 1962, p. 203/317, 49 refs., A63-17571.

. . . details of such modern craft as the X-15, Dynasoar, Mercury, and Vostok.

FUNCTIONAL AND ENVIRONMENTAL FACTORS AFFECTING THE MILITARY UTILITIES OF MAN IN SPACE
I. Katz, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 63/68.

EMERGENCY AND ROUTINE SPACE VEHICLE RECOVERY
J. B. Meyer, et al., 1962 IRE Internat. Conv. Rec. Pt. 5, vol. 10, p. 153/162, A63-12527.

. . . results of several investigations concerning the critical re-entry and recovery phase of manned and unmanned space flight. The terminal support system is described, and various flight requirements for support are reviewed for several known re-entry, landing, and recovery missions. . . . shown that the necessary requirements can be met by using a mobile X-band CW beacon-tracking radar with integral voice, command, and telemetry channels, in association with a digital data-processor designed for real-time control applications.

MANAGEMENT OF MANNED SPACE PROGRAMS
W. von Braun, In: Science, Technology, and Management, National Advanced-Technology Management Conference, Proc., Seattle, Wash., Sept. 4-7, 1962, New York, McGraw-Hill Book Co., Inc., 1963, p. 248/262, A63-16601.

. . . organization and management of the Marshall Space Flight Center. . . . particular attention to the Saturn-Apollo program. . . .

MANNED SPACE FLIGHT
E. Clark, et al., Aviation Week and Space Technol., vol. 79, no. 4, July 22, 1963, 131 p., N63-22118.

. . . special issue . . . devoted to U. S. civilian and military manned spaceflight and to Soviet spaceflight includes . . . (11) Preliminary Design Frozen on Lunar Bug (lunar excursion module LEM); (12) LEM Flight Schedule Detailed; (13) LEM Program to include Nine Test Articles; (14) LEM Mission Sequence Outlined; (15) LEM Logistics Version Proposed by Grumman; (16) Gemini Evolves into Operational Program . . . (19) Gemini to Be Rendezvous Proving Ground . . . (33) Integration, Reliability, Checkout Emerge as Key Apollo Challenges; and (34) Vostok Flights Widen Soviet Experience.

PROSPECTS FOR EARLY MANNED INTERPLANETARY FLIGHT
R. W. Gillespie, et al., Institute of the Aerospace Sciences, Annual Meeting, 31st, New York, N. Y., Jan. 21-23, 1963, Paper 63-84, 11 p., A63-15220.

. . . requirements for manned interplanetary flights to Mars and Venus during the first half of the 1970's. . . . presented for single-or multiplanet flybys, as well as for short orbiting capture missions. . . .

MANNED SPACE FLIGHT - 1963
D. B. Holmes, Washington, U. S. Govt. Printing Office (1963), 88 p., Based on testimony presented before the Subcomm. on Manned Space Flight, Comm. on Sci. and Astron., House of Representatives, March 6-7, 1963, and before the Comm. on Aeron. and Space Sci., U. S. Senate, April 26, 1963, N63-20647.

MANNED MARS MISSIONS
B. Kovit, Space/Aeronautics, vol. 40, Nov. 1963, p. 65/71, A64-10690.

Study of Martian mission requirements, vehicle concepts, and timing, in preparation for actual development work likely to get underway in the late sixties. . . .

MANNED FLIGHT TO MARS AND VENUS IN THE 70's
B. P. Martin, In: 2nd Manned Space Flight Meeting, New York, American Institute of Aeronautics and Astronautics, 1963, p. 236/253, A63-19014.

. . . System requirements . . . (4) navigation and control systems; (5) reconnaissance and scientific instrumentation for gathering data during course of missions, and requirements for storage and/or readout . . .

THE MANNED SPACE FLIGHT PROGRAM
G. E. Mueller, American Astronautical Society, Annual Meeting, 10th, New York, N. Y., May 4-7, 1964, Preprint 64-1, 14 p., A64-17957.

. . . the Gemini and Apollo programs are progressing well and that the most challenging technical task appears to be the integration of all the systems and subsystems. In the light of new information obtained from satellites, it is felt that radiation and meteoroids do not present the danger that was once attributed to them . . .

SPACE RENDEZVOUS, RESCUE AND RECOVERY
P. C. Rogers, Jr. (comp.), Defense Documentation Center, Alexandria, Va., An Abstract Compilation and Report Bibliography, Aug. 1963, 117 p., 570 refs., AD 410 085, N63-22857.

. . . included: space capsules, space navigation . . . space communication systems, space surveillance systems . . . spaceborne computers . . . data processing systems, radar equipment, optical equipment, infrared equipment . . .

MANNED MILITARY MISSIONS IN ORBITAL SPACE: AN ANNOTATED BIBLIOGRAPHY
P. R. Stromer (comp.), Lockheed Aircraft Corp., Van Nuys, Calif., Rept. no. 3 87 63 1, SB63 27, Feb. 1963, 56p., AD 420 145.

A review of the recent (1958-1963) aerospace literature has been made in an attempt to identify and isolate those missions of primary military significance for manned spaceflight. . . .

2ND MANNED SPACE FLIGHT MEETING
American Inst. of Aernautics and Astronautics, New York, N.Y., 1963, 402 p., refs., A Volume of Technical Papers Presented at Dallas, April 22-24, 1963, N63-23201.

1-2-3 AND THE MOON: PROJECTS MERCURY, GEMINI, AND APOLLO OF AMERICA'S MANNED SPACE FLIGHT PROGRAM
NASA EP-7, 1963, 32 p., N63-16696.

. . . launch procedures and control of the flight, orbital rendezvous, lunar explorations, unmanned spaceflights in preparation for project Apollo . . .

AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, AND NASA, CONFERENCE ON ENGINEERING PROBLEMS OF MANNED INTERPLANETARY EXPLORATION, PALO ALTO, CALIF., SEPT. 30-OCT. 1 1963, PROCEEDINGS
New York, American Institute of Aeronautics and Astronautics, 1963, 159 p., A63-24229.

. . . manned missions to the Moon, Venus, and Mars, and different environmental and re-entry problems. . . .

DIVISION 4D. 1
ENVIRONMENT FOR ELECTRONIC SYSTEMS

4D. 100: Special Environment for Electronic Systems in Manned Spacecraft

Included: Life support systems; Electrostatic shielding of spacecraft; Radiation protection of manned spacecraft; Analysis of spacecraft atmosphere; Attitude control systems for manned spacecraft; Extra-vehicular movements of astronauts; Physiological monitoring systems; Closed environment contamination from electronic equipment; Human factors in space communications; Human engineering; Biotechnology (surveys); Communications operators' abilities in space environment; Display and control devices for operators in manned spacecraft; Acoustic noise conditions; Meteorite impact probabilities.

Not Included: Radiation protection in general; Space radiation prediction; Design of attitude control systems.

Cross References: Space environment simulation and training systems (4D. 900).

Principal Publications:

ENVIRONMENTAL REQUIREMENTS FOR EXTENDED OCCUPANCY OF MANNED SATELLITES
S. H. Dole, RAND Corp., Santa Monica, Calif., Rept. no. P-1577, 12 Dec. 1958, 28 p., AD 288 172.

RELIABILITY AND MAN IN SPACE
R. D. Sorkin, et al., East Coast Conf. Aerospace Navig. Electronics, vol. 6, no. 9.4, Oct. 1959, p. 1/5.

MAN'S VISUAL CAPABILITIES IN SPACE
C.A. Baker, East Coast Conf. Aerospace Navig. Electronics, vol. 7, no. 6.2, Oct. 1960, p. 1-1/5.

NASA SPACE FLIGHT PROGRAMS - 6. LIFE SCIENCES PROGRAMS
A. M. Mayo, Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 49/52.

ELECTROSTATIC SHIELDING OF HIGH ENERGY PROTONS
T. W. Bailey, Directorate of Materials and Processes, Aeronautical Systems Div., Wright-Patterson, Air Force Base, Ohio, Rept. for May-Dec. 1961, on the Chemistry and Physics of Materials, ASD TDR 62-244, March 1962, 17 p., incl. illus., 13 refs., AD 277 955.

. . . to determine if it should be considered for protecting manned space vehicles against solar cosmic rays. It was concluded that electrostatic shielding is feasible and that it has some advantages over other types of shields. However, considerable applied research will be necessary.

AN EVALUATION OF HIGH-PRESSURE OXYGEN SYSTEMS
J. V. Baum, et al., Battelle Memorial Inst., Columbus, Ohio, Final rept. 1 May 1961-30 June 1962, on Equipment for Life Support in Aerospace, AMRL TDR 62-102, Sept. 1962, 85 p., incl. illus. tables, 10 refs., AD 289 575.

THE CONDITIONS OF COMMUNICATION
J. D. Chapline, Proc. Nat. Electronics Conf., vol. 18, Oct. 1962, p. 685/689.

The human individual is a psycho-dynamic organism in continuing relationship with environment. This relationship includes all the remembered past experiences, new data coming in from current new experiences, and the continual marshalling of energy in reaction to the new data. . . . These observations are pertinent to the communication problem because, whether by word, gesture, music, or any other form of human communication, every new experience, representing a reaction between an individual and the external world, must be registered along communication channels.

ANALYTICAL METHODS FOR SPACE VEHICLE ATMOSPHERIC CONTROL PROCESSES
C. S. Coe, et al., Airesearch Mfg. Co., Los Angeles, Calif., Rept. for 1 April 1961-31 March 1962, A revision and amplification of Part I, released July 1961, Rept. no. SS-695-R, ASD TR 61-162, pt. 2, Nov. 1962, 580 p., incl. illus. tables, 149 refs., AD 292 701.

A SPACE TRAJECTORY RADIATION EXPOSURE PROCEDURE FOR CISLUNAR MISSIONS
W. Cranford, et al., General Dynamics/Fort Worth, Tex., Document no. NARF-62-11T; FZK-9-178, 31 July 1962, 104 p., incl. illus. tables, 19 refs., AD 283 295.

The Space Trajectory Radiation Exposure Procedure (STREP) is designed to compute the time-integrated spectra for any specified trajectory in cislunar space for any combination of the several components of space radiations. . . . will also calculate the accumulated dose behind a thin vehicle skin at any time after the start of the mission. . . .

SOME CONSIDERATIONS ON PHYSIOLOGICAL/PSYCHOPHYSIOLOGICAL DATA SYSTEMS IN MANNED SPACE EXPLORATION
D. O. Ellis, Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 268/287.

COMMUNICATION BETWEEN MAN AND MACHINE
J. E. Karlin, et al., Proc. IRE, vol. 50, May 1962, p. 1124/1128.

THE SYSTEM SYSTEM AND BRIDGES OVER THE GULF BETWEEN MAN-MACHINE-SYSTEM RESEARCH AND MAN-MACHINE-SYSTEM DEVELOPMENT
J. C. Licklider, Bolt, Beranek and Newman, Inc., Cambridge, Mass., Jan. 1962, 30 p., AD 424 284.

The need for greater coherence in the man-machine and other high-order interactions of our major systems is described, and an approach to achievement of that coherence is proposed. The apporach involves a computer-centered meta-system (the 'system system') designed to facilitate communication, coordination, and problem-solving.

MAN/MOON/MACHINE RELIABILITY RELATIONSHIPS
E. P. McDowell, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 220.

. . . man's first efforts to travel beyond the immediate vicinity of earth will be in the direction of the moon . . . it is likely that he will be interested in the probability of successful return. Can we, or should we, guarantee 99.99% probability of success, 99%, 90% or perhaps only 50%. . . . we must first examine the present and foreseeable state-of-the-art in equipment design. . . . (Abstract only.)

THE MAN-MACHINE SYSTEM CONCEPT
D. T. McRuer, et al., Proc. IRE, vol. 50, May 1962, p. 1117/1123.

IN-FLIGHT NOISE MEASUREMENTS FOR THREE PROJECT MERCURY VEHICLES
W. H. Mayes, et al., National Aeronautics and Space Administration, Washington, D. C., NASA Technical note D-997, Jan. 1962, 27 p., 7 refs., AD 270 809.

HUMAN ENGINEERING
S. G. Ramsay, J. Brit. Instn. Radio Engrs., vol. 24, no. 1, July 1962, p. 37/43.

. . . Some of the special difficulties encountered in experimentation with human beings are briefly covered . . . some typical problem areas such as design and layout of displays, design of equipment and controls, illumination, noise, etc. . . .

ANALYSIS OF THE SPACECRAFT ATMOSPHERE
R. A. Saunders, Naval Research Lab., Washington, D. C., NRL rept. no. 5816, 23 Oct. 1962, 17 p., incl. illus., 3 refs., AD 288 255.

A study was made of the nature of the contaminants introduced into the cabin atmosphere of a Project Mercury space capsule, external to the pressure suit, by the deliberately induced malfunction and overheating of certain parts of the capsule equipment during simulated flight. . . .

VISUAL COMMUNICATION AND PSYCHOPHYSICS OF VISION
A. J. Seyler, Proc. Instn. Radio Engrs. Australia, vol. 23, no. 5, May 1962, p. 291/304, 56 refs.

. . . to discuss the effects which result when man is considered to be a constituent part of electrical communication systems in general and in particular of systems designed for visual communication. . . . adaptive behavior can be applied to signal coding methods which are designated as "Adaptive Parameter Codes" and which may be used alone or in conjunction with statistically matched codes arising from the concepts of Information Theory. . . .

DISPLAY AND CONTROL IN MANNED SPACE VEHICLES
A. Shulman, In: Advances in the Astronautical Sciences, Vol. XI, American Astronautical Society, Annual Meeting, 8th, Washington, D. C., Jan. 16-18, 1962, Proceedings, Edited by Horace Jacobs, North Hollywood, Calif., Western Periodicals Co., 1963, p. 271/298, 50 refs., A64-11455.

. . . particularly suited to the manual operation of manned space vehicles. A system plan has evolved that features closed-circuit television for presenting either symbolic displays derived from vehicle sensor data or television picture video from vehicle TV cameras. The system plan calls for the translation of sensor data and operator control commands to be carried out primarily by a digital control unit. The control unit is comparable to a special-purpose digital computer facility. . . .

AN ATTITUDE CONTROL SYSTEM FOR A MANNED LUNAR VEHICLE
D. W. Thompson, Minneapolis-Honeywell Regulator Co., Aeronautical Div., Minn. 1962, 48 p., 3 refs., N63-15533.

SIMILITUDE CONSIDERATIONS IN SPACE ENVIRONMENTAL SIMULATION
T. Y. Toong, Air Force Office of Scientific Research, Washington, D. C., Rept. on Biodynamics of Flight, Rept. no. AFOSR/DRA-62-16, Aug. 1962, 6 p., AD 283 353.

OXYGEN REGENERATION IN SPACE VEHICLES
Aerospace Information Div., Washington, D. C., AID rept. no. 62-113, 13 July 1962, 3 p., 5 refs., AD 283 245.

MAN AND MACHINE IN THE EXTRACTION AND USE OF RADAR INFORMATION
R. Benjamin, J. Brit. Instn. Radio Engrs., vol. 26, no. 4, Oct. 1963, p. 309/316.

. . . Even the filtered information arising from automatic extraction cannot be efficiently used by the unaided human operator. . . . A research and experimental program has been conducted over some years, aimed at the application of automation to radar data processing and, eventually, the automatic control of the radar's mode of operation. The paper outlines some of the requirements and problems in matching the man and machine to each other, to their input soruces and to the appropriate output systems. . . .

CLOSED ENVIRONMENT CONTAMINATION FROM ELECTRONIC EQUIPMENT
T.M. Crook, et al., Rec. Nat. Space Electronics Symp., no. 8.1, 1963.

Abstract only . . . In the confines of an inhabited, closed environment such as a space station, the small amounts of volatiles generated from exposed materials can accumulate to objectionable levels. . . . The contamination levels must be controlled . . . below that necessary to produce physiological impairment to the station personnel. . . .

RADIATION ENVIRONMENT FOR MANNED SPACECRAFT
S.H. Dole, RAND Corp., Santa Monica, Calif., April 18, 1963, 8 p., 4 refs., Presented at Inst. of Environmental Science, Los Angeles, April 18, 1963, p-2691, N63-16171.

Van Allen belts, electromagnetic radiation, solar flare protons, and galactic cosmic particles are discussed in relationship to the danger they present to man in space. . . .

BIOTECHNOLOGY: CONCEPTS AND APPLICATIONS
L.J. Fogel, Engelwood Cliffs, N.J., Prentice-Hall, Inc., 1963, 826 p., A63-19628.

. . . man/machine relationships . . . interdisciplinary point of view of psychologists, biologists, and engineers . . . Human limitations are examined with respect to the acceptance of information, decision making, and the ability to transmit the result of such decisions to the controlled equipment systems.

A PROTOTYPE SELECTIVE MONITORING SYSTEM FOR PHYSIOLOGICAL DATA
G. W. Morton, et al., Rec. Nat. Space Electronics Symp., no. 8.2, 1963.

. . . selective monitoring techniques to extract the significant information from data typical of that originating in a manned space vehicle. Use of these techniques substantially reduces the load on all portions of the transmission and analysis facilities. . . .

INFLUENCE OF SELECTED VIBRATIONS UPON SPEECH (RANGE OF 2 CPS-20 CPS AND RANDOM)
C.W. Nixon, et al., Aerospace Medical Div., Wright-Patterson AFB, Ohio, Aerospace Medical Research Labs. (6570th), Final Report, Nov. 1961-Dec. 1962, AMRL-TDR-63-49, June 1963, 18 p., 10 refs., N63-21059.

. . . Standard speech material read by talkers exposed to low frequency sinusoidal and random vibration conditions was recorded. This material was evaluated both objectively and subjectively in terms of intelligibility, duration, and quality of speech . . . No significant differences in speech production were found due to random vibration (0.5 to 8cps). Speech communication from the space vehicle may be adequate for environments represented by the conditions of this study. However, when these conditions are exceeded by factors, such as higher G levels and higher noise levels at the microphone, a continuous speech communication capability may not exist.

ENVIRONMENTAL CONTROL SYSTEMS SELECTION FOR MANNED SPACE VEHICLES
R.J. Oberto, North American Aviation, Inc., Los Angeles, Calif., ASD TR 61-240, pt. 2, vol. 1, Feb. 1963, 305 p., incl. illus. tables, 45 refs.

. . . Analytical studies of thermal and atmosphere control systems were conducted for three types of earth orbital manned space vehicles . . . Discussions of vehicle air lock characteristics and escape and emergency provisions are included.

PACE: PREFLIGHT ACCEPTANCE CHECKOUT EQUIPMENT
W.E. Parsons, et al., Astronautics and Aerospace Engineering, vol. 1, July 1963, p. 51/53, A63-18584.

. . . The equipment, named Preflight Acceptance Checkout Equipment for Spacecraft (PACE-S/C), is designed by NASA for the Apollo and Gemini programs. . . . major subsystems. . . are the PCM ground station and the computing, display and control, data transmission, and spacecraft associated subsystems. Some problems involved in the man-machine relationship are briefly discussed.

CORRELATION BETWEEN VISUAL AND AUDITORY VIGILANCE PERFORMANCE
L.T. Pope, et al., Aerospace Medical Div. Aerospace Medical Research Labs, (6570th) Wright Patterson AFB, Ohio, Final Report, AMRL-TDR-63-57, July 1963, 10 p., 7 refs., N63-21281.

. . . Various indices of correlation computed from the data obtained in this study show no relationship between auditory and visual vigilance performance.

INSTRUMENTATION FOR SPACE CABIN ATMOSPHERE ANALYSIS
P. Rosenbaum, IEEE Internat. Conv. Rec., Pt. 5, vol. 11, March 1963, p. 228/233.

EXPERIMENTAL STUDIES IN MAN-COMPUTER DIALOGUE
H. Sackman, System Development Corp., Santa Monica, Calif., Rept. no. SP1486 000 01, 14 Feb. 1964, 111 p., AD 437 774.

. . . emergence of applied man-machine digital systems. . . . reviews the SAGE system with special emphasis on the man-computer interface and describes three experimental studies in SAGE man-computer dialogue. . . . emergence of a pragmatic testing philosophy . . .

SIGNALS ASSIMILABLE BY LIVING ORGANISMS AND BY MACHINES
O. H. Schmitt, IEEE Trans. Mil. Electronics, vol. MIL-7, no. 2/3, April/July 1963, p. 90/93.

. . . It appears possible to develop communication codes based on mathematical models more closely in conformity with in-dwelling biological codes and thus to facilitate man-machine and other bio-engineering interactions . . .

OBSERVATIONS OF SPACE PHENOMENA
S. D. Soules, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Mercury Proj. Summary including Results of the 4th Manned Orbital Flight, May 15-16, 1963, p. 327/347, 25 refs., N63-21970.

. . . principal scientific observations made by the Mercury astronauts, arranged according to the sequence: daylight, twilight, and night. . .

METEOROID IMPACT ON SHIELDED SPACE VEHICLES
D. J. Trent, Douglas Aircraft Co., Inc., Missile and Space Systems Div., Santa Monica, Calif., American Society of Mechanical Engineers, Aviation and Space, Hydraulic, and Gas Turbine Conference and Products Show, Los Angeles, Calif., 3-7 March 1963, Paper 63-AHGT-69, 14 p., A63-17489.

. . . simplified hydrodynamic analysis for the solution of cratering and penetration probe.

ASTRONAUT MANEUVERING UNIT FOR SPACE MECHANICS
P. N. Van Schaik, IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1262/1269.

. . . to give man the capability of extra-vehicular travel while in orbit, various concepts for individual propulsion units have been analyzed. These concepts varied from the hand-held gun to the Astronaut Maneuvering Unit (AMU). . . .

RESEARCH REQUIREMENTS FOR FUTURE MANNED SPACE FLIGHT COMMUNICATIONS
J. M. Walker, In AIAA 2nd Manned Space Flight Meeting (1963), p. 17/22, N63-23205.

. . . The nominal communications requirements for future manned spaceflight are: bit rate = 10^6 sec; size and weight = no increase; reliability = order of magnitude of improvement; and primary power = no increase. Methods for improving . . . (1) increasing antenna sizes; (2) increasing transmitter power; (3) increasing the frequency; and (4) lowering the system noise temperature . . . improving the modulation techniques to closer approximate Shannon's limit, employing on-board data processing to eliminate redundancy and thereby increasing the information per bit, and careful design of the experiments to be conducted during space missions . . .

CONTROL-DISPLAY DESIGN IN MANNED SPACE SYSTEM DEVELOPMENT
E. L. Warren, et al., In: 2nd Manned Space Flight Meeting, New York, American Institute of Aeronatucs and Astronautics, 1963, p. 111/113, A63-18996.

. . . the role of man in vehicle control . . .

STUDY ON THE APPLICATION AND INSTRUMENTATION OF VISUAL PERCEPTION FOR SPACE EXPLORATION
Sylvania Electronic Systems, Waltham, Mass., Applied Research Lab., Final Report, Aug. 27, 1963, 29 p., 74 refs., N63-21731.

. . . utility of human vision and color perception concepts in space exploration . . . (1) the extension of the Yilmaz theory of color perception . . . (2) the extension of the Biernson spectral scanning theory . . .

SUPPORT SYSTEM
JPL Space Prog. Summ., vol. 6, no. 37-20, Jan./March 1963, 59/67.

Required to support the mission-independent activities . . . in the SFOF . . . Industrial Design . . . Human Factors Development Analysis . . . Personnel System Development . . . Information Coordination.

Related Publications:

INTEGRATION OF RADIO EQUIPMENT CONTROLS FOR HIGH PERFORMANCE AIRCRAFT
W. D. Philips, East Coast Conf. Aerospace Navig. Electronics, vol. 6, no. 1.3, Oct. 1959, p. 1/3.

. . . designed with particular stress applied to human factors. This was necessary in that the best possible man-machine relationship was required to relieve pilot workload . . . consists of the cockpit equipment as used by the pilot for tuning his CNI equipments. . . .

PEOPLE, ORGANIZATIONS AND COMMUNICATIONS

J. N. Bloom, Laboratories for Research and Development, Franklin Inst., Philadelphia, Pa., 1962, 18 p., incl. illus., AD 281 672.

. . . assessing the effectiveness of the human and organizational elements in military communication networks in terms of a trade-off between the control of error and the delay involved in error control. . . . Information is characterised in terms of its urgency, importance, and policy status. . . .

TELECHIRICS - FOR OPERATIONS IN HOSTILE ENVIRONMENTS

J. W. Clark, Battelle Technical Review, vol. 12, Oct. 1963, p. 3/8, A64-10942.

Description of telechiric techniques for the remote control of equipment performing tasks in environments hazardous to human beings. General considerations for the operation and design of telechiric systems are discussed in terms of the manipulations the equipment will carry out. . . .

INFORMATION TRANSFER BETWEEN MEN AND COMPUTERS

A. Debons, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 377/388.

ADVANCED LANGUAGE PROCESSING PROCEDURES

S. J. Keyser, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 391/398.

. . . The problem is: How does one impart to a computer based system the ability to be questioned in ordinary English?

DIVISION 4D.2
SPECIAL COMMUNICATIONS EQUIPMENT

4D.200: Special Communications Equipment for Manned Space Flight

Included: Space television for manned spacecraft; DAEMON, a data management system for manned spacecraft.

Not Included: Design of biotelemetry systems.

Cross References: Special environment for electronic systems in manned spacecraft (4D.100).

Principal Publications:

INSTRUMENTATION OF NERVOUS SYSTEM FOR STUDIES OF BEHAVIOR AND PERFORMANCE IN SPACE FLIGHT
W. R. Adey, IRE Trans. Nat. Symp. Space, no. 6-2, Sept. 1960, p. 1-13.

REQUIREMENTS FOR MONITORING PHYSIOLOGICAL FUNCTION IN SPACE FLIGHT
L. D. Carlson, IRE Trans. Nat. Symp. Space, no. 6-1, Sept. 1960, p. 1/11.

DAEMON—AN ADVANCED SYSTEM FOR DATA MANAGEMENT IN MANNED SPACE VEHICLES
T. J. Carr, et al., Nat. Telem. Conf., no. 14-1, May 1962, p. 1/17.

. . . a complex space vehicle on a critical mission is made substantially independent of earth data processing for performance evaluation and related decision making. . . In the vehicle, DAEMON's real-time adaptive data reduction relieves the crew of major information-housekeeping burdens without usurping command prerogatives. . . .

MICROMINIATURIZED INSTRUMENTATION PACKAGE
A. B. Ellis, et al., Hughes Aircraft Co., Culver City, Calif. Rept. on Phase 3, 27 Aug. 1963, 115 p., incl. illus., tables, 184 refs., AD 286 333.

. . . three Micro-Miniaturized Instrumentation Packages. . . summarization. . . of the previous reports. . . . improved techniques and equipment for making measurements of relatively well known parameters defining human physiological condition. These measurements were to be made in unusual situations, such as high performance aircraft, near-space vehicles, and in space simulation chambers.

SPACE TELEVISION: AN ANNOTATED BIBLIOGRAPHY
E. E. Graziano (Comp.), Lockheed Missiles and Space Co., Sunnyvale, Calif., LMSC-3-79-61-1; SB-61-63, March 1963, 36 p., refs., AD 296 805, N64-15758.

This selective bibliography was compiled in support of research regarding television as a medium to obtain biomedical information by monitoring space travelers during flight. All aspects of space vehicle television systems, including recording, transmission, and ground reception, were of interest. The materials cited date from January 1959 to October 1961.

GEMINI FUEL CELL POWER SOURCE - FIRST SPACECRAFT APPLICATION
J. L. Schanz, et al., American Rocket Society, Space Power Systems Conference, Santa Monica, Calif., Sept. 25-28, 1962, Paper 2561-62, 8 p., A63-11776.

. . . design and development of the ion-exchange membrane fuel cell intended to furnish electric power and drinking water for the Gemini spacecraft. . . .

FIRST DETAILS ON MERCURY SPACECRAFT COMMAND RECEIVER
R. Elliott, Electronics, vol. 36, Feb. 1, 1963, p. 32/35, A63-12072.

Description of the Project Mercury dual-command receiver. It is a double-conversion FM superheterodyne which supplies 20-channel operation and initiates the escape rocket sequence should trouble develop in the launch vehicle. It also actuates retrorocket firing, makes a spacecraft clock changes, and can be used for instrument calibration. Design features of the receiver, reciever RF assembly, decoder drive, and decoders are covered.

Related Publications:

DISPLAY AND CONTROL REQUIREMENTS FOR MANNED SPACE FLIGHT
J. P. Loftus, East Coast Conf. Aerospace Navig. Electronics, vol. 7, no. 6.2.4-1, Oct. 1960.

4D.250: Unified S-band Communications and Ranging System

Included: Coherent binary communications methods; Strong signal sideband discriminator.

Not Included: Modulation methods (1); Ranging techniques; Ranging codes (2); Information processors for ranging systems (3A).

Cross References: Project Apollo reports (4D.820).

Principal Publications:

S-BAND SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-10, May/June 1961, p. 75/76.

The preliminary design of the new S-band RF subsystem, including receiver, exciter, and doppler extractor has been largely completed. . . . certain additional RF tracking capabilities are currently being added to the system. . . . simplified block diagram. . . in Figure 88. The RF tracking loop design noise bandwidth is to be 3 cps, and total residual PM in the loop from all sources is not to exceed 3 degrees peak-to-peak. The resultant receiver threshold sensitivity (defined as the signal for which S=N at the phase detector) should be nominally -162 dbm. Provision is made for incorporation of three individual RF tracking loops, in addition to the angle channels, in order to allow simultaneous tracking of up to three signals possessing widely different doppler characteristics. In addition, multiple IF tracking loops may be added to provide additional channels for signals with doppler characteristics similar to those of the signal being RF phase-tracked in each reference channel.

S-BAND SYSTEM
JPL Space Progr. Summ., vol. 1, no. 37-12, Sept./Oct. 1961, p. 81/82.

. . . system design effort related to the DSIF S-band conversion program has been completed . . .

S-BAND RANGING EXPERIMENT
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 66/69.

At this time all DSIF stations are equipped to locate and track satellites and space probes by obtaining and recording angles. . . and two-way coherent doppler. . . . For planetary and interplanetary range determinations. . . a more powerful method. . . to be devised, preferably one whose accuracy is not a function of the distance involved. During the past 3 years . . . testing of several versions of precision ranging by essentially digital means. This report concerns the application of these methods to provide precision ranging for the Ranger RA-6, -7, -8 and -9 lunar probes.

S-BAND RF SUBSYSTEMS PROTOTYPE PROGRAM
JPL Space Progr. Summ., vol. 1, no. 37-14, Jan./Feb. 1962, p. 72.

DSIF S-band RF subsystems prototype functional hardware is in the final stages of fabrication and module check-out. . . . the over-all prototype configuration is firm.

PROTOTYPE S-BAND SYSTEM INTEGRATION
JPL Space Progr. Summ., vol. 3, no. 37-15, March/April 1962, p. 14.

. . . objective. . . is to accomplish an RF system frequency translation from L-band to S-band that will eventually be incorporated at each DSIF station. . . .

STATUS OF S-BAND SUBSYSTEM SPECIFICATIONS
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 18/19.

TRANSPONDER RANGING SYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-16, May/June 1962, p. 53/64.

The L-band system is now operating successfully both in the laboratory and in helicopter tests. Acquisition experiments have been performed in the laboratory at signal levels corresponding to nominal Mars communication distance. On helicopter tests the acquisition procedure has been taking about two minutes on the average, and preflight calibrations show good consistency, with an rms deviation of about 3 m. Fig. 37 shows the correlation output during transponder-to-ground acquisition in the laboratory with both units operating at Mars nominal levels. Correlation is noisier than in the closed-loop case because the noise of the transponder-clock VCO is added to the other noise in the system.

GOLDSTONE DUPLICATE STANDARD (GSDS) S-BAND RF SUBSYSTEMS
JPL Space Progr. Summ., vol. 3, no. 37-18, Sept./Oct. 1962, p. 8/16.

S-Band RF Prototype Test Program
S-Band Communication Ground Subsystem
. . . to provide the capability of adequately testing the S-band transponders during the initial and final phases of development.
a. Transmitter. . . principal design characteristics. . . b. Receiver. . .
c. Ranging Subsystem. . .

DEMODULATION AND DETECTION EFFICIENCY OF AN UNCODED, COHERENT, BIORTHOGONAL DIGITAL CHANNEL IN GAUSSIAN NOISE
G. L. Fultz JPL Space Progr. Summ., vol. 4, no. 37-21, April/May 1963, p. 204/210.

In uncoded, coherent subcarrier communication systems, data is usually demodulated from the subcarrier by multiplying the received subcarrier with a locally generated reference and then detecting the data with a matched filter. . . From the results of the . . . discussion, the data demodulation and detection efficiency of the Mariner 2 demodulator was questioned and subsequently analyzed. The results of the investigation are presented below.

A COMMUNICATIONS SYSTEM FOR "APOLLO"
D. R. Holcomb, Electronic Industr., vol. 22, Oct. 1963, p. 108/110, A64-13483.

. . . S-band radio system for maintaining two-way contact with the Apollo spacecraft throughout its journey to the Moon and back. . . .

ANALYSIS OF THE MOD IV DIGITAL PHASE-TRACKING LOOP
P. Schottler, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 163/171.

One of the experiments associated with the Goldstone planetary radar system is a closed range measuring experiment. This experiment yields time-of-flight data on planetary targets for possible use in: (1) Refining the astronomical unit; (2) Refining planetary ephemerides; (3) Improving planetary range-measuring techniques. . . . This article contains an approximate analysis of the digital phase-tracking loop in the 1962 Venus range-measuring system.

ON THE ALLOCATION OF POWER IN A SYNCHRONOUS BINARY COMMUNICATION SYSTEM
J. J. Stiffler, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 176/181.

. . . One of the principal remaining difficulties encountered in implementing such a system is that of synchronization. . . . it is advantageous, although not absolutely necessary, to establish coherence between the receiver and transmitter subcarriers, an operation commonly referred to as subcarrier synchronization. . . . The optimum power division is that which results in the minimum bit-error probability. . . question of optimum power allocation is investigated here for the two synchronization problems discussed above.

ERROR PROBABILITY FOR A PARTIALLY COHERENT BINARY COMMUNICATION SYSTEM
A. J. Viterbi, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 171.

. . . The carrier phase . . . is never known exactly. . . . error in the phase estimate is a random variable. . .

THE APOLLO TELECOMMUNICATIONS SYSTEM
S. E. Watson, et al., Proc. Nat. Space Electronics Symp., no. 6.4, 1963.

. . . For use during operations within a few thousand miles of the surface of the earth, the Apollo spacecraft contains a VHF-FM transmitter for down transmission of data and a C-band transponder as an aid to earth-based radar tracking. . . . Utilized during both near-earth operations and lunar journeys are an inter-comm, signal conditioners, a PCM telemeter and data storage equipment. . . .

S-BAND COMMUNICATION COMPONENT
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 7/9.

5/221 Parametric Frequency Divider. . . The phase coherent 498-kc signal for synchronizing the range code generator, in the S-band ground system, is derived by multiplying the 22-Mc signal from the transmitter by ratio of 5/221. In previous systems, a phase-locked-loop frequency shifter was used satisfactorily to perform this multiplication function. . . . The assignment of several S-band frequencies, over a 10-Mc band, requires that the shifter track frequency changes of approximately ±0.25%. . . . a circuit was developed which utilizes the nonlinear capacitance characteristics of varactors to perform the desired frequency division.

A LINEAR VOLTAGE CONTROLLED OSCILLATOR USING FREQUENCY FEEDBACK
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 19/21.

To be used as a digitally controlled VCO in a programmed local oscillator. . . The VCO must have (1) low phase noise and (2) a definite range of useful frequency shift. . . . must also exhibit (3) stability, from one 10-sec period to the next of less than 1/4 cps when multiplied by 75, i.e., 7×10^{-9} for a 475-kc VCO.

STRONG SIGNAL SIDEBAND DISCRIMINATOR
JPL Space Progr. Summ., vol. 3, no. 37-22, May/June 1963, p. 38/43.

Acquisition of a telemetry modulated RF carrier by a phase-lock receiver is generally susceptible to spurious sideband locking effects.

A subsystem capable of discriminating within certain limitations against virtually any type of modulation suitable for carrier tracking has been developed and subjected to preliminary tests. For a more detailed introduction to this problem, the reader is referred to SPS No. 37-21, Vol. III, p. 80. . . . The system as presently assembled for initial evaluation consists of an S-band test transmitter, conventional receiver carrier and AGC loops, frequency discriminator and square law detector at 455 kc, synchronous lock detector, control and indicator logic, and an acquisition ramp generator.

S-BAND IMPLEMENTATION FOR DSIF
JPL Space Progr. Summ., vol. 3, no. 37-23, July/Aug. 1963, p. 58/61.

TWM for DSIF. . . We plan to equip the DSIF with traveling wave masers (TWM's) in closed cycle refrigerators (CCR) as part of the S-band implementation program. S-Band Acquisition Aid for the DSIF. . . being designed for the DSIF 85-ft antennas at S-band. The design concept is discussed.

MARK I RANGING SUBSYSTEM
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 9/11.

. . . The laboratory prototype has been constructed and has undergone preliminary tests with the S-band test receiver-transmitter. Helicopter transponder ranging tests are to be flown shortly. Construction of the Serial No. 1 (Pioneer) and Serial No. 2 (Johannesburg) GSDS subsystems is proceeding satisfactorily. Documentation to permit construction of Serial Nos. 3 and 4 off-laboratory is progressing satisfactorily.

S-BAND IMPLEMENTATION FOR DSIF
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 76/81.

1. TWM for DSIF

. . . Six TWM systems are required; subsystem construction is being done by commercial engineering firms; system integration will be done at JPL. . . . Satisfactory progress is being made in all areas of the program. The experimental prototype TWM/CCR system was installed in the planetary radar receiver at the Venus site on Sept. 5 and has been operating satisfactorily since then; the use of the TWM has reduced the radar receiver total system temperature to a minimum of 25°K. . . . The block diagram for the TWM subassembly is shown . . .

2. Acquisition Aid for DSIF

An acquisition aid is being developed for the DSIF 85-ft antennas at S-band. The basic design has been completed, and all major components are on order for the prototype system. . . . described in SPS 37-23, Vol. III, p. 60/61 . . . is basically similar to the existing L-band system (SPS 37-23, Vol. III, p. 8/11) . . .

S-BAND SYSTEMS ENGINEERING
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 12.

A preliminary IBM listing of all inter-subsystem signal paths has been published and is undergoing review by the respective cognizant engineers for each subsystem. . . .

RANGING AND TRACKING SYSTEM DEVELOPMENT
JPL Space Progr. Summ., vol. 3, no. 37-25, Nov./Dec. 1963, p. 47/50.

Monostatic Radar Operating Parameters - Preliminary test results of the anti-sideband system now under development, coupled with the effects of target dynamics discussed in Ref. 14, have pointed up several areas of compromise in the selection of receiver loop bandwidth, keying rate, and predetection bandwidth. Inherent in the problem are the uncertainties of prediction of range and range rate at the time of satellite acquisition. A largely qualitative description of the anti-sideband system and its performance is followed by a discussion of over-all system trade-offs.

Related Publications:

OPTIMUM DESIGN OF PHASE-LOCKED LOOP SYSTEM WITH FINITE OBSERVATION TIME
T. Nishimura, JPL Space Progr. Summ., vol. 4, no. 37-25, Dec./Jan. 1963, p. 181/186.

The simplified model of a phase-locked loop system employing PN modulation is presented here as a first-order feedback system. . . . To estimate the phase of the incoming PN wave when the observation time T is finite, an optimum selection of the time constant τa (hence the gain a) should be made to minimize the deviation due to the system transient response and input noise. Such an optimum design is pursued in this report.

DIVISION 4D. 3
VOICE COMMUNICATIONS

4D. 300: Voice Communications Facilities

Included: Personal communications; Astronaut's intercom system; Radio intercommunications system for astronauts outside the spacecraft; Echo problems in space-earth-space conversations.

Not Included: Intelligibility theories; Design of intercom facilities; Speech compression methods (2).

Principal Publications:

AN ELECTRONIC DEVICE TO MEASURE THE INTELLIGIBILITY OF SPEECH
J. C. Licklider, et al., Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 329/334.

PERFORMANCE IMPROVEMENT IN SINGLE-CHANNEL VOICE COMMUNICATION RADIO SYSTEM IN SPACE
L. P. Yeh, Proc. Nat. Electronics Conf., vol. 15, Oct. 1959, p. 151/162.

. . . explores the possibilities of improving the performance of a single-channel voice communication radio system, when the transmitter power is at a premium, as when communicating in space. . . . The only techniques covered are AM (double, sideband with full carrier), DSBSC (double-sideband suppressed-carrier), SSB (single-sideband) and NBFM narrow-band frequency-modulation — an FM channel restricted to AM spectrums. . . .

EVALUATION OF MESSAGE CIRCUIT NOISE
A. J. Aikens, et al., Bell Syst. Tech. J., vol. 39, no. 4, July 1960, p. 879/909, 16 refs.

. . . measuring some physical attribute of the electrical noise such that two noises that are judged to be equally interfering are assigned approximately equal numerical magnitudes. . . . The correlation between a noise measurement and its associated over-all end-effect may be made by finding the transmission-loss equivalent of the noise being measured or by the direct application of telephone-user opinions expressing degree of transmission satisfaction. . . .

A STUDY OF TALKING DISTANCE AND RELATED PARAMETERS IN HANDS-FREE TELEPHONY
M. B. Gardner, Bell Syst. Tech. J., vol. 39, no. 6, Nov. 1960, p. 1529/1551.

. . . problems of providing satisfactory hands-free operation of the telephone and discusses various methods which can be applied to their solution. Particular attention is given to acoustic environment, proximity talking (as applied to hands-free operation of the telephone) and voice switching. . . .

TRANSMISSION PERFORMANCE IN PRESENCE OF CIRCUIT NOISE
F. Markman, Ericsson Tech., vol. 16, no. 2, 1960, p. 165/206.

Comprehensive work on transmission performance in the presence of circuit noise of different types has been done during the last decade by telephone administrations . . . and the CCITT Laboratory in Geneva. . . . tests . . . were made using the AEN technique; as this method suffers from many serious artificialities a new method, based on the opinions of ordinary telephone users, has been adopted by the . . . CCITT. . . . Results obtained from both methods are given. . . .

ELECTRO-ACOUSTICS FOR HUMAN LISTENERS
C. Cherry, J. Brit. Instn. Radio Engrs., vol. 21, no. 1, Jan. 1961, p. 5/15.

. . . The way in which human listeners distinguish sounds is discussed and its applications in speech compression systems considered. . . . relationship between speech perception and speech production . . . Stereophonic hearing . . . What is it that an electro-acoustic transducer, such as a microphone, a loudspeaker or a sterophony system, is really required to do? . . .

A LOUDSPEAKING TELEPHONE WITHOUT VOICE SWITCHING - LOUDSPEAKING - TELEPHONE NO. 1
W. T. Lowe, et al., Post Off. Elect. Engrs. J., vol. 54, no. 1, April 1961, p. 1/8.

AN IMPROVED FM OSCILLATOR-MODULATOR
A. R. Cumming, IRE Internat. Conv. Rec., Pt. 8, vol. 10, March 1962, p. 12.

Abstract only. . . . design considerations . . . particularly suitable for use in radio transmitters intended for the Personal Communications. . . .

RESEARCH AND DEVELOPMENT OF TECHNIQUES FOR A SHORT RANGE HEADSET TRANSCEIVER
N. Lewin, et al., Motorola, Inc., Chicago, Ill., Final rept. ASD TDR 62-994, 15 Oct. 1962, lv. incl. illus., AD 295 568.

. . . to be worn on the person . . . to eliminate the restructions and the failures of

flexible cables and their connectors . . .comprehensive survey of the state-of-the-art of microminiaturization techniques was undertaken. . . . design . . . in integrated circuit form. . . .

SPEECH VOLUMES ON BELL SYSTEM MESSAGE CIRCUITS
K. L. McAdoo, Commun. and Electronics, vol. 80, no. 59, March 1962, p. 8/13.

The volume of message signals at various points in the telephone network is of utmost importance to those who design and engineer telephone systems and equipment, and ultimately, of course, to the listener. . . .

SOME PERFORMANCE FACTORS OF SPEECH PROCESSING SYSTEMS
W. A. Runge, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 174/178.

The degree of intelligibility and over-all quality factors of certain vocoders and other speech processing devices was determined. Input magnetic test tapes, containing speech with several background noise conditions, were run through various speech processing devices while in back-to-back operation. Samples from the listeners to obtain intelligibility and quality scores. . . .

METHOD OF INCREASING THE NOISE IMMUNITY OF TELEPHONE SIGNALS
S. P. Baronin, Radio Engng: Transl. of Radiotekhnika, vol. 18, no. 3, March 1963, p. 28/35.

. . . It is shown that the use of a filter with variable parameters, capable of tracking the statistical features of the signal and noise, enables the received signal to be converted to a form more convenient for perception. The block diagram of a suitable circuit is described, and an approximate calculation of the efficiency obtained is given. . . .

INTERCOMMUNICATION TELEPHONE SETS
R. Beith, et al., Elect. Commun., vol. 38, no. 2, 1963, p. 240/245.

MICRO-MODULARIZED HELMET RADIO
M. Curtis, et al., IEEE Internat. Conv. Rec., Pt. 8, vol. 11, March 1963, p. 58/70.

SOME FACTORS AND PROBLEMS PERTINENT TO INTELLIGIBILITY TESTING OF COMMUNICATION DEVICES
J. W. Falter, Electronic Warfare Div., Air Force Avionics Lab., Aeronautical Systems Div., Wright Patterson AFB, Ohio, ASD TDR 63 518, July 1963, 59 p., AD 414 862.

. . . has been an area of investigation for many years. However, the totality of what elements are necessary to define speech precisely has never been determined and therefore no generally accepted, precise, well-defined standard of evaluation is presently available. . . . This report reviews some of the parameters and problems of intelligibility testing . . .

ELECTRONIC EVALUATION OF VOICE COMMUNICATIONS SYSTEMS
R. E. Fitts, Rome Air Development Center, Griffiss AFB, N.Y., RADC TDR 63 355, Aug. 1963, 31 p., AD 417 700, N63-21675.

. . . articulation testing . . . can be time consuming . . . electronic evaluation promises savings in time and money if it can be shown to have results equivalent to articulate test. . . . certain theoretical and practical limitations of the Voice Interference Analysis Set are discussed.

DESIGN OF A 150-MEGACYCLE POCKET RECEIVER FOR THE BELLBOY PERSONAL SIGNALING SYSTEM
A. E. Kerwien, Bell Syst. Tech. J., vol. 42, no. 3, May 1963, p. 527/565.

A highly sensitive pocket receiver with a code-responsive signaling device has been designed for the 150-megacycle BELLBOY personal signaling system. Ten transistors in a single-IF, superheterodyne receiver circuit convert the FM signaling wave to produce excitation of a sound generator through a tuned reed selector circuit . . . design problems and an analysis of circuit performance is included. Sensitivity sufficient to signal in a 20-microvolt per meter field is achieved.

SPEECH VOLUMES ON BELL SYSTEM MESSAGE CIRCUITS —1960 SURVEY
K. L. McAdoo, Bell Syst. Tech. J., vol. 42, no. 5, Sept. 1963, p. 1999/2012.

. . . measured at class 5 offices. Data are presented for intrabuilding, interbuilding, tandem and toll connections. Average speech volumes are lowest for intrabuilding calls and increase in level for the other types of connections, with volumes on toll calls being the highest. In general, volumes on business calls are higher than those on social calls, and men speak louder than women. Speech volumes remain substantially the same in locations comparable to those in a survey made in 1950.

INFLUENCE OF SELECTED VIBRATIONS UPON SPEECH (RANGE OF 2 CPS-20 CPS AND RANDOM)
C. W. Nixon, et al., Aerospace Medical Div., Wright Patterson AFB, Ohio, Aerospace Medical Research Labs., (6570th), Final Report, Nov. 1961 - Dec. 1962, AMRL-TDR-63-49, June 1963, 18 p., 10 refs., N63-21059.

. . . Standard speech material read by talkers exposed to low frequency sinusoidal and random vibration conditions was recorded. This material was evaluated both objectively and subjectively in

terms of intelligibility, duration, and quality of speech . . .No significant differences in speech production were found due to random vibration (0.5 to 8 cps.) Speech communication from the space vehicle may be adequate for environments represented by the conditions of this study. . . However, when these conditions are exceeded by factors, such as higher G levels and higher noise levels at the microphone, a continuous speech communication capability may not exist.

COMPUTATION AND MEASUREMENT OF SPEECH INTELLIGIBILITY
N. B. Pokrovskiy, Joint Publications Research Service, Washington, D.C., JPRS-21-885: OTS-63-41146, Nov. 18, 1963, 350 p., refs., Transl. into English of a book "Raschet i Izmereniye Razborchivosti Rechi" Moscow, Svyaz'izdat 1962, p. 1/391, Its Foreign Develop. in Machine Transl. and Inform. Process. No. 44, N64-10381.

. . . presents a theory of speech intelligibility, and gives a qualitative and quantitative description of the properties and acoustical characteristics of speech and hearing which determine the amount of phonetic and semantic information conveyed by telephone and radiotelephone communications channels . . . methods of experimental determination of speech intelligibility by articulation measurements . . . fundamentals of computing optimal electroacoustical characteristics of voice channels in telephone and radiotelephone apparatus . . .

SUBJECTIVE EVALUATION OF DELAY AND ECHO SUPPRESSORS IN TELEPHONE COMMUNICATIONS
R. R. Riesz, et al., Bell Syst. Tech. J., vol. 42, no. 6, Nov. 1963, p. 2919/2941.

The effect of transmission delay upon the quality of a telephone circuit was investigated using naturally occurring telephone conversations. Round-trip delays of 600 and 1200 msec went almost unnoticed at first when no echo sources or echo suppressors were present in the circuit. After exposure to pure delays of up to 2400 msec, considerable dissatisfaction, indicated by rejection of the circuit, developed with the 600- and 1200-msec delays. When echo sources and echo suppressors were added to the circuit, some dissatisfaction developed immediately for round-trip delays of 600 and 1200 msec. No adaptation to the effects of delay occurred; in fact dissatisfaction increased with experience under certain conditions.

EFFECT OF TRANSMISSION ERRORS ON THE INTELLIGIBILITY OF VOCODED SPEECH
R. W. Steele, et al., IEEE Trans. Commun. Syst., vol. CS-11, no. 1, March 1963, p. 118/123.

. . .Intelligibility tests are run to determine the loss of intelligibility with increasing error rates. Curves are plotted showing these effects for a number of speakers. . . . The 16-Channel Philco Vocoder has a data rate of 2400 bits/sec and operates with data transmission equipments such as the Sebit 24 or AN/GSC-4. . . .

PERCEPTION AND INTERPRETATION OF DYNAMIC TACTILE STIMULATION
W.H. Stevenson, III, et al., IEEE Trans. Aerospace, vol. AS-1, no. 2, Aug. 1963, p. 1127/1136.

This paper describes a system of tactile communications and its associated electro-mechanical devices. Experiments conducted in human engineering indicate that dynamic excitation of cutaneous tissues on a six point limen on the skin can be meaningfully interpreted at rates up to 1000 characters per minute. The Ste-Re System provides an easily learned, coded and decoded language of communications capable of actuating, programming and transmitting information. . . .

THE RETROMETER: A LIGHT-BEAM COMMUNICATIONS SYSTEM
N. E. Thomas, Washington, NASA, NASA SP-5005, March 1964, 20 p., N64-18503.

A new system of voice communications transmitted on a beam of light is described. It differs from prior systems in that the originating station requires no power other than that of the human voice . . .

PARAMETER STUDY OF PULSED RADIO FREQUENCY TRANSMISSION
Westinghouse Electric Corp., Baltimore, Md., Final rept., 15 Oct. 1963, 42 p., AD 424 390.

. . . for maintaining communications between individual members of tactical fighting unit in a limited war situation . . . considering the signalling or communication problem associated with the dense jungle environment . . . to . . . recommend a course of action to be taken for the future design of jungle signalling equipment. The merits of wide-band versus narrow-band FR pulses are investigated so that an optimum choice of signal structure (with respect to transmitted energy) can be established. The system problem is studied in light of the adverse jungle propagation losses that exist. A jungle range equation is derived and a universal jungle communication system design chart is developed. . . .

Related Publications:

THE MEGACODER — A HIGH-SPEED, LARGE-CAPACITY MICROMINIATURE DECODER
H. Kihn, et al., RCA Rev., vol. 20, no. 1, March 1959, p. 153/179.

. . . which can be preset to respond to any one of one million possible code combinations provided by a bipolar twenty-pulse binary code. . . . occupying less than one cubic inch . . . incorporated in a pocket size FM personal paging receiver to provide a personal paging system

capable of selectively calling one million subscribers at rates exceeding 5,000 calls per minute. . . .

SIGNALING SYSTEMS FOR CONTROL OF TELEPHONE SWITCHING
C. Breen, et al., Bell Syst. Tech. J., vol. 39, no. 6, Nov. 1960, p. 1381/1444.

Telephone signaling is basically a matter of transferring information between machines, and between humans and machines. . . . history of . . . systems used between central offices of the nationwide telephone network . . . influence on such systems of the characteristics of switching systems and their information requirements, the transmission media and the compatibility problem. . . . some of the systems presently in use. . . . problem of signaling between Bell System and overseas telephone systems . . . new transmission media. . . . some speculation is made on the future trends of telephone signaling systems. . . .

ACOUSTIC THEORY OF SPEECH PRODUCTION
G. Fant, The Hague, Netherlands, Mouton, 1960, 323 p.

. . . complete contemporary work on the physics of speech. . . . liberal use of Laplace transforms and models of network theory. . . .

DIGITAL BATTLEFIELD COMMUNICATIONS
W. C. Slagle, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 289/293.

BASIC is digital communications equipment developed by Stromberg-Carlson - San Diego for the United States Marine Corps. The name BASIC stands for Battle Area Surveillance and Integrated Communications. . . . an electronic display on a CHARACTRON Shaped Beam Tube serves as the output device. . . . The transmitted message contains 22 characters. . . . thumb-operated information switches . . . have 10 positions each, are marked for an intelligence application. . . . 10 digits of position information . . .

MILITARY APPLICATIONS FOR SPEECH COMPRESSION TECHNIQUES
A. J. Strassman, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 75/81.

. . . there will be continued, and even increased, usage of voice communications throughout the military complex. . . . military need in the communications field is that of providing proper security . . . to this end also, speech compression can be utilized. . . . If speech is compressed first, and then digitalized, provision for transmission of encrypted digital speech over a normal 3-kc voice circuit can be made. . . . the Hughes Aircraft Company has developed a miniature Vocoder of sound quality which can be utilized for the above outlined military applications.

A MINIATURE TUNED REED SELECTOR OF HIGH SENSITIVITY AND STABILITY
L. G. Bostwick, IRE Internat. Conv. Rec., Pt.8, vol. 10, March 1962, p. 21/27.

. . . describes a selective contacting device that is responsive only to sustained frequencies in a discrete narrow band and is insensitive to speech and noise interference. . . . of small size suitable for use in a pocket carrier radio receiver. . . sufficiently stable to permit 33 discrete resonant frequencies . . . has a threshold sensitivity of about 35 microwatts . . .

A NEW VOICE-COMMUNICATION SYSTEM FOR AIR TRAFFIC CONTROL
T. E. Allen, IEEE Trans. Commun. Electronics, no. 66, May 1963, p. 189/199.

THE "MARATHON" SYSTEM OF TELETRANSMISSION, PRINCIPLES AND APPLICATIONS (In French)
J. Fuzellier, Onde Electr., vol. 43, no. 431, Feb. 1963, p. 170/176.

. . . designed and developed by the C.S.F. . . . is especially applicable to industrial installation . . . Bipolar FSK system on tone-subcarriers . . . two examples of its use in two types of links: one by telephone line between two stations, the other by radio links connecting three stations.

SPEECH SIGNALS IN CYBERNETICS AND COMMUNICATION (Speech Conversion Applied to Problems of Communication and Cybernetics Techniques) (In Russian)
M. A. Sapozhkov, Moscow, Svyaz'izdat, 1963, 450 p.

. . . an attempt is made at unifying the large amount of material connected with problems of the compression and expansion of the volume of speech signals, as well as problems of the automatic recognition of speech sounds and their synthesis. . . . problems of information theory, speech formation, the principles of speech conversion and reproduction, and the characteristics of Russian speech . . . methods of compression and expansion of speech signals . . . method of direct compounding and limiting, linguistic and parametric compounding and limiting . . . methods of automatic recognition and synthesis of speech. . . . intended for specialists working in communication techniques, automation and cybernetics . . .

THIN FILM LASER COUNTER
J. T. Winkler, Proc. Nat. Electronics Conf., vol. 19, Oct. 1963, p. 764/767.

. . . requirements of a man-portable laser ranging device will be presented . . .

FULL-DUPLEX DIGITAL VOCODER, PART I
L. A. Yaggi, Jr., Texas Instruments, Inc., Dallas, Final Rept., Rept. no. SP16A63, AFCRL 63 301, pt. 1, 10 June 1963, 122 p., AD 420 870.

. . . design, development, and manufacture of a polymodal, full-duplex, digital vocoder system. . . . provides the user with a choice of five primary modes of operation. . . . Fully automatic bit and frame synchronization is used. An all-digital technique of pitch pulse code modulation encoding/decoding has been designed that provides rapid and accurate conversion of the pitch frequency information to digital data. . . .

SPEECH ANALYSIS TECHNIQUES
Royal Inst. of Tech. (Sweden), Technical rept. no. 4 (Final), 1 July 1962 - 30 June 1963, 30 June 1963, 1v., AD 419 261.

. . . emphasis on instrumentation and methods for automatic extraction of speech signal parameters. . . . study of the performance of speech compression systems which were demonstrated at the Stockholm Speech Communication Seminar 1962.

DIVISION 4D.4
GROUND COMMUNICATIONS

4D.400: Ground Communications Facilities for Manned Space Flight

Included: Flight operations facility (for manned operations); Ground operational support system; AGE=aerospace ground equipment; Apollo flight operations; Mission control center for manned space flight; IMCC=integrated mission control center; Control of recovery operations.

Not Included: Deep space operations center (4C.386).

Cross References: Simulation and test facilities (4D.900).

Principal Publications:

FACILITY REQUIREMENTS AND CRITERIA
R. S. Cronhardt, Philco Corp. Western Development Labs., Palo Alto., Calif., Sept. 7, 1962, 54 p., N63-18487.

. . . Integrated Mission Control Center. . . technical equipment and operational facilities within the building. . . communication, data processing, mission operation, simulation and checkout, and support.

NASA MANNED SPACECRAFT CENTER FACILITIES
M. A. Faget, In: Annual Symposium on Nondestructive Testing of Aircraft and Missile Components, 3rd, Proceedings, San Antonio, Society for Nondestructive Testing, Inc., South Texas, Sect., 1962, p. 191/198, A63-17173.

The establishment of the Manned Space Flight Center. . . communication facilities. . .

DESIGN CONSIDERATIONS FOR THE NASA GROUND OPERATIONAL SUPPORT SYSTEM
R. L. Schroeder, et al., Raytheon Co., Equipment Div., Waltham, Mass., In its Space Vehicle Recovery Control System Concepts, 1962, p. II-1/II-8, N63-17968.

. . . for a real-time operational support required for Gemini, Apollo, and other manned space programs is discussed. The system will include a world-wide tracking, telemetry, and communication network.

COMMUNICATION SYSTEM REQUIREMENTS FOR SPACE GCA
R. L. Schroeder, Raytheon Co., Equipment Div., Waltham, Mass., In Its: Space Vehicle Recovery Control Systems Concepts, 1962, p. III-1-III-7, Presented at the Air Force Assoc. Annual Conv., Las Vegas, Nev., Sept. 1962, N63-17969.

A space ground-controlled communication system for re-entry vehicles is discussed. The recovery concept calls for an integrated ground tracking network tied to a centralized control-decision center via a real time ground data link.

COMMON TECHNICAL CONTROL OF MILITARY SPACE SYSTEMS
J. Adleman, et al., System Development Corp., Santa Monica, Calif. Interim rept., Rept. no. TM LX 63, 18 June 1963, 56 p., AD 437 666.

IMCC SYSTEMS AND PERFORMANCE REQUIREMENTS SPECIFICATION
R. S. Cronhardt, et al., Philco Corp. Western Development Labs., Palo Alto, Calif., Tech. rept., Sept. 7, 1963, 330 p., 4 refs., N63-18255.

. . . Integrated Mission Control Center (IMCC) in support of the rendezvous phases of Project Gemini and Project Apollo. . . considers the display console, data processing, operational simulation, and training in GOSS (ground operational support system) interface and communication requirements.

LAUNCH OPERATIONS SUPPORT IN SATURN/APOLLO
K. H. Debus, American Astronautical Society, Annual Meeting, 10th, New York, N. Y., May 4/7, 1964, Preprint 64-10, 18 p., A64-17808.

Description of a new "mobile" launch concept developed for the Saturn V/Apollo program. . . will be assembled and checked out in a controlled environment, and then transferred to the launch pad. . . advantages of the new concept. . . Facilities at Launch Complex 39 of the John F. Kennedy Space Center, NASA, where the "mobile concept" is being implemented. . . .

FLIGHT OPERATIONS FACILITIES
J. D. Hodge, et al., NASA, Manned Spacecraft Center, Houston, Tex., In Its Manned Orbital Operations Spec. Section 1963, p. 87/90, N63-17415.

FLIGHT CONTROL OPERATIONS
J. D. Hodge, et al., National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex., In Its Mercury Proj. Summary including Results of the 4th Manned Orbital Flight, May 15/16, 1963, p. 253/267, N63-21966.

See N63-21951 22-01.

AUTOMATIC CHECKOUT AND LAUNCH CONTROL OF MANNED OPERATIONAL SPACECRAFT

L. S. Klivans, et al., In: Aerospace Electrical Society, Annual Aerospace Electrical Electronics Conference, 21st, Los Angeles, Calif., Oct. 9/11, 1963, North Hollywood, Western Periodicals Co., 1963, p. 89/128, 7 refs., A64-17247.

. . . a computer-controller system representing highly versatile data-handling, processing, and display capabilities. This system definition makes maximum utilization of the spacecraft on-board equipment, such as PCM telemetry and digital command guidance systems, in order to allow real-time integration and evaluation of all airborne equipments and also the astronauts during the prelaunch and countdown phases. . . . The future application of such a system would allow for essentially identical equipment at factory, field, launch pad, and worldwide tracking and control stations, thereby assuring consistent spacecraft performance verification, minimization of logistic support and software, and simplification of training requirements due to commonality of equipment.

MISSION CONTROL FOR MANNED SPACE FLIGHT

C. C. Kraft, Jr., et al., National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex., In AIAA 2nd Manned Space Flight Meeting, 1963, p. 199/205, N63-23227.

See N63-23201.

. . . development of the real-time controlling agency from its concept through a Mercury mission to Project Apollo. . . the flight-control tasks are identified and developed commensurate with the time frame allowed.

APOLLO FLIGHT OPERATIONS

C. C. Kraft, Jr., American Astronautical Society, Annual Meeting, 10th, New York, N. Y., May 4-7, 1964, Preprint 64-11, 24 p., A64-17807.

Description of the progress that has been made in planning the Apollo lunar mission and in establishing the ground support requirements for tracking and communications and for the recovery of the spacecraft. . . .

SPACE RENDEZVOUS, RESCUE, AND RECOVERY. A DDC ABSTRACT COMPILATION

P. C. Rogers, Jr., Defense Documentation Center, Alexandria, Va., Aug. 1963, lv., 570 refs., AD 410 085.

This bibliography was prepared for the Specialist Meeting on Space Rendezvous, Rescue and Recovery held at Edwards Air Force Base on 10-12 September 1963. Citations are included for reports catalogued by DDC from 1953 to June 1963 and are restricted to unclassified, unlimited references. . . rendezvous guidance, control and/or propulsion . . . control center operations; simulation techniques; spaceborne computers and data processing. . . communications and telemetry . . .

SATELLITE DATA RECOVERY AND TRACKING SYSTEM FOR MANNED SATELLITE PROGRAM

G. M. Truszynski, National Aeronautics and Space Administration, Washington, D. C., Aug. 16, 1963, 43 p., For presentation at the Conf. on Artificial Satellites, Blacksburg, Va., Aug. 12-16, 1963, N63-22013.

. . . accomplishments and plans in the area of Tracking and Data Acquisition for manned satellites are discussed. . . accuracy and its reliability and augmentations planned for the support of the upcoming GEMINI program is also discussed.

X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM. VOLUME 3. SURFACE EQUIPMENT

RCA Defense Electronic Products, Camden, N.J., Development engineering rept., Rept. no. CR64 408 34 3 1, 31 March 1964, lv., AD 437 771.

X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM. VOLUME 4. AEROSPACE GROUND EQUIPMENT (AGE)

RCA Defense Electronic Products, Camden, N. J., Development engineering rept., Rept. no. CR 64 408 34 4 1, 31 March 1964, lv., AD 437 200.

Related Publications:

PACE: PREFLIGHT ACCEPTANCE CHECKOUT EQUIPMENT

W. E. Parsons, et al., Astronautics & Aerospace Engineering, vol. 1, July 1963, p. 51/53, A63-18584.

. . . The equipment, named Preflight Acceptance Checkout Equipment for Spacecraft (PACE-S/C), is designed by NASA for the Apollo and Gemini programs. . . . major subsystems. . . are the PCM ground station and the computing, display and control, data transmission, and spacecraft associated subsystems. Some problems involved in the man-machine relationship are briefly discussed.

A SIMULATION SYSTEM FOR THE MANNED SPACE-FLIGHT GROUND-SUPPORT NETWORK

L. L. Ruetz, et al., In: Testing of Manned Flight Systems Conference, Edwards AFB, Calif., December 4-6, 1963, Proceedings, New York, American Institute of Aeronautics and Astronautics, 1963, p. 109/113, A64-11347.

. . . permit integrated training for astronauts and flight controllers. . . .

. . . permit integrated training for astronauts and flight controllers. . . .

DIVISION 4D.7
MANNED SPACE STATIONS

4D.700: Communications Requirements for Manned Space Stations

Included: Manned antisatellite system; Manned rotating space stations; 24-man orbital space station; Six-man Apollo type spacecraft; Laboratory in space; Self-deploying space stations; Earth-orbiting space stations.

Not Included: Manned lunar missions (deep space problems) (4C).

Principal Publications:

THE ROLE AND EVOLUTION OF MULTI-PURPOSE ORBITAL STATIONS
S. J. Colby, American Rocket Society, Annual Meeting, 17th, and Space Flight Exposition, Los Angeles, Calif., Nov. 13-18, 1962, Paper 2721-62, 27 p., 10 refs., A63-12232.

Survey of historical trends in delivery - vehicle size and weight for terrestrial and space systems. Data on airships, trains, ocean vessels, aircraft, and rocket vehicles are given as a basis for the prediction of the size of future space vehicles designed to deliver orbital-station components as well as for resupply. Satisfactory capabilities of less than 400,000 lb is postulated. Possible orbital-station configurations, and criteria for the selection of a station geometry suitable for the expected multiple use are discussed. A procedure for establishing such a station is outlined.

SELF-DEPLOYING SPACE STATION REQUIREMENTS FOR INFLATABLE SECTIONS
H. U. Schuerch, et al., Astro Research Corp., Santa Barbara, Calif., In North American Aviation, Inc., Downey, Calif., Self-Deploying Space Station—Vol. II, Appendixes, April 10, 1962, p. B-1/B-74, 121 refs., N63-19953.

SELF-DEPLOYING SPACE STATION — VOLUME II, APPENDIXES
L. M. Tinnan, et al., North American Aviation, Inc., Downey, Calif., Space & Information Systems Div., SID-62-658-2, April 10, 1962, 100 p., 146 refs., N63-19951.

MANNED SPACE STATIONS
S. J. Colby, Ordnance, vol. 48, Nov.-Dec. 1963, p. 308/311, A64-13743.

. . . requirements for proposed permanent multipurpose orbiting manned space stations designed to serve as testing laboratories, command posts, launching facilities, and storage and supply centers. . . .

CONCEPTS AND TECHNIQUES FOR ATTITUDE CONTROL, DYNAMIC BALANCE, AND STABILIZATION OF A MANNED, ROTATING SPACE STATION
J. E. Drake, et al., In: Advances in the Astronautical Sciences, Vol. 16, Pt. 1, Space Rendezvous, Rescue, and Recovery, USAF and American Astronautical Society, Space Rendezvous, Rescue, and Recovery, Symposium, Edwards AFB, Calif., Sept. 10-12, 1963, Edited by Norman V. Petersen, North Hollywood, Calif., Western Periodicals Co., 1963, p. 384/401, A63-24765.

UTILIZATION OF EXPANDED BOOSTER STAGES FOR MANNED SPACE LABORATORIES
C. H. Hanson, et al., American Society of Mechanical Engineers, Aviation and Space, Hydraulic, and Gas Turbine Conference and Products Show, Los Angeles, Calif., March 3/7, 1963, Paper 63-AHGT-101, 11 p., A63-17768.

LABORATORY IN SPACE
C. M. Hanson, et al., Mechanical Engineering, vol. 85, Nov. 1963, p. 56/60, A64-11724.

Description of a small-crew space laboratory designed for mid-1965 deployment, which could be utilized for collecting vital information in support of major space programs . . . control and protection, communication and instrumentation . . . The laboratory could be converted to an unmanned laboratory for monitoring transient conditions of the space environment.

MANNED ANTI-SATELLITE SYSTEM
E. E. Honeywell, General Dynamics Corp., Pomona, Calif., In AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol. Vol. 2 (1963), p. 369/409, refs., N64-15266.

A conceptual design of a manned orbital inspection system is presented. The concept provides for close inspection of the target satellite while still allowing the crew to remain a relatively safe distance from the potentially hostile satellite. In addition, the concept includes a means of destroying the target satellite if it is determined to be hostile . . .

DYNAMIC BEHAVIOR OF LARGER FLEXIBLE ROTATING SPACE STATIONS DURING DOCKING MANEUVERS. Appendix - ORTHOGONALITY RELATIONSHIPS FOR LATERAL BENDING MODES
F. W. Hopper, In: Advances in the Astronautical Sciences, Vol. 16, Pt. 1, Space Rendezvous, Rescue, and Recovery, USAF and American Astronautical Society, Space Rendezvous, Rescue, and Recovery, Symposium, Edwards AFB, Calif., Sept. 10/12, 1963, Edited by Norman V. Petersen, North Hollywood, Calif., Western Periodicals Co., 1963, p. 366/383, A63-24764.

APPROACH TO SPACE STATION LOGISTICS OPTIMIZATION
N. Kallay, J. Spacecraft and Rockets, vol. 1, March. - April 1964, p. 209/212, A64-16683.

Presentation of an anlytic-computational method, utilizing dynamic programming techniques, designed to minimize the cost of supplying an extraterrestrial base. The minimization is accomplished by selection and scheduling of supply vehicles.

A MULTIPURPOSE, MANNED, ORBITAL SPACE STATION
C. W. Mathews, et al., American Institute of Aeronautics and Astronautics, and Aerospace Medical Association, Manned Space Laboratory Conference, Los Angeles, Calif., 2 May 1963, Paper 63132, 27 p., A63-19726.

Discussion of the concepts, approaches, and philosophy utilized in the design of a space station, emphasizing human factors considerations.

SPACE STATIONS — LOGISTICS SYSTEMS AND ASSOCIATED OPERATIONS REQUIREMENTS
C. W. Mathews, NASA, Manned Spacecraft Center, Houston, Texas, In its Manned Orbital Operations Spec. Section (1963) p. 60/63, N63-17409.

See N63-19401 . . .

SPACE STATIONS — CONFIGURATIONS AND DESIGN CONSIDERATIONS
O. E. Maynard, et al., NASA, Manned Spacecraft Center, Houston, Tex., In Its Manned Orbital Operations Spec. Section (1963), p. 57/59, N63-17408.

. . . various . . . configurations proposed by NASA are reviewed and classified by mode of assembly . . .

EARTH ORBITING SPACE STATIONS
E. H. Olling, NASA, Manned Spacecraft Center, Houston, Tex., In its Manned Orbital Operations Spec. Section (1963) p. 53/55, N63-17407.

The implications of orbiting space-station missions, the objectives of such vehicles, certain design configurations for the vehicles, and mission logistics and operations are discussed. . . . (See N63-17401).

SPACE-STATION LOGISTICS SUPPORT - SOME PRELIMINARIES
E. R. Schuberth, Astronautics and Aerospace Engineering, vol. 1, Aug. 1963, p. 38/43, A63-20267.

. . . major factors influencing the design of a logistic-support system oriented around a 15-man space laboratory in a 300-nautical mile Earth orbit. . . .

APPOLLO-TYPE, SIX-MAN SPACECRAFT DESIGNED TO SUPPORT 24-MAN ORBITAL SPACE STATION
I. Stone, Aviation Week and Space Technology, vol. 79, Aug. 19, 1963, p. 72/73+, A63-21824.

Brief description of a six-man, modified Apollo-type logistics spacecraft (Modap) projected to provide support service for a 24-man-crew space station in Earth orbit.

MANNED MILITARY MISSIONS IN ORBITAL SPACE: AN ANNOTATED BIBLIOGRAPHY
P. R. Stormer (Comp.), Lockheed Missiles and Space Co., Sunnyvale, Calif., LMSC-3-87-63-1, Feb. 1963, 60 p., 142 refs., N63-22807.

A review of the recent aerospace literature has been made in an attempt to identify and isolate those missions of primary military significance for manned spaceflight.

A SELECTED BIBLIOGRAPHY ON MANNED ORBITAL SPACE STATIONS
M. W. Sykes, Space Sciences Lab., General Electric Co., Rept. no. R63SD65, Aug. 1963, 42 p., AD 418 016.

. . . contains 135 references to publications on manned orbital space stations and their components. . . .

Related Publication:

MARSFLIGHT II SPACE CABIN SIMULATOR
R. A. Ibison, Medical and Biological Problems of Space Flight: Proceedings of a Conference held in Nassau, the Bahamas, November 1961, Edited by Geoffrey H. Bourne, New York and London, Academic Press, 1963, p. 63/84, 31 refs., A63-19995.

Description of the Marsflight II, a large multiman space-cabin simulator. It comprises a space cabin 24 ft. long and a ground-station complex of four console groups, including the main control, the ground radio and facsimile center, the biomedical center, and the maintenance and special operations station.

DIVISION 4D.8
SPECIAL MANNED SPACE FLIGHT PROBLEMS

4D.820: Project Apollo

Principal Publications:

PRESENT AND FUTURE OF MANNED SPACE FLIGHT-3. MERCURY AND APOLLO: RESULTS AND PLANS
R.R. Gilruth, Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 110/112.

PROJECT APOLLO, PRE-CONTRACTURAL DOCUMENTATION AND ORBITAL RENDEZVOUS: A LITERATURE SURVEY
North American Aviation, Inc., Downey, Calif., Rept. no. SID 61-470, 29 Dec. 1961, 38 p., AD 282 470.

A review of literature on Project Apollo and Orbital Rendezvous . . . from August 1959 to December 4, 1961 . . .

APOLLO PROJECT STATUS
C.W. Frick, In: Technology of Lunar Exploration, Progress in Astronautics and Aeronautics, vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 927/940, A63-23452.

. . . The spacecraft consists of a command module, service module, launch escape system, adapter, and a landing stage, which will be either a lunar excursion module or a staged landing system for the command module. . . .

RELATIONSHIP BETWEEN THE MANNED AND UNMANNED PROGRAMS
J.F. Shea, In: Technology of Lunar Exploration, Progress in Astronautics and Aeronautics, vol. 10, American Rocket Society, Lunar Missions Meeting, Cleveland, Ohio, July 17-19, 1962, Edited by Clifford I. Cummings and Harold R. Lawrence, New York and London, Academic Press, Inc., 1963, p. 971/974, A63-23453.

Brief discussion of the data requirements for the Apollo manned lunar landing program, and of the plans for obtaining these data through the unmanned lunar programs. . . .

SOME ASPECTS OF THE LOGICAL DESIGN OF A CONTROL COMPUTER: A CASE STUDY
R.L. Alonso, et al., IEEE Trans. Electronic Comp., vol. EC-12, no. 5, Dec. 19[illegible] p. 687/697.

Some logical aspects of a digital computer for a space vehicle are described, and the evolution of its logical design is traced. . . . the Apollo Guidance Computer (AGC) . . . is an onboard computer for one of the forthcoming manned space projects, a fact which is relevant primarily because it puts a high premium on economy and modularity of equipment, and results in much specialized input and output circuitry. The computer is a parallel, single address machine with more than 10,000 words of 15 bits. Such a short word length yields advantages of efficient storage and speed, but at a cost of logical complexity in connection with addressing, instruction selection, and multiple-precision arithmetic.

THE APOLLO GUIDANCE COMPUTER
R.L. Alonso, et al., Rec. Nat. Space Electronics Symp., no. 6.1, 1963.

SPECIFICATION FOR A LUNAR SURFACE VEHICLE DESIGNED TO SUPPORT AN EARLY APOLLO MISSION
A. Baker, Rec. Nat. Space Electronics Symp., no. 6.2, 1963.

. . . problem areas in designing the payload of a lunar roving vehicle specifically to support an early Apollo mission. The vehicle must be capable of either manned or unmanned operation, in both a day and night environment.

The paper considers three major subsystem areas in detail —Communications, Power Sources, and Environmental Control. . . .

COMMUNICATIONS AND TRACKING ON THE APOLLO LUNAR EXPLORATION MISSION
S.W. Fordyce, Rec. Nat. Space Electronics Symp., no. 6.3, 1963.

. . . current plans for the communications and tracking links for the Apollo lunar mission. . . . the rationale behind the selection of the Apollo communications and tracking systems.

A COMMUNICATIONS SYSTEM FOR "APOLLO"
D.R. Holcomb, Electronic Indust., vol. 22, Oct. 1963, p. 108-110, A64-13483.

. . . S-band radio system for maintaining two-way contact with the Apollo space-craft throughout its journey to the Moon and back. . . .

APOLLO FLIGHT OPERATIONS
C. C. Kraft, Jr., American Astronautical Society, Annual Meeting, 10th, New York, N. Y., May 4-7, 1964, Preprint 64-11, 24 p., A64-17807.

Description of the progress that has been made in planning the Apollo lunar mission and in establishing the ground support requirements for tracking and communications and for the recovery of the spacecraft. . . .

RANGE CAPABILITY OF S-IVB AND SERVICE MODULE USED AS ABORT VEHICLES FROM SATURN V BOOST TRAJECTORIES
V. V. Moore, et al., In NASA, Marshall Space Flight Center Implementation Rept. no. 1 on Studies in the Fields of Space Flight and Guidance Theory, 1963, p. 71/88, refs., N64-16524.

The minimum and maximum range capability of the S-IVB Stage and Service Module, used as vehicles for powered abort from an expected volume of Saturn V boost trajectories, has been determined. Abort is assumed to occur between the time of second-stage ignition and a time near final lunar injection. Abort trajectories terminate at a reentry altitude of 120 km with flight path angles of 94° and 99.5°.

LUNAR LOGISTIC SYSTEM SCIENTIFIC FACILITY
C. A. Pearse, et al., Bellcomm. Inc., Washington, D. C., 31 Jan. 1963, 16 p., refs., N64-13136.

. . . to examine possible methods for increasing the overall scientific capability of early Project Apollo missions, utilizing a nominal 1500-pound payload delivered by a C1-B, automated LEM, or C-5 Lunar Logistic Vehicle . . .

TECHNICAL DEVELOPMENT STATUS OF THE APOLLO COMMAND AND SERVICE MODULES
N. J. Ryker, American Astronautical Society, Annual Meeting, 10th, New York, N. Y., May 4-7, 1964, Preprint 64-15, 45 p., A64-17818.

. . . progress achieved as of May 1964 in the development of the Apollo command and service modules, which are being produced by North American Aviation's Space and Information Systems Division . . . The presentation includes photographs of major hardware already delivered to NASA flight centers, as well as data and illustrations of ground and flight tests. . . .

THE APOLLO MISSION
A. B. Shepard, Jr., American Astronautical Society, Annual Meeting, 10th, New York N. Y., May 4-7, 1964, Preprint 64-9, 19 p., A64-17815.

. . . The lunar rendezvous mission is described from the viewpoint of crew operations. . . .

SYSTEMS CHECKOUT FOR APOLLO
J. E. Sloan, et al., Repr. from Aeron. and Aerospace Eng., March 1963, p. 37/40, N63-16972.

APOLLO RELIABILITY CONTROL PROGRAM
W. K. Warner, et al., Institute of the Aerospace Sciences, Annual Meeting, 31st New York, N. Y., Jan 21-23, 1963, Paper 63-89, 15 p., A63-14742.

Examination of the reliability requirements for the Apollo manned space program, with emphasis on high-integrity design, stringent control measures, comprehensive ground testing, and the selection, assignment, training, and movtivation of personnel associated with the project. . . .

THE APOLLO TELECOMMUNICATIONS SYSTEM
S. E. Watson, et al., Rec. Nat. Space Electronics Symp., no. 6.4, 1963.

. . . For use during operations within a few thousand miles of the surface of the earth, the Apollo spacecraft contains a VHF-FM transmitter for down transmission of data and a C-band transponder as an aid to earth-based radar tracking. . . .

SYSTEMS ENGINEERING
JPL Space Progr. Summ., vol. 3, no. 37-24, Sept./Oct. 1963, p. 12/13.

. . . status . . . activities . . . Surveyor . . . Ranger III . . . Mariner C (Mars Mission, 1963) . . . Mariner B. (Centaur-Based Entry-Capsule Mission) . . . Apollo. Specifications prepared by Goddard Space Flight Center for the Manned Space Flight Network (MSFN) were reviewed . . .

INITIAL CONCEPT OF LUNAR EXPLORATION SYSTEMS FOR APOLLO, VOLUME V. SUMMARY DIGEST
National Aeronautics and Space Administration, Washington, D.C., March 1964, 34 p., Work performed under contract by Boeing Co., N64-15969.

. . . to develop the conceptual design of a lunar-exploration support system within the following general criteria: (1) utilization of a modular approach . . . (2) flexibility in scope (2 to 18 men), duration (3 months to 2 or more years), and type of mission activity; (3) maximum lunar-logistic-vehicle payload weight of 25,000 earth pounds; and (4) feasibility of development for the 1970 to 1974 time period . . .

Related Publications:

NASA PROGRAMS LEADING TO EXPLORATION OF THE MOON
D. B. Holmes, In: Science, Technology and Management, National Advanced-Technology Management Conference, Proceedings, Seattle, Washington., Sept. 4-7, 1962, New York, McGraw-Hill Book Co., Inc., 1963, p. 238/247, A63-16600.

. . . manned space-flight program. . . . technical task of the lunar landing is outlined. . . .

SCIENCE, TECHNOLOGY, AND MANAGEMENT (National Advanced-Technology Management Conference, Proceedings, Seattle, Wash., Sept. 4-7, 1962)
F. E. Kast and J. E. Rosenzweig (editors), New York, McGraw-Hill Book Co., Inc., 1963, 379 p., A63-16579.

. . . discussion . . . of managing very large and complex advanced-technology programs, from their inception to the operation of the end products. . . . Discussed are ballistic missile programs, the Navy's Polaris program, the world-wide Mercury communications network, and the program for manned flight to the Moon. . . .

APOLLO-TYPE, SIX-MAN SPACECRAFT DESIGNED TO SUPPORT 24-MAN ORBITAL SPACE STATION
I. Stone, Aviation Week and Space Technology, vol. 79, Aug. 19, 1963, p. 72/73+, A63-21824.

Brief description of a six-man, modified Apollo-type logistics spacecraft (Modap) projected to provide support service for a 24-man-crew space station in Earth orbit.

4D.826: Project Dyna Soar (X-20), Aerospace Plane

Principal Publications:

DYNA SOAR STEP-I. BIBLIOGRAPHY OF RESEARCH AND DEVELOPMENT REPORTS
J. H. Allen, Martin-Marietta Corp., Baltimore, Md., Rept. no. ER11349 2, 15 April 1961, 11 p., AD 431 903.

DEVELOPMENT TEST PLAN DYNA-SOAR COMMUNICATIONS AND TRACKING SUBSYSTEM
RCA Defense Electronic Products, Camden, N.J., Rept. no. CR62 408 15 0, 30 June 1962, 1 v., AD 430 789.

FUNCTIONAL INTEGRATION TEST PLAN (PRELIMINARY) X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM
RCA Defense Electronic Products, Camden, N.J., Rept. no. CR62 408 15 3 1, 30 Nov. 1962, 139 p., AD 430 792.

A preliminary Functional Integration Test Plan for the X-20 (Dyna-Soar) Communications and Tracking Subsystem is presented. . . . Five areas are considered: Airborne prime equipment, Airborne prime/AGE equipment, Surface prime equipment, Surface prime AGE equipment, Integrated system tests.

RCA 8540725 SPECIFICATION FOR X-20 (DYNA-SOAR) COMMUNICATION AND TRACKING SUBSYSTEM. VAN SITE EQUIPMENT
RCA Industrial Electronic Products, Camden, N.J., Rept. no. RCA 8540725, 30 Nov. 1962, 1 v., AD 431 879.

. . . antennas capable of acquiring, tracking, and receiving signals radiated by the Dyna-Soar vehicle and transmitting signals to the vehicle . . . ground equipment capable of exciting the transmitting antenna elements with the correct intelligence and power levels such that communications can be established from the ground equipment to the Dyna-Soar vehicle . . . ground equipment capable of accepting the received energy from the antenna elements and converting this energy to signals at standard VHF telemetry frequencies . . . controls, displays, and monitoring functions . . .

ANALOG COMPUTER SIMULATION OF THE DYNA-SOAR GLIDER INTEGRATED ENVIRONMENTAL CONTROL AND SECONDARY POWER SUBSYSTEMS
E. W. Cravens, et al., Boeing Co., Seattle, Wash., 29 March 1963, 315 p., 1 v., and 145 p., respectively, AD 433 561, AD 433 563, and AD 433 564.

SIGNAL DATA CONVERTER DESIGN SPECIFICATIONS
G. B. Kuenster, Boeing Co., Seattle, Wash., Document no. D2 80269, 6 Sept. 1962, rev., 23 Dec. 1963, 30 p., AD 430 468.

. . . for use in the X-20 spacecraft. . . . accepts data inputs from the inertial guidance system verdan computer and converts these data into forms suitable for use by the test data subsystem and certain of the pilots displays.

X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM. VOLUME 1. SYSTEM AND SUPPORT
RCA Defense Electronic Products, Camden, N. J., Development engineering rept., Rept. no. CR64 408 34 1 1, vol. 1, 31 March 1964, 1 v., AD 437 171.

X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM. VOLUME 2. AIRBORNE EQUIPMENT
RCA Defense Electronic Products, Camden, N. J., Development engineering rept., Rept. no. CR64 408 34 2 1, 31 March 1964, 1 v., AD 437 831.

The airborne equipment described include: SHF test-data/voice transmitter; Transmitter antenna multicoupler; SHF command receiver; SHF command decoder set; C-band tracking equipment; UHF voice receiver/transmitter. UHF command receiving set, control/intercommunication as well as UHF search, and rescue receiver/transmitter. . . .

X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM. VOLUME 3. SURFACE EQUIPMENT
RCA Defense Electronic Products, Camden, N. J., Development engineering rept., Rept. no. CR64 408 34 3 1, 31 March 1964, 1 v., AD 437 771.

X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM. VOLUME 4. AEROSPACE GROUND EQUIPMENT (AGE)
RCA Defense Electronic Products, Camden, N. J., Development engineering rept., Rept. no. CR64 408 34 4 1, 31 March 1964, 1 v., AD 437 200.

ACQUISITION AND TRACKING ANALYSIS FOR X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM
RCA Defense Electronic Products, Camden, N. J., Rept. no. CR64 408 28 1, 20 March 1964, 1 v., AD 434 102.

X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM
RCA Defense Electronic Products, Camden, N. J., Final design analysis rept., Rept. no. CR64 408 35 1, 31 March 1964, 1 v., AD 437 172.

AIRBORNE INSTRUMENTATION PLAN FOR DEVELOPMENT TEST PROGRAM. X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM
RCA Defense Electronic Products, Camden, N. J., Rept. no. CR63 408 15 1 4 1, 22 Nov. 1963, 1 v., AD 430 791.

. . . details the technical approach in the design of the airborne instrumentation system for the developmental evaluation of the glider portion of the X-20 CTS and furnishes a technical description of the equipment. . . . uses two 14-track magnetic tape recorders and a 16 mm cine camera to provide permanent test data records. . . .

GROUND INSTRUMENTATION PLAN FOR DEVELOPMENT TEST PROGRAM. X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM
RCA Defense Electronic Products, Camden, N. J., Rept. no. CR63 408 15 1 5 1, 15 Nov. 1963, 1 v., AD 430 790.

FLIGHT TEST PLAN AND FACILITY REQUIREMENTS FOR X-20 REMOTE CONTROL RECOVERY SUBSYSTEM DEVELOPMENT FLIGHT TEST PROGRAM
Sperry Phoenix Co., Ariz., Rept. nos. 273 110; 273 111; 273 112, 28 Feb. 1963, 1 v., AD 431 885.

. . . will be used to recover the early unmanned X-20 vehicles. . . . two ground control stations will be used along with transponder and flight control coupling equipment installed in the X-20 vehicle. During the recovery operation, one ground station, the Acquisition Control Center (ACC), will be located at Point Arguello, California . . . The second ground station, the Terminal Control Center (TCC), will be located at Edwards Air Force Base, California . . .

4D.830: Project Gemini

Principal Publications:

INFORMATION FLOW PLAN (GEMINI RENDEZVOUS OPERATION)
R. S. Cronhardt, Philco Corp., Western Development Lab., Palo Alto, Calif, Preliminary Issue, July 9, 1962, 238 p., N63-18413.

. . . Concepts of operations, information flow requirements, and planning for the Gemini rendezvous missions are presented . . .

GEMINI LAUNCH VEHICLE. ACTIVATION PLAN FOR LAUNCH COMPLEX 19 AND THE LAUNCH VEHICLE SUPPORT AREA. VOLUME I
R. W. Powell, Martin Marietta Corp., Baltimore, Md., Rept. no. ER12211A I, Oct. 1962, 1 vol., AD 424 725.

. . . description of all major activation events that must occur from the moment of contract award through launch complex verification to provide a complex from which the Gemini spacecraft can be successfully launched. . . .

GEMINI FUEL CELL POWER SOURCE—FIRST SPACECRAFT APPLICATIONS
J. L. Schanz, et al., American Rocket Society, Space Power Systems Conference, Santa Monica, Calif., Sept. 25-28, 1962, Paper 2561-62, 8 p., A63-11776.

Brief description of the design and development of the ion-exchange membrane fuel cell intended to furnish electric power and drinking water for the Gemini spacecraft. It employs a solid electrolyte material and is insensitive to gravity effects. Except for valves and a small pump for the coolant system, it has no moving parts. The lightweight fuel cell possesses a high-power density because of its thin-cell construction.

QUALITY PROGRAM PLAN FOR PROJECT GEMINI
Lockheed Aircraft Corporation, Sunnyvale, Calif., Rept. no. LMSC A054657, 31 July 1962, 74 p., AD 421 636.

. . . establishes . . . Product Assurance . . . covers all phases of LMSC GEMINI activities from design conception to the delivery . . .

PROJECT GEMINI. FACT SHEET
NASA, Houston, Tex., Manned Spacecraft Center, News Release, Sept. 1962, (Rev.), 34 p., N63-19423.

. . . will employ a two-man spacecraft for long-duration missions and for rendezvous and docking experiments. . . .

GEMINI DESIGN KEYED TO MISSION FLEXIBILITY
G. Alexander, Aviation Week and Space Technology, vol. 78, 13 May 1963, p. 53/55+, A63-17200.

Examined in detail are the four spacecraft modules: (1) the forward module, housing the rendezvous radar, the stabilizing drogue parachute, and the paraglider; (2) the re-entry control module; (3) the cabin, including the manned pressurized hull; and (4) the adapter module consisting of two separate sections—retrograde and equipment.

ON-BOARD NAVIGATION AND LANDING SITE SELECTION—PROJECT GEMINI
J. R. Burton, et al., In: Advances in the Astronautical Sciences, Vol. 16, Pt. 1, Space Rendezvous, Rescue, and Recovery, USAF and American Astronautical Society, Space Rendezvous, Rescue, and Recovery Symposium, Edwards AFB, Calif., Sept. 10/12, 1963, Edited by Norman V. Petersen, North Hollywood, Calif., Western Periodicals Co., 1963, p. 881/897, A63-24793.

. . . This capability is made possible by the availability of a digital computer and inertial measurement unit on the spacecraft. The system utilizes available display and input/output equipment to permit the crew to operate the system and observe the results.

GEMINI PROGRAM AND MISSION
J. A. Chamberlin, et al., In: 2nd Manned Space Flight Meeting, New York, American Institute of Aeronautics and Astronautics, 1963, p. 23/32, A63-18985.

. . . emphasizing the rendezvous aspects. . . .

PROJECT GEMINI DESIGN PHILOSOPHY
J. A. Chamberlin, et al., In its Manned Orbital Operations Spec. Section, 1963, p. 35/39, 2 refs., N63-17405.

PROJECT GEMINI DESIGN PHILOSOPHY
J. A. Chamberlin, et al., Astronautics and Aerospace Engineering, vol. 1, Feb. 1963, p. 35/39, A63-13326.

. . . particular attention to the primary objectives . . . (1) to provide a logical follow-up to Project Mercury, with a minimum of expense and time; (2) to subject two men and their supporting equipment to long-duration flights in space, a requirement for lunar trips and beyond; (3) to rendezvous and dock with another orbiting vehicle; (4) to maneuver a spacecraft in space after docking to a new propulsion system; (5) to experiment with men climbing out of the spacecraft for short periods while in orbit; and (6) to perfect methods for returning and landing the spacecraft on a small preselected land site. . . .

FLIGHT CONTROL MALFUNCTION MANAGEMENT FOR THE GEMINI LAUNCH VEHICLE
H. Hecht, Aerospace Corp., Los Angeles, Calif., TDR 169 3126 TN 4, 12 July 1963, 112 p., AD 411 856.

. . . examples of switchover simulations . . . over-all evaluation of the protection afforded by the malfunction management system as presently planned . . . discussion of an alternate implementation which may be considered in the future for similar vehicles.

FIRST GEMINI COMPUTER MODEL COMPLETED
R. D. Hibben, Aviation Week and Space Technology, vol. 79, 15 July 1963, p. 58/59+, A63-19651.

. . . proposed operation of the computer during the mission . . . regarding steering, velocity changes, and radar lock-on. The prototype developer is of the general-purpose, binary and serial type, with a fixed arithmetic operation. A basic element of the random-access nondestructive advanced memory is a two-hole ferrite core. The memory unit, whose capacity is 159,744 total bits is discussed.

PCM TELEMETRY ENCODER FOR THE GEMINI LAUNCH VEHICLE
J. W. Peghiny, et al., Proc. Nat. Telem. Conf., no. 3-5, May 1963.

. . . on-board PCM . . . Encoder which accepts 196 analog and 48 digital functions, multiplexes, amplifies, staticizes, converts to a serial digital code, and provides a filtered PCM train to the vehicle FM transmitter. The unit is completely self contained, all solid-state, adjustment and calibration free. . . .

GEMINI RENDEZVOUS RADAR
W. W. Quigley, Presented at the AIAA Guidance and Control Conf., MIT, Cambridge, Mass., Aug. 12-14, 1963, AIAA Paper 63-350, 8 p., 1 ref., N63-20319.

GEMINI MALFUNCTION DETECTION SYSTEM TEST PLAN FOR SM-68B AT AMR
Martin-Marietta Corp., Denver, Colo., Rept. no. CR61 5 R1, June 1963, 5 p., AD 408 081.

This document outlines the testing to be performed using the Gemini malfunction detection system (MDS) with the WS 107C (Titan II) flight test program at Atlantic Missile Range (AMR) Stands P-15 and P-16 . . .

GEMINI PROJECT PROGRAM PLAN FOR THE LAUNCH VEHICLE GUIDANCE COMPUTER
Burroughs Corp., Detroit, Mich., 23 Aug. 1962, rev. 17 May 1963, 24 p., AD 431 251.

. . . list of deliverable items . . . appropriate test and procedure . . . milestone charts . . .

GEMINI PROGRAM PLAN
Lockheed Aircraft Corp., Sunnyvale, Calif., Rept. no. LMSC-A306070, 1 April 1963, 1 vol., incl. illus., AD 401 926.

. . . for the purpose of investigating, testing, docking, and joint maneuvering of vehicles in space.

C & C SUBSYSTEM ENGINEERING ANALYSIS REPORT GEMINI AGENA TARGET VEHICLE
Lockheed Aircraft Corp., Sunnyvale, Calif., Rept. no. SP63 11, 19 July 1963, 1 vol., AD 412 660.

Descriptors: Rendezvous vehicles . . . Communication systems, Control systems, Ultrahigh frequency, Pulse communication systems, Digital systems . . . the design of the Communication and Control (C&C) Subsystem for the Gemini Agena Target Vehicle. . . .

TITAN IN SPACE
Flight International, vol. 83, Jan 17, 1963, p. 83/87, A63-12356.

Description of the development of the Titan 2 ICBM and its application to the NASA Gemini program. The advantages of the Titan system are outlined, and the planned rendezvous in space is discussed. . . .

4D.840: Project Mercury

Principal Publications:

MERCURY CAPSULE COMMUNICATIONS
R. J. Pierce, Astronautics, Dec. 1959, p. 24/27 & 86/88.

Discussion of communications, equipment developed to provide the following functions: voice communication, command function, telemetry, orbital tracking, precision tracking, and rescue beacons.

COMMUNICATIONS SYSTEM FOR PROJECT MERCURY SPACE CAPSULE
W. Benner, McDonnell Aircraft Corp., St. Louis, Mo., Feb. 1960.

REMARKS ON THE STATUS OF PROJECT MERCURY
A. C. Bond, et al., Advisory Group for Aeronautical Research and Development, Paris, France, Rept. 290, Oct. 1960, 20 p., Presented at the Flight Mechanics Panel, held from 3rd to 5th October, 1960, in Instanbul, Turkey, AD 263 709.

A broad over-all review . . . is presented in the light of experience gained in the two years since its initiation . . . The space capsule and some of its primary systems are described in conjunction with the mission and its requirements.

WORLD-WIDE COMMUNICATIONS FOR PROJECT MERCURY
F. E. Demaree, Proc. Nat. Commun. Symp., vol. 6, Oct. 1960, p. 8/16.

PROJECT MERCURY WORLD-WIDE TELEMETRY AND DISPLAY SYSTEM
D. Ferber, Proc. Nat. Telemetering Conf., May 1960, p. 361/374.

THE CONTROL AND MEASUREMENT OF THE MERCURY CAPSULE ENVIRONMENT
R. S. Johnston, IRE Trans. Nat. Symp., Space Electronics Telem., no. 6-3, Sept. 1960, p. 1/11.

BEACON ANTENNAS FOR PROJECT MERCURY
D. F. Shea, et al., IRE WESCON Conv. Rec., vol. 1, Aug. 1960, p. 149/157.

PRESENT AND FUTURE OF MANNED SPACE FLIGHT—3. MERCURY AND APOLLO: RESULTS AND PLANS
R. R. Gilruth, Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 110/112.

PRESENT AND FUTURE OF MANNED SPACE FLIGHT—2. MERCURY CAPSULE DESIGN AND DEVELOPMENT EXPERIENCE
J. S. McDonnell, Proc. Nat. Conf. Peaceful Uses Space, vol. 1, May 1961, p. 108/109.

MEASURED RADAR BACKSCATTER CROSS SECTIONS OF THE PROJECT MERCURY CAPSULE
R. B. Mack, et al., Air Force Cambridge Research Labs., Bedford, Mass., Rept. no. AFCRL-38, Feb. 1961, 45 p., AD 259 427.

The feasibility of tracking the Project Mercury capsule with active radars depends on the radar scattering characteristics of the capsule. Radar backscatter cross sections of the Project Mercury capsule were measured by standard modeling techniques at simulated radar frequencies of 440, 933.3, 1184, 2800, and 5600 mc, and for climb angles alpha of 0, 15, 30, 45, 60, 75, and 90 degrees. Both horizontal and vertical polarizations were used. The largest backscatter cross section sigma over the widest angular intervals were obtained at 933.3 and 2800 mc. Values of delta were somewhat higher at 933.3 mc than at 2800 mc.

ATLAS MISSILE FLIGHT SAFETY SYSTEM FOR PROJECT MERCURY
J. W. Schaelchlin, et al., IRE Internat. Conv. Rec., vol. 5, March 1961, p. 147/150.

ASTRONAUT JOHN H. GLENN ORBITS THE EARTH FOR AMERICA, FEBRUARY 20, 1962
Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., Catalog no. NAS 1.2:G 48, 1962, 8 p.

Pictorially this publication presents a short resume of the events of this historical day from the time he arose at 2:20 a.m., until the touchdown, in the ocean southeast of Cape Canaveral at 2:43 p.m., and the recovery of the astronaut and the capsule.

WHITE SANDS MISSILE RANGE AN/FPS-16 RADAR PERFORMANCE IN TRACKING THE PROJECT MERCURY CAPSULE
R. E. Green, Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex., Electronic Instrumentation Div., Technical Report, Sept. 1962, 33 p., 1 ref., N63-21465, AD 291 741.

GROUND DISPLAYS FOR FLIGHT MONITORING AND CONTROL OF THE PROJECT MERCURY MISSION
H. C. Kyle, Proc. Nat. Telem. Conf., no. 11-3, May 1962, p. 1/12.

INTEGRATING MERCURY ELECTRONIC SUBSYSTEMS
C. V. Wolfers, Astronautics, vol. 7, May 1962, p. 32/35.

RESULTS OF THE FIRST UNITED STATES MANNED ORBITAL SPACE FLIGHT, FEBRUARY 20, 1962
National Aeronautics and Space Administration, Washington, D. C., 20 Feb. 1962, 204 p., incl. illus., tables, 27 refs., AD 274 174.

MERCURY SPACECRAFT PRE-LAUNCH PREPARATIONS. PART I: AT THE MANUFACTURER'S PLANT
A. P. Anderhub, et al., Presented at the AIAA Space Flight Testing Conf., Cocoa Beach, Fla., March 18-20, 1963, AIAA Paper 63071, N63-17518.

REVIEW OF LESSONS LEARNED IN THE MERCURY PROGRAM RELATIVE TO SPACECRAFT DESIGN AND OPERATIONS
F. J. Bailey, Jr., American Institute of Aeronautics and Astronautics, Space Flight Testing Conference, Cocoa Beach, Fla., 18-20 March 1963, Paper X 63073, 19 p., A63-17225.

TRACKING PERFORMANCE OF THE MERCURY QUAD-HELIX ACQUISITION AID
J. G. Barry, et al., IEEE Trans. Commun. Electronics, no. 69, Nov. 1963, p. 657/663.

. . . Project Mercury uses a telemetry-frequency direction finder as an acquisition aid for assisting narrow-beam radars to acquire the spacecraft, but the broad beamwidth of the

quad-helix antenna allows multipath reception to degrade tracking accuracy at low elevation angles. . . . Aircraft acquisition tests show the ability of the equipment to place the AN/FPS-16 tracking radar on target.

PROJECT MERCURY EXPERIENCES
W. M. Bland, Jr., et al., NASA, Manned Spacecraft Center, Houston, Tex., In its Manned Orbital Operations Spec. Section, 1963, p. 29/34, N63-17404.

. . . in retrospect . . . found . . . to have: (1) confirmed the basic Mercury concepts of using simple, reliable systems, and existing launch vehicles, and a logical and progressive test program; (2) proved the Mercury design, production, inspection, qualification, and check-out systems; (3) shown the value of training the flight and ground-network crews to overcome deviations from the normal pattern; (4) proved the possibility of analyzing, documenting, and distributing the data from a manned space mission within three weeks of the mission. . . .

SPECIAL INFLIGHT EXPERIMENTS
L. R. Fisher, et al., National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex., In its Mercury Proj. Summary Including Results of the 4th Manned Orbital Flight, May 15-16, 1963, p. 213/229, 2 refs., N63-21963.

. . . experiment program . . . Mercury spacecraft . . .

CHECKOUT OF MERCURY-ATLAS LAUNCH VEHICLES
C. D. Fowler, Presented at the AIAA Space Flight Testing Conf., Cocoa Beach, Fla., 18-20 March 1963, AIAA Paper 63070, 15 p., N63-17660.

PROJECT MERCURY-A CHRONOLOGY
J. M. Grimwood, Washington, NASA, NASA SP-4001; MSC-HR-1, 1963, 250 p., refs., N63-21848.

A brief but accurate chronology of important events throughout the Mercury program . . .

FLIGHT CONTROL OPERATIONS
J. D. Hodge, et al., National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex., In its Mercury Proj. Summary including Results of the 4th Manned Orbital Flight, May 15-16, 1963, p. 253/267, N63-21966.

See N63-21951.

C-BAND RADAR—BEACON TRACKING FOR PROJECT MERCURY
B. H. Labitt, IEEE Trans. Commun. Electronics, no. 69, Nov. 1963, p. 647/656.

. . . Lincoln Laboratory performed an analysis of the Mercury beacon-tracking capabilities. Calculations of signal strength to be expected for orbital flights were made. As a result of the marginal signal levels which were computed, a program of improvements was initiated. . . . Attention was focused on C-band tracking problems because the C-band monopulse tracking radar (AN/FPS-16) used in the Mercury program is inherently more accurate than its S-band conically scanned counterpart; VERLORT.

OBSERVATIONS OF SPACE PHENOMENA
S. D. Soules, et al., National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., In its Mercury Proj. Summary including Results of the 4th Manned Orbital Flight, May 15-16, 1963, p. 327/347, 25 refs., N63-21970.

. . . principal scientific observations made by the Mercury astronauts, arranged according to the sequence: daylight, twilight, and night . . .

ATTENUATION IN RE-ENTRY COMMUNICATIONS
F. J. Tischer, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., Plans Office Technical Report no. 2, NASA TM X-51027; NASA X-520-62-92, 19 June 1962, 63 p., refs., N64-12399.

. . . Methods are presented for computing the approximate attenuation of radio signals passing through the shock layer of large reentry vehicles . . . to obtain estimates for the reentry "blackout." Based on this concept, approximate equations are derived for the reentry attenuation. The derived equations are then applied to the MA-6 Mercury flight.

COMMUNICATION BLACKOUT AT RE-ENTRY
F. J. Tischer, Alabama U., Research Inst., Huntsville, NASA CR-55167; UARI-RR-61, Sept. 1963, 15 p., refs., Presented at the Fifth Intern. Symp. on Space Technol. and Sci., ISTS, Tokyo, 2-7 Sept. 1963, N64-13335.

MERCURY SPACECRAFT PRE-LAUNCH PREPARATIONS. PART II—AT THE LAUNCH SITE
J. J. Williams, et al., Presented at AIAA Space Flight Testing Conf., Cocoa Beach, Fla., March 18-20, 1963, AIAA Paper 63072, 49 p., 2 refs., N63-17519.

AIR PROVING GROUND CENTER SUPPORT FOR PROJECT MERCURY
Air Force Proving Ground Command, Eglin AFB, Fla., APGC TDR 63 64, Nov. 1963, 57 p., AD 423 773.

Presented is the Air Proving Ground Center support for the NASA's man-in-space program, Project Mercury, from the planning stages to completion of the program in June 1963. The general mission objectives, global tracking facilities . . . are presented with emphasis on the . . . missions supported by Mercury Station 17.

MERCURY-ATLAS 9 PRESS KIT
NASA, Washington, D. C., News Release no. 63-90, May 10, 1963, 71 p., N63-17743.

. . . manned one-day spaceflight. . . . experiments scheduled . . . include . . . television system operation . . . HF antenna test . . .

REPORT TO THE SECRETARY OF DEFENSE ON DEPARTMENT OF DEFENSE SUPPORT OF PROJECT MERCURY
Department of Defense, Washington, D. C., Final rept., 1 July 1959-13 June 1963, 11 Sept. 1963, 79 p., AD 417 073.

Contents . . .DOD support (Aircraft/ships) . . . Communications; Network comm MA-9, Aircraft and astronaut voice relay . . . Predicted recovery comm/AT1 . . . Reimbursed & absorbed costs, Review of Mercury missions.

4D.850: Manned Orbiting Laboratory (MOL)

Principal Publications:

EXTERNAL OPERATIONS ON THE MANNED SPACE LABORATORY
J. W. Clark, American Institute of Aeronautics and Astronautics—Aerospace Medical Association, Manned Space Laboratory Conference, Los Angeles, Calif., 2 May 1963, Paper 63146, 13 p., A63-17536.

. . . application of modern remote handling techniques to the design of auxiliary vehicles to perform external operations on the Manned Space Laboratory.

4D.860: Project VOSTOK (USSR)

Principal Publications:

RADIO LINK EARTH-"VOSTOK-2"
V.A. Kotel'nikov, Radio Engng: Transl. of Radiotekhnika, vol. 16, no. 9, 1961, p. 1/2.

. . . Transmission from the spaceship to the earth over very great distances were effected with the aid of two simultaneously operating short wave telegraph-telephone AM transmitters. As previously announced, their frequencies were 15.765 and 20.006 megacycles. These transmitters operated with special separation filters on

Related Publications:

SCIENCE, TECHNOLOGY, AND MANAGEMENT (National Advanced-Technology Management Conference, Proceedings, Seattle, Wash., Sept. 4-7, 1962)
F. E. Kast and J. E. Rosenzweig (editors), New York, McGraw-Hill Book Co., Inc., 1963, 379 p., A63-16579.

. . . Discussed are ballistic missile programs, the Navy's Polaris program, the worldwide Mercury communications network, and the program for manned flight to the Moon. . . .

PHASE SHIFTING TO AVOID INTERFERENCE REGIONS BETWEEN ANTENNA ELEMENTS
B. H. Labitt, Lincoln Lab., Mass. Inst. of Tech., Lexington, Rept. no. 42G-2, AFESD TDR 62-99, 23 May 1962, 11 p. incl. illus., 4 refs., AD 277 561.

The creation of interference regions in satellite or missile borne antenna systems as in Project Mercury which utilize multiple radiating elements, has caused erratic and generally poor ground tracking. One method of modifying the above interference regions has been accomplished by modulating the phase of one of the antenna elements with respect to its adjacent element. The effect of such phase modulation is described mathematically . . .

PHYSICAL SCIENCES RESEARCH PROGRAM IN A MANNED ORBITING LABORATORY
J. B. Edson, American Institute of Aeronautics and Astronautics, Aerospace Medical Association, Manned Space Laboratory Conference, Los Angeles, Calif., 2 May 1963, Paper 63135, 7 p., A63-17470.

A MANNED SPACE LABORATORY ENVIRONMENT CONTROL SYSTEM
A. M. Mayo, et al., American Institute of Aeronautics and Astronautics—Aerospace Medical Association, Manned Space Laboratory Conference, Los Angeles, Calif., 2 May 1963, Paper 63140, 10 p., A63-17480.

a common antenna. When flying over the territory of the USSR . . . aid of a third ultra-short wave transmitter . . . operated at a frequency of 143,625 megacycles with frequency modulation in a band of ± 30 kilocycles from a special antenna. . . .

SEVENTEEN TIMES AROUND THE EARTH
E. Nagyt, Foreign Tech. Div., Air Force Systems Command, Wright Patterson AFB, Ohio, 3 Nov. 1961, 9 p., Trans. no. FTD-TT-61-61 of Science & Technology, 5 p., 28 Aug. 1961, AD 266 753.

A report of Titov's space flight on Aug. 21, 1961, covers the aspects of guidance navigation, landing, and communication systems.

AN OUTSTANDING SCIENTIFIC EXPERIMENT
Ye. P. Aksenov, et al., Foreign Tech. Div., Air Force Systems Command, Wright Patterson Air Force Base, Ohio, 1 June 1962, 21 p., incl. illus., Trans. no. FTD-TT-62-653 from Priroda, no. 8, p. 7/15, 1961, AD 286 141.

The launching, motion in orbit, and re-entry of Gagarin's Vostok are reported.

SOVIET SATELLITES AND SPACE SHIPS (SELECTED ARTICLES)
S.G. Aleksandrov, et al., Air Force Systems Command, Foreign Technology Div., Wright Patterson AFB, Ohio, Feb. 23, 1962, 269 p., 154 refs., Transl. from the book "Sovietskiye Sputniki I Kosmicheskiye Korabli" Moscow, Akad. Nauk SSSR, 1961, 2nd Ed., p. 24/82, 117/124, 144/147, 182/184, 217/242, 256/394, 427/456, FTD TT 62-121/1+2, N63-18430.

SPACE TANDEMS
Z. Dobrichovsky, Foreign Tech. Div., Air Force Systems Command, Wright Patterson Air Force Base, Ohio, 26 Nov. 1962, 4 p., Trans. no. FTD-TT-62-1621 from Veda A. Technika Mladezi, no. 17, p. 582/583, 1962, AD 292 622, AD 287 417.

. . . the meeting of the Vostok-4 and Vostok-3 at a definite point along both their trajectories.

FIVE DAYS WHICH ELECTRIFIED THE WORLD
O.G. Gazenko, Air Force Systems Command, Wright Patterson AFB, Ohio Foreign Technology Div., In its Sci. and Life (Selected Articles), 10 Dec. 1962, p. 1/18, N64-16352.

The interesting features of the flights of Kikolayev and Popovich appear to be the duration of their flights as well as the fact that the two cosmic ships were simultaneously in orbit near each other . . . study of: man's ability to work under conditions of long-lasting weightlessness, the cooperation between the cosmonauts, their communication with ground observation points, and their control of the flights . . .

THE WORLD'S FIRST TANDEM FLIGHT IN SPACE (BASIC RESULTS)
Space Technology Labs., Inc., Redondo Beach, Calif., (Pervyi v Mire Gruppovoi Polet v Kosmicheskoe Prostranstvo (Osnovyne Itogi), Nov. 1962, 24 p., incl. illus., Rept. 9990-6333-KU-000, Trans. no. 70 from Pravda no. 295 (16151) p. 1/3, 22 Oct. 1962, AD 291 429, AD 289 028, N63-18841, N64-12055.

. . . guidance and measurement, radio and TV communication, protection from radiation . . . microclimate in the capsule . . .

USSR: LAUNCHING PLATFORM TO THE UNIVERSE AND CYBERNETICS OF THE EYE
R. Svoren', Joint Publications Research Service, San Francisco, Calif., JPRS, 16718, 17 Dec. 1962, 13 p., AD 400 017.

. . . discussion of Soviet manned space flight projects with emphasis on the tandem orbitals of Nikolayev and Popovich. . . . A summary of recent research concerning the electrophysiology of the eye.

TOWARD NEW SUCCESSES IN STUDY OF OUTER SPACE
G.S. Titov, Foreign Tech. Div., Air Force Systems Command, Wright Patterson Air Force Base, Ohio, 6 Sept. 1962, 20 p., Trans. no. FTD-TT-62-1189 from Vestnik Akademii Nauk, SSSR 32:7, p. 10/18, 1962, AD 286 573.

RADIO (SELECTED ARTICLES)
Foreign Tech. Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, 28 June 1962, 16 p., Trans. no. FTD-TT-62-532 from Radio, No. 11, p. 3/7, 1961, AD 286 137.

About man's second flight into the cosmos . . . Radio communication earth-Vostok-2 . . . Unforgettable signals.

GRUPPOVOI POLET V KOSMOS (Group Flight into Space) (In Russian)
Radio, Dec. 1962, p. 7/9, A63-12765.

General description of the characteristics and the principles of operation of the radio, TV, and telemetry equipment used in the Vostok-3 (1962 Alpha Mu 1) and Vostok-4 (1962 Alpha Nu 1) spaceships. In addition, some data on control and ground receiving stations are presented.

MANNED SPACE FLIGHT
E. Clark, et al., Aviation Week and Space Technol., vol. 79, no. 4, July 22, 1963, 131 p., N63-22118.

. . . special issue . . . devoted to U.S. civilian and military manned spaceflight and to Soviet spaceflight includes . . . (34) Vostok Flights Widen Soviet Experience.

POLETY KORABLEI "VOSTOK 5" I "VOSTOK 6" (Flights of Spaceships "Vostok 5" and "Vostok 6") (In Russian)
V.I. Iazdovskii, et al., Akademiia Nauk SSSR, Vestnik, vol. 33, Sept. 1963, p. 17/22, A64-12278.

Survey of some preliminary results of the still incompleted processing of data obtained during the flights of Vostok 5 . . . and Vostok 6 . . . The principles of the stabilization and guidance of a manned space vehicle in orbit are reviewed.

THE ORBITAL CHARACTERISTICS OF VOSTOKS III AND IV DURING THE APPARENT NEAR RENDEZVOUS FLIGHT OF AUGUST 12-15, 1962
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Analysis of tracking data obtained at a research tracking station in Cleveland, Ohio for the orbits of Vostoks III and IV . . . The data show that the two spaceships had nearly identical orbit inclinations. The launch time of Vostok IV and its orbit parameters were sufficiently precise to permit it to come within three to five miles of Vostok III, which was launched approximately 23-1/2 hr earlier. The nearest approach of the two spaceships occurrred during the fifth orbit of Vostok IV.

FOUR DAYS IN SPACE
Redstone Scientific Information Center, Redstone Arsenal, Ala., RSIC T2 63, 4 Feb. 1963, 23 p., AD 437 829.

Descriptors: Manned spacecraft . . . Space capsules, USSR . . .

ACCOUNTS OF COSMIC FLIGHTS OF "VOSTOK -5" and "VOSTOK-6" AND IONIZING RADIATION IN COSMIC FLIGHTS
Lebedinskiy, et al., Joint Publications Research Service, JPRS-21138, OTS-63-31785, Sept. 18, 1963, 24 p., Transl. into English of three articles from Priroda, Moscow, no. 7, 1963, N63-21931.

. . . Brief Diary . . . Press Conference . . . Cosmic Flights and Ionizing Radiation . . .

RADIO OBSERVATIONS OF USSR SATELLITE SHIPS
Y. Nakata, et al., Ministry of Posts and Telecommunications, Japan, AFCRL Rept. no. 62 489, May 1963, 12 p., AD 417 378.

. . . Doppler frequency shift observed in the beacon signals and voices transmitted from the satellite ships which were launched in the USSR.

NEW PHASE IN INVESTIGATING THE COSMOS
L. Sedov, Foreign Tech Div., Air Force Systems Command, Wright Patterson AFB, Ohio, FTD TT 63 676, 23 July 1963, 6 p., AD 417 410.

Radio and TV communications between cosmonaut and Earth have been checked and highly valuable experience was obtained for subsequent flights. The action of a number of improved systems has been investigated, systems assuring orientation, flight control, and descent to Earth of piloted ships-satellites.

PROBLEMY KOSMICHESKOI RADIOELEKTRONIKI (Problems of Aerospace Radioelectronics) (In Russian)
V. Siforov, Aviatsiia i Kosmonavtika, Aug. 1963, p. 22/26, A63-26024.

General description of the operation and characteristics of TV and radiotelemetry equipment used in the Soviet Vostok 5 (1963 20A) and Vostok 6 (1963 23A) spaceships. Some of the potential applications of electronics in space exploration and the results obtained thus far are considered.

A BRILLIANT ASTRONAUTICAL ACHIEVEMENT, VOSTOK-3 AND VOSTOK-4 IN SIMULTANEOUS FLIGHT
F. Zaganescu, Foreign Tech. Div., Air Force Systems Command, Wright Patterson Air Force Base, Ohio, FTD TT 63 306, 9 May 1963, 10 p., AD 409 944.

MATERIALS ON VOSTOK-5, VOSTOK-6, AND POLET-1 FLIGHTS
Aerospace Information Div., Washington, D.C., AID U64 9, 2 March 1964, 131 p., AD 437 806.

. . . material drawn from Soviet and Soviet-bloc open literature . . . general data on the Vostok series of Soviet manned space flights. Discussion of the Soviet space program (sections, A, B, and G) is felt to be the most significant material in this report.

CUMULATIVE DATA ON VOSTOK FLIGHTS.
Aerospace Information Div., Library of Congress, Washington, D.C., AID Press: vol. 2, no. 44, Aug. 29, 1963, 7 p., 33 refs., N63-20740.

. . . compilation of data from Soviet open literature . . . include communications frequencies . . .

DIVISION 4D.9
TESTING AND TRAINING

4D.900: Testing and Training Facilities for Manned Space Flight

Included: In-flight simulation of manned flight with unmanned spacecraft; MSC (Manned Spacecraft Center) test facility; Integrated mission simulator; Simulation system for manned space flight ground support system; Electromagnetic environment simulation; Testing manned space flight systems.

Not Included: Flight trainers; Deep space test facilties (4C).

Principal Publications:

ELECTROMAGNETIC ENVIRONMENT SIMULATION FOR SYSTEM TRAINERS
F. P. Cullen, et al., Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 331/337.

The complexity of modern airborne electromagnetic surveillance and countermeasures systems requires an intensive training program in order to achieve a high order of operator proficiency. . . . use must be made of simulator devices that can present with a high degree of realism the conditions that the operator would experience during an actual mission. . . .

EFFECTS OF OUTER-SPACE ENVIRONMENT IMPORTANT TO SIMULATION OF SPACE VEHICLES
E. M. Hart, Cornell Aeronautical Lab., Inc., Buffalo, N.Y., Rept. for 1 Nov. 1959-30 Sept. 1960, ASD TR 61-201, Aug. 1961, 109 p., AD 269 014.

. . . results of a literature survey to define the effects of the outer-space environment important . . . Only the natural environment of space is considered . . . near vicinity of the earth-moon system . . . at heights greater than 80 kilometers above the earth's surface. To specify those effects that need to be incorporated into a space training simulator.

THE DEVELOPMENT OF A DYNAMIC TARGET AND COUNTERMEASURES SIMULATOR
R. L. Norton, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 4, June 1960, p. 338/342.

AROUND THE WORLD BY SIMULATION
H. D. Irvin, et al., Bell Laboratories Record, no. 39, Oct. 1961, p. 342/349.

Training of Mercury project personnel by Simulation. Very good pictures of Project Mercury organization.

A FIXED-BASE-SIMULATOR STUDY OF THE ABILITY OF A PILOT TO ESTABLISH CLOSE ORBITS AROUND THE MOON
M. J. Queijo, et al., NASA, Washington, D.C., NASA Tech. note D-917, June 1961, 53 p., AD 257 804.

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A TELEMETRY SIMULATION AND SIGNAL CONDITIONING SYSTEM FOR TRAINING PROJECT MERCURY FLIGHT CONTROLLERS
B. S. Ritter, Proc. Nat. Telemetering Conf., May 1961, p. 7/67-7/77.

MICROMINIATURIZED INSTRUMENTATION PACKAGE
A. B. Ellis, et al., Hughes Aircraft Co., Culver City, Calif., Rept. on Phase 3, 27 Aug. 1962, 115 p., incl. illus., tables, 184 refs., AD 286 333.

. . . measurements were to be made in unusual situations, such as high performance aircraft, near-space vehicles, and in space simulation chambers.

FIXED-BASE SIMULATOR STUDIES OF THE ABILITY OF THE HUMAN PILOT TO PROVIDE ENERGY MANAGEMENT ALONG ABORT AND DEEP-SPACE ENTRY TRAJECTORIES
J. W. Young, et al., Proc. Nat. Aerospace Electronics Conf., vol. 10, May 1962, p. 472/486.

ZERO-GRAVITY PARABOLA TECHNIQUES
R. Weiss, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 6, June 1962, p. 122/130.

A SPACECRAFT MOTION SIMULATOR: FEATURING UNLIMITED ANGULAR FREEDOM
F. E. Altoz, Conf. Proc. Nat. Conv. Mil. Electronics, vol. 7, Sept. 1963, p. 447/450.

. . . training astronauts for future space missions . . .

A REVIEW OF IN FLIGHT SIMULATION PERTINENT TO PILOTED SPACE VEHICLES
N. A. Armstrong, et al., Advisory Group for Aeronautical Research and Development, Paris, France, AGARD Rept. no. 403, July 1963, 19 p., AD 410 499.

. . . shows how the environment of actual flight may be used to simulate many phases of manned space exploration . . . survey . . . Quantitative results may be extracted from the Papers mentioned in the references.

A MULTIMAN MACHINE SYSTEM SIMULATION FACILITY AND RELATED RESEARCH ON INFORMATION PROCESSING AND DECISION MAKING TASKS
J. B. Feallock, et al., Laboratory of Aviation Psychology, Ohio State U. Research Foundation, Columbus Final rept., 1 April 1960 - 28 Feb. 1963, AMRL TDR63 48, June 1963, 139 p., AD 411 552.

. . . the development of Comcon, a general-purpose simulation facility for research on information processing in multiman systems, and (b) four developmental and three substantive system studies conducted on IPAC, a small scale multiman systems simulator . . .

SIMULATION AND TRAINING FACILITIES
H. I. Johhson, NASA, Manned Spacecraft Center, Houston, Tex., In its Manned Orbital Operations Spec. Section, 1963, p. 82/86, N63-17414.

FACILITIES FOR MANNED SPACECRAFT DEVELOPMENT —MSC TEST FACILITIES
J. N. Kotanchik, et al., NASA, Manned Spacecraft Center, Houston, Tex., In its Manned Orbital Operations Spec. Section, 1963, p. 78/81, N63-17413.

. . . Included are: the astronaut training facilities, the space environment simulator, the flight acceleration facility, the thermochemical test area, and the structures and materials laboratory . . .

THE INTEGRATED MISSION SIMULATOR
E. E. Markson, et al., In: AIAA Simulation for Aerospace Flight Conference, Columbus, Ohio, Aug. 26-28, 1963, New York, American Institute of Aeronautics and Astronautics, 1963, p. 230/243, A63-20580.

. . . development of an analog program capable of continuously simulating an entire lunar mission in six-degrees-of-freedom with high resolution throughout. The program is traced through the equations of motion, the guidance and control equations, and the analog mechanization. . . . A previously reported guidance technique is shown to be applicable to all phases of the mission. It is concluded that the method leads to minimum computer loading for simulating a manned space mission without program discontinuities. . . .

SIMULATING MANNED SPACE FLIGHT
O. Romaine, Space/Aeronautics, vol. 40, Dec. 1963, p. 68/72, A64-12903.

Discussion of space-flight simulation programs and facilities from the research standpoint. The four basic parts of a space-flight simulator are the vehicle command station, with its controls, instruments, and displays; the out-of-window displays; the motion-generating equipment for the vehicle or displays; and the computation setup. . . .

A SIMULATION SYSTEM FOR THE MANNED SPACE-FLIGHT GROUND-SUPPORT NETWORK
L. L. Ruetz, et al., In NASA, Flight Test Center AIAA/AFFTC/NASA FRC Testing of Manned Flight Systems, Dec. 1963, p. 109/113, N64-12882.

. . . will provide means of conducting training of ground control personnel for the network, and in connection with a spacecraft flight crew trainer, will permit realistic training of ground and spacecraft crews simultaneously.

TECHNIQUES FOR EVALUATING OPERATOR LOADING IN MAN-MACHINE SYSTEMS. MODIFICATION AND FURTHER EVALUATION OF A DIGITAL MAN-MACHINE SIMULATION MODEL
A. I. Siegel, et al., Applied Psychological Services, Wayne, Pa., July 1963, 59 p., AD 414 428.

TESTING OF MANNED FLIGHT SYSTEMS CONFERENCE, EDWARDS AFB, CALIF., DECEMBER 4-6, 1963, PROCEEDINGS.
New York, American Institute of Aeronautics and Astronautics, 1963, 123 p., N64-12879.

Collection of papers dealing with recent developments in methods for testing and simulating aircraft and spacecraft flight conditions. Among the topics discussed are in-flight testing of inertial navigation systems, flutter onset at subcritical speeds, satellite thermodynamic analytical techniques; and simulation of the X-20 hypersonic research vehicle, and of a manned space-flight ground support network.

Related Publications:

SYSTEM ORGANIZATION OF A MULTIPLE-COCKPIT DIGITAL OPERATIONAL FLIGHT TRAINER

J. H. Gray, Jr., et al., IRE Trans. Electronic Comp., vol. EC-8, no. 3, Sept. 1959, p. 326/330.

. . . a digital computer whose purpose is to activate simultaneously more than one cockpit of an operational flight trainer. The simulated aircraft are assumed to be all of the same type, but each is simulated independently.

A MANNED SPACE LABORATORY ENVIRONMENT CONTROL SYSTEM

A. M. Mayo, et al., American Institute of Aeronautics and Astronautics-Aerospace Medical Association, Manned Space Laboratory Conference, Los Angeles, Calif., 2 May 1963, Paper 63140, 10 p., A63-17480.

SIMULATION TECHNIQUES FOR ASTRONAUT TRAINING

J. Prodan, In: Advances in the Astronautical Sciences, vol. 16, Pt. 1, Space Rendezvous, Rescue, and Recovery, USAF and American Astronautical Society, Space Rendezvous, Rescue, and Recovery Symposium, Edwards AFB, Calif., Sept. 10-12, 1963, Edited by Norman V. Peterson, North Hollywood, Calif., Western Periodicals Co., 1963, p. 566/572, A63-24775.

. . . approach used by the USAF Aerospace Research Pilot School in developing and implementing the simulation required to train pilot-astronauts. . . .

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Multi-noun terms are presented in two ways: 1) the full term is listed in alphabetical order of the first noun, e.g., "aliasing error"; and 2) the full expressions are permuted or separated so as to provide multiple listings of a single expression, e.g., "error, aliasing". General usage of the technical terms is followed in the permuting process; combinations of words which fail to make technical sense are not included.

In instances where a particular term is not located in the index, the user should refer to the table of contents. When used in conjunction, the table of contents and index will enable the user to locate the proper section or subdivision and, in turn, the pertinent citations.

As a general rule, if a proper name, e.g., Fourier, identifies a theory, process, etc., the name has been included in the index. Words and expressions that denote general concepts, e.g., systems, problems, technologies and techniques, methods, etc., have not been included in the index.

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