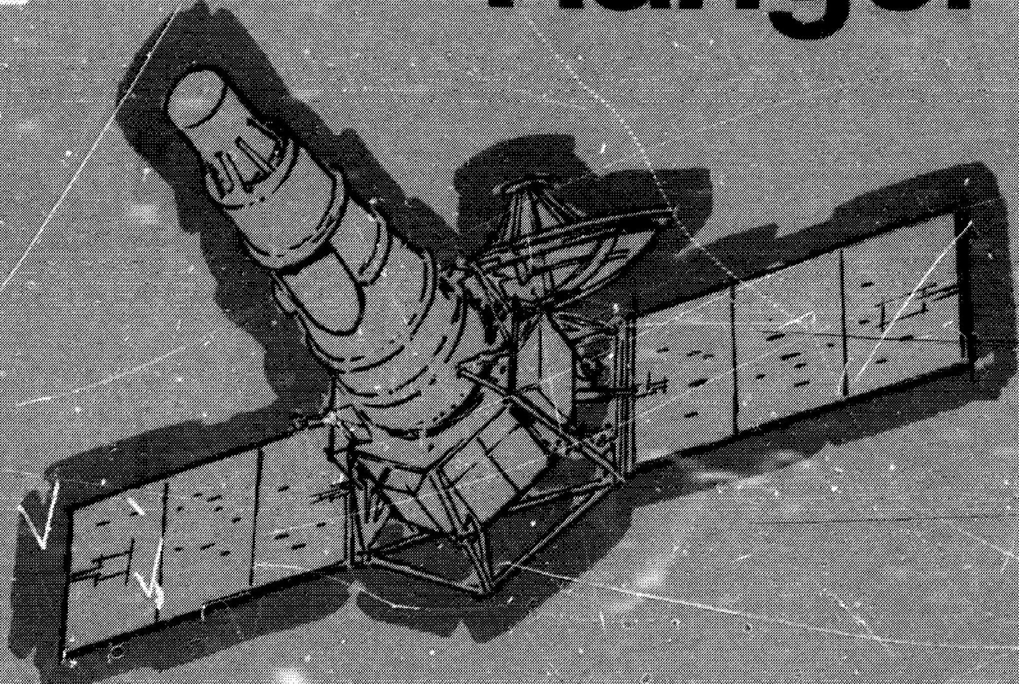
JPL/HR-2

Project Ranger



A Chronology

R. Cargill Hall

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

JPL/HR-2

PROJECT RANGER: A CHRONOLOGY

R. Cargill Hall

Jet Propulsion Laboratory
California Institute of Technology

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FOREWORD

The Ranger Project was a landmark in the development of this nation's capability for flying unmanned missions to the Moon and the planets. Many of the space sciences and technologies that were later to prove so important to both soft-landed and manned lunar missions, and to the automated exploration of the near planets, were conceived and developed out of Ranger experience.

In this sense, Ranger was a pioneer effort—a fruitful and highly fertile seedbed out of which the United States thrust into deep space had many of its origins. This chronology records the principal events—the successes and failures, the accomplishments and disappointments—of those critical years, 1957-1965.

W. H. Pickering, Director
Jet Propulsion Laboratory

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PREFACE

A large topographical map of the visible side of the Moon has occupied the north wall of the lobby of the main administrative building at the Jet Propulsion Laboratory since 1965. On its face, the points of impact of Ranger spacecraft are surrounded by the signatures of personnel who took part in Project Ranger. Today, the map commands no more than a cursory glance from passers-by long accustomed to its presence, or unfamiliar with its significance. Nevertheless, for all of those who participated in that project, in government, in industry, and especially at JPL, it represents a capstone to an important segment in the history of United States astronautics.

Ranger--the first U.S. deep-space vehicle involving full attitude stabilization and instrumented payload--was developed by the Jet Propulsion Laboratory for the National Aeronautics and Space Administration. The Ranger vehicle, conceived at JPL in the late 1950's as a first-generation interplanetary spacecraft, was designed, developed, and flown between 1959 and 1965 to return scientific and engineering data from cislunar space and the surface of the Moon, and later to support the Apollo manned lunar landing program as well.

Work on what was to become Project Ranger began shortly before the creation of NASA and the transfer of JPL to that agency in 1958. Because of its position in time, Ranger became a proving ground for subsequent unmanned deep space missions conducted by NASA and JPL: the organizational structure and managerial roles and interfaces among NASA, JPL, Air Force, the scientific community, and industry were first established; requisite deep-space flight operations and technology were developed; techniques for decontamination and sterilization of spacecraft were originated; and supporting systems and facilities were constructed. Numerous technical and organizational difficulties--both novel and prosaic in nature--were encountered and eventually resolved during the course of this enterprise; they were, in turn, a product of the magnitude and complexity of the work, and the sometimes conflicting attitudes and perspectives of the participants involved. The early flight failures and ultimate success that marked this project reflected these conditions; together they constitute the legacy bequeathed to second-generation NASA unmanned lunar and planetary flight projects.

This chronology is a first step toward a complete history of Project Ranger, sequentially identifying major policies, problems, decisions, and other related events associated with this effort--from the first serious consideration given unmanned deep-space flight during the International Geophysical Year 1957-1958, through the final flight mission of Ranger 9 in 1965. In addition, some items are included which, at first glance, appear unrelated but which do have important "situational value;" that is, they represent outside developments which had an effect on the conduct of Project Ranger or reflect institutional changes resulting from the experience offered by Project Ranger and other contemporary NASA-JPL unmanned deep-space programs.*

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*For example, a number of alterations in the organizational structure of JPL and NASA fall into this category, as well as changes in the basic NASA-Caltech contract, scientific interest in selenology, and the evolution of processes by which science could more adequately be joined to the unmanned--and even manned--deep-space programs.

For the reader, one caveat: this work is not a history; any chronological recapitulation of events does not necessarily explain cause and effect. Hopefully, however, this chronology will provide a useful source of reference for major events and achievements from which certain patterns of relationship may be ascertained, and further study undertaken.

The author is indebted to numerous individuals who assisted in the task of research or who took time to review and critique early drafts of this chronology. Special thanks are due Lee D. Saegesser, NASA Archivist; Eugene M. Emme, NASA Historian; Edgar M. Cortright, NASA, Director, Langley Research Center; Oran W. Nicks, NASA, Deputy Associate Administrator of the Office of Space Science and Applications; James H. Wilson, Ph.D. candidate, UCLA History Department; Tom Carroll, B.S. candidate, Caltech History Department; Barney Huber, JPL, Assistant to the Director (deceased); Brooks T. Morris, JPL, Manager, Quality Assurance and Reliability Division; M. Loretta Steward, formerly with JPL Central Files; Vivian S. Pritchard and Jack G. Jackson, JPL Technical Information Division; James D. Burke, JPL Plans and Programs Division; Harris M. Schurmeier, Deputy Assistant Laboratory Director for Flight Projects; the staffs of the JPL Library and Central Document Control--most especially to Sharon Onak, JPL Reference Librarian; and to Lillie Duryea, who possessed the tenacity and stamina necessary to complete typing of this work over a two-year period.

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Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

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INTRODUCTION

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INTRODUCTION

JPL Background

After its founding in 1926, the Guggenheim Aeronautical Laboratory, California Institute of Technology (GALCIT) rapidly developed into one of the nation's leading schools of aeronautics under the guidance of Dr. Theodore von Karman.[1] Beginning in 1936, theoretical and empirical experiments on the performance of various types of solid- and liquid-propellant jet propulsion engines were conducted by several graduate students and their associates. They hoped eventually to construct a high-altitude sounding rocket; however, their ultimate aspirations were directed toward flight beyond the earth's atmosphere. In 1937, a contribution of $1,000 for this work was accepted by the Institute and, with the support of Dr. von Karman, these efforts gained official recognition as the GALCIT Rocket Research Project.[2] Caltech thus became the first university in the United States to formally sponsor rocket research; publication of the results of rocket research and experiments during the next few years drew interest from other quarters, and formal government support followed in

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[1] A review of the courses of study available at this time appears in "The Daniel Guggenheim Graduate School of Aeronautics of the California Institute of Technology: A History of the First Ten Years," Bulletin of the California Institute of Technology, Vol. 49, No. 2, Pasadena, Calif., May, 1940, 3-5.

[2] Frank J. Malina, "Origins and First Decade of the Jet Propulsion Laboratory," The History of Rocket Technology, E. M. Emme (ed.). (Detroit: Wayne State University Press, 1964), 50.

1939-1940.[3] (Figure 1.)

On June 25, 1940, the Army Air Corps awarded Caltech a contract to continue design and development of solid and liquid-propellant rocket motors for the protean application to "super-performance" of aircraft.[4] In accepting this contract Caltech held no expectation that this specialized research and development effort would continue beyond conclusion of hostilities in Europe, which had begun in the preceding year. As a result, temporary facilities were erected to accommodate the project; construction began in August, 1940[5] at what is now the present site of the Jet Propulsion Laboratory in the Arroyo Seco on the western edge of Pasadena. The dissonant sounds that soon began to reverberate out of this canyon were tolerated by the residents in neighboring communities as another inconvenient part of the "war effort" that, like ration stamps, would not persist. (Figure 2.)

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[3]Cf. F.J. Malina and A.M.O. Smith, "Flight Analysis of a Sounding Rocket," Jour. Aero. Sci., Vol. 5, 1938; Malina, Tsien, Parsons, Smith, and Bollay, Report of the GALCIT Rocket Research Project, Report No. RRP-1 GALCIT, April 10, 1957; F.J. Malina, "Rocketry in California: Plans and Progress of the GALCIT Rocket Research Group," Astronautics, No. 41, July 1938; and F.J. Malina, Report on the Rocket Motor and its Applications as an Auxiliary to the Power Plants of Conventional Aircraft, RRRP-GALCIT Report No. 2, August 1938. It was this last report, in the hands of Dr. von Karman as a member of the National Academy of Science Committee on Army Air Corps Research, that was largely responsible for stimulating government interest.

[4]Theodore von Karman, a book review of "Assisted Take-Off of Aircraft," the James Jackson Cabot Fund lecture by Rear Admiral Calvin M. Bolster, Norwich University, Northfield, Vt., Publication No. 9, 1950, in ARS Journal, No. 85, June, 1951, 92-93.

[5]F. J. Malina, "Rocket Research and Development: Excerpts from Letters Written Home by Frank J. Malina Between 1936 and 1946," 33, unpub., copy in JPL Historical Files (hereafter referred to as JPLHF).

Figure 1: Caltech students and associates at static test of rocket engine in the Arroyo Seco, October-November 1936. Left to right: R. Schott, A. M. O. Smith, F. J. Malina, E. S. Forman and J. W. Parsons.

Figure 2: Caltech (JPL) Rocket Research Facility on the Arroyo Seco, fall of 1940. Test pits appear at the far right against the hillside.

In the new facilities off-campus during World War II, the GALCIT Rocket Research Project developed the first restricted-burning, "castable," solid-propellant rocket motors, and hypergolic red fuming nitric acid-aniline liquid-propellant rocket motors which were employed for jet-assisted takeoff (JATO) of aircraft. Since Caltech was not equipped for, nor did it wish to engage in, fabricating large numbers of these rocket units, production for the armed services was undertaken by the Aerojet Engineering Corporation (now the Aerojet General Corporation) formed by members of the GALCIT Rocket Research Project in 1942.[6]

Receipt of British intelligence information concerning the imminent appearance of the German V-2 rocket in the European theatre of operations caused the GALCIT Rocket Research Project to examine the military potential of long-range missiles, and, after analysis, development of these vehicles was recommended to the U. S. military services.[7] This study proved a turning point in the course of Caltech's association with rocketry; what had begun as a student-led investigation of rocket motor efficiency and utility, and had grown to include development of these units for application in aircraft, now was extended and formalized to

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[6]Theodore von Karman with Lee Edson, The Wind and Beyond (Boston: Little, Brown and Company, 1967), 256-257

[7]Theodore von Karman, Memorandum on the Possibility of Long-Range Rocket Projectiles, and H. S. Tsien and F. J. Malina, A Review and Preliminary Analysis of Long-Range Rocket Projectiles, combined and released as Memo JPL-1, November 20, 1943.

embrace research and development related to tactical guided missiles.[8] On June 22, 1944, Army Ordnance awarded Caltech a contract to design and develop complete long-range missiles and suitable launching equipment.[9] The original objective of the Caltech graduate students--to build a high-altitude sounding rocket--was ultimately realized in the work performed under the new contract.

In order to undertake its new mission--with continued research and development work assured for some years to come--the GALCIT Rocket Research Project was reorganized and renamed the Jet Propulsion Laboratory (JPL), GALCIT, on November 1, 1944. (At that time the word "rocket" was still in such bad repute, even in academic circles, that Caltech decided against employing the term in naming the new organization: "It is for this reason that the Laboratory at Caltech is called the Jet Propulsion Laboratory rather than the Rocket Propulsion Laboratory.")[10] Dr. Frank J. Malina, organizer of the original graduate student research

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[8] There was, however, another clandestine wartime rocket project directed by Caltech for the Office of Scientific Research and Development under the leadership of Dr. C. C. Lauritsen, which began in late 1941. This group designed and developed several types of unguided, unrestricted-burning solid-propellant barrage rockets later used by naval forces in the Pacific against Japanese-held islands. This program ultimately grew into the Naval Ordnance Test Station (NOTS) at Inyokern, California after Caltech withdrew from the effort at the close of the war. Cf. material in John E. Burchard, Rockets, Guns and Targets (Boston: Little, Brown, and Company, 1948; and, Howard Seifert, "Twenty-five Years of Rocket Development," Jet Propulsion, November 1955, 594-603; also, "Rocket Research and Development," Engineering and Science, Vol. 7, No. 11, December 1944, 16. An adequate history of this project is not yet written.

[9] F. J. Malina, The Jet Propulsion Laboratory, GALCIT, Memo JPL-3, June 25, 1945, 10.

[10] F.L. Wattendorf and F.J. Malina, "Theodore von Karman, 1881-1963," Astronautica Acta, Vol. 10, 1964, 85.

in the 1930's, became the first Director of JPL and, in 1946, he was succeeded by Dr. Louis G. Dunn. In addition, a second phase of construction began at this time in which permanent facilities were erected--to the consternation of some of the nearby surburban residents--and new employees were hired.[11] (Figure 3.)

Proceeding from an accumulated expertise in rocket engine technology, under the new mandate JPL continued to design and develop the liquid-propellant WAC Corporal sounding rocket, the Corporal tactical missile, and the solid-propellant Loki anti-aircraft rocket and Sergeant missile system during the late 1940's and 1950's. Flight testing of these vehicles took place at White Sands Proving Ground in New Mexico, and, following precedent, production for the armed services was also turned over to industry. During the same period the Laboratory also participated in the V-2 Bumper-WAC program (in which a WAC Corporal sounding rocket was staged atop a V-2 rocket for high-altitude research), and pioneered in the development of FM-FM radio telemetry and various radio and inertial guidance systems for the Army Ordnance which were used

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[11]For several years after the war concluded there was a great deal of agitation and concern expressed, especially among land developers in nearby La Canada and Altadena, over the continuance and expansion of the Laboratory. Flyers were circulated that JPL was liable to blow up at any time. Val Larsen, former business manager at JPL, recollects attending a community meeting at a La Canada school in which the owner of a certain piece of property charged that late at night ambulances would leave the Laboratory bearing the bodies of those employees who had been killed in rocket tests conducted during the day. (Interview with V. C. Larsen, May 28, 1968, JPLHF.) JPL installed noise suppressors in its rocket test stands and, about 1950, moved testing of all rocket engines to the ORDCIT Test Station in the desert at what is now Edwards AFB; by that time the commotion had subsided.

Figure 3. JPL from the Arroyo Seco, 1952.

in the Corporal and Sergeant missiles, and which were refined for use in the Jupiter Intermediate Range Ballistic Missile (IRBM).

Dr. William H. Pickering, a professor at Caltech in electrical engineering and a specialist in telecommunications, was named Director of JPL in 1954 at about the time JPL began collaboration with the Army Ordnance and the Office of Naval Research (ONR) on a proposal to construct and launch an artificial earth satellite. Original ONR-Army Ordnance plans called for a five pound earth satellite to be launched by a Redstone rocket as a first stage vehicle with clustered Loki solid-propellant rockets as upper stages. After evaluating the proposal for Army Ordnance, JPL recommended substituting subscale Sergeant rockets for the upper stages in place of Loki in order to increase the payload capability of the vehicle and at the same time improve overall reliability. This approach was adopted by the Army-Navy team when the satellite proposal, named Orbiter, was formally submitted for review in the Department of Defense in early 1955.[12]

Orbiter, later to become known as Explorer, was one of the first formal satellite proposals drawn up in this country, but it was never developed under the original title. On September 9, 1955, shortly after President Eisenhower announced that a United States satellite would be constructed and launched as part of the United States contribution to

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[12] Dr. Homer J. Stewart, comments on the JPL-Orbiter satellite effort, in a letter to the author, March 13, 1964.

the International Geophysical Year, a special committee in the Department of Defense announced selection of the Naval Research Laboratory's Vanguard satellite as the official American program.[13] With this decision, work on the Orbiter program was terminated at JPL while the preliminary design phase was nearing completion. However, work on the Orbiter upper stages began again, this time as part of another program.

In September 1955, Army Ordnance commissioned JPL to continue work on the subscale Sergeant upper stages for the Redstone missile. The Redstone with JPL upper stages was christened Jupiter C, and was intended for use as a reentry test vehicle (RTV) to verify design of a nose cone for the Army Jupiter IRBM then under development.[14] JPL went on to complete design of the high-speed upper stages in January 1956, and the first proof-test version of the Jupiter C was successfully fired on schedule, September 20, 1956. The RTV program was concluded in August 1957, with the first successful recovery of a Jupiter reentry nose-cone.[15] When Soviet Sputniks I and II were launched in October and November 1957, the Army had at hand in the Jupiter C a satellite launcher of the Orbiter

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[13] U. S. Congress, Inquiry into Satellite and Missile Programs, Part I, Preparedness Investigating Subcommittee, Senate Committee on Armed Services, 85th Congress, 1st and 2nd Sessions, November and December, 1957, 315-316.

[14] A. R. Hibbs, "Development of the High-Speed Stages for the Re-entry Test Vehicle," Publication No. 68, April 13, 1956.

[15] Juno, JPL Brochure, n.d., circa 1959, 5 (JPLHF, 3-153).

class. On November 8, 1957, the Department of Defense, aware of development difficulties encountered in the construction and testing of the Vanguard satellite rocket, authorized Army Ordnance to prepare to launch an earth satellite.[16]

Major General John B. Medaris, Commanding General of the Army Ballistic Missile Agency (ABMA) pledged a first launch within ninety days, and work began immediately on refurbishing several Redstone-Jupiter C rockets that had been stored upon conclusion of the RTV program. The assignment given JPL consisted of fabricating the second and third stages used in the RTV program toegether with the fourth-stage satellite rocket. In addition, the Laboratory was responsible for the necessary space-to-ground satellite communications and instrumentation, and the integration of scientific experiments into the cylindrical body of the satellite. A light-weight phase-locked loop radio system, known as Microlock, that permitted tracking and receipt of telemetry data from a low-power transmitter flown in the reentry nose cones for the RTV program was adapted for use in the satellite program.[17] Microlock ground stations were activated at Cape Canaveral, and new stations were set up at Earthquake Valley east of San Diego, California, and at Singapore, and in Nigeria.

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[16] R. Cargill Hall, "Origins and Development of the Vanguard and Explorer Satellite Programs," The Airpower Historian, Vol. 11, No. 4, October 1964, 110.

[17] Cf. E. Rechtin, "The Jet Propulsion Laboratory Microlock System," Publication No. 88, January 27, 1957; also, W.K. Victor, H.L. Richter, and J.P. Eyraud, "Explorer Satellite Electronics," Technical Release 34-12, January 29, 1960.

The ninety-day deadline was met. America's first satellite, Explorer I, was successfully launched and placed in orbit on January 31, 1958. For JPL as well as the United States this event marked the beginning of a new era of scientific exploration of outer space by means of remotely controlled spacecraft. Shortly thereafter, as the United States began large-scale preparations for this activity, a phased program for deep space exploration was established at JPL and ABMA under the auspices of the Advanced Research Projects Agency. On December 3, 1958 this effort and all contract functions and the Government-owned facilities at JPL were transferred from the Army to the newly created National Aeronautics and Space Administration in support of NASA's civilian space mission.[18]

For the second time Caltech's Jet Propulsion Laboratory re-directed its research and development efforts, in this case from missile system projects to lunar and planetary projects; new facilities were erected, and additional engineers, scientists and support personnel were employed. The first NASA/ABMA/JPL lunar probes, Pioneers III and IV, were launched in December 1958, and March 1959, respectively. Since then, JPL has been responsible for a number of history-making projects executed for the NASA Office of Space Science and Applications: Ranger, the first U.S. lunar impact project; the highly successful lunar soft-lander, Surveyor; and the Mariner planetary probes that have investigated Mars and Venus. In addition, under the NASA Office of Tracking

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[18] Executive Order 10793, 23 F.R. 9405, cited in Robert L. Rosholt, An Administrative History of NASA, 1958-1963, NASA SP-4101, Washington, D.C., 1966, 47.

and Data Acquisition, JPL developed and operates the NASA Deep Space Network (DSN)--derived from the early Explorer/Microlock efforts--a world-wide system which tracks, commands, controls and receives data from lunar and planetary spacecraft. The Laboratory also has continued to pursue basic and applied research in support of these space programs. NASA/JPL flight projects have thus far returned a wealth of scientific information on the physical constitution of our nearby celestial neighbors and the interplanetary medium. These data comprise an initial step toward positive answers to questions concerning the origin of the solar system and life within it. (Figure 4.)

Project Ranger, Some Considerations

Project Ranger was born, reached maturity, and expired in the rather brief albeit extremely active period in astronautics between 1959-1966. The conduct of this research and development effort--to examine the moon at first hand--took place in an historical context characterized by circumstances that, of themselves, are not readily apparent in the chronology, but which appear superimposed across the complete spectrum of events. For this reason it is instructive to note and briefly explain the more important of these circumstances and situational considerations as an interpretive aid: they had a major influence upon the manner in which the project developed, and, to some extent at least, conditioned the outcome. These desiderata may be roughly divided into three broad, interrelated, categories: technical, operating roles and organization, and participant attitudes and philosophies of operation.

Figure 4: JPL in 1970. Original buildings were located on the bank of the Arroyo Seco at right center.

Technical Considerations. The first-generation Ranger spacecraft was conceived at JPL in 1958-1959 as a basic building block for American unmanned planetary and lunar exploration projects. The vehicle and its associated operative systems involved a technological advance which was not graduated or additive in nature, but rather more nearly approximated a multiple jump in complexity and capability over contemporary United States deep space probes. Ranger was designed to weigh hundreds of pounds rather than tens of pounds, and incorporated electrical power derived from deployable solar panels as well as from batteries; it was attitude stabilized on three axes rather than spin stabilized so that scientific instruments and the solar panels could be properly positioned, and was capable of performing midcourse maneuvers to refine its trajectory to impact or permit a close approach to celestial bodies; it employed a steerable high-gain antenna that could be used up to planetary distances to transmit engineering and scientific data, and it possessed the necessary onboard timers and computers to accept and act upon real time as well as stored commands.

To support Ranger and its sister unmanned deep space flight projects on the ground, new control systems and test facilities were developed. Deep space tracking stations utilizing large aperture, steerable, antennas were established at various locations around the world, and a communications network between these stations and a flight operations command center at JPL were created together with the necessary operating procedures and data processing equipment. Environmental test facilities were designed and constructed at the Laboratory which could duplicate the environment encountered during launch and flight in deep space, including mechanisms that could vibrate spacecraft at low and high frequencies, and vacuum chambers large enough to accommodate complete spacecraft.

Much of the equipment and techniques that went into this complex enterprise during the late 1950's and early 1960's were not available and had to be designed, developed, tested and integrated into the complete system under short-term schedules. Satisfactory lightweight transistorized power conversion equipment for use in spacecraft, for example, was not available and had to be developed. Concurrently, very little was known about the performance of electronic and mechanical components in the hard vacuum of space, and thermal control and equipment packaging problems had to be solved. In order to avoid contamination of celestial bodies from terrestrial organisms, sterilization techniques also were formulated and applied in the fabrication of early Ranger spacecraft. Technical difficulties associated with all of these developments in both the ground and space-borne segments of this project had to be resolved, and the state-of-the-art for virtually all project subsystems, with the possible exception of main stage rocket propulsion, had to be rapidly advanced in order that ambitious flight objectives could be met.[19]

Operating Roles and Organization. Establishing a viable operating role under NASA auspices as well as adequate modes to organize and manage resources for Project Ranger proved to be tasks equally as demanding as the creation of new equipment and the solution of technical

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[19] Several early Ranger flight failures, for example, may have been caused by an imperfect understanding of the zero-g environment peculiar to attitude-stabilized spacecraft: exposed terminals could have been short-circuited by foreign particles floating in the spacecraft equipment modules. For the later Ranger and Mariner spacecraft, all terminals were coated and insulated to remove this hazard.

problems of spaceflight.[20] Principal among these tasks at JPL were: (1) revising the pre-1958 research and development role of the Laboratory to meet the demands of new missions; (2) acquiring and integrating large numbers of new employees into the Laboratory structure, and establishing a working relationship between JPL/Caltech and NASA; and (3) reorganizing the Laboratory to accommodate expansion of activities, and adapting to the organizational superstructure created for Ranger that existed above and independent of the Laboratory.

The Jet Propulsion Laboratory, like the older established NACA research centers which became components of the National Aeronautics and Space Administration, underwent a pronounced change in its operating role and method of performing work under contract. JPL shifted from a support facility in which guided missile systems were developed in-house and then turned over to industrial firms for production and release to a using government agency, to become an operating line agency not only providing NASA research and development leading to the creation of new lunar and planetary spacecraft systems, but conducting spaceflight operations as well. In addition, the Laboratory undertook direction of industrial firms which performed space systems engineering and development services under contract to JPL. During this transition JPL continued in-house

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[20]The difficult task of organizing and managing resources for spaceflight projects was by no means unique; it confronted and was coped with by all industrial and government agencies engaged in this activity in the early 1960's. A useful survey of organizational and contracting problems involving government space agencies is contained in Government Operations in Space, U. S. Congress, Thirteenth Report by the Committee on Government Operations, U. S. House of Representatives, 89th Congress, 1st Session, House Report No. 455, June, 1965. For a more opinionated review of the same subject, see H. L. Nieburg, In the Name of Science, (Chicago: Quadrangle Books, Inc., 1960), *passim*.

development of a number of flight projects (including Ranger and Mariner) to obtain desired results as rapidly as possible, and to maintain a competence in those fields of technology with which the Laboratory was primarily involved (necessary for evaluation of contractor capabilities and for the direction of contractor work in progress). Other spaceflight projects, such as Surveyor, were assigned to an industrial systems contractor under JPL direction.

Between 1958 and 1965 the number of personnel employed at JPL nearly doubled, from approximately 2,300 to a peak of more than 4,000, as the Laboratory staffed to meet its new assignment.[21] (During the same period NASA expanded fourfold to undertake both manned and unmanned space programs.) At the same time--but unlike NACA field centers--the Laboratory appeared on NASA organization charts as neither fish nor fowl; it also had to establish a satisfactory working relationship with NASA, attempting to respond both as field center and line agency in an operational sense, while remaining legally a non-profit contractor facility operated by the California Institute of Technology. It was a situation in which few were comfortable--not the least of which were aerospace firms that tended to resent this privileged relationship.[22] An amenable working

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[21]After its formation in 1944 (with a total of 170 employees), the number of personnel employed at JPL rapidly increased until, by 1956, the Laboratory employed 1,500 and approximated in size its parent, Caltech. Ten years later the child was twice the size of the parent; presently, in 1970, the total number of employees is stable at approximately 4,100.

[22]A brief review of this condition is contained in "JPL Program Growth Forces Increased Contracting to Industry," Missiles and Rockets, Nov. 25, 1963, 181.

relationship with NASA was established, but it was not achieved swiftly nor easily, and it continues to be refined and improved.

Finally, the Laboratory undertook an internal reorganization to accommodate its new operating role and to manage additional personnel, and at the same time acted to meet its obligations in the organizational structure created for Project Ranger. When it was formed as an independent non-profit organization in 1944, JPL adopted a functional matrix type organization similar to that of the parent institute; technical sections were created in Engineering Design, Materials, Solid Propellants, etc., that approximated the division of disciplines found in university departments. Personnel were drawn from the technical divisions and sections on a temporary basis and assigned to support work in a given missile development effort. With minor alterations this management structure remained in effect throughout the 1950's; designated program or project offices were not to be found in the organization charts,[23] although they existed _de facto_ in specific departments.

With the transfer to NASA and accompanying change in mission emphasis, JPL reviewed its existing organization structure, and also contracted with a management consultant firm to perform a similar study in 1959.[24] Recommendations contained in these studies were implemented in 1960 with the appointment of a Deputy Director at

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[23] _Historical File, Organization Charts_, JPL, n.d., bound copy in the JPLHF.

[24] _Improving Organizational Structure and Administrative Processes, Jet Propulsion Laboratory_ (Los Angeles: McKinsey & Company, Inc., Sept., 1959).

the Laboratory and the creation of separate Lunar and Planetary Offices to devote full attention to the respective deep space flight projects. Ranger and Surveyor (lunar) Project Offices were established and reported to the former organization, Mariner (planetary) Projects reported to the latter group. Personnel from the several technical line divisions (including the systems engineering function) and their technical sections were assigned to support the various project offices in a manner corresponding to past practice.[25]

The matrix organization thus established was believed to be the most efficient method for organizing resources in a situation where JPL, with a limited number of personnel restricted by manpower ceilings, would (a) develop vehicles/equipment and conduct flight operations for a number of similar, concurrent, spaceflight projects with restricted periods of performance (initially forecast at about three years duration per project), and (b) pursue other advanced research and development efforts in support of existing and proposed flight projects. Furthermore, this form of systems management permitted the Laboratory to apply the entire capability of an appropriate discipline organization to a given technical problem

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[25]The Laboratory developed and operated spaceflight projects through the mechanism of a relatively small project staff. The project manager was responsible for the supervision and integration of the four systems in the project: the spacecraft system; the spaceflight operations system; the tracking and data acquisition system; and the launch vehicle system. The launch vehicle system for Agena launches (Ranger and Mariner) was managed for JPL by the Marshall Space Flight Center; later, management was transferred to the Lewis Research Center. In the Ranger Project systems engineering development and testing were conducted in-house by the appropriate technical division; JPL divisions also controlled and monitored the various subcontracts involved. In the case of the Surveyor Project,

at the time it appeared, and led to a cross-fertilization of knowledge among the flight projects and between the projects and research personnel in each technical discipline.[26] Over and beyond this internal reorganization, the necessary integration and coordination of myriad Ranger-related organizations including JPL, NASA, USAF, various ad hoc government committees, scientific groups, and hundreds of subcontractors was also achieved.

Participant Attitudes and Philosophies of Operation. When the National Aeronautics and Space Administration was created by an act of Congress in 1958, it was initially composed of the personnel and installations of the old NACA research centers, the NRL Vanguard team, and the Jet Propulsion Laboratory in Pasadena. Of these elements, only Vanguard and JPL personnel possessed experience in developing and managing spaceflight projects, and members of the former group still shared the onus of adverse publicity that accompanied that effort. Conversely, JPL, together with the Von Braun missile team in Huntsville, had received national

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responsibility for the spacecraft system was initially delegated to Hughes Aircraft Company under a prime system contract from JPL; technical direction was maintained by JPL via the Surveyor Project Office and the supporting technical divisions. Planetary flight projects were ordered and developed in-house in a manner similar to the Ranger Project in the early 1960's. (See statements by J.D. Burke and R.J. Parks in JPL-Industry Conference Proceedings, Pasadena: JPL, Nov. 19, 1960, p. 12 and p. 16, respectively; and, statement by W.H. Pickering in Investigation of Project Ranger, U. S. Congress, Hearings before the Subcommittee on NASA Oversight, of the Committee on Science and Astronautics, U.S. House of Representatives, 88th Congress, Second Session, No. 3, p. 143.) All of the JPL spaceflight projects operated under the rules of NASA General Management Instruction 4-1-1, issued on Jan. 19, 1961.

[26] Pickering, Ibid., p. 143.

recognition in the success of America's first satellite, Explorer I, and their technical competence was acknowledged and widely acclaimed.

At the beginning of what eventually became known as Project Ranger, in 1959, virtually everyone at JPL was aware, in a very real collective sense, of the Laboratory's demonstrated technical competence;[27] and this awareness was reflected in the attitudes of Laboratory personnel in their relations with NASA Headquarters, industry, the Air Force, and the scientific community. If it is at all possible to circumscribe the combined attitudes which prevailed at JPL, it can be said that they centered about three principal focuses at this time: a high esprit de corps, ebullient self assurance and optimism concerning the outcome of JPL programs[28]--coupled with a tendency to "think big" (no job is too large or complex)--and to overcommit in regard to undertaking new work with a limited staff. As one JPL engineer later recalled, "We were good and we knew it, and we did not hesitate to request permission to take on another child while still nine months pregnant."

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[27] Letter from Dr. W.H. Pickering, JPL Director, to NASA Administrator Dr. T. Keith Glennan, Nov.20, 1958. (JPLHF 2-407a)

[28] Dr. James Van Allen, a longtime friend of Dr. Pickering, observed in Time Magazine: "They have tremendous esprit at JPL; it's almost offensive. It's like the Marines." "Voyage to the Morning Star," Mar. 8, 1963, 79. See also, comments by Dr. William Pickering, Space Science Seminar, Part I, JPL Publication 30-10, Aug. 5, 1959, 16.

The operational philosophy[29] exhibited by JPL in 1958-59 and which, to a certain degree, carried over into the early 1960's--especially in Project Ranger--was largely conditioned by previous weapons system-arsenal development experience, and by what might be termed a "local option credo." Design review, verification, and development were accompanied by a constrained amount of ground testing before a first flight. Actual shake-down flights substituted for and provided equivalent data on flight performance that could otherwise only be approximated in elaborate ground test complexes. For Project Ranger this approach was reinforced, rather than weakened, because (a) sufficient flights were programmed which allowed for early engineering test flights, (b) ground test facilities for larger spacecraft were not yet in existence when America's space programs got underway (e.g., a vacuum chamber that could accept a complete spacecraft and duplicate the environment of outer space was not completed at JPL until 1962-1963), and (c) stringent schedules between flights had been agreed upon which left little enough time to incorporate design improvements. (This last condition was also the result of a NASA-JPL desire to enhance national prestige by "beating the Russians" in lunar exploration, later made explicit national policy in Project Apollo.)[30]

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[29]The operational philosophy, or philosophy of operation, is here construed as the prevailing approach to, and processes employed in, the conduct of applied scientific research and development operations.

[30]See, for example, comments of Dr. Homer Newell, NASA Associate Administrator for Space Science and Applications, Investigation of Project Ranger, op. cit., 45; also, outlook of the first NASA Administrator Dr. T. Keith Glennan, cited in the November 6, 1964 Report of OSSA Staff Meeting, 5; James E. Webb, second NASA Administrator, in Astronautics and Aeronautics, 1963: Chronology on Science, Technology, and Policy, 460-461;

The second major determinant in JPL operational philosophy, the local option credo, stemmed in large measure from the university background of the Laboratory. (In fact, since 1944 JPL personnel have often worn two hats, holding responsible positions at the Laboratory and on the teaching staff at Caltech in the engineering or chemistry departments, for example.) Local option was a principal source of the Laboratory's creative strength; at the same time, when combined with the expanded mission role with NASA, it proved a handicap as well.

This ethic, pervasive throughout JPL in the early 1960's, held that once responsibility for an assignment was delegated in-house, a minimum amount of follow-up was called for, and a technical subgroup exercised more of the important decisions concerning the assignment than normally would be found in industry or military agencies. This approach to delegation of authority called for a high degree of attention to duty and ingenuity on the part of a subgroup; it was expected and, in most cases, received. However, those for whom various assigned technical work was performed occasionally accepted work on assurance and trust alone, and defended work that subsequently proved inadequate in terms of design or performance. The introduction of stringent reliability and quality assurance controls under the direction of a separate office as a cross-check--as opposed to permitting technical sections to evaluate and sign-off on their own work--eventually eliminated this

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and, letter, W.H. Pickering to A. Silverstein, February 3, 1959, (JPLHF 2-827). JPL was equally moved, see Dr. W.H. Pickering, "Do We Have a Space Pro ram?" Astronautics, January 1960, 83-84; and, IOM from Dr. W.H. Pickering to Senior Staff, Subject: Study on Accelerating the National Space Program, April 25, 1961. For Project Apollo, see Vernon Van Dyke, Pride and Power: The Rationale of the Space Program (Urbana, Illinois: University of Illinois Press, 1964), 144; comprehensive treatment in John M. Logsdon, The Decision to Go to the Moon: Project Apollo and the National Interest (Cambridge: MIT Press, 1970).

shortcoming; however, it had the effect of making the technical sections more conservative in their approach to problem-solving.

In Washington, D.C., personnel at NASA Headquarters who were drawn from the NACA field centers and Vanguard Project did not express as well defined a consensus of attitudes as those found at JPL in the late 1950's and early 1960's. Like their counterparts at JPL they shared an equivalent enthusiasm and interest but were, in general, more cautious and less inclined to be as self-assured due either to a lack of prior experience in spaceflight activity or, as in the case of the Vanguard team, because of prior experience in a spaceflight project which had attempted to rapidly advance the state-of-the-art. The philosophy of operation that evolved, however, was substantially different than that found at JPL, and is susceptible to some generalization.

As the operating government agency charged with this nation's civilian space effort--which carried with it all the emotional appendage identified as national prestige in this newest of man's technical endeavors--those in charge of NASA were, at the outset, particularly sensitive to and concerned with Congressional approbation. By 1960 NASA Headquarters had determined upon a course of action to enlist the services of universities for support, and industry as systems contractors for most space flight projects rather than relying completely upon in-house developments at field centers.[31] In addition, Headquarters established sharply defined roles for

[31]Prior to service allocation of jurisdiction for missiles and space activities in the early 1950's, both the Air Force and the Army were avid contestants for these missions. The Air Force, however, relied upon a broad base of industrial systems contractors for its procurement and was able to bring more pressure to bear in Congress and in defense councils than was the Army, which tended to prefer in-house development at Army-operated

the field centers in which flight projects were assigned to Goddard (earth orbit and manned flight), Marshall (booster systems), and to JPL (unmanned deep space), with research centers (Ames, Langley, Lewis) performing the bulk of supporting research and development.[32] To ensure contracting to industry, and to control costs and the rapid growth of the agency, manpower ceilings were imposed upon all NASA field centers including JPL. Finally, the international political ramifications of spaceflight projects determined that initial emphasis was placed upon rapid flight development schedules. By 1963-1964, however, the great costs of this activity combined with early flight failures in the unmanned programs caused a tacit, albeit major, shift in emphasis to flight success (i.e., achievement of primary mission objectives) on every launch.[33]

NASA management of space flight projects by means of committees was abandoned after three years, replaced by a largely projectized and line oriented structure in which supervision was exercised by responsible NASA Headquarters offices that, inter alia, established operating policy and confirmed technical decisions and larger contract awards made by the field

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arsenals. The Air Force was successful in securing all military space and long-range missile assignments, and the Army was redirected from space to other concerns. It would appear that this lesson--the ability to influence Congress through indirect constituent support in the form of aerospace contractors--was not lost upon those charged with guiding NASA in its formative years. (See, for example, "Dryden Foresees NASA-Industry Teams," Aviation Week, June 23, 1958, 38-39.)

[32]NASA, "Suggested Program for Implementation of Proposal Made to the Honorable Neil H. McElroy, the Secretary of Defense on October 15, 1958;" major concepts also cited in Note No. 15, JPL Director's Staff Meeting, April 11, 1960. In 1963 the roles for field centers were revised, and thereafter research centers were assigned flight projects.

[33]Within the first few years after NASA's creation this tendency was manifest in NASA presentations made during Congressional authorization hearings by casting the year's flight results in a success/failure ratio, and by emphasizing any "space firsts" that may have transpired.

centers.[34] During this early period if there was any expectation at JPL of a "partnership" arrangement with Headquarters on deep space exploration--even though JPL occupied a large and novel role[35]--it soon evaporated as NASA Headquarters exercised its management prerogatives under the terms of the Caltech-NASA contract.

The more decentralized form of organization at JPL, its university ties and contractor status, in-house approach to development and early insistence upon local option (formalized to a limited degree in early contracts with NASA in the form of a so-called "mutuality clause")[36] did color

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[34]The new roles and responsibilities appear in NASA General Management Instruction 4-1-1, January 19, 1961. Program offices in OSSA were not formally established until February 1962.

[35]The JPL role and mission evolved to approximate a microcosm of NASA, including lunar and deep space scientific exploration, project management of complete spacecraft systems, tracking, data acquisition, and data reduction and analysis required in lunar and deep-space flights. Suddenly grasping the scope and magnitude of this enterprise during Congressional hearings, one Congressman was moved to remark that "this looks like it is a little NASA all within its own. They can do everything from beginning to end." (Comment of Congressman Evins in U.S. Congress, House of Representatives, Independent Offices and Department of Housing and Urban Development Appropriations for 1969, Hearings before a Subcommittee of the Committee on Appropriations, 90th Congress, 2nd Session, Part 2, February 19, 1968, 1160)

[36]The term is a misnomer inasmuch as there was no single provision that dealt exclusively with mutual agreement upon conditions for work. It does refer to portions of Article I, Scope of the Contract, paragraphs (a) and (c) in the initial Contract NASw-6 (1959-1961) and subsequent NAS7-100 (1962-1964) with the California Institute of Technology: "(a) During the term of this contract the Contractor shall engage in a program of basic engineering research and of applied research and development in such fields as the parties hereto from time to time may mutually agree upon, including liaison with and the technical supervision of other private contractors. . . . (c) The parties hereto recognize that the maximum benefits

relations between the Laboratory and NASA Headquarters in the early 1960's as NASA sought to guide JPL activity. At Headquarters the Laboratory came to be viewed as somewhat parochial in its outlook--a square peg in a matrix composed of round holes--and it acquired an informal, not altogether affectionate title: "the JPL Campus."[37]

All of these varied situational considerations, technical, organizational, participant attitudes and philosophies of operation, were present during the design, development, and operational phases of Project Ranger. Taken individually each is a separate story that played some part in Project Ranger; historically, they should be considered together in context--forming the larger environment in which the separate events, recounted in the pages which follow, transpired.

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obtainable from the work to be performed hereunder will be realized by the Contractor's pursuing a research and development program . . . , and by providing for an extensive interchange of information between the Government and the Contractor as a basis for periodic revisions of the program <u>through mutual agreement</u>. . . ." (Italics added.) A brief review of the origins of this kind of task contracting with universities is contained in J.J. Penick, Jr., <u>et al</u>. (eds.) <u>The Politics of American Science: 1939 to the Present</u> (Chicago: Rand McNally & Company, 1965) 136.

[37]This sentiment still persists to some extent. Former NASA Administrator James Webb, testifying before Congress in February 1968 concerning a recent NASA evaluation of JPL performance under contract, observed that "we are steadily bringing in more people to make JPL serve a broader national interest and not be simply a one-university laboratory." <u>Independent Offices and Department of Housing and Urban Development Appropriations for 1969</u>, <u>op. cit</u>., 1161.

II

RANGER CHRONOLOGY, A SUMMARY

RANGER CHRONOLOGY, A SUMMARY*

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Ranger Blocks I and II, 1960-1962

1960

Jan. 7	Ranger Project management plans and responsibilities defined.
Jan. 13	JPL S-1 spacecraft designated for use in Ranger lunar missions.
Jan. 20	Science package for Ranger Block I flight missions confirmed with NASA.
Jan. 21	First flight schedule released.
Feb. 13	Agena second stage booster selected for Project Ranger.
Mar. 25	RCA awarded contract for approach television camera for Ranger Block II spacecraft.
Apr. 12	Lockheed Missiles and Space Division awarded a contract for Agena B vehicle for NASA space missions.
Apr. 17-19	Mission objectives and design criteria for Ranger Block I and Block II issued at JPL.
Apr. 25	Aeronutronics, Division of Ford Motor Co. selected to develop the lunar rough landing capsule system for Ranger Block II spacecraft.
Apr. 26	Ranger spacecraft sterilization procedures established at JPL.
May 5	JPL recommended scientific experiments for Ranger Block II.
May 9	NASA approved science for Ranger Block II.
June 29	Vela Hotel experiments approved for Ranger Block I flights.
Aug. 24	Ranger Block II spacecraft design review held at JPL.
Oct. 14	J.D. Burke appointed Ranger Project Manager at JPL; C.I. Cummings remained as head of the Laboratory's Lunar Program.
Nov. 17	NASA issued <u>NASA-Atlas Agena B Launch Operations Management Organization and Procedures, AMR</u>.

*Only events associated with Ranger Project after 1960 are included in this summary.

RANGER CHRONOLOGY, A SUMMARY

1960

Dec. 14	New interorganizational arrangement established for preparation of Ranger guidance and trajectory calculations.

1961

Jan. 3	Atlas Agena B launch operations management organization and procedures at AMR agreed upon by all affected organizations.
Jan. 19	NASA General Management Instruction 4-1-1, <u>Planning and Implementation of NASA Projects</u> issued.
Jan. 24	AMR Launch Complex 12 made available for NASA occupancy.
Feb. 10	The Woomera, Australia, DSIF tracking station dedicated.
Feb. 16	Ranger Block II spacecraft weight problem became critical.
Apr. 4	Design of Ranger Block II spacecraft frozen at JPL.
May 7	Ranger 1 accepted by NASA for shipment to AMR.
May 24	<u>Ranger Project Development Plan</u> (Ranger Blocks I and II) issued issued by JPL.
May 25	In a special message delivered before a joint session of Congress, President Kennedy called for a national decision for "achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth."
June 2	NASA requested JPL to consider plans for a possible extension of the Ranger Project.
June 5	Ranger Block II weight problems resolved; additional weight made available could not be used.
June 9	JPL informed NASA of a probable four flight extension in the Ranger Program (Block III).
June 21	Ranger Block III flights approved by NASA.
June 30	NASA approved selection of RCA to develop Ranger Block III television subsystem.
June	Construction of the Johannesburg DSIF station completed.

RANGER CHRONOLOGY, A SUMMARY

1961

Aug. 21	NASA SSSC considered potential experiments to be carried on Ranger Block III flights. No decision reached pending OSFP recommendations.
Aug. 23	Flight of Ranger 1.
Aug. 25	RCA accepted contract to develop Ranager Block III TV subsystem.
Sept. 23	Ranger Project Development Plan, Supplement A (Block III flights) issued at JPL. Two science experiments were to be included on each of the television impact flights.
Oct. 16	The NASA SSSC approved space science experiments for Ranger Block II flights, including addition of a radar reflectivity experiment.
Oct. 26	NASA directed JPL to prepare a recovery plan for the Ranger Block II capsule program.
Nov. 9	Recovery plan for Ranger Block II capsule program completed.
Nov. 18	Flight of Ranger 2.
Dec. 28	Ranger 3 accepted by NASA for launch in January 1962.

1962

Jan. 26	Flight of Ranger 3.
Mar.-Apr.	NASA space science decisions altered for Ranger Block III flights (trinket episode).
Apr. 23	Flight of Ranger 4.
Apr. 24	JPL proposed employing an industrial systems contractor to fabricate any additional follow-on Ranger spacecraft.
May 10	RCA began work on a feasibility study of a Ranger Lunar Orbiter (completed July 10).
June 15	NASA OMSF issued requirements for data on the lunar surface to be provided by unmanned lunar probes.

RANGER CHRONOLOGY, A SUMMARY

1962

July 13	A serious electrical power problem on Block III spacecraft became apparent at JPL.
July 19	NASA determined that JPL carry out the complete Ranger program with a minimum of contracting to industry.
July 20	At NASA request, JPL released guidelines for an expanded Ranger Project including five additional flights.
July 25	Discussions commenced at JPL over possibility of relaxing spacecraft sterilization requirements because of the risk to spacecraft component reliability.
Aug. 2	NASA informed of the power problem on Ranger Block III spacecraft.
Aug. 15	JPL requested NASA clarification of Ranger follow-on plans and OSS, JPL, OMSF relations.
Oct. 3	NASA authorized Ranger Block IV spacecraft.
Oct. 4	JPL reconsidered contracting Ranger Block IV spacecraft fabrication to an industrial contractor.
Oct. 11	Representatives from NASA-OSS, OMSF, and JPL met in Washington, D.C. to establish working relationships.
Oct. 18	Flight of Ranger 5.
Oct. 20	NASA announced Board of Inquiry to investigate Project Ranger.
Nov. 6	NASA authorized cessation of further heat sterilization of Ranger spacecraft.
Nov. 30	NASA Final Report of the Ranger Board of Inquiry issued.
Dec. 4	Ranger Block III reprogramming guidelines issued at JPL.
Dec. 7	At JPL, Mr. R.J. Parks appointed Assistant Laboratory Director for Lunar and Planetary Projects; Mr. H.M. Schurmeier appointed Ranger Project Manager.
Dec. 17	Revised objectives for the Ranger Project agreed upon between NASA and JPL.

RANGER CHRONOLOGY, A SUMMARY

Ranger Blocks III, IV, and V, 1963-1965

1963

Jan. 21	NASA announced elimination of all non-visual passenger science experiments from Ranger Block III flights.
Jan. 25	Ranger Block III spacecraft design changes announced at JPL.
Jan. 28	Agena booster management responsibility moved from MSFC to LeRC. Dr. S. Himmel designated as Agena Systems Manager.
Feb. 12-13	NASA and JPL agreed upon Ranger reprogramming; planning for additional Ranger Block V flights authorized.
Feb. 15	Revised Ranger Block III objectives confirmed by NASA.
Feb. 20	JPL resubmitted proposal for bringing in an industrial systems contractor to assist in Ranger Block IV efforts and to fabricate Block V spacecraft.
Feb. 28	New Ranger flight schedule issued by NASA.
Mar. 5	NASA authorized Ranger Block V, selected Northrop Corp. as systems contractor.
Mar. 11	Northrop Corp. received a JPL contract for industrial support on Ranger Blocks III and IV, and for spacecraft system contractor responsibility for Block V.
Mar. 21	NASA approved the experimenter team for Ranger Block IV television subsystem.
Apr. 8	NASA issued formal mission objectives for Ranger Block IV.
Apr. 26	NASA approved non-visual passenger science for Ranger Block IV.
May 22	NASA Headquarters reduced Block V Rangers from twelve to six flights.
July 2-3	JPL recommended cancelling Ranger Block IV.
July 12	NASA cancelled Ranger Block IV. JPL requested to study implications of terminating the Ranger Project after Block III.
July 19	NASA designated the principal investigator and co-experimenters for Ranger Block III flights.

RANGER CHRONOLOGY, A SUMMARY

1963

Aug. 9	Separate project management established for Ranger Block III and Ranger Block V at JPL; H.M. Schurmeier remained Manager of Ranger Block III; G. Robillard appointed Manager of Ranger Block V.
Sept. 3	NASA determined the scientific payload for Ranger Block V.
Sept. 14	Ranger Block III diode gold-flake problem uncovered.
Oct. 18	JPL recommended that flight of Ranger 6 be postponed pending resolution of the diode contamination problem.
Oct. 21	NASA slipped flight dates for Rangers 6 and 7.
Oct. 31	A revised <u>Ranger Block III Project Development Plan</u> was issued by JPL.
Dec. 13	NASA cancelled Ranger Block V.
Dec. 17	Ranger 6 accepted by NASA for shipment to AMR.
Dec. 24	The Deep Space Net created.

1964

Jan. 1	NASA altered names of Ranger spacecraft from numeric to alphabetic designations.
Jan. 30-Feb. 2	Flight of Ranger 6.
Feb. 2	JPL established a Ranger 6 Review Board.
Feb. 3	NASA established a Ranger 6 Review Board.
Feb. 14	Initial findings of NASA Ranger 6 Review Board presented at NASA Headquarters.
Feb. 19-20	Ranger television subsystem modifications established.
Feb. 24	Ranger 7 launch date slipped three months.
Mar. 5	NASA changes in Caltech contract for operation of JPL dercribed to Senate Committee on Aeronautical and Space Sciences.

RANGER CHRONOLOGY, A SUMMARY

1964

Mar. 17 NASA issued the Final Report of the Ranger 6 Review Board.

Mar. 27 JPL issued EPD 205, Ranger VI Failure Analysis and Supporting Investigation.

Mar. 31 NASA Administrator James Webb directed a letter to the House and Senate space committees in which he charged that deficiencies existed in Ranger design, construction, and testing.

Apr. 9 The Chairman of the Committee on Science and Astronautics, U.S. House of Representatives, announced plans for a Congressional investigation of Project Ranger.

Apr. 27–May 4 Congressional hearings to investigate Project Ranger conducted.

May 14 Space Flight Operations Facility dedicated at JPL.

June 17 NASA Headquarters accepted Ranger 7 for shipment to AMR.

June 29 JPL concluded Ranger 6 investigations.

July 28-31 Flight of Ranger 7.

Aug. 1 President Lyndon Johnson briefed on results of Ranger 7 flight.

Aug. 3 Dr. Alex Bratenahl completed his investigation of the Ranger 6 flight, and formulated the most plausible explanation for accidental turn-on of the television subsystem.

Aug. 28 Ranger 7 Preliminary Scientific Results Press Conference held in Washington, D.C.

Nov. 16-19 Ranger 7 lunar impact site selection process began.

Dec. 16 Results of astronomical observations of the impact of Ranger 7 issued at JPL.

Dec. 22 Ranger experimenters team presented findings of Ranger 7 mission to NASA Headquarters.

1965

Jan. 4 NASA accepted the Ranger 8 spacecraft for shipment to AMR.

III

RANGER PRELIMINARY EVENTS, 1957-1959

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RANGER PRELIMINARY EVENTS, 1957-1959

1957

July 1 — The International Geophysical Year (IGY) began.* Both the United States and the Soviet Union had pledged to launch scientific earth satellites as part of their respective contributions in this program. During the IGY the world's scientists conducted the most comprehensive scientific study of the earth ever undertaken. Sixty-seven nations eventually participated, including the United States and the Soviet Union. The IGY was originally planned to extend from July 1, 1957, through December 31, 1958. However, in October 1958, the International Council of Scientific Unions (ICSU), meeting in Washington, D.C., approved an extension of the IGY through December 1959. To carry on the pioneering space work of the IGY, ICSU established its international Committee on Space Research (COSPAR) in 1959. The National Academy of Sciences, through its Space Science Board, became the United States adhering body to COSPAR.

Aug. 27 — The Soviet News Agency, Tass, announced that Russia had successfully tested an intercontinental-range ballistic missile. (E.M. Emme, "Historical Perspectives on Apollo," Journal of Spacecraft and Rockets, April 1968, 371.)

During August — The Air Council approved the USAF Agena satellite program as presented by Air Force Ballistic Missiles Division (AFBMD), and recommended "go ahead" as fast as possible consistent with good management.

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*Two International Polar Years (IPY 1 & 2) for the study of geophysical phenomena in remote areas of the earth had been conducted previously; IPY 1 in 1882-83, when meteorological, magnetic, and auroral stations were first established in the arctic regions, and IPY 2 fifty years later in 1932-33. Both contributed significantly to man's knowledge of the earth's magnetism and of the ionosphere. IPY 2 and the IGY (briefly known as IPY 3 but altered to IGY with the expansion in the scope of inquiry) were sponsored by the various international scientific unions which had been organized in 1919. The International Council of Scientific Unions (an administrative body comprising the chief officers of the unions) coordinated their efforts and established the Comité Spécial de l'Année Géophysique International (CSAGI) to oversee the project. The idea to advance the date for an IPY 3 by twenty-five years to take advantage of the advance in electronics and communications made during World War II originated at a dinner party held at the home of Dr. James Van Allen in Washington, D.C., in April 1950. J. Tuzo Wilson, IGY, The Year of the New Moons, New York: Alfred A. Knopf, 1961, 7-10; also, Hugh L. Dryden, "IGY--Man's Most Ambitious Study of His Environment," National Geographic, February 1956, 285-298.

1957

Oct. 4 The world's first earth satellite, Soviet Sputnik I, was placed in orbit. The space era came of age with this event and, for the moment, the IGY became the focal point for the fledgling astronautical programs of both the United States and the Soviet Union.

Oct. 14 The American Rocket Society (ARS) called for the creation of a national space agency and the inauguration of a space program which excluded military operations and weapons development. (E.M. Emme, "Historical Perspectives on Apollo," loc. cit.)

Oct. 16 An Aerobee rocket launched the first man-made body into interplanetary space from Alamogordo, New Mexico. The experiment, conducted by Dr. Fritz Zwicky of Caltech, consisted of small artificial meteors (coruscatives) which, at 90 kilometers altitude, were propelled to a velocity of 15 km/sec by means of a shaped charge. The artificial meteors escaped the gravitational pull of the earth and went into solar orbit.

Following in the wake of Sputnik I, little news of this event appeared in the communications media, and Zwicky was unsuccessful in attempts to gain official support for a follow-on experiment designed to obtain information on the chemical composition of the lunar surface. In this experiment it was planned to direct coruscatives on a lunar impact trajectory and observe explosions of the small ultrafast particles on the lunar surface with terrestrial telescopes. (F. Zwicky, "The First Shots Into Interplanetary Space," Engineering and Science, January 1958; also, Discovery, Invention, Research: Through the Morphological Approach, New York: The MacMillan Company, 1969, 234-235; and, Morphology of Propulsive Power, Pasadena, California: Society for Morphological Research, 1962, [illegible]8-190.)

Nov. 1 The Secretary of Defense McElroy approved the Air Council recommendation to proceed with the USAF Agena satellite program at maximum rate consistent with good management.

Nov. 3 Soviet Sputnik II, carrying a dog named Laika, was placed in earth orbit. The possibility of near-term manned spaceflight was made evident. Consternation in the United States over the Soviet space triumphs was measurably increased by this event, and government reorganizations and Congressional investigations of missiles and astronautics followed. The demand for almost any sort of national action soon became overwhelming.

Nov. 7 President Eisenhower announced creation of a Special Assistant to the President for Science and Technology. Dr. James R. Killian, Jr., President of the Massachusetts Institute of Technology (MIT), was appointed to fill this position, effective November 29, 1957. (U.S. Congress, House of Representatives, Committee on Government

Nov. 7 cont. Operations, House Report No. 445, Government Operations in Space (Analysis of Civil-Military Roles and Relationships), 89th Congress, 1st Session, June 4, 1964, 34. Hereafter referred to as Government Operations in Space.)

Nov. 8 The Secretary of Defense announced that the Army was to participate in the U.S. IGY satellite program, and directed the Army to prepare to attempt two satellite launchings in March 1958. The code name Juno I was assigned to the Army's earth satellite program; experiments were to provide scientific information on satellite temperature, micrometeoroid impact and erosion, cosmic-ray count, geomagnetic field intensity, and atmospheric density at high altitudes.

Juno I launch vehicles were the same basic Jupiter-C developed for the Army's Reentry Test Vehicle (RTV) program--an elongated Redstone with JPL solid-propellant upper stages--with the addition of a fourth stage rocket and satellite payload. (Juno, JPL Brochure, n.d., circa 1959, 5, JPLHF 5-153.)

Nov. 18 Looking ahead to potential unmanned experiments that could be conducted on or in the vicinity of the Moon, Dr. S. Fred Singer, Associate Professor of physics at the University of Maryland, categorized two: (1) to employ the Moon's gravitational field to return a vehicle to earth after swinging around the "far side" of the Moon, obtaining information on fields and particles in cislunar space, and (2) for operations concerned with impacting the Moon, "one of the more spectacular projects would be to explode an H-bomb on the Moon's surface to observe the results of this explosion. Only a very small part of the Moon would be vaporized and we could follow the motion of the vaporized rock from the Earth. A tiny crater would remain as a mark of man's work on the Moon. One important application of such a project might be for testing nuclear devices without producing any hazards to life on Earth." (S. Fred Singer, "A Reply to Sputnik," 10, reprinted in U.S. Congress, House of Representatives, Staff Report of the Select Committee on Astronautics and Space Exploration, The Next Ten Years in Space 1959-1969, 86th Congress, 1st Session, House Document No. 115, 1959, 183.)

Nov. 21 The Main Committee of the National Advisory Committee on Aeronautics (NACA) authorized establishment of a Special Committee on Space Technology to study and delineate space flight problem areas, and to recommend means for resolving these problems as well as needed space programs. Dr. H. Guyford Stever of MIT, and Chairman of the USAF Science Advisory Board's ad hoc committee on national defense in cislunar space, was named committee chairman. (NACA Press Release, "Space Technology Committee Established by NACA," January 13, 1958, JPLHF, 3-151a.)

The Rocket and Satellite Research Panel, chaired by James A. Van Allen, issued its report on "A National Mission to Explore Outer Space"

Nov. 21 cont. recommending that a national space establishment be created: "In the interest of human progress and our national welfare, it is proposed that a national project be established with the mission of carrying out the scientific exploration and eventual habitation of outer space. . . . To carry out the objectives of the stated mission it is recommended that a National Space Establishment be created. . . ." (As reprinted in U.S. Senate, 85th Congress, Second Session, Compilation of Materials on Space and Astronautics, No. 1, March 27, 1958, 14, JPLHF 2-1913.)

Nov. 25 The Preparedness Investigating Subcommittee of the Committee on Armed Services of the United States Senate commenced hearings on the state of U.S. rocketry and astronautics, and the implications that the Russian satellites had for national security. In his opening remarks subcommittee chairman Senator Lyndon B. Johnson observed that "It is not necessary to hold these hearings to determine that we have lost an important battle in technology. That has been demonstrated by the [Soviet] satellites that are whistling over our heads. . . . Our country is disturbed over the tremendous military and scientific achievement of Russia. Our people have believed that in the field of scientific weapons and in technology and science, that we were well ahead of Russia. . . ." (U.S. Congress, Inquiry into Satellite and Missile Programs, Hearings before the Preparedness Investigating Subcommittee of the Committee on Armed Services, U.S. Senate, 85th Congress, 1st and 2nd Sessions, Part I, November 25 through January 23, 1958, 3, 1.)

During November At JPL, Jack E. Froehlich was appointed "Satellite Project Director" for the Juno I Project since, in the first rush of events after the Soviet Sputniks, there was still no formal name assigned to the effort. Dr. Froehlich, who happened to be an inveterate card player, named America's catching-up operation "Project Deal," and so it was known at JPL in official papers and documents until the name Explorer was finally selected. Later he explained the name: "When a big pot is won, the winner sits around and cracks bad jokes and the loser cries, 'Deal!'" ("Coast Lab 'Birthplace' of U.S. Rocket Power," The Evening Star, Washington, D.C., February 5, 1959, B-12; see also A.R. Hibbs, Notes on Project Deal, JPL External Publication No. 471, March 14, 1958.)

Dr. W.H. Pickering, Director of JPL, and Dr. L.A. DuBridge, President of Caltech, presented a moon-probe proposal to Secretary of Defense Neil McElroy. The "Red Socks" proposal called for nine lunar flights; the first 15-pound payload to be launched by a Jupiter IRBM and JPL upper stages (subsequently known as Juno II) in June 1958, and the second, composed of a Jupiter IRBM with scaled up RTV upper stages

During November cont.

built by Grand Central Rocket Company and capable of launching a 120-pound spin-stabilized payload, would be launched in January 1959. (The latter vehicle became known as Juno III, see Dec. 10, 1957.) The overriding rationale advanced on behalf of this quick-development effort was to restore U.S. confidence at home and prestige abroad by beating the Russians to the moon; technical objectives were to: (1) photograph the hidden side of the moon during a swing-by, and (2) refine space guidance and communication techniques. (Information would be returned to earth via an expanded Microlock link employing large receiving antennas.) Secretary of the Air Force Donald Quarles, who was present for the briefing, suggested that the Air Force be allowed to study the effort and make a comparable counter-proposal rather than have the Department of Defense (DOD) accept this Army proposal at face value. Dr. Pickering later recalled: "Well, in view of the feelings between the Air Force and Army at the time, it was quite clear that as soon as Quarles said that, and McElroy agreed with him, that the program was dead, at least as far as the Defense Department was concerned." It was decided that the proposal would be taken under consideration by the responsible authorities.

Following this meeting DuBridge and Pickering went over to the Executive Offices where the President's Scientific Advisory Committee was in session. The proposal was discussed with members of PSAC, but received only modest support. Dr. I.I. Rabi in particular, a member of PSAC and former Chairman of the Science Advisory Committee in the Office of Defense Mobilization, was unimpressed. Having exhausted the most potential areas for support, Drs. DuBridge and Pickering returned to Pasadena. (Interview with W.H. Pickering, August 20, 1968, JPLHF, 2-753.)

Dec. 5

The Department of Defense announced that it planned to create an Advanced Research Projects Agency (ARPA) within DOD to direct all military space and anti-missile projects. (James M. Grimwood, Project Mercury: A Chronology, MSC Publication HR-1, Office of Scientific and Technical Information, NASA, Washington, D.C., U.S. Government Printing Office, 1963, 12.)

Dec. 6

The first attempt to launch an experimental Vanguard satellite occurred. The test vehicle involved in this launching was not originally programmed as one of the U.S. IGY satellite shots, but rather as a checkout flight for the first "live" upper stages. Nevertheless, it was committed to the task by an earlier announcement from the White House that the flight would carry the first American satellite into outer space. The attempt ended in an explosion on the launch pad at Cape Canaveral, accompanied by an equivalent explosion of unfavorable publicity. With this failure

Dec. 6 cont. following previous Soviet space successes, Vanguard acquired the mantle of scapegoat for America's lag in a "space race." (R. Cargill Hall, "Origins and Development of the Vanguard and Explorer Satellite Programs," The Airpower Historian, Vol. 11, No. 4, 110.)

Dec. 9 In response to a query concerning a proposed future course for space activities from the Senate Preparedness Investigating Subcommittee, Dr. Homer E. Newell of the Office of Naval Research urged that basic research of the atmosphere and outer space be placed on a firm foundation, independent of reliance upon military research and development funding, and that a national space establishment be created. He emphasized that "basic research is the search for new knowledge for the sake of knowledge, and can be carried out only in that spirit. . . ." (Letter, Homer E. Newell to Edwin L. Weisel, Dec. 9, 1957, JPLHF, 5-417.)

Dec. 10 ABMA Development Operations Division released the document A National Integrated Missile and Space Vehicle Development Program which proposed consolidation of military and scientific space objectives. It outlined a full satellite and deep space effort by the United States for the next few years, and the capability of the Army to launch a number of satellite vehicles with various payload applications. Various type vehicle and payload combinations were designated Juno I, Juno II, Juno III, etc., each representing a distinct growth potential over the preceding type. (ABMA Report No. D-R-37, December 10, 1957.)

During December Aware of the potential for biological research in outer space conducted by unmanned space probes, the President of the National Academy of Sciences (NAS) suggested convening a "Satellite-Life Sciences Symposium" to explore this subject. He requested that the Chairman of the Earth Satellite Panel of the U.S. National Committee for the IGY (USNC/IGY) act as Chairman of a planning committee to organize the symposium. The NAS was joined by the American Institute of Biological Sciences and the National Science Foundation (NSF) in the sponsorship of the Symposium, which was subsequently held in Washington, D.C. in May 1958. (A Review of Space Research, NAS-National Research Council, Publication No. 1079, Washington, D.C., 1962, 10-11.)

The Martin Company proposed to the DOD that a stage of the Titan ICBM be combined with the Vanguard rocket to provide a launch vehicle capable of placing an instrument package into lunar orbit and ultimately on the lunar surface. (The Martin Company, Lunar Vehicle, 1957, 2.)

1958

Jan. 4 Officers of the American Rocket Society and the Satellite Research Panel submitted a more detailed proposal to Congress for the creation of a National Space Establishment. The mission specified for this new organization was to include: "(a) An intensified program of scientific soundings with high altitude rockets, immediately, (b) An intensified program of scientific and technical developments with small instrumented satellites of the earth, immediately, (c) Impact on the moon with nonsurvival of apparatus, by 1959, (d) Placing an instrumented satellite in an orbit about the moon, by 1960 . . . . (f) Impact on the moon with survival of scientific instruments, by 1960. . . . (j) Manned circumnavigation of the moon with return to the earth, by 1965, (k) Manned expedition to the moon by 1 or 2 men, by 1968." (U.S. Congress, Compilation of Materials on Space and Astronautics, No. 1 op. cit., 17-18.)

Jan. 12 James H. Doolittle, Chairman of NACA, announced the creation of a Space Technology Committee (as authorized by the Main Committee at the board of directors meeting of November 21, 1957). (NACA Press Release, loc. cit.)

Jan. 14 NACA issued a staff study, "A National Research Program for Space Technology." (E.M. Emme, Twenty-Five Years After "Science: The Endless Frontier" 1945-1970, NASA HHN-101, June 1970, 5, JPLHF 5-424.)

Jan. 23 The U.S. Senate Preparedness Investigating Subcommittee of the Senate Committee on Armed Services issued its findings on the investigation of United States satellite and missile programs, and recommended a course of action for space exploration. (U.S. Senate, 85th Congress, Second Session, Compilation of Materials on Space and Astronautics, No. 2, April 14, 1958, 203, JPLHF 2-1914.)

Jan. 27 Speaking before the Institute of Aeronautical Sciences in New York, Dr. Hugh Dryden presented his views "as to what the national [space] program should be, the role of research, and specifically the role of the NACA. . . . In my opinion the goal of the program should be the development of manned satellites and the travel of man to the moon and nearby planets. . . ." (Hugh L. Dryden, "Space Technology and the NACA," January 27, 1958, JPLHF 5-140.)

Jan. 31 ABMA-JPL Juno I, Project Deal, placed America's first earth satellite (Explorer I) in orbit. Scientific instrumentation of the payload was divided into three categories: (1) cosmic radiation, (2) micrometeoroid (impact microphone), and (3) temperature. Two transistorized transmitters with a total of eight telemetering channels were employed to relay the environmental data to ground stations; mercury batteries provided onboard power. Flight test results from the Van Allen experiment determined the existence of a band of radiation about the earth. (Juno, loc. cit.) (Figures 5 and 6.)

Figure 5: Success! Drs. von Braun, Van Allen, and Pickering with full-scale Explorer I satellite model after orbit was confirmed.

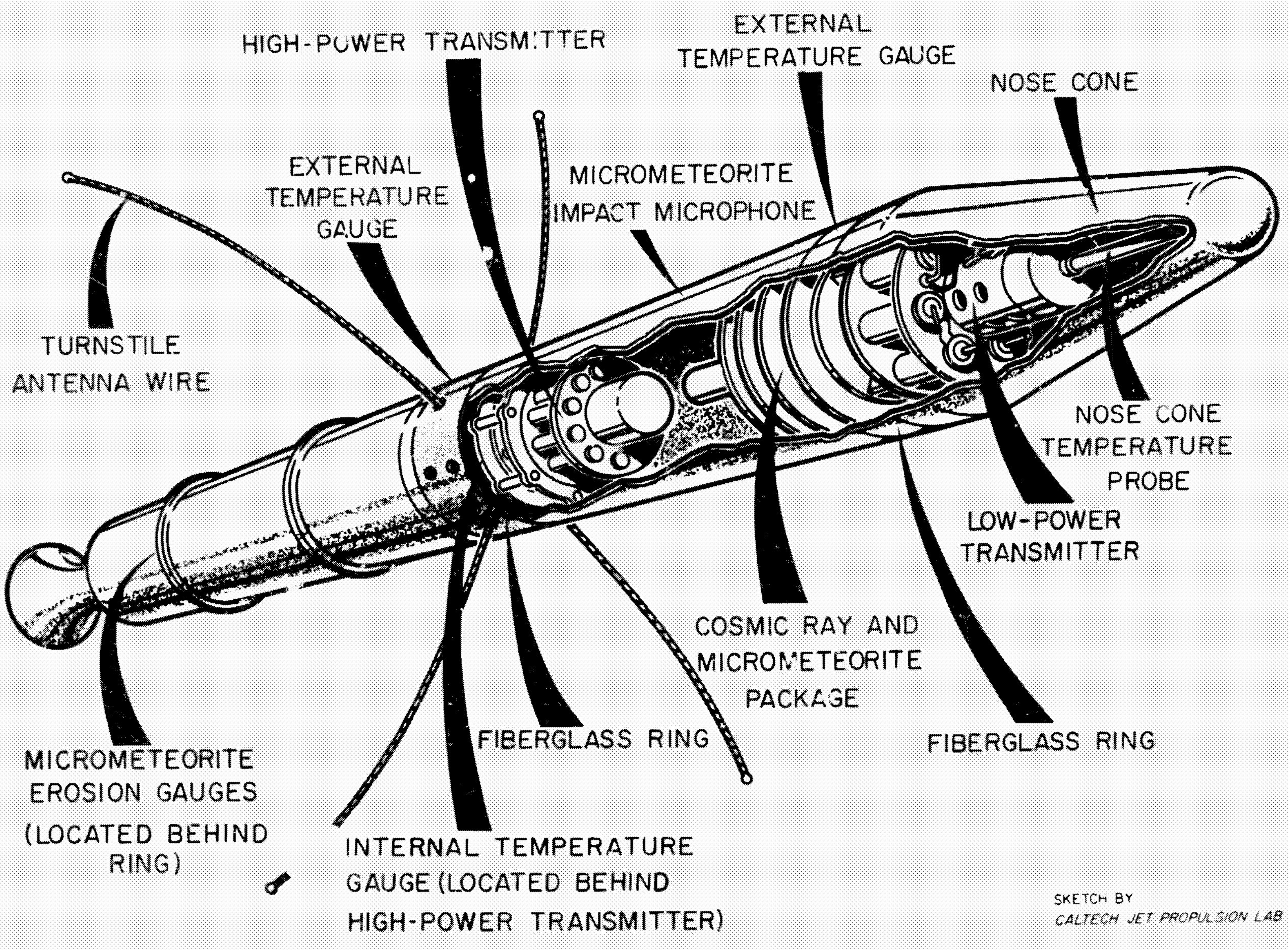

Figure 6: Explorer I.

During January — The Army consolidated its missile development program in the Army Ordnance Missile Command (AOMC) with headquarters at the Redstone Arsenal in Huntsville, Alabama. Under AOMC (activated March 31, 1958) were three subordinate commands: the Army Ballistic Missle Agency (ABMA), the Army Rocket and Guided Missile Agency (ARGMA), and the White Sands Missile Range (WSMR). JPL, with facilities owned by the Army, was responsive to AOMC. With this move, supporting the Ordnance Corps "arsenal concept," the Army "had concentrated in AOMC complete capability to design, manufacture, and launch large, multistage vehicles; with JPL help, the payload could be included as well." (Robert L. Rosholt, An Administrative History of NASA, 1958-1963, NASA, Washington, D.C., 1966, 46.)

The ABMA-generated document A National Integrated Missile and Space Vehicle Development Program (Dec. 10, 1957) was turned over to the NACA Committee on Space Technology, Working Group on Vehicle Program. The report encouraged, among other things, commencement of a vigorous lunar exploration program culminating in "a manned lunar landing in advance of the Soviets." In the introductory abstract, ABMA emphasized that "this report is not a proposal that any particular organization direct the national program, but rather a service that ABMA has performed in the interest of national welfare and security." (See also April 1, 1958, and testimony of General J.B. Medaris before the House Committee on Science and Astronautics, Review of the Space Program, No. 3, Part 2, 86th Congress, Second Session, 1960, 822-823.)

The Air Force directed the Lockheed Missile Systems Division to augment and accelerate the USAF Agena satellite program, which utilized the Atlas ICBM as a booster, by adding ten flights which would employ the Thor IRBM as a booster. The Thor flights would take precedence over the Atlas flights and permit earlier achievement of orbital capability. A new contract was awarded to Lockheed to account for this effort. (The original USAF-Agena systems development contract had been executed on October 29, 1956.)

Professor Joshua Lederberg, Chairman of the Department of Medical Genetics at the University of Wisconsin, circulated a memorandum in the scientific community expressing concern over possible lunar and planetary contamination by spacecraft. These thoughts were formalized in a paper presented at the Satellite-Life Sciences Symposium in May 1958, and subsequently appeared as "Moondust," in Science, 127: 1473, 1958. (A Review of Space Research, op. cit., 10-12.)

The ARS policy statement of October 14, 1957 was forwarded to the White House with the endorsement of the National Academy of Sciences IGY Rocket and Satellite Panel. Concerning a lunar program, the

During January cont.	statement said that the recommended space establishment should achieve an unmanned hard landing on the moon in 1959, and a soft landing with an instrumented spacecraft in 1960. Manned circumlunar flight and return to earth should have been accomplished in 1965, and a manned lunar landing by 1968. (E.M. Emme, "Historical Perspectives on Apollo," loc. cit.)
Feb. 3	A Presidential directive assigned DX (top) priority to the Air Force satellite program.
	JPL issued Memo No. 20-161, D.H. Lee, J.S. Martinez and A.F. Grant, Jr., A Monopropellant-Hydrazine Thrust Unit for Velocity Control of Extraterrestrial Vehicles.
Feb. 7	Secretary of Defense Neil McElroy issued Directive No. 5105.15 establishing the Advanced Research Projects Agency (ARPA), an organization which had been under consideration since November 15, 1957. This centralized agency was charged with management of all U. S. space and anti-missile system projects. A time limit for ARPA initiation of non-military space projects was subsequently set by Congress at one year, ending in February 1959, since planning for a civilian space agency was already underway. (U. S. Congress, House of Representatives, Committee on Government Operations, Eleventh Report by the Committee, Organization and Management of Missile Programs, 85th Congress, 1st Session, September 2, 1959, 136; and U. S. Congress, House of Representatives, Select Committee on Astronautics and Space Exploration, Report of the Committee, The National Space Program, 85th Congress, 2nd Session, Report No. 1758, May 21, 1958, 9.)
Feb. 8	Following the note of caution expressed by Dr. Lederberg in January, the Council of the NAS passed several resolutions expressing deep concern that biological contamination of celestial bodies resulting from initial deep space flight operations might "compromise and make impossible forever . . . critical scientific experiments." The resolutions urged: (1) scientists to plan lunar and planetary missions with great care; (2) the ICSU "to encourage and assist in the evaluation of such contamination and the development of means for its prevention;" and (3) that the Academy would plan any missions in which it participated so as to prevent contamination of celestial objects. (A Review of Space Research, op. cit., 10-11.)

1958

Feb. 13 The first formal meeting of the NACA Special Committee on Space Technology was held at NACA Headquarters in Washington, D.C. Working Groups were established and authorized to prepare reports on various aspects of space exploration. (NASA Special Committee on Space Technology, Recommendations Regarding a National Civil Space Program, October 28, 1958, Appendix.)

Feb. 14 The Technical Panel on the Earth Satellite Program of the National Academy of Sciences IGY Committee released its report on "The Basic Objectives of a Continuing Program of Scientific Research in Outer Space" in which a program of space research was proposed to continue beyond the IGY (then scheduled to end on December 31, 1958). A lunar research program was considered an initial step toward investigation of the planets: "There are several potentially fruitful experiments and observations on the moon now being considered, some of which could be made by impacting the moon directly. . ., some of which could be made by a satellite in a circumlunar orbit. . ., and some of which would require the lowering of instruments to the surface. Ultimately there will be manned vehicles capable of landing on the moon." The panel recommended that, in seeking any determination of the processes by which the moon was formed and evolved, experiments which provide information concerning the moon as a whole should take precedence over experiments involving a particular point of impact. "The three quantities to be measured which pertain to the moon as a whole are the lunar gravity or mass, the moon's magnetic field, and its atmosphere. Of these, probably the last is the only one which requires a landing on the moon. A further experiment. . . is the determination of the internal structure of the moon by seismic prospecting techniques; this will certainly require the landing of an instrumented package." (Report as reprinted in Science, April 11, 1958, 799.)

Feb. 26-28 A "Juno Meeting" was held at ABMA with JPL representatives in which existing and planned Juno space projects were discussed. Dr. Wernher von Braun announced that Mr. William Holaday, Director of Guided Missiles for DOD, had approved three Juno III missions, two of which were to consist of lunar probes (subsequently named Pioneer III and IV). Launch dates were tentatively set at November 11 and December 14, 1958. Design and development of the "Red Socks" Juno III upper stages were approved.* Dr. C.R. Gates sought permission for JPL to proceed with development of four

*At ABMA and JPL, the Juno Program had been subdivided during December 1957 and January 1958 to match new launch vehicle configurations

1958

Feb. 26-28 cont. Juno III lunar spacecraft for launch in 1959: (a) one craft to photograph the hidden side of the moon, (b) one craft to carry a bomb to explode on the moon's surface, and (c) two craft to conduct terminal guidance and control experiments for soft landing (see November 18, 1957). The proposal for four Juno III lunar flights during 1959 met with resistance from ABMA personnel, and the matter was not resolved. (Memo, C.R. Gates to J.E. Froehlich, "Trip Report on Juno Meeting at ABMA," March 10, 1958; and memo, J.D. Burke to File, "Trip Report, Juno Meeting at ABMA, February 26-28, 1958," March 3, 1958.)

March 3-5 The resolutions of the Council, NAS (Feb. 8, 1958) concerning biological contamination of celestial bodies were communicated to the ICSU Bureau at its meeting during March 3-5 by Dr. Lloyd V. Berkner (then ICSU President). As a result, the ICSU Bureau established an ad hoc Committee on Contamination by Extraterrestrial Exploration (CETEX--later renamed Committee on Extraterrestrial Exploration) to study this problem. (A Review of Space Research, op. cit., 10-12.)

March 5 President Eisenhower approved the recommendations of his Advisory Committee on Government Organization that "the leadership of the civil space effort be lodged in a strengthened and redesignated National Advisory Committee for Aeronautics" and that legislation be enacted to "give NACA the authority and flexibility to carry out its expanded responsibilities." (R.L. Rosholt, An Administrative History of NASA, 1958-1963, op. cit., 8.)

March 17 J.R. Dempsey of Working Group 4 of the NACA Space Technology Committee, released a study memorandum "Launching Sites for Space" which evaluated the launch and logistic constraints associated with satellite and space probe flights, and proposed site locations. With respect to lunar flights, he observed

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with new space missions. The Juno I program continued to employ the modified Redstone (Jupiter-C) for earth satellites in the 15-to-30 lb. class. A new Juno II Program was proposed to utilize the higher energy capabilities of the modified Jupiter IRBM for space probes (Phase I), and earth satellites in the 100-lb. class (Phase II). The common denominator of the entire Juno Program was the spinning cluster of JPL high-speed solid-propellant upper stages and the Microlock communications system. In addition, a Juno III Program was conceived, based on the Red Socks proposal of November 1957. It was to consist of a Jupiter IRBM with a spinning cluster of solid rockets as upper stages similar to, but larger than, the JPL-built upper stages employed in the Juno I and II Programs. This large upper stage design--also known as "Red Socks"--and the Juno III concept was ultimately rejected by ARPA on the grounds that future flight missions would require spacecraft guidance and stabilization, and that unguided, spin-stabilized upper stages would not meet expected mission needs.

March 17 cont. that an eastward firing from a low latitude would take advantage of the earth's peripheral rotation, and that "when firing in the plane of the lunar orbit, firing in two steps is likely - 1. launch into satellite orbit when the launching site crosses the lunar plane - 2. final impulse when correct position with respect to the Moon is reached."

Vanguard I, the second U.S. IGY satellite (developed by the Naval Research Laboratory), was successfully launched into earth orbit.

March 20 At an ABMA meeting in which JPL propulsion personnel were present, General J.B. Medaris announced that he wished to proceed with development of a three-stage liquid propellant rocket, using the Jupiter IRBM as the first stage, for earth satellite and deep space missions. He requested that JPL investigate preliminary design of the two upper stages using earth-storable propellants, and report the findings to ABMA in early April. The new vehicle was tentatively identified as Juno IV (see February 26-28, 1958). (A. Briglio Jr., JPL, Comment on Ranger Chronology preliminary draft, January 1969.)

In a keynote address before the Western Space Age Conference in Los Angeles on March 20-22, Dr. Lee A. DuBridge, President of the California Institute of Technology, offered his opinion of manned space flight:

> For most scientific explorations in space the presence of a man involves quite unwarranted complications and expense not justified by what he can contribute to the success of the venture. True, a man makes a pretty good servo system--he could keep a telescope pointed at the right star, for instance. He could also supply a little bit of energy--by turning a crank connected with a dynamo to charge up a battery, possibly. But in return for this he demands a colossal price. He not only requires that we take along air and water and food and other things to keep him alive and comfortable, but he also requires fantastically expensive provisions to bring him back alive. Now no set of instruments demands such a ridiculously expensive luxury. Instruments are content to coast around in space unused and unattended for years and to come back to earth, if at all, in a fiery cataclysm. But not a man! He wants to get back to earth and he wants to get back not only unburnt but essentially unjarred.

(Lee A. DuBridge, "The Challenge of the Space Age," March 20, 1958, JPLHF 5-223.)

March 26 A Statement by the President and Introduction to Outer Space, prepared by the President's Science Advisory Committee, was released. The document was concerned primarily with the scientific objectives of space exploration, and listed "Minimal Moon Contact" as an early goal: "Moon exploration will involve three distinct levels of difficulty. The first would be a simple shot at the moon, ending either in a 'hard' landing or circling of the moon. Next in difficulty would be a 'soft' landing. And most difficult of all would be a 'soft' landing followed by a safe return to earth . . . ." (4-5).

The scientific purpose cited for close-up studies of the moon was the acquisition of new knowledge concerning its origin and history. "Was it originally molten? Does it now have a fluid core, similar to the earth's? And just what is the nature of the lunar surface? The answer to these and many other questions should shed light, directly or indirectly, on the origin and history of the earth and the surrounding solar system." (9-10).

Finally, if any study of possible lunar life forms or organisms are to be made, "we must be careful not to contaminate the moon's surface, in the biological sense, beforehand. . . ." (10).

March 27 Following the evaluation of Air Force lunar flight studies and the JPL "Red Socks" moon-probe proposal submitted in November 1957, Secretary of Defense Neil McElroy announced inauguration of a program "to determine our capability of exploring space in the vicinity of the moon, to obtain useful data concerning the moon, and provide a close look at the moon." The ARPA-directed Lunar Program, a part of the United States participation in the IGY (and corrdinated with the NAS and PSAC, see March 26, 1958), was to consist of three Air Force launches using a Thor-Able combination (a Thor IRBM with Vanguard upper stages) with a "Red Socks" communications link, and two Army launches using a Jupiter IRBM with JPL upper stages. (DOD Press Release No. 588-58, and ARPA Order No. 1-58.) This announcement confirmed the Juno II-Phase I lunar effort, but eliminated any continuing activity on the larger Juno III "Red Socks" solid-propellant upper stages. Basic scientific objectives were to measure cosmic radiation, to establish the lunar probe trajectory, to verify the design of a tracking and communications system, and to permit a more accurate determination of the moon's mass. These objectives were, for the most part, accomplished in the subsequent launching of Pioneers III and IV in late 1958 and early 1959, respectively.

During March An area survey for a deep space tracking station near JPL, Pasadena, (to support the Juno II-Phase I) was completed. Based on "low noise" and favorable terrain geometry, the site was established near Goldstone Dry Lake in the Mojave Desert at Camp Irwin near the

During March cont.

city of Barstow, California. A detailed evaluation of large antenna designs that could be employed in this facility also commenced at JPL. This was the beginning of what would eventually become NASA's world-wide Deep Space Network (DSN). (Rough-draft manuscript, "Antenna and Microwave Activities at the California Institute of Technology, Jet Propulsion Laboratory," no author indicated, December 22, 1960, 6, JPLHF 3-172.)

During March 1958, an Air Force deep space net was authorized by ARPA. AF operated at 400 mc as contrasted with DSIF's 960 mc. (Dr. E. Rechtin, Comment on Ranger Chronology preliminary draft, Dec. 16, 1968.)

April 1

The Working Group on a Vehicular Program reissued a second edition of "A National Integrated Missile and Space Vehicle Development Program" for the NACA Special Committee on Space Technology. It is uncertain which portions of the text are contributed by NACA or ABMA; however, the statement of the task at hand is clear and can be considered as subscribed to by both organizations: "The problem undertaken in preparing this report is that of compiling all available essential facts and outlining a feasible plan which will allow the United States to catch up with and ultimately surpass the Soviets in the race for leadership on this planet and for scientific and military supremacy in space. . . ." (7). The report outlines desirable civilian and military space missions, and the types of rocket vehicles that should be developed for these programs. A first lunar hard landing with a 100-lb. spin-stabilized payload was proposed for August 1959, utilizing a "Red Socks" Jupiter III first stage and Grand Central Meteor rocket upper stages assembled by JPL (Tables 1 and 2).

A $61,000 contract was signed by the Yerkes Observatory, University of Chicago, and the Air Force. Dr. Gerard P. Kuiper, principal investigator, was to produce a new lunar photographic atlas during calendar year 1959. The moon's visible surface would be divided into 44 areas, and each would be represented by at least four photographs taken under varying lighting conditions. (U.S. Congress, House of Representatives, Committee on Science and Astronautics, Army Lunar Construction and Mapping, Committee Report, 86th Congress, 2nd Session, 1960, Appendix.)

April 2

In a message to Congress, President Eisenhower proposed the creation of a civilian space agency to conduct Federal aeronautical and space science activities. NACA was visualized as the nucleus of the new agency. Bills in support of this proposal

April 2 cont. were introduced in Congress, and Congressional hearings began on April 14 and April 15, respectively. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, NASA, GPO, 1961, 97.)

In a memorandum, the President directed the Secretary of Defense and the Chairman, NACA, to consider what functions and facilities of the Department of Defense might be transferred to the then contemplated NASA. The President stated: "'I desire that the skills and experience that have been developed within the Department of Defense be fully utilized in support of civil space programs. . . .'" (Cited in NASA document Suggested Program for Implementation of Proposal Made to the Honorable Neil H. McElroy, The Secretary of Defense, on October 15, 1958, October 15, 1958, 1, JPLHF 2-618.)

April 4 JPL preliminary design studies of Juno IV upper stages indicated that second stage thrust should be on the order of 45,000 lbs. and third stage thrust about 6,000 lbs. The storable propellants selected for the proposed pressure-fed systems were nitrogen tetroxide (N_2O_4) and hydrazine (N_2H_4). This information was communicated to ABMA (see March 20, 1958). (A Briglio Jr., JPL, Comment on Ranger Chronology preliminary draft, op. cit., January 1969.)

April 24 The Working Group on Instrumentation, NACA Special Committee on Space Technology, released its report on tracking, communications, guidance, and power needs for space flight. Appendix B of this document consists of the JPL plan for "Establishment of a World Network for Radio Tracking of Space Vehicles" (for lunar and interplanetary flights). ("Report of the Working Group on Instrumentation," NACA Special Committee on Space Technology, April 24-25, 1958, JPLHF 3-151d.)

April 29 JPL Director William H. Pickering, speaking before the Second Annual AFOSR Astronautics Symposium in Denver, Colorado offered another view of manned space flight. Dr. Pickering stated that:

> It seems to me that we should now ask the question, what do we gain by placing man in the vehicle? To answer this question, we must ask another, what is the mission of the flight? If the mission is to land a man on the moon, then clearly a man is part of the payload; but, if the mission is to record cosmic radiation as observed from a satellite orbit, then it is equally clear that a man is an unnecessary passenger. . . . To sum up--the capability for manned space flight becomes useful only when we consider the exploration of other planets. Before that time comes, unmanned vehicles

April 29 cont.

can accomplish almost all of the missions assigned to space flight, in a cheaper and more reliable fashion.
(W.H. Pickering, "Man in Space," April 29, 1958, 1,2, JPLHF 3-320.)

During April

W.H. Pickering requested that the JPL design group undertake design concept studies for a 350 lb. Mars spacecraft to be launched by Juno IV. It was this study which resulted in the basic design of the Vega-Ranger spacecraft. (Memo, W.H. Pickering to D. Schneiderman--memo is lost--recollection of the recipient.)

Initial studies of the deep space World Tracking Net (WTN)--with an ultimate composition forecast at three-to-five stations around the world--were concluded at JPL, and contracts were awarded for hardware development. For the ground antenna, an 85-foot diameter, equatorial mounted design was selected as most compatible with existing and proposed deep space flight requirements. A contract was subsequently let to the Blaw-Knox Company, Pittsburgh, Pennsylvania, for fabrication and installation of one of these antennas at the Goldstone site. The basic method of feeding the 85-foot antenna for simultaneous lobing operation in the Juno II-Phase I project was also established. Secondary pattern tests were performed at 1/10 scale to verify the feed design concept, and a contract was awarded to the Collins Radio Company of Cedar Rapids, Iowa, to fabricate two of these feed units for the Goldstone antenna.

Lunar spacecraft constraints imposed by weight, size, power, antenna pattern coverage (under spin stabilization), and environmental design, led to the selection of an unsymmetrically fed conical antenna for both Juno II lunar probes (Pioneers III and IV). Largely on the basis of ground and vehicle antenna considerations and experience gained on the Jupiter radio guidance system, the L-band region was chosen for the lunar probe communication frequency. ("Antenna and Microwave Activities at Caltech-JPL, <u>loc. cit</u>.)

May 1

Responsibility for the Project Vanguard U.S. IGY scientific satellite program was transferred from the Navy to the Advanced Research Projects Agency in the DOD. (Emme, <u>op. cit</u>., 98.) The ABMA-JPL Juno I and Juno II programs were also assigned to ARPA, as well as the USAF Agena satellite program. For the next five months ARPA was the single agency in charge of policy and technical direction for all U.S. IGY and military space projects.

1958

May 2 — The Army released funding to JPL for the lunar program that was approved in March. Rear Admiral John E. Clark, Deputy Director of ARPA, announced that it was hoped the moon probe could be launched sometime before the end of 1958. ("Caltech Gets Contract," New York Times, May 2, 1958, 3.)

May 12-13 — CETEX (see March 3-5, 1958) convened and prepared a report on extraterrestrial contamination that recommended, inter alia, the adoption of a code of conduct for deep space exploration in order to avoid contamination, and that the ICSU request its national members to prepare detailed papers on the topics raised in the report. The papers were to be available at the second meeting of CETEX which was scheduled to meet before the end of 1958. The report was circulated to national members of the ICSU with a request for comments in July 1958. (The second meeting was not convened until March 9-10, 1959.) (A Review of Space Research, op. cit., 10-11.)

May 13 — The first Lunar and Planetary Exploration Colloquium, sponsored by the RAND Corporation, North American Aviation, and the California Research Corporation, was held in Downey, California. This meeting was called in response to widespread interest generated by Dr. Richard Holbrook's paper on "Lunar Base Planning" which he had presented at UCLA several weeks earlier, and was the first American colloquium devoted to lunar and planetary exploration. Three principal objectives established for the colloquium were: "(1) to bring together people of common interest for the exchange of scientific and engineering information; (2) to define the scientific and engineering aspects of lunar and planetary exploration and to provide a means for their long-term appraisal, (3) to make available, nationally, the collective opinion of a qualified group on this subject." At this first meeting four papers dealing with selenology and selenography were presented and discussed. The colloquium continued, informally, to meet quarterly at different locations on the West Coast through May, 1963. (Proceedings of the Lunar and Planetary Exploration Colloquium, Vol. I, No. 1, May 13, 1958, "Introduction.")

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May 15 Soviet Sputnik III was placed in orbit; total payload weight was estimated at approximately 1300 kg.

May 23 Merton E. Davies of the RAND Corporation proposed a fly-by mission of the moon in which a spin-stabilized spacecraft would photograph the hidden side. (Davies, A Photographic System for Close-up Lunar Exploration, RAND Corporation Research Memorandum RM-2183, Santa Monica, California, May 23, 1958, JPLHF 2-1347.)* (See During November 1957.)

May 31 ABMA granted temporary authorization for JPL to proceed with design of a new liquid-propellant upper stage for the Jupiter IRBM. The configuration was designated Juno IV. (Letter, V. Larsen, JPL, to William D. Brown, ABMA Tech. Liaison Office, including projected budget necessary to accomplish development of Juno IV, May 31, 1958.)

During May ABMA and JPL began formal design studies that would provide for increased payloads through the use of larger and more efficient boosters and upper stages. Beyond the "Red Socks" Juno III effort (February 26-28) that was terminated in March, there was now Juno IV and Juno V. Juno IV was to be comprised of a Jupiter IRBM with a JPL developed 45,000-lb. thrust second stage, and 6,000-lb. thrust pressure-fed, liquid-propellant third stage, embodying onboard guidance and stabilization. The JPL study for a second and third stage eventually progressed through tank layout, propellant combination, means for tank pressurization, and vehicle guidance and control, before it was cancelled in October 1958. (The JPL 6K engine was later reinstated by NASA in the Vega Program in 1959.) Juno V was an ABMA study for a new class of first stage booster employing a cluster of pump-fed, liquid-propellant engines. (This concept was ultimately developed by NASA as the Saturn I.) (The Ranger Project: Annual Report for 1961, JPL Technical Report No. 32-241, June 15, 1962; and Space Program Summary No. 4, for the period May 15 through July 15, 1959, JPL, August 1, 1959, 53.)

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*This proposal was based on a still earlier RAND study which established the feasibility of "rough-landing" a spin-stabilized payload on the surface of the moon. See R.W. Buchheim, General Report on the Lunar Instrument Carrier, RAND Research Memo RM-1720, May 28, 1956; and H.A. Lang, Lunar Instrument Carrier--Landing Factors, RAND Research Memo RM-1725, June 4, 1956.

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June 3 — First firing tests of JPL 45,000-lb.-thrust uncooled developmental engine for Juno IV second stage took place at JPL. (A. Briglio Jr., loc. cit.)

June 4 — The IGY Committee and its Satellite Panel in the National Academy of Sciences expressed concern over the continuity of United States scientific work in the exploration of space after the IGY expired. Similar concern was shared at NACA and the NSF since it was known that the International Council of Scientific Unions expected to establish a Committee on Space Research and that it would then call upon adhering academies to provide a means for their participation in the work of this committee. Under these circumstances, Dr. Detlev W. Bronk, President of the Academy, established the NAS Space Science Board; Dr. Lloyd V. Berkner was named Chairman. The new Board, formally announced August 2, 1958, would act to focus "the interests and responsibilities of the Academy-Research Council in space science; to establish necessary relationships with civilian science and with governmental scientific activities, particularly the proposed new space agency, the National Science Foundation, and the Advanced Research Projects Agency; to represent the Academy-Research Council in our international relations in this field on behalf of American science and scientists; to seek ways to stimulate needed research; to promote necessary coordination of scientific effort; and to provide such advice and recommendations to appropriate individuals and agencies with regard to space science as may in the Board's judgment be desirable." (Bronk, as reprinted in Science in Space, L.V. Berkner and H. Odishaw, eds., New York: McGraw-Hill Book Co., Inc., 1961, Appendix, 430; also, C.M. Atkins, NASA and the Space Science Board of the National Academy of Sciences, NASA Historical Note HHN-62, Washington, D.C. September 1966, 13.)

June 23 — Dr. Hugh Dryden of the NACA Main Committee, in an article in Aviation Week, outlined a proposed NASA philosophy of operation in which he asserted that, while additional field centers could be established to conduct in-house research and development for space missions, the most efficacious use of talent would be to employ facilities and teams of experts already available in the aircraft industry operating under contract to and at the direction of NASA field centers. ("Dryden Foresees NASA-Industry Teams." Aviation Week, June 23, 1958, 38-39.)

During June — Initial study of the design concepts for a new generation of lunar and planetary spacecraft that would be launched by the Juno IV configuration were concluded at JPL. The design group, led by James D. Burke and including Walter Downhower,

During June cont.	Mark Comuntzis, John Small, and Dan Schneiderman, determined upon a three-axis attitude controlled vehicle in order to use a high gain antenna for interplanetary communications. This decision was approved by a five-man JPL design review board (composed of Jack N. James, Jack E. Froehlich, Jack McKenney, Eberhardt Rechtin, and Walker E. Giberson). (JPL, RA-5 Failure Investigating Committee Report, Interviews, Testimony of J.D. Burke, November 2, 1962, 1, JPLHF 2-460b.)
	Construction began on the Goldstone deep space station with completion of roads to the site and test corings for the antenna foundation. (JPL, Space Programs Summary No. 1, Pasadena, Feb. 1, 1959, 45.)
	Space Technology Laboratory (STL) proposed an Atlas-Able (Atlas booster with Vanguard upper stages) lunar probe project to the Advanced Research Projects Agency. The STL spin-stabilized payload would weigh approximately 380 lbs. and carry a retrorocket onboard. This proposal was ultimately acted upon by NASA in November 1958. (Interview, E.M. Emme with George Mueller, January 15, 1960.) In addition, STL proposed construction of an Air Force Deep Space Net (Jodrell Bank, Hawaii, and Singapore stations). (Dr. E. Rechtin, Comment on Ranger Chronology, loc. cit.)
July 1	JPL released Publication No. 135, Description of World Network for Radio Tracking of Space Vehicles. A minimum of three stations in the tropic zone and two stations in the arctic zones was considered desirable. Proposed locations for the near-tropic stations were California, the East Indies, and Africa. "The exact locations are under negotiation." (JPLHF 7-1.)
July 15	The second Lunar and Planetary Colloquium was held at the RAND Corporation in Santa Monica, California (see May 13, 1958). (Proceedings, Vol. I, No. 2, July 15, 1958.)
July 16	Following extended hearings, Congress passed the National Aeronautics and Space Act. (NASA, First Semiannual Report to the Congress, October 1, 1958 - March 31, 1959, June 16, 1959, 1.)
	The Working Group on the Range, Launch, and Tracking Facilities of the NACA Special Committee on Space Technology, released its report, "Ground Environment for a National Civil Space Research Program." The document evaluated available launch, tracking

July 16 cont.	and ground support facilities, and proposed additional facilities to meet requirements of proposed civilian programs. Turning to management concepts for a civilian space flight program embracing space science, manned space flight, and advanced applications of space technology, the NACA working group "contemplates the use of [outside] military, industrial, and scientific groups competent in the field under the management and support of NASA." (1).
July 25	A further JPL "Proposal for an Interplanetary Tracking Network" was released in response to a request from Mr. Richard Cesaro of ARPA, who had asked Dr. Eberhardt Rechtin to explain in detail how the modified Microlock tracking net established for Juno II lunar probes could be expanded into a worldwide tracking network that could be used in a variety of deep space tracking applications. The proposed JPL multipurpose system was entitled TRAC(E)--Tracking and Communications, (Extra-terrestrial), and would be comprised of three stations located 120 degrees apart in longitude and within 35 degrees of the equator in order to provide continuous space coverage. Proposed sites were Goldstone, California, Southern Spain, and Woomera, Australia. (Nigeria, Ascension Island, and Earthquake Valley, California were all rejected for a variety of technical, financial, or climatic considerations.) (Rechtin, Victor, Stevens, and Gates, <u>Proposal for an Interplanetary Tracking Network</u>, JPL Publication No. 140; see also JPL Technical Memos No. 39-5, "Design for Space Communications," July 7, 1958, and No. 39-4, "World Net Program Report," July 23, 1958.)
July 26	Juno I, Vehicle 44, carried the 37-pound <u>Explorer IV</u> satellite into earth orbit. The satellite carried radiation detection and measuring devices especially designed to probe the radiation belts around the earth. Data from this satellite later confirmed the presence of high-intensity ionizing radiation surrounding the earth which could interfere with the photographic payload then under development for the Juno II lunar probe. (John R. Scull, <u>A System for Lunar Photography and Data Transmission</u>, JPL Technical Release No. 34-142, May 28, 1960, 1, JPLHF 2-120.)
July 29	President Eisenhower signed the National Aeronautics and Space Act which created NASA.
During July	The NAS-SSB strongly endorsed the first report of CETEX (see May 12-13, 1958) and its recommendations. Support for and cooperation with these recommendations was secured from ARPA, the Federal agency responsible for launching space probes, and the first U.S. lunar probe was decontaminated with a lethal

During July cont. — emulsified liquid injected into the sealed nose compartment of the rocket (which housed the payload) prior to liftoff on August 17, 1958. Similar measures were planned for future deep space launchings. (Walter Sullivan, "United States to Sterilize Lunar Vehicles," New York Times, September 30, 1958, 13, JPLHF, 2-764.)

August 8 — President Eisenhower nominated T. Keith Glennan, President of Case Institute of Technology, as the first Administrator of NASA. Hugh L. Dryden, Director of NASA's predecessor--The National Advisory Committee for Aeronautics (NACA)--was appointed Deputy Administrator. The U.S. Senate confirmed the appointments on August 14. (NASA, First Semiannual Report, op. cit., 4.)

August 15 — ARPA issued Orders 14-59, 15-59 and 16-59 to AOMC. Order 14-59 authorized development of the Juno V, 1.5 million pound thrust booster (later known as Saturn I). Order 15-59 authorized development of six Juno IV vehicles for the purpose of launching 500-pound earth orbiting payloads. Order 16-59 provided for JPL component development of the Juno IV upper stages and guidance system. (See March 20 and May 1958.) With planned lunar and deep space missions eliminated for Juno IV, JPL and ABMA began design and development of this vehicle for earth-satellite applications. A program consisting of three two-stage vehicles to be followed by three three-stage firings was proposed; a first launch was scheduled for June 1959. Because of limits on the amount of payload weight that could be carried aboard the two-stage Juno IV, JPL also began development of a light weight inertial guidance system for the first three firings. Contingent upon additional funds, an alternate program was also offered in which a General Electric 405H engine would be pressed into service for the second stage in the first three firings, thereby making all flights three-stage vehicles. (AOMC, Satellite & Space Program Progress Report for NASA, November 18, 1958, 4; and, J.D. Burke, D.R. Bartz, A. Briglio, and C.R. Gates, Juno IV Rocket Vehicle System, JPL Report No. 20-123, December 27, 1960, 2,3.) (Figure 7.)

August 17 — The USAF launched its first lunar probe (designed and built by STL) with a Thor-Able rocket from Cape Canaveral. The attempt ended in a failure when the booster exploded 74 seconds after lift-off. The 85 lb. payload carried a facsimile television system, designed by the Naval Ordnance Test Station, to return crude pictures of the hidden side of the moon via a "Red Socks" communication link. (Space Technology Laboratories, Inc., 1958 NASA/USAF Space Probes Able-1 Final Report, Volume 1, Summary, February 18, 1959, 82 and passim.)

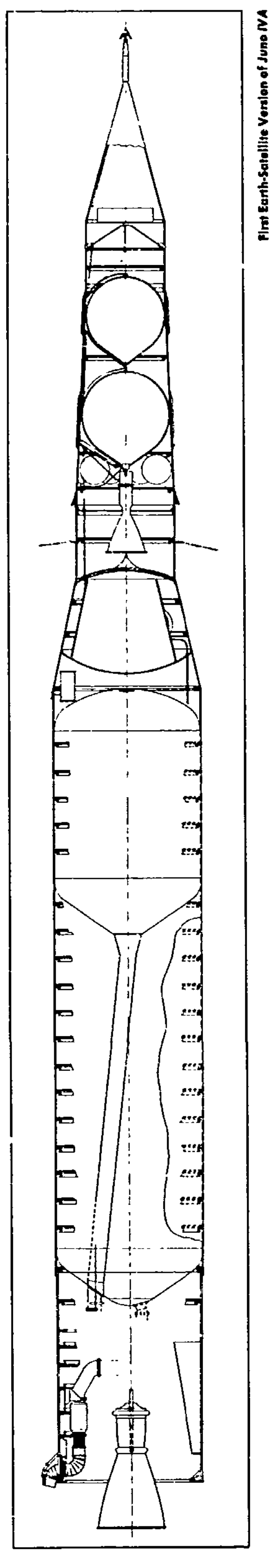

Figure 7: Proposed Juno IV launch vehicle.

During August — At the fifth meeting of CSAGI, in Moscow, the Soviet Union proposed that the work of the IGY be continued through 1959 rather than terminate in December 1958, as originally scheduled. (Wilson, op. cit., 12.)

Analysis of the data received from Explorer IV radiation detection experiment (see July 26) indicated that high intensity radiation in space could severely fog the film carried in the photographic experiment planned for the Juno II lunar probes. Consequently, in late August, a vidicon camera development program was initiated using radiation-insensitive equipment. The payload was comprised of (1) a slow scan television camera, and (2) a low power, bandwidth-compression, magnetic tape recorder. The first component was developed by the Astro-Electronic Products Division of the Radio Corporation of America under contract to JPL, and the second was developed at the Laboratory. (JPL Technical Memorandum No. 30-4, Vidicon Camera and Tape Recorder System Development, June 8, 1959, passim.)

Sept. 18 — During a meeting with Dr. Glennan and Dr. Dryden at AOMC, General John Medaris pledged full support from the Army for NASA's space mission. He suggested that this support be implemented by means of NASA Task Orders to AOMC. (Letter to Distribution from J.B. Medaris, October 14, 1958, transmitting AOMC document "Army Support to NASA," 13-14.)

During September — A meeting was held at Caltech attended by H.J. Stewart, J.E. Froehlich, W.H. Pickering, R.J. Parks, and L.A. DuBridge. NACA invitations for JPL to join the newly-formed NASA as a component field center under the existing contractual arrangement with Caltech were reviewed. The principal question was whether such a move was desirable and, if so, what the role of JPL should be in NASA. Following discussion it was decided that JPL would favorably consider transfer to NASA, and that the role for the Laboratory should center about unmanned exploration of deep space, the moon and planets in particular. (Interview with H.J. Stewart, October 22, 1969.)

A JPL-ABMA review of the Juno IV earth satellite missions (see August 15, 1958) was conducted, and it was determined that the proposed vehicles could meet all of the payload and altitude requirements provided that a transfer-orbit or "kick" technique was employed for the higher-altitude missions. In order to improve the prospects for meeting all of the scheduled

During September cont. flight dates, a decision was made to defer introduction of the second-stage JPL 45,000-pound-thrust engine and to make the six requested flights with three two-stage vehicles (Jupiter IRBM plus the JPL 6K upper stage) and three three-stage vehicles incorporating the GE second-stage power plant. (Burk et. al., Juno IV Rocket Vehicle System, op. cit., 2.)

Oct. 1 The National Aeronautics and Space Administration (NASA) officially began operations. NASA absorbed the 43-year-old National Advisory Committee for Aeronautics including its staff and five laboratories and field stations. An Office of Space Flight Development (OSFD), headed by Dr. Abe Silverstein, was established to conduct space exploration projects. In this office Dr. Homer E. Newell was named Assistant Director for Space Sciences Research. (See, for example, NASA memo from H.E. Newell to A. Silverstein, October 6, 1958, JPLHF 2-1915a.)

On the same day President Eisenhower issued Executive Order 10783, 23 F.R. 7643, which directed transfer of a number of DOD ARPA-directed space flight projects to NASA. Included in this order were Project Vanguard--with the staff from the Naval Research Laboratory--and responsibility for the AOMC Juno I and II programs; the Air Force Thor-Able lunar probe effort, and several other advanced engine development programs.

Oct. 2-4 The General Assembly of the International Council of Scientific Unions (ICSU) met in Washington, D.C. The organization established the Committee on Space Research (COSPAR), designed to continue East-West cooperation in rocket and satellite research which was the hallmark of the International Geophysical Year; further, approval was given the Russian proposal to extend the IGY through December 1959. The extended program was identified as the International Geophysical Cooperation--1959 (IGC-1959). The National Academy of Sciences-Space Science Board (NAS-SSB) became the United States adhering body to COSPAR. Finally, the CETEX recommendations (May 12-13, 1958) were made public, and COSPAR was directed to draft a code of conduct, with a minimum of delay, to guide national exploration of celestial bodies. (Walter Sullivan, Assault on the Unknown, New York: McGraw-Hill Book Co., Inc., 1961, 409-410.)

Oct. 9 Mr. Conright (ARPA) and Lt. Col. Glenn Crane (AOMC) met with the NASA Propulsion Committee to discuss NASA requirements for ABMA space boosters. Dr. Silverstein indicated that NASA would place orders for Juno II vehicles, but that Juno IV would not be required since "when developed it would do no job that the old boosters that are around now cannot do. Consequently, NASA would not program with AOMC for any Juno IVs." (Trip Report from Lt. Col. Glenn Crane, to Commanding General ORDXM-X, October 13, 1958, JPLHF 2-873.)

Oct. 10 Lt. Col. Glenn Crane met again with Dr. Silverstein at his office to further discuss Juno IV. Silverstein reaffirmed his earlier position (October 9, 1958) stating that ABMA effort was being wasted on Juno IV, and that NASA would answer AOMC's recent proposal for four Juno IIs and three Juno IVs by ordering only the Juno IIs. (Ibid.) Inasmuch as ARPA was no longer responsible for a deep space program of its own, Juno IV was without a sponsoring agency. (See October 17, 1958.)

NASA Administrator T. Keith Glennan conferred with Secretary of the Army Brucker, and proposed transfer of JPL in its entirety and part of ABMA to NASA. (Letter to Distribution from J.B. Medaris, op. cit., 2.)

Initial discussion at NASA Headquarters concerning acquisition of JPL from the Army had progressed to the point where a "Possible Statement of Mission for Jet Propulsion Laboratory" was released preparatory to a "meeting with Quarles" (Deputy Secretary of Defense) in the DOD. The Statement proposed establishment of the "Karman Space Flight Center [JPL]·operated by Cal Tech under contract to NASA." JPL's mission was proposed to consist of (1) "supporting research in communications, telemetry, guidance and control, rocket propulsion utilizing both solid and liquid propellants and in related fields--all subject to coordination with other Centers to avoid undesirable duplication," and (2) "specific interplanetary mission assignments together with research and development including, in some cases, technical direction." (NASA Draft, "Possible Statement of Mission for Jet Propulsion Laboratory," no author indicated, October 10, 1958, JPLHF 3-196.)

Oct. 11 The second USAF (NASA) Thor-Able lunar probe was launched from Cape Canaveral. The STL payload was the same as that launched on August 17, 1958, except that the television camera was an STL design. Earth escape velocity was not attained, but the probe, named Pioneer I, reached 70,700 miles altitude before falling back to earth. (NASA, First Semiannual Report, op. cit., 14-15; also, Frank Pollard, "Pioneer: An Achievement," Journal of Space Flight, March 1959.)

Oct. 14 NASA Administrator T. Keith Glennan made a formal request to the DOD for the transfer of JPL and ABMA from AOMC to NASA. (New York Times, Oct. 15, 1958, 1; and "Army Fights Loss of Its Labs," Business Week, Oct. 25, 1958, 29, which also notes that "some private contractors fear NASA's ultimate objective is, like the predecessor National Advisory Committee for Aeronautics, to concentrate research and development in government

Oct. 14 cont. laboratories. But NASA officials claim that, quite the contrary, they intend to farm out much of the R&D to private operations.") (See June 23, 1958.)

Oct. 15 NASA Administrator Glennan outlined the NASA proposal concerning the transfer of JPL and ABMA to NASA auspices to Secretary of Defense Neil McElroy. (NASA, Suggested Program for Implementation of Proposal made to the Honorable Neil H. McElroy, loc. cit.)

Oct. 17 ARPA directed cancellation of Orders No. 15-59 and 16-59, thus eliminating the Juno IV program at ABMA and JPL. (AOMC, Satellite and Space Program Progress Report for NASA, op. cit., 14-15.)

Oct. 28 The NACA Special Committee on Space Technology, commonly called the Stever Committee, concluded its work and submitted its report to NASA: Recommendations Regarding a National Civil Space Program (also known as the Stever Report). Principal objectives for this program were categorized as "scientific research in the physical and lif. sciences, advancement of space flight technology, development of manned spaceflight capability, and exploitation of space flight for human benefit. . . ." (1). Curiously, under the discussion of each of these objectives, no mention was made of lunar or deep space investigations, although an accompanying report of the Working Group on Space Research Objectives, chaired by Janes Van Allen, did include this kind of activity.

Oct. 29 The Third Lunar and Planetary Colloquium was held at the Jet Propulsion Laboratory, Caltech, in Pasadena. Among other papers, Dr. Harold Urey, UC-La Jolla, presented a study on "The Chemistry of the Moon" in which he postulated a lunar model without a central core, with iron masses scattered around throughout the body of material. (Proceedings of the Lunar and Planetary Exploration Colloquium, Vol. I, No. 3, October 29, 1958.)

During October Milton Rosen and others at NASA Headquarters began studies of various boosters as potential NASA launch vehicle combinations for earth orbit and deep space missions based on the NACA Stever Report recommendations (see April 1, 1958). A new launch vehicle combination based on Atlas was favored for certain earth orbit and deep space applications because (1) the weight-lifting capability of an ICBM-class booster was considered necessary and the Atlas was further along in the development cycle than was Titan, and (2) NASA would provide for upper stages and, therefore, would not be dependent upon the military services for their procurement. (Interview with H.E. Newell, March 5, 1968, JPLHF 2-385.)

Nov. 3 While examining the lunar crater Alphonsus with a 50-inch telescope, Soviet astronomer N.A. Kozyrev photographed the spectrum of a brief-lived reddish cloud. The spectrograms were considered by many as evidence of vulcanism, and it rekindled controversy over the moon's origin and evolution as well as increased interest in that particular lunar crater (see October 29, 1958). (Dinsmore Alter, "The Alphonsus Story," Proceedings of the Lunar and Planetary Exploration Colloquium, Vol. I, No. 4, January 12, 1959, 20.)

Nov. 7 JPL submitted a proposal to conduct a Space Flight Program Study, with support from ABMA, to Dr. Abe Silverstein, Director of the Office of Space Flight Development, NASA Headquarters. The proposal offered to define a deep space exploration program for JPL and NASA, and the flight experiments and development work necessary to create a continuing effort. (JPL, "Proposal for Space Flight Program Study," November 7, 1958; cover letter to A. Silverstein from V.C. Larsen, same date, JPLHF 2-620.)

Nov. 8 The third USAF/NASA Thor-Able lunar probe, named Pioneer II, was launched from Cape Canaveral. The STL payload was the same as that flown on October 11, 1958. The third stage separated but failed to ignite, and the vehicle fell back to earth. (1958 NASA/USAF Space Probes (Able-1) Final Report, Vol. 1, op. cit., 84, 40.)

Nov. 10 Dr. Robert Jastrow joined NASA and was assigned responsibility for establishing a Theoretical Division devoted to basic research in astronomy and the planetary sciences. " . . . and three weeks later I [Jastrow] traveled across the United States to the Laboratory at La Jolla, California, to visit a man who, I had been told, would be able to give me some advice. . . . Professor Urey seemed pleased to be sought out by a physicist working for the new space agency. He sat me down, handed me his book on the planets, opened to the chapter on the moon, and began to tell me of the unique importance which this arid and lifeless body has for anyone who wishes to understand the origin of the earth and the other planets. I was fascinated by his story, which had never been told to me before in fourteen years of study and research in physics..." (Robert Jastrow, Red Giants and White Dwarfs, New York: Harper & Row, 1967, 2.)

Nov. 12-13 In an address before the Royal Society in London, England, Dr. Homer E. Newell outlined United States Plans for space research and the role to be taken by the Space Science Board of the NAS: "The conclusions and thinking of the Space Science Board will be available to NASA and should be of invaluable

Nov. 12-13 cont. assistance in planning the total program and in deciding what proposals to support." (H.E. Newell, "The U.S. Program in Space Research," October 27, 1958, JPLHF 2-1916.)

Nov. 12-15 The second and third meetings were held between NASA and Army representatives concerning details for the proposed transfer of JPL and ABMA to NASA. It became apparent during these discussions that the Army would acquiesce in the transfer of JPL if NASA would accede to the Army's desire to retain ABMA. (Ira H. Abbot and Wesley L. Hjornevik, "Memorandum for Record," Subject: "Second meeting with Army representatives to discuss NASA proposal for transfer of JPL and ABMA," and , third meeting, dated November 12 and November 15, 1958, respectively, JPLHF 2-612, see also "Army Plan for Implementing NASA Proposal for Transfer of JPL from Army to NASA," November 14, 1958, JPLHF 2-613.)

Nov. 14 General Medaris directed a letter to Dr. Glennan agreeing to the use of Army facilities for the JPL Space Flight Program Study. (Letter, J. B. Medaris, U.S. Army, to T. K. Glennan, NASA, November 14, 1958, JPLHF 2-619.)

Nov. 14-15 The first meeting of COSPAR was convened; in accordance with ICSU instructions, COSPAR assumed responsibility for the CETEX studies concerning biological and chemical contamination of celestial bodies. COSPAR requested that the U. S. and USSR consider methods of avoiding contamination. The U. S. delegate to COSPAR subsequently communicated this request to the Space Science Board for action. (A Review of Space Research, op. cit., 10-13.)

Nov. 18 NASA agreed to the JPL space flight study program in accordance with the JPL proposal of November 7. The study was to be completed by February 15, 1959; a cost type contract was authorized in the amount of $1.3 million, designated NASw-6. (TWX, Ralph Cushman, NASA, to G. W. Green, Caltech, November 18, 1958, JPLHF.) The Laboratory thereupon formed a "NASA Program Study Committee" to formulate a five-year development program for deep space exploration. Although the committee was composed of only seven people, each formed working groups of specialists from other areas in the Laboratory with the result that the best talents of the Laboratory were engaged in defining a proposed deep space flight program. (The study report, No. 30-1, was released in April 1959.) (JPL, Space Programs Summary No. 1, op. cit., 116.)

Nov. 28 The Department of Defense notified NASA that conditions established for the transfer of JPL were acceptable. "The Department of Defense cannot agree, however, to the proposed partial transfer of ABMA to NASA. . . ." (Letter, Donald A Quarles to Dr. T. Keith Glennan, November 28, 1958, JPLHF.) During the next few days a "Cooperative Agreement on the Jet Propulsion Laboratory between the National Aeronautics and Space Administration and the Department of the Army" was drawn together with an Executive Order directing the transfer.

"AFMTC officially announced the establishment at AMR of the Directorate of NASA Tests, with Melvin N. Gough as Director. For the first several months following his assignment by NASA to perform various liaison functions at AMR, Mr. Gough worked with only a skeleton staff and without specific charter of responsibilities." The first formal statement of functions and authority for the Gough organization came in the form of a memorandum from the NASA Administrator on May 1, 1959. NASA AMROO reported directly to the Office of Space Flight Development. (F.A. Jarrett and R.A. Lindemann, Historical Origins of NASA's Launch Operations Center to July 1, 1962, NASA, KSC HM-1, Comment ed., October 1964, JPLHF 5-225, 54.)

A GD/A Atlas ICBM first flew its entire designed range--6300 miles--down the Atlantic Missile Range. Three weeks later on December 18, an Atlas sustainer stage was placed in orbit as a communications relay satellite called "Project Score." "Roy Johnson [Director] of ARPA claimed he was 'sleeping more comfortably each night' after that." (Loyd S. Swenson, James M. Grimwood, and Charles C. Alexander, This New Ocean: A History of Project Mercury, Washington, D.C.: GPO, 1966, 126.)

During November NASA agreed to proceed with the STL-proposed Atlas-Able lunar probe project in conjunction with the USAF Air Research and Development Command. The project was originally proposed to ARPA in June 1958. (Interview, E.M. Emme with George Mueller, loc. cit.)

Construction of the Goldstone tracking station, antenna TRAC(E) equipment, and communications system between JPL, Goldstone, AMR and the Mayaguez, Puerto Rico station, was completed preparatory to the launch of the first Juno II lunar probe. In addition, a JPL site selection team completed a survey and determined upon the location for the second station in the WTN at Woomera, Australia. (JPL, Space Programs Summary No. 1, op. cit., 31, 74.)

During November cont.	Dr. Homer E. Newell proposed creation of a Space Sciences Planning Group in OSFD to assist in defining scientific payload and support requirements. NASA, Responsibilities and Steps in the Establishment of a Space Sciences Project or Task, Table III-1, by Homer E. Newell, Nov.-Dec. 1958, JPLHF 2-1921.)
Dec. 3	President Eisenhower issued Executive Order No. 10793 which transferred the functions and facilities of the Jet Propulsion Laboratory California Institute of Technology, from the Department of the Army to NASA. The order transferred to NASA all of JPL's non-military functions and related Government property, as well as appropriations of $4,078,250. JPL was authorized to continue development work on the Sergeant Missile system for the Department of the Army through 1959. (NASA, First Semiannual Report, op. cit., 36.) The Department of the Army and NASA released a Cooperative Agreement on the Jet Propulsion Laboratory Between the National Aeronautics and Space Administration and the Department of the Army. This agreement was the result of the November negotiations between these parties, and set forth responsibilities of each organization with respect to JPL; January 1, 1959, was established as the date NASA would assume technical direction of the Laboratory. Dr. Lee DuBridge, President of CIT, and Dr. William Pickering, Director of JPL, issued a joint statement praising the past association with the Department of the Army and the new association with NASA. They observed that "much of the success of JPL has been due to the excellent relationship which has existed between the California Institute of Technology and Army Ordnance. The Laboratory has been able to develop a program which has consisted of both supporting research and vehicle development. . . . With this background, JPL is uniquely well qualified to satisfy the requirements of the new space agency." (Caltech News Release, n.d., JPLHF 3-191.)
Dec. 6	The Army (ABMA-JPL), acting as the agent for NASA, launched the lunar probe Juno II-A, Pioneer III. The 12.95-pound conical JPL payload contained several experiments as well as test components for the Pioneer IV payload, including two radiation counters, two temperature sensors, a shutter-trigger mechanism designed to be tripped by the reflective light of the moon, and an experimental despin device consisting of two weights attached to wires that were wrapped around the payload. Flight

Dec. 6 cont. objectives were: (1) to determine the actual flight trajectory by tracking the probe, (2) to measure the intensity of cosmic radiation between the earth and the moon, and (3) to test the inflight behavior of payload components to be used in future probes. (Figure 8.)

Pioneer III failed to achieve escape velocity due to premature cutoff of the booster stage coupled with angular dispersion in the high-speed upper stages. Nevertheless, the payload rose to a height of 63,500 miles and was successfully tracked by the Goldstone station. Moreover, the despin mechanism functioned properly, and the radiation counters returned high quality data which established the existence of two shells of radiation about the earth: an inner belt with a peak intensity at about 2,000 miles altitude, and an outer belt with its peak approximately 10,000 miles from earth. (JPL Technical Release No. 34-11, Pioneer III and IV Space Probes, January 29, 1960, 11; see also NASA First Semiannual Report, op. cit., 15-16.)

Dec. 8 Mr. John Corson of McKinsey & Company contacted Dr. T.K. Glennan, NASA Administrator, and proposed expansion of the McKinsey study of NASA organization to include the Jet Propulsion Laboratory. He noted that "the most immediate and probably the most time-consuming problem is that of developing the basic relationships that should obtain between JPL and major elements of NASA headquarters, particularly SFD and Business Administration. Operation of a large laboratory. under contract with a private institution, presents problems unprecedented by the experience of NACA with the present three Research Centers. (Memo for Discussion, from John J. Corson, McKinsey & Co., Inc., to Dr. T. K. Glennan, Administrator, NASA, Subject: "Next Steps in Organization of the National Aeronautics and Space Administration," December 8, 1958, JPLHF 3-193.)

Dec. 10 Based on prior Juno IV development efforts, JPL submitted a proposal to NASA for development of a 6000-pound-thrust storable propulsion system for use in an upper stage vehicle. (Letter from V.C. Larsen, Jr., JPL, to Albert Siepert, Director of Business Administration, NASA, December 10, 1958, JPLHF 2-816.)

Dec. 17 An interagency planning meeting was held among representatives of the DOD and NASA to formulate a National Launch Vehicle Program. The new ICBM launch vehicle combination, later known as Vega, was discussed as one of a family of vehicles NASA would like to see developed. The single-burn Agena-A upper

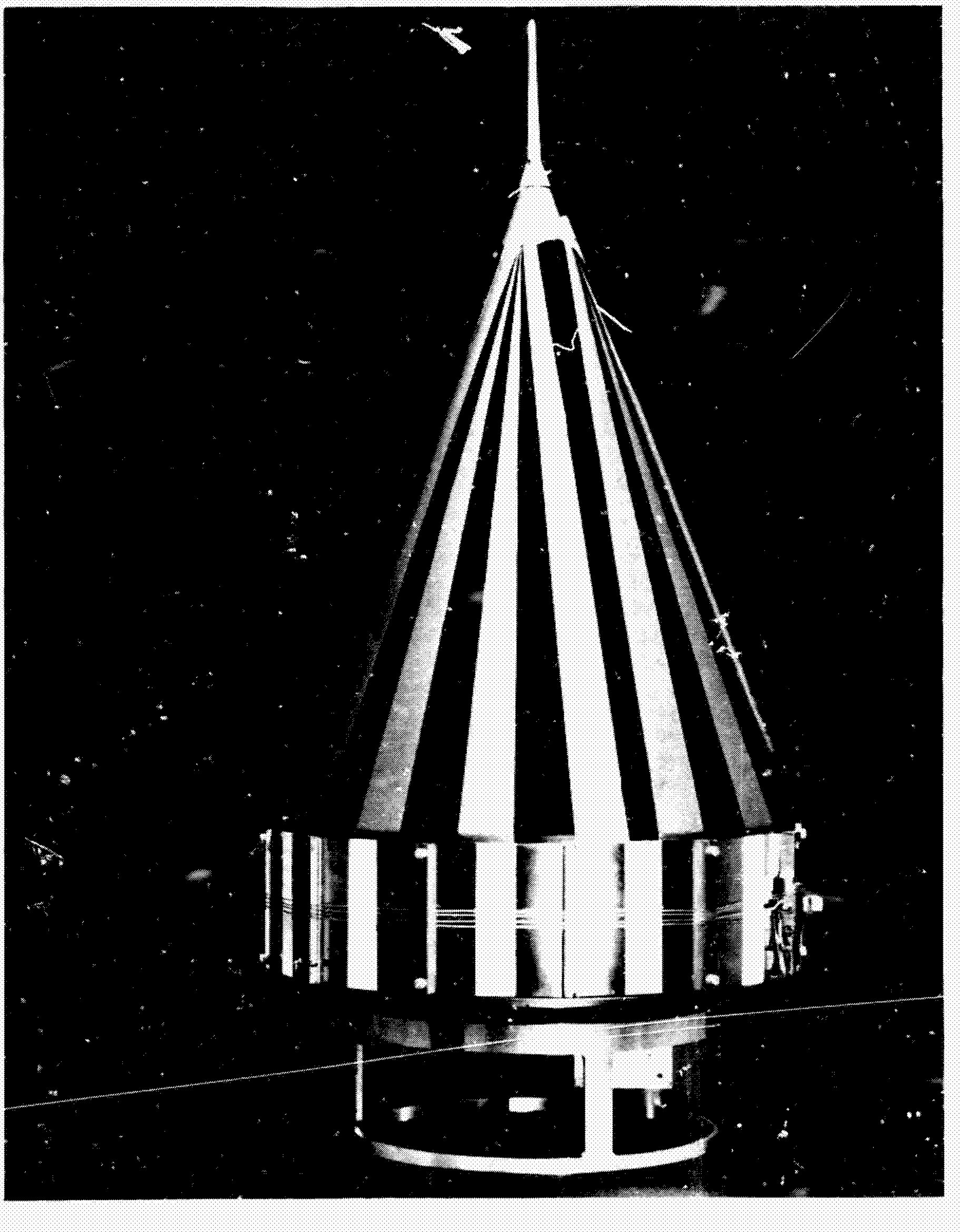

Figure 8: Pioneer III lunar probe.

Dec. 17 cont. stage vehicle, under development by the Air Force and ARPA, was also presented by the military representatives. The Agena-A possessed only about one-half the load-carrying ability of Vega; nevertheless, military representatives indicated that they had no interest in Atlas-Vega for Air Force missions. No mention was made of any ARPA plans for an uprated dual-burn Agena-B which was roughly equivalent to Vega.* (Evert Clark, "Vega Study Shows Early NASA Problems," Aviation Week, June 27, 1960, 62, JPLHF 2-707; and, Paul Means, "Vega-Agena-B Mix-up Cost Millions," Missiles and Rockets, June 20, 1960, 19-20, JPLHF 2-754; also, see remarks by T.K. Glennan, NASA-Industry Plans Conference, July 28-29, 1960, 2, JPLHF 2-859; and, NASA, Report to the Committee on Science and Astronautics, House of Representatives, Review of the Canceled Atlas-Vega Launch Vehicle Development, December 1958 - December 1959, by the Comptroller General of the United States, April 1960, 7-8, JPLHF 2-1127.)

Dec. 18 NASA Order No. HS-41 was issued to JPL providing authority and funds for continuing work on NASA programs. Upon transfer to NASA jurisdiction, JPL research and engineering development was concentrated in the fields of liquid and solid propellants; guidance and control systems; communications; aerodynamics; materials and structures; chemistry; physics; heat transfer and cooling; fluid mechanics; instrument development and instrumentation; combustion; and vehicle development and testing. In the communications area, JPL was assigned responsibility for designing, developing, engineering, installing and operating the Deep Space Net, including provision of the supporting research and development necessary to maintain the Net at the state-of-the-art in space communications.

Dec. 19-20 A meeting was held under the auspices of the NAS-SSB in Cambridge, Massachusetts, to consider problems connected with the detection of extraterrestrial life and the prevention of contamination of celestial bodies during deep space exploration. Present at this seminar were representatives of the biological, astronomical, physical and engineering sciences; this group, subsequently known as EASTEX, circulated its proceedings in the scientific community

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*Present at the meeting were Brig. Gen. Homer A. Boushey, USAF; Maj. Gen. W.W. Dick, Dept. of the Army; Dr. T. Keith Glennan, Dr. Abe Silverstein, and Mr. Milton Rosen, NASA; Dr. Wernher von Braun, Mr. Herman Koelle, and Dr. Ernst Stuhlinger, AEMA; Mr. A.F. Donovan, Space Technology Laboratories; and Mr. W.H. Lawrence and Major R.L. Dennen, AFBMD.

Dec. 19-20 cont. as a basis for further deliberation by other interested groups. (A preliminary conference on the same subject had already been held at MIT on December 4.) (Draft, "Discussions at the Meeting on the Problem of Detection of Extra-terrestrial Life, Held at M.I.T. December 19 and 20, 1958;" "Tentative Agenda," JPLHF 2-1067b and 2-1067c; also, A Review of Space Research, loc. cit.)

During December Drs. Harold Urey and Robert Jastrow (see Nov. 10, 1958) visited the office of Homer Newell at NASA Headquarters in Washington, D.C. They discussed the significance of the moon to any understanding of the origins of the solar system, pointed out that NASA did not have a firm program for lunar exploration, and convinced Dr. Newell that such a program should be undertaken. According to Dr. Newell: "The Ranger Program was in effect born on [that] day. . ." Although somewhat overstated, perhaps, what was born that day was a determination to have a lunar flight program. Detailed planning for these missions did not take place until the following summer and fall. (H. Newell, Memorandum for the Files, "Telephone Conference Report with Robert Cowen, Christian Science Monitor," January 6, 1965, JPLHF 2-730.)

JPL design of a new generation spacecraft for deep space missions, first conceived for flight on a Juno IV (see June 1958), was committed to employ the sun as the point of reference for the main attitude control axis. (This choice allowed the solar panels to be fixed in one position; also, it was not known whether the earth could be "seen" by sensors onboard the spacecraft at planetary distances.) The JPL Design Review Board concurred in this decision. These early studies of missions and spacecraft design indicated that useful lunar and planetary experiments were marginally feasible using weights afforded by IRBM (50-ton-class) boosters such as Thor-Able and Juno IV. Consequently, by this date, JPL opinion on this question coincided with that held by NASA, and favored the use of ICBM (100-ton-class) boosters for future NASA deep-space missions, even though the reliability risk was higher with these more recently developed larger rockets. (JPL, RA-5 Failure Investigating Committee Report, Testimony of J.D. Burke, loc. cit.; also, Ranger Project: Annual Report for 1961, op. cit., 2.)

Dr. Hugh L. Dryden, NASA Deputy Administrator, completed delineation of the roles for NASA Field Centers. A sharp distinction was made between the Research Centers (Ames, Langley, Lewis) and the Flight Centers (Goddard [not yet constructed] and JPL). A research and development role was assigned to the former centers, and flight projects were assigned to the latter. Goddard assumed responsibility for earth orbit missions, while JPL acquired the deep space missions. (W.R. Corliss, draft of Chapter IV, "Space Science and Applications," August 23, 1968, 10-11, JPLHF 2-734.)

During December cont.

Dr. W.H. Pickering submitted a proposed "Agreement on Principles for Operating the Jet Propulsion Laboratory by the California Institute of Technology," to Dr. T.K. Glennan, NASA Administrator. Discussion of the agreement was deferred pending further study of this subject by NASA Headquarters. (Letter, T.K. Glennan to W.H. Pickering, December 23, 1958, plus enclosure, JPLHF 2-817a.)

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Jan. 1 The physical plant of JPL was transferred from the U.S. Army to NASA ownership. JPL work under the Army Ordnance contract was phased out during 1959-1960. (U.S. Congress, House of Representatives, Investigation of Project Ranger: Hearings before the Subcommittee on NASA Oversight of the Committee on Science and Astronautics, 88th Congress, 2nd Session, Washington, D.C., 1964, 212, testimony of James Webb.)

Jan. 2 The U.S.S.R. launched Luna I (later redesignated "Mechta") on a lunar trajectory. The spacecraft carried metal pennants emblazoned with the Soviet coat of arms, and instruments for measuring the moon's magnetic field and radioactivity, and particles in the interplanetary medium. The craft missed the moon by 3,728 miles and went into orbit around the sun; nevertheless, it became the first vehicle to escape the earth's gravitational attraction. The event increased the debate over Soviet space capabilities and the need for a U.S. deep space program, as well as producing strong counter-arguments that Luna I was actually a hoax (see April 11, 1959). (U.S. Congress, House of Representatives, The First Soviet Moon Rocket, Report of the Committee on Science and Astronautics, 86th Congress, 1st Session, H.R. No. 1086, Washington, D.C., August 31, 1959, 6; also, Wilson, IGY, The Year of the New Moons, op. cit., 72.)

The House Select Committee on Astronautics and Space Exploration, on the last day of its existence, adopted a resolution urging all possible speed in the launching of another U.S. space probe. (The First Soviet Moon Rocket, loc. cit.)

Jan. 3 President Eisenhower issued a statement congratulating the Soviet scientists and engineers responsible for Luna I. (Ibid.)

Jan. 5 NASA authorized the General Electric Company to commence charging costs for development of the Vega second-stage engine preceding issuance of a contract. (Evert Clark, "Vega Study Shows Early NASA Problems," op. cit., 62.)

Jan. 10 NASA and the DOD reached agreement on a "National Program to Meet Satellite and Space Vehicle Tracking and Surveillance Requirements for FY 1959 and FY 1960." The agreement provided for the division of responsibilities between NASA and the DOD for all areas of tracking and data acquisition, for the orderly allocation and development of new tracking stations, and joint tracking support, wherever necessary, for the space programs of each agency. The

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Jan. 10 cont. agreement was signed by T. Keith Glennan, NASA, and Mr. Neil McElroy, Secretary of Defense. In addition, four additional tracking and data acquisition stations were approved for deep space communications and broad-band data readout, to be located overseas. Two stations were to be operated by NASA and two by ARPA, with provision for the exchange of common data. (NASA, First Semiannual Report, op. cit., 23.)

Jan. 12 A new Reliability Section was established at JPL. (IOM, W.H. Pickering to All Supervisors, Subject: Formation of Reliability Section, January 12, 1959, JPLHF 3-218.)

The Fourth Lunar and Planetary Exploration Colloquium was held at Griffith Observatory in Los Angeles. Dr. Dinsmore Alter of the Observatory staff presented a paper on "The Alphonsus Story" which reviewed Soviet and American observations of outgassing in that lunar crater (see November 3, 1958). (Proceedings, Vol. I, No. 4, op. cit., 19ff.)

Jan. 15 Joint proposals for the Atlas-Vega second stage were submitted to NASA by Convair (spaceframe structure) and G.E. (for modification of the X405 rocket engine that would be used in the Convair second-stage). (Paul Means, "Vega-Agena-B Mix-up Cost Millions," op. cit., 20; also, Review of the Canceled Atlas-Vega, op. cit., 14-15.)

Jan. 16 The Air Force issued Contract Change No. 8 to Lockheed to initiate "'a study and test program to investigate the parameters and methods required to provide a restart capability'" for the second-stage Hustler-Agena booster-satellite. The Agena A, then under development, did not possess this feature, and provision of increased tank capability and engine restart capability would provide a vehicle roughly equivalent to the proposed NASA Atlas-Vega launch vehicle system (see December 17, 1958). Paul Means, "Vega-Agena-B Mix-up Cost Millions," loc. cit.; also, Review of the Canceled Atlas-Vega, op. cit., 34.)

Jan. 19 NASA issued Request HS-20 to ABMA directing that that organization support JPL in its Space Flight Program Study (indicated earlier in November 1958). (AOMC, Satellite & Space Program Progress Report for NASA, op. cit., 9.)

Jan. 20 Dr. Lloyd V. Berkner, addressing the American Geophysical Society, suggested the probable pattern deep space exploration would follow: (1) lunar and interplanetary probes to the moon, Mars, Venus, and perhaps close to the sun, to transmit back scientific

Jan. 20 cont. information; (2) hard landings of experiments on the moon and planets; and (3) soft landings of experiments, with possible automatic return of such vehicles to earth. (The Next Ten Years in Space 1959-1969, op. cit., supra, at November 18, 1957, 26.)

Dr. Homer E. Newell, NASA, Assistant Director for Space Sciences, Office of Space Flight Development, determined that the following three science working groups would be formed in order to prepare payload packages for satellites and space probes: (a) an astronomy working group on radiation observation, (b) a working group to study the moon, and (c) a working group to study magnetic fields and plasmas in space. (Dr. Homer E. Newell, Jr., "Miscellaneous Notes," January 20, 1959, 2-3, JPLHF 2-1760.)

Jan. 27 NASA released A National Space Vehicle Program, prepared by the Launch Vehicle Group in the Office of Propulsion, and written by Milton Rosen and Abraham Hyatt. The report was directed to the President and asserted that "this National Space Vehicle Program was formulated after discussion and consultation with agencies of the Department of Defense, principally the Advanced Projects Research Agency (sic), the Department of the Air Force, and the Department of the Army. Existing and planned projects of the Department of Defense in this area, including those intended for military missions, have been taken into account with the purpose of avoiding any unnecessary duplication of effort." (p. 1.) The first general purpose vehicle of the National series was identified as The Vega; the document referred to the Air Force Atlas-Hustler (Agena A) noting that it would have only half the load carrying capability of Vega (p. 3). No mention was made of an uprated Atlas-Hustler (Agena B--see January 16, 1959). It was in the preparation of this report that the Launch Vehicle Group generated the concept of the Atlas-Vega launch vehicle. (Memo, M. Rosen to E.M. Emme, Comment on Ranger Chronology Preliminary Draft, December 27, 1968.)

Firm specifications for an Atlas-Able Lunar probe (see During November 1958) were submitted to NASA by STL and ARDC. (Emme, Interview with George Mueller, loc. cit.)

JPL requested that NASA establish a policy to handle release of the scientific data resulting from experiments carried out on board space vehicles. Should data be distributed as soon as possible, or should tradition be followed and the data withheld until the scientist in charge has had an opportunity to thoroughly analyze the data and publish his findings? (Letter, W.H. Pickering to T.K. Glennan, January 27, 1959, JPLHF 2-818.)

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Jan. 30 NASA authorized JPL $2 million for continued development of the 6000-pound-thrust storable-propellant engine to be employed in the Vega third stage (see December 10, 1958). Review of the Canceled Atlas-Vega, op. cit., 16.)

During January With the commitment to "Vega Program" formalized at NASA, JPL and NASA agreed to utilize this vehicle for the next available planetary opportunities, viz., Mars in October of 1960, and Venus in January of 1961. This decision was reinforced by the prior JPL design efforts already expended on spacecraft for interplanetary flights (planned for the Juno IV in 1958). (JPL, "RA-5 Failure Investigating Committee Reports," testimony of J.D. Burke, loc. cit.)

The House Select Committee on Astronautics and Space Exploration issued its report, The Next Ten Years in Space 1959-1969. In a statement prepared for this document, Dr. W. H. Pickering, Director of JPL, observed that "inadequacy of planning, particularly that of a long-range nature, may well prove to be our most serious handicap . . . in the next ten years of the Space Age. Impractically conceived missions having little chance of success because of premature scheduling which is based on the use of unproven components in the very early stages of development can have a most demoralizing effect on those involved in a program." (133) The introduction to this document, prepared by the committee staff, summarized caveats gleaned from testimony noting: "It is an interesting commentary that most of the scientists questioned by the committee suspected that the biggest space problem of the future might lie less with technology than with the attitude of the people. . . ." (17)

Feb. 1 Modifications and additions to the TRAC(E) communications and data handling net (derived from experience gained in the Pioneer III flight) were completed, and tests of the revised system began preparatory to the launch of Pioneer IV. (JPL, Space Programs Summary No. 2, for the period January 15 through March 15, 1959, Pasadena, April 1, 1959, 38.)

Feb. 3 In response to suggestions from NASA that the United States should move to launch some space "spectaculars," JPL proposed that NASA consider utilizing several of the Atlas-Able flights to attempt hard landings or partially slowed impacts on the moon. (Letter, W.H. Pickering to A. Silverstein, February 3, 1959, JPLHF 2-827.) (See January 2, 1959.)

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Feb. 3 cont. NASA issued a supplemental agreement to its contract with McKinsey and Co. (NASw-1, dated October 10, 1958) for management studies. The agreement increased the scope of the contract to include (1) NASA relationships with JPL, and (2) the role of a NASA Western Operations Office. (Letter Supplemental Agreement from NASA to McKinsey and Company, Inc., February 3, 1959, adding Amendment No. 1 to NASA Contract NASw-1, JPLHF 3-195.)

Feb. 5 A NASA ad hoc Working Group on Lunar Explorations, chaired by Dr. Robert Jastrow, met for the first time at JPL. In attendance were R. Jastrow, "H.C. Urey, Jim Arnold, Frank Press, Harrison Brown, et. al." Those in attendance considered what experiments could be conducted from capsules after impact or hard landings on the lunar surface. Action items recommended to NASA were: (1) develop suitable vehicles for carrying out a lunar hard landing mission, and (2) support development of lunar seismograph and communications for use in a hard-landing capsule. This working group continued to operate throughout 1959, contributing concepts for the scientific exploration of the moon, and acting as a point of contact between NASA and the U.S. scientific community. (N.W. Cunningham, Lunar Science Chronology, "Working Group on Lunar Explorations," January 15, 1965, 1; also Letter, W.H. Pickering to A. Silverstein, December 17, 1959, JPLHF 2-803.) (See During December 1958, and January 20, 1959.)

Feb. 6-7 Members of NASA and JPL met at NASA Headquarters to establish Vega management responsibilities. A decision was reached that JPL should actively supervise and integrate the technical side for NASA, and not simply monitor the efforts of GE and Convair. (C.I. Cummings, "Summary of Conference, NASA Headquarters, February 6 and 7, 1959," February 9, 1959, JPLHF 2-828.)

The name Vega was assigned to the NASA three-stage space booster consisting of an Atlas first stage, G.E.-Convair second stage, and JPL third stage. (IOM to All Supervisors from J.E. Froehlich, Subject: Name for Space Vehicle, February 11, 1959, JPLHF 3-219.)

Feb. 10 Mr. Milton W. Rosen at NASA proposed a management plan for Vega which consisted of: (1) establishment of an operating relationship between NASA and JPL, (2) direct contracting between NASA and Convair and between NASA and G.E. Co. for Vega vehicles and engines, (3) assumption of responsibility by JPL for system integration including vehicle, payload, and tracking, and (4) assignment of a project manager by NASA to represent Headquarters in relation with JPL and other contractors on Vega. (NASA, Memo from M.W. Rosen to A. Hyatt, February 10, 1959, JPLHF 2-1494.)

Feb. 11 Maj. General Bernard A. Schriever, Commander of BMD, addressed a letter to USAF Chief of Staff General Thomas D. White recommending construction of another Atlas launch stand at Cape Canaveral, Florida, to accommodate planned USAF, ARPA, and NASA flights. This letter apparently did not request stand utilization for the NASA Atlas-Vega. (Clark, op. cit., 64.)

Discussions continued at NASA Headquarters as to whether JPL should actively supervise primary work on the Vega program or act solely as a technical monitor for contracts placed at Convair and elsewhere. (NASA, Memo for the Administrator, by A.F. Siepert, February 11, 1959, JPLHF 2-1783.)

In response to the request of January 27, NASA Headquarters informed JPL that "we favor the earliest possible publication of reduced [scientific] data. There will be of course some inadvertent errors which will have to be corrected but the advantages of early publication clearly outweigh the disadvantages. . . ." (NASA, letter from H.L. Dryden to W.H. Pickering, February 11, 1959, JPLHF 2-1784.)

Feb. 14 The second meeting of the NASA Working Group on Lunar Explorations was held in Washington, D.C. Proposals were requested for radioactivity (gamma ray), seismometer, magnetometer, and X-ray fluorescence experiments for use in lunar spacecraft. The Working Group recommended immediate action to solicit these proposals. (N.W. Cunningham, Lunar Science Chronology, loc. cit.)

Feb. 19 Dr. Homer E. Newell, Assistant Director of Space Sciences in OSFD, established tentative science objectives for Vega lunar flights:

> For lunar probe missions, both lunar satellites and soft-landing probes are required. A lunar satellite with a perilune (distance of closest approach) of 50 to 100 miles would investigate cislunar radiation intensities and magnetic fields, would scan the lunar surface in the visible and infra-red, and would conduct spectroscopic measurements of the moon's residual atmosphere. Objectives of the lunar soft landing include seismological exploration, ecological studies, and measurements of surface composition and structure, atmospheric and ionic composition and structure, and electric and magnetic fields.

Later in the year, with a change in emphasis to lunar exploration in NASA's unmanned deep space program, the Vega spacecraft was in fact designed as a lunar orbiter. (NASA, memo from H.E. Newell to M.W. Rosen, February 20, 1959, JPLHF 1785a; also, enclosure to above entitled, "Notes, Tentative Objectives for Project Vega," February 19, 1959, JPLHF 2-1785b.)

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Feb. 21 Responding to the SSB EASTEX seminar and proceedings (see December 19-20, 1958), Dr. Joshua Lederberg (also acting under SSB sponsorship) formed a comparable group on the West Coast (WESTEX) which held its first meeting this date. (Subsequently, meetings of WESTEX took place in March, May and September 1959.) WESTEX selected as the most pressing problem the establishment of biological requirements for space probe sterilization. (A Review of Space Research, op. cit., 10-13; also, letter from W.H. Pickering to H.E. Newell, February 25, 1959, JPLHF 2-850.)

Feb. 23 The third meeting of the NASA Working Group on Lunar explorations convened. "In attendance were Jim Arnold, Marvin Van Dilla, Charles Sonett, et. al." The Group recommended that NASA place a gamma-ray spectrometer on lunar spacecraft. (N.W. Cunningham, Lunar Science Chronology, loc. cit.)

Representatives from JPL and Convair met to decide guidance responsibilities of the Vega contract. It was decided that JPL would be responsible for developing, procuring and installing third stage guidance and would be responsible for system integration of the guidance in the first and second stages. (NASA, memo from R. Snodgrass to R. Rosen, February 26, 1959, JPLHF 2-1495.)

Feb. 24 Space Handbook: Astronautics and its Applications, prepared as a Staff Report for the House Select Committee on Astronautics and Space Exploration, was released for distribution. The document was written by a team from the RAND Corporation and contains one of the most thorough surveys of astronautics and its potential applications available at that time. Scientific objectives suggested for a lunar program included: low and high resolution photographs of the moon's surface, the accurate measurement of the moon's mass, its magnetic field, the composition and properties of its atmosphere and crust, the surface temperature and radioactivity, and seismic properties of the interior. (pp. 215-216)

Feb. 26 JPL submitted proposals to NASA for scientific packages to be carried on lunar missions outlined at the February 14, 1959 meeting in Washington, D.C. on lunar and planetary surfaces. (Letter, V.C. Larsen, Jr., JPL, to Dr. Robert Jastrow, February 26, 1959, JPLHF 2-829.)

Feb. 28 The first Air Force-Lockheed Agena A was launched into earth orbit from the Vandenburg launch complex in California. The Thor-boosted vehicle was designated Discoverer I; subsequent Atlas-Agena A flights were first launched from Cape Canaveral in Florida.

1959

During February	Preliminary Vega spacecraft design was initiated. (N.W. Cunningham, Ranger Program Chronology, April 22, 1964, JPLHF 2-650.) The design concepts were oriented toward planetary flights rather than lunar flights.
	A joint technical team of ARPA-NASA specialists visited Australia with the dual purpose of selecting a suitable site for the installation of an 85 foot "dish" antenna, similar to one in operation at Goldstone, California, and of reaching tentative technical agreement upon the operation of such equipment by Australian technical teams from Weapons Research Establishment. In all, seven potential "dish" sites were inspected, sketched, and photographed on the Woomera Test Range with an area near Island Lagoon considered the most adequate. (Edward M. Walters, Comment Edition, The Origins of the Australian Cooperation in Space, NASA HHN-82, May 1969, 17, JPLHF 5-195.)
Mar. 1	NASA entered into Contract NASw-45 with Convair (Astronautics) Division of General Dynamics Corp., for (1) the design, development, manufacture and test of eight Vega second stage vehicles, (2) design of modifications to the Atlas to make it compatible with the Vega second stage, and (3) launching of eight complete Atlas-Vega vehicles. NASw-45, however, was not executed until May 21, 1959. (Review of the Canceled Atlas-Vega, op. cit., 12-15.)
Mar. 3	Juno II-Pioneer IV lunar probe was launched toward the moon. The small conical probe, twenty inches long and nine inches in diameter at the base, weighed 13.4 pounds and carried two Geiger-Mueller tubes to measure radiation, and a photo-electric sensor to be triggered by reflected light from the moon. Injection velocity was less than planned, and the probe missed the moon by 37,000 miles; the light-sensor did not operate since it was designed to work at a maximum range of 20,000 miles. Pioneer IV went into orbit around the sun and was tracked to a distance of 406,000 miles. (NASA, First Semiannual Report to the Congress, op. cit., 17; and, JPL Technical Release No. 34-16, Pioneer III and IV Space Probes, Pasadena, January 29, 1960, 11, JPLHF 2-568.)
Mar. 9-10	CETEX II convened, examined the problem of space contamination, and reviewed and modified its original report (see May 12-13, 1958). CETEX reported to the ICSU that the contamination problem was an integral part of the duties assigned to COSPAR. (A Review of Space Research, op. cit., 10-12; report of CETEX II Proceedings appear in Nature, April 4, 1959, 925-928.)

Mar. 12 The NASA Space Science Division in OSFD issued plans for a United States Space Sciences Program. Fields involved were Atmospheres, Ionospheres, Energetic Particles, Electric and Magnetic Fields, Gravitational Fields, Astronomy, and Biosciences. (NASA, "The United States National Space Sciences Program," March 12, 1959, JPLHF 2-1925.)

Mar. 12-14 COSPAR convened and, in accordance with instructions from the ICSU, acknowledged the CETEX II report and assumed responsibility for the contamination problem from CETEX. The U.S. and the U.S.S.R. were asked to consider methods for avoiding extraterrestrial contamination. The U.S. delegate communicated this request to the NAS Space Science Board for action. (A Review of Space Research, op. cit., 10-13.) (See November 14-15, 1958.)

Mar. 17 Drs. J.R. Arnold, E.C. Anderson and M.A. Van Dilla submitted a proposal to NASA to obtain a gamma ray spectrum of the moon. (JPL, memo from A.E. Metzger to R.C. Hall, Comments on Ranger Chronology, January 8, 1970.)

The first test of a fuel cooled developmental model of the 6K engine was conducted at JPL (A. Briglio Jr., loc. cit.)

Mar. 18 NASA Contract NASw-30 was agreed upon with G.E. for modification of the Model X405 liquid-propellant Vanguard first stage rocket engine and for delivery of eleven of the restartable engines and spare parts for use as second stage engines in the Vega second stage vehicle. NASw-30, valued at approximately five million dollars, was executed on March 24, 1959 and provided for payment of costs "'incurred in the performance of this contract starting on January 5, 1959. . .'" (NASA, First Semiannual Report to the Congress, op. cit., 26; also, Review of the Canceled Atlas-Vega, loc. cit.)

Mar. 23 JPL notified NASA Headquarters that it would commence formal work on the Vega Program on March 30, and requested the necessary authorization and funds by that date. (TWX, W.H. Pickering to T.K. Glennan, March 23, 1959, JPLHF 2-830.)

Mar. 24 Amplifying on the TWX of the previous day, Dr. W.H. Pickering informed Dr. Glennan that failure to execute necessary contracts for the Vega Program would mean that the Mars 1960 flight would not be obtained, with resulting loss of prestige for all concerned; and second, the Vega schedule would slip close to planned Centaur flights and, therefore, "a powerful argument will be presented that Vega is unnecessary. . . ." (Letter, W.H. Pickering to T.K. Glennan, March 24, 1959, JPLHF 2-831.)

1959

Mar. 26 NASA made available to JPL $3 million in initial funding for development of the Atlas-Vega third stage spaceframe, guidance, and injection spacecraft (see January 30, 1959). (Review of the Canceled Atlas-Vega, op. cit., 16.)

The U.S.S.R. Academy of Sciences announced plans to explore the moon and nearest planets before the expiration of the current seven-year plan (1958-1965). (NASA, memo from Robert Jastrow to H.E. Newell, April 20, 1959, JPLHF 2-1927.)

During March McKinsey and Co., Inc. released its report NASA-JPL Relationships and Role of the Western Coordinating Office. The document recommended that JPL be given a fair measure of operative freedom, and that NASA and JPL mutually agree upon "what elements of its [NASA's] program can best be performed by JPL." (Sec.2(a), p. 1-3.)

Site selection was completed for the second 85-foot antenna (Echo station) at the Goldstone Tracking facility in the Mohave desert. (DSN Facility Activation Dates, undated, JPLHF 2-141.)

Apr. 4 NASA issued a planned launch schedule for eight Atlas-Vega flights. Flights were to be conducted at two-month intervals, beginning in August of 1960. (Review of Canceled Atlas-Vega, op. cit., 5.)

Apr. 7 NASA and ARPA presented their planned scheduling of flights from the Missile Test Ranges at a joint meeting between representatives of NASA, AFBMD, and STL. Some initial comparisons were made between the ARPA and NASA flight schedules, and it was agreed that a joint meeting of the Range people, ARDC, BMD, and NASA was needed at an early date to resolve differences. (JPL is indicated as the technical director of the Vega Program.) (NASA, Notes of Meeting with Representatives of BMD - STL, April 7, 1959, JPLHF 2-806.) (See February 11, 1959.)

With formal establishment of the Vega Project under technical direction of the Laboratory, Dr. W.H. Pickering assumed the position of Acting Project Director at JPL. Other positions

Apr. 7 cont. were established as follows:

Vehicles	C.W. Cole
Propulsion	J.D. McKenney
Guidance	W.E. Giberson
Flight Instrumentation	J.N. James
Field Operations	J.N. James
Science and Missions	A.R. Hibbs
Communications	E. Rechtin
Payload Structures and Propulsion	C.W. Cole
Payload Guidance	W.E. Giberson
Reports Administration	J. Keyser

Eight vehicles were scheduled for launch. The first four flights were to be primarily for engineering test purposes, the last four were to carry out scientific experiments. (JPL, Vega Management Document No. 6, April 7, 1959; and, IOM from W.H. Pickering to Distribution, Subject: Vega Program Objectives and Schedule, April 7, 1959, JPLHF 2-832.) (Figures 9 and 10.)

Apr. 8 A meeting was held in San Diego between representatives of Convair and JPL to establish Vega planning schedules. Following the conference, JPL notified NASA that launch stand availability at AMR appeared to be the critical pacing item; four alternatives were suggested:

(1) Build a new stand,
(2) complete complex 20,
(3) modify complex 14, or
(4) modify complex 12.

Since a new stand would require eighteen months for construction it would not be available for initial Vega launchings. Therefore, it was recommended that NASA obtain a firm commitment from BMD for the transfer of either stand 12 or 14 to NASA. "2. If this is not forthcoming, then complex 20 must be activated immediately. 3. If complex 20 cannot be made available, then Vega schedule slips about six months and, on present schedules, Vega will be very little ahead of Centaur." (See April 4, and April 7, 1959.) (Letter, W.H. Pickering to T.K. Glennan, April 9, 1959, JPLHF 2-826.)

Apr. 10 ARPA issued Amendment No. 4 to ARPA Order No. 17-59 (September 4, 1958) to the Commander ARDC. Task No. 3 of this amendment directed modification of "'the Bell-Hustler [Agena A] stage to obtain dual burning capability, simplify guidance and control system, structural simplification. . ., and increased propellant carrying capacity.'" Air Force and Lockheed studies at this time indicated a 60 percent increase in the Agena propellant tanks was most desirable. The modifications cited were the principal differences between the then existing Agena A stage and the yet-to-be developed Agena B. (Review of Canceled Atlas-Vega, op. cit., 36.)

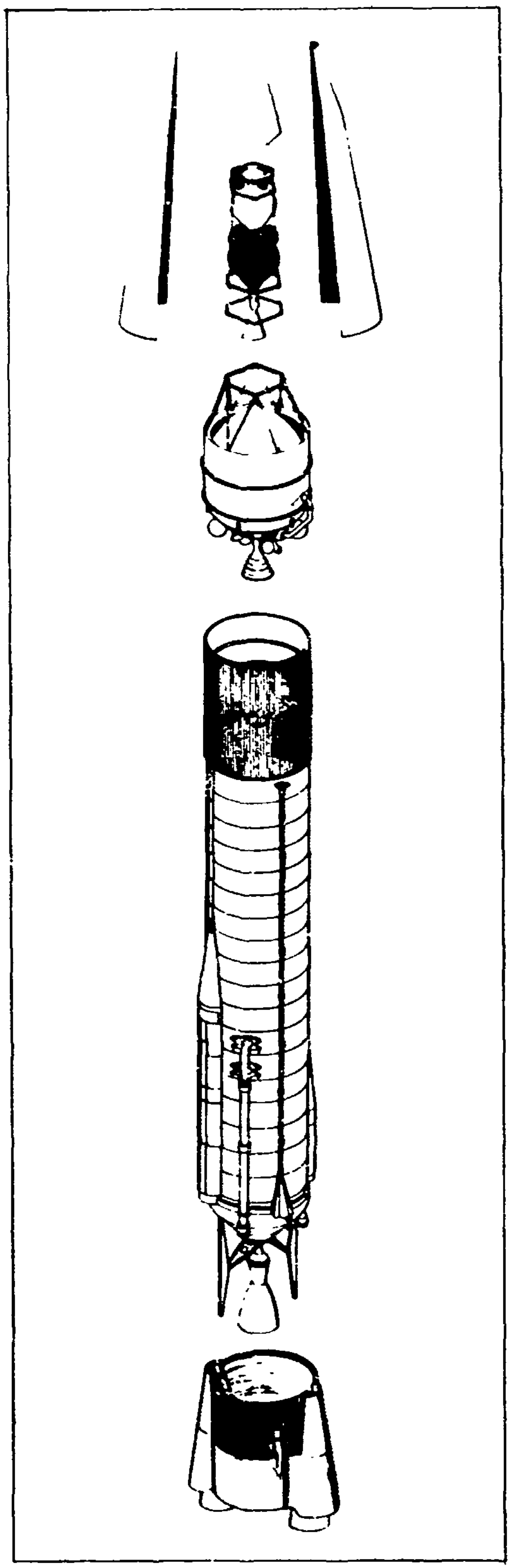

Figure 9: Vega launch vehicle.

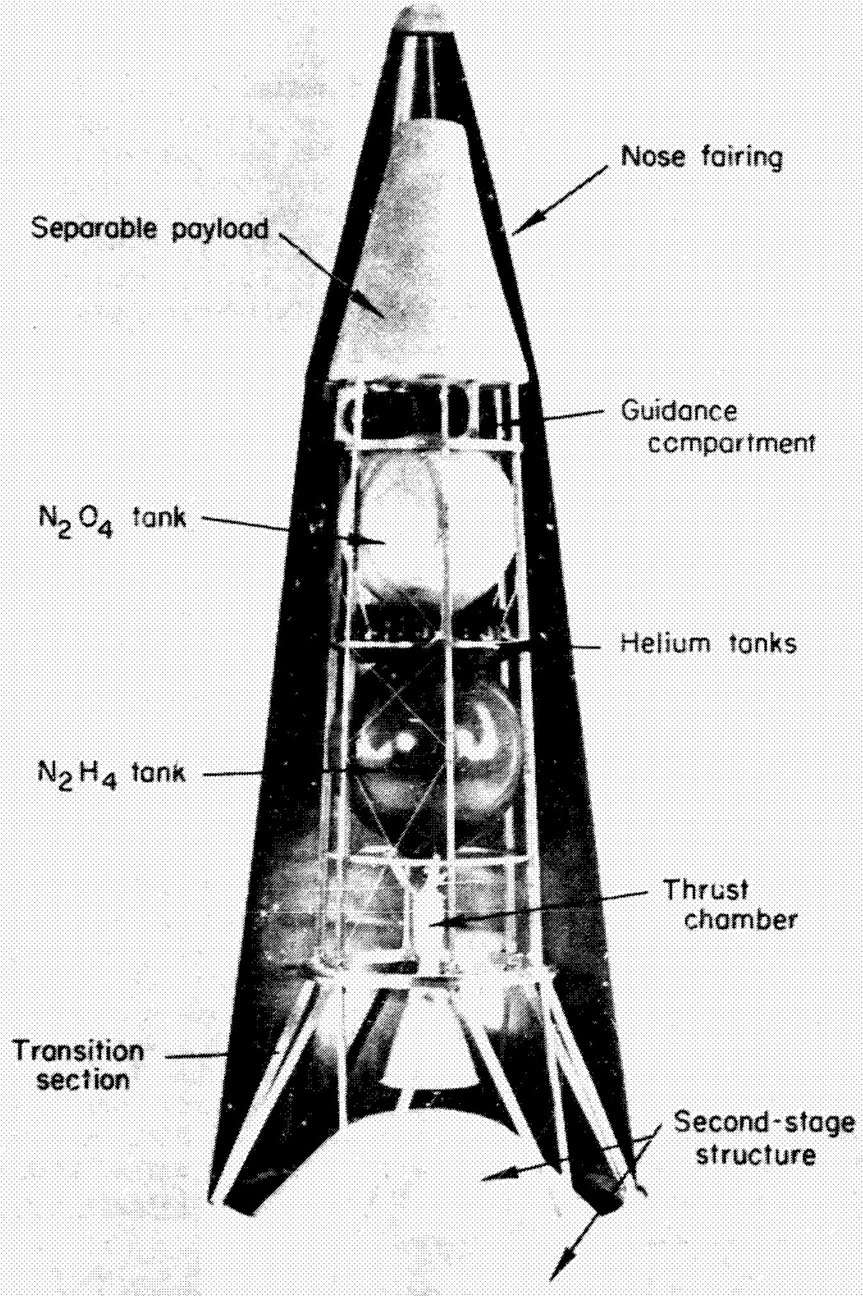

Figure 10: Vega third stage and payload.

Apr. 11 An article by science writer Lloyd Mallan entitled "The Big Red Lie" appeared in True Magazine and attracted national attention. Mallan contended that the USSR had not in fact launched a space probe in January, that Soviet announcements to the contrary were false, and that the world had swallowed a gigantic hoax. The material was widely circulated among various groups in the U. S. anxious to believe that the Russians were incapable of performing any sophisticated engineering or science.

Apr. 13 The Tiros meteorological satellite program was transferred from the DOD to NASA auspices. To ensure DOD "interest" in this program, a Joint Meteorological Satellite Committee was established. The space-borne television system utilized in Tiros satellites had its origin in contracts with RCA from the Army and ARPA during the period 1956-1959. (John H. Ashby, NASA, A Preliminary History of the Evolution of the Tiros Weather Satellite Program, August 1964, 24, 64.)

Apr. 14 Assignments for preliminary design of the Vega payload were made at JPL. Design report requirements were due by May 1, 1959. (IOM to Distribution from J.H. Keyser, Subject: Vega Program: Preliminary Design Phase Assignments and Schedule, April 14, 1959, JPLHF 2-1002.)

Apr. 15 A meeting was held between T. K. Glennan and H. Dryden of NASA and Secretary of Defense N. McElroy and his Deputy, D. Quarles, to discuss NASA-DOD relations. After discussion, Glennan and Dryden recommended that resolution of policy and planning problems could be best achieved through more frequent meetings of the top operating people of both agencies. McElroy countered with the suggestion that the Civilian-Military Liaison Committee (CMLC) could be made more effective, and indicated he would release its chairman, William Holaday, to serve full time on CMLC matters. "It was agreed that this course of action should be taken." (An Administrative History of NASA, op. cit., 102-103.)

Apr. 17 In discussions at NASA Headquarters, NASA Associate Administrator Richard E. Horner recommended that JPL should be assigned tasks associated with the development of spacecraft and payloads, and that booster vehicle development should be contracted with industry. (NASA, "Notes on Meeting on Vehicle Program Status," April 17, 1959, 2-3, JPLHF 2-1788.)

Apr. 20 Dr. Robert Jastrow recommended inclusion of a lunar orbiter in the NASA OSFD flight schedules: "Without this package the [lunar]

Apr. 20 cont. program has a relatively slow and uninspired beginning. . . . Criticism will be especially strong if it turns out that a slow-paced United States lunar program must be contrasted with early Soviet achievements in this field." (NASA, memo from R. Jastrow to H.E. Newell, loc. cit.) (See During December 1958)

Apr. 24 AFBMD, implementing Amendment 4 to ARPA Order No. 17-59, issued Contract Change Notice 23 to Lockheed authorizing funds for a development program to provide a restart capability for the Bell-Hustler engine utilized in the Agena, and for such other changes in the propulsion subsystem as were required to make it compatible with the restart capability. (Review of Canceled Atlas-Vega, op. cit., 36,37.)

Apr. 27 NASA issued Fiscal Year 1960 Estimates for Scientific Investigations in Space. Plans called for three lunar probes during the coming fiscal year. The report cautioned that "While the lunar probes to be launched will give us a better understanding of many of the basic physical and biological phenomena predominant in our solar system, not all of the questions puzzling to us can be answered by even the most sophisticated instrumentation conceivable. They will have to wait until man himself has reached the moon and can conduct detailed surveys on the spot." (NASA, "Scientific Investigations in Space, Fiscal Year 1960 Estimates," JPLHF 2-1188.)

Apr. 29 JPL released "Basic Policy and Principles Governing Operation of the Jet Propulsion Laboratory," which described the Laboratory's planned role in NASA and chief areas of emphasis in advanced research and development. (IOM from W.H. Pickering to Distribution, April 29, 1959, JPLHF 3-221a.)

Given the planned transfer of Centaur to NASA from the DOD, JPL recommended combining systems management responsibility for both Vega and Centaur at JPL. (Letter, W.H. Pickering to T.K. Glennan, April 29, 1959, JPLHF 2-833.)

Apr. 29-30 The first nationally sponsored conference devoted to the special problems of space physics convened in Washington, D. C. under the auspices of the National Academy of Sciences, NASA, and the American Physical Society. The second session was opened by Dr. Homer Newell, who reviewed for participants the imminence of serious lunar and planetary exploration and the opportunities for research in the national space program. (Robert Jastrow, ed., The Exploration of Space, New York: The MacMillan Co., 1960, 3.)

April 30 JPL completed its study of a flight program for deep space exploration, begun under NASA Contract NASw-6 in November 1958, and released a report Exploration of the Moon, Planets, and Interplanetary Space. Lunar and planetary exploration were integrated in an alternating flight series with some planetary missions dependent upon demonstration of necessary technology in lunar flights. Individual flight projects were not identified, but a series of specific missions was outlined with recommended scientific and engineering features.

The ambitious flight schedule proposed:

Flight No.	Goal	Date	Vehicle
1	Lunar Miss	August 1960	Vega
2	Mars Fly-by	October 1960	Vega
3	Venus Fly-by	January 1961	Vega
4	Lunar Rough Landing	June 1961	Vega
5	Lunar Orbiter	September 1961	Vega
6	Venus Orbiter	August 1962	Vega
7	Venus Entry	August 1962	Vega
8	Mars Orbiter	November 1962	Saturn 1
9	Mars Entry	November 1962	Vega
10	Lunar Orbit & Return	February 1963	Saturn 1
11	Lunar Soft Landing	June 1963	Saturn 1
12	Venus Soft Landing	March 1964	Saturn 1

The report noted that, in agreement with NASA, "The Laboratory program will consist of both the design, development, and operation of some of the rocket vehicles to be used in the space program and the design, development, and operation of some of the payloads which will carry the scientific measuring devices. In the area of payload development, it is the intention of the Laboratory to concentrate on those payloads designed for lunar and planetary investigations, as contrasted to artificial earth satellites. The area of study of the scientific missions in space, like the other areas of the study program, was governed by this statement of Laboratory intention--concentration on the moon, the planets, and the space between them." This was the first detailed examination of a potential deep space program made available to NASA, and the report became a basic reference work in the development of NASA deep space flight programs which followed in 1959-1960. (JPL Report 30-1, Exploration of the Moon, the Planets and Interplanetary Space, A.R. Hibbs, ed., Pasadena, April 30, 1959, p. 2 and passim, JPLHF 2-12.)

During April — Construction of facilities for ground testing of the Vega third stage 6000-pound-thrust (6K) rocket engine at a low ambient pressure was completed at JPL.

Expansion of the Goldstone tracking station from the TRAC(E) one-way receiving link to a two-way station commenced with construction of additional buildings and antenna equipment. Plans called for a facility developed to accommodate proposed Vega deep space missions utilizing an 85-foot diameter tracking antenna and 960-megacycle receiver, and an 85-foot diameter transmitting antenna and a 10-kilowatt transmitter operable from 890 to 3000 megacycles. The transmitting site was located seven air miles from the receiver antenna. (First use of the new facilities was anticipated in support of the Echo passive communications satellite experiment.) (NASA Second Semiannual Report to the Congress, April 1, 1959-September 30, 1959, March 18, 1960, 102-103.)

May 1 — NASA established its Atlantic Missile Range Operations Office (AMROO) to conduct planning, checkout and launch of NASA space vehicles. (Memo from the Administrator of NASA [T. Keith Glennan], Subject: Functions and Authority - NASA Atlantic Missile Range Operations Office, May 1, 1959, JPLHF 2-1003.)

NASA Contract NASw-6 with the California Institute of Technology for operation of the Jet Propulsion Laboratory was executed. The period of performance extended from May 1, 1959 through December 31, 1961. (NASA Authorization for Fiscal Year 1960, Part II, Program Detail for Fiscal Year 1960, May 21, 1959, 809.) (See November 18, 1958.)

The fourth meeting of the NASA Working Group on Lunar Explorations was held. "In attendance were H. Friedman, Frank Press, Rossi, Simpson, G. Kuiper, H. Urey, et. al." The Group heard a report on, and subsequently discussed, Vega capabilities. Members concurred that NASA should re-examine the limited Vega payload capability, and investigate the potential of other vehicles for lunar exploration. The possible application of a radar experiment for a lunar payload was also discussed. (N.W. Cunningham, Lunar Science Chronology, loc. cit.)

May 7 — A meeting was held at Convair Astronautics Division, San Diego, to review the schedule for launch stand procurement and modification at AMR. The schedule established in this meeting was based on utilizing either stand 12 or 14, with a modified stand readiness date of June 7, 1960 necessary for a first Vega firing on August 1, 1960. Identification of the Vega stand and an

May 7 cont. authorization to proceed with modifications from the DOD and NASA was determined as necessary by June 1, 1959--"The entire schedule hinges on this date and must slip if this date is not met." (Letter, W.H. Pickering to T.K. Glennan, May 11, 1959, JPLHF 2-834.) (See April 4, 7 and 8, 1959.)

May 7-9 The Space Science Board of the NAS recommended formation of a small ad hoc Biology Panel to consider effective procedures for space probe sterilization. Dr. Joshua Lederberg agreed to serve as chairman of this new ad hoc committee. (A Review of Space Research, loc. cit.)

May 9 Milton W. Rosen, Chief of NASA's Space Vehicle Propulsion Section, directed a memo to Dr. Abe Silverstein, Director of the Office of Space Flight Development, proposing a simple, direct plan for obtaining high-resolution photographs of the moon prior to impact of a lunar probe. A photographic payload was recommended, since the ground resolution would be at least an order of magnitude better than a TV system could be expected to provide. (Office memo to Dr. Silverstein, via A. Hyatt from M.W. Rosen, May 9, 1959, JPLHF 2-714.) (See May 23, 1958.)

May 14 NASA notified the Air Force of firm flight test dates for Vega from the Atlantic Missile Range at Cape Canaveral, and at the same time requested from AFBMD a fixed price quotation for eight Atlas first stage vehicles. The NASA flight schedule called for several developmental test flights beginning in the fall of 1960 preceding the Mars launch attempt in October of that year. (Two launch stands--numbers 12 and 14--were then available for launching multistage Atlas-boosted vehicles, with a third [launch complex 36] requested by General Schriever on February 11, 1959.) (NASA, "Tentative NASA Launching Schedule," May 20, 1959, JPLHF 2-799; and Review of Canceled Atlas-Vega, op. cit., 20, 21.)

May 15 Construction of the additional launch stand (No. 36) for Atlas flights at AMR requested on February 11, 1959 was approved by DOD-BMD. (Ibid.)

May 21 JPL released Procedures for the Technical Direction of NASA-Convair Astronautics, Contract NASw-45. (Vega Management Document No. 7, May 21, 1959, JPLHF 2-1005b.)

NASA Contract NASw-45 with Convair for the Vega second stage vehicle was executed. (Review of Canceled Atlas-Vega, op. cit., 35.)

May 23	The Air Force Ballistics Missile Division (BMD), under the command of Major General Schriever, took sharp issue with the NASA request for launch stand utilization at AMR made on May 14, 1959. In its teletype response BMD asserted that the two existing launch stands, 12 and 14, were committed to a firm launch schedule for 1960, and that, if Vega could be accommodated in the schedule for the newly authorized launch stand, its construction would not be completed until late 1960. BMD agreed that NASA could deliver Vega launch vehicles to the Cape but noted that this authorization "'cannot, repeat, cannot be construed as an indication of an Air Force launch stand capability for the Vega Program. . . .'" A meeting between representatives of NASA and BMD to establish a "'mutually agreeable and supportable launch schedule'" was recommended. (_Ibid._, 21.)
May 25	In a meeting at NASA OSFD concerning the NASA lunar explorations program, two major changes were adopted for recommendations to Dr. Silverstein: (1) use two Vega flights for Lunar Orbiters; (2) following an initial rough landing mission launched by a Vega, use two Centaur vehicles for lunar soft landings. (NASA, Memo to Files from N.W. Cunningham, June 16, 1959, JPLHF 2-1928.) (See April 20 and May 9, 1959.)
May 25-26	The NASA Goett Committee, headed by Dr. Harry Goett, Director of the Goddard Space Flight Center, and established to identify manned spaceflight programs to follow Mercury, recommended that the United States undertake manned circumlunar flight missions. (JPL, _Space Programs Summary No. 4_, _op. cit._, 78.)
May 28	JPL responsibility for technical management of the Vega vehicle was formally established at NASA Headquarters. (NASA, memo from T.K. Glennan to Director of Space Flight Development, May 28, 1959, JPLHF 2-1789.) (See February 6-7 and February 11, 1959.)
	Dr. T.K. Glennan, in a memo to Dr. Silverstein, reviewed initial difficulties encountered in integrating JPL into NASA, and outlined the scope of operational responsibilities for JPL that would govern its relationship with Headquarters: "Within the project objectives, guidelines, and funds approved by NASA, the technical judgments and decisions required to carry out the project will, to the maximum extent possible, be left to the judgment of the Laboratory's management." (Memo for the Director of Space Flight Development from T.K. Glennan, May 28, 1959, JPLHF 2-807; also, memo to the Director of Business Administration and Director of Space Flight Development, from Richard Horner, November 16, 1959, 2, JPLHF 3-314.)

1959

During May — As a result of the furor created by the Soviet space probe Luna I (Mechta) and the subsequent assertions that it was a hoax (see April 11, 1959), the House Committee on Science and Astronautics held ten hearings during the month in an attempt to discern the truth. The opinion of experts who testified before the Committee tended to support the claims made by the U.S.S.R. (The First Soviet Moon Rocket, op. cit., 8.)

Vega design had proceeded to the point where JPL projected a planned payload capability of about 5000 pounds in a 300-mile earth orbit, 800 pounds could be delivered to the moon, and approximately 450 pounds to nearby planets. A first launch into earth orbit was now scheduled for September 1960 (see May 23, 1959). The first generation spacecraft (V-1), designed to be adaptable to various deep-space flight missions, was to embody the following features: (1) two-way communications up to 40×10^6 miles; (2) redundant low power communication for engineering telemetry up to 10^6 miles; (3) solar energy converted to electrical power; (4) attitude control; and (5) basic scientific instruments. (Space Programs Summary No. 4, loc. cit.; NASA Authorization for Fiscal Year 1960, op. cit., 750.) (Figures 11,12, and 13.)

June 2 — AFBMD and Lockheed agreed upon the optimum increased propellant tank capacity for the dual-burn Agena: double that of the Agena A. (Review of the Canceled Atlas-Vega, op. cit., 37.)

June 3 — The Air Force issued Contract Change No. 30 to the basic Lockheed Agena development contract directing a one-hundred percent increase in propellant tank capacity for the dual-burn Agena (see April 24, 1959), a modified guidance system for the Agena, and any other changes necessary to make vehicle subsystems and ground support equipment compatible with the specified alterations. This authorization formalized an Agena B development program. (Ibid.)

June . — ARPA concurred in the AFBMD/Lockheed decision concerning an optimum tank capacity for the Agena B. (Ibid.)

June 8 — JPL issued findings concerning the TV payload subsystem developed for the Juno II lunar probes. (Thomas R. Atkinson, et. al., JPL Technical Memo No. 30-4, Vidicon Camera and Tape Recorder System Development, June 8, 1959, JPLHF 2-566.)

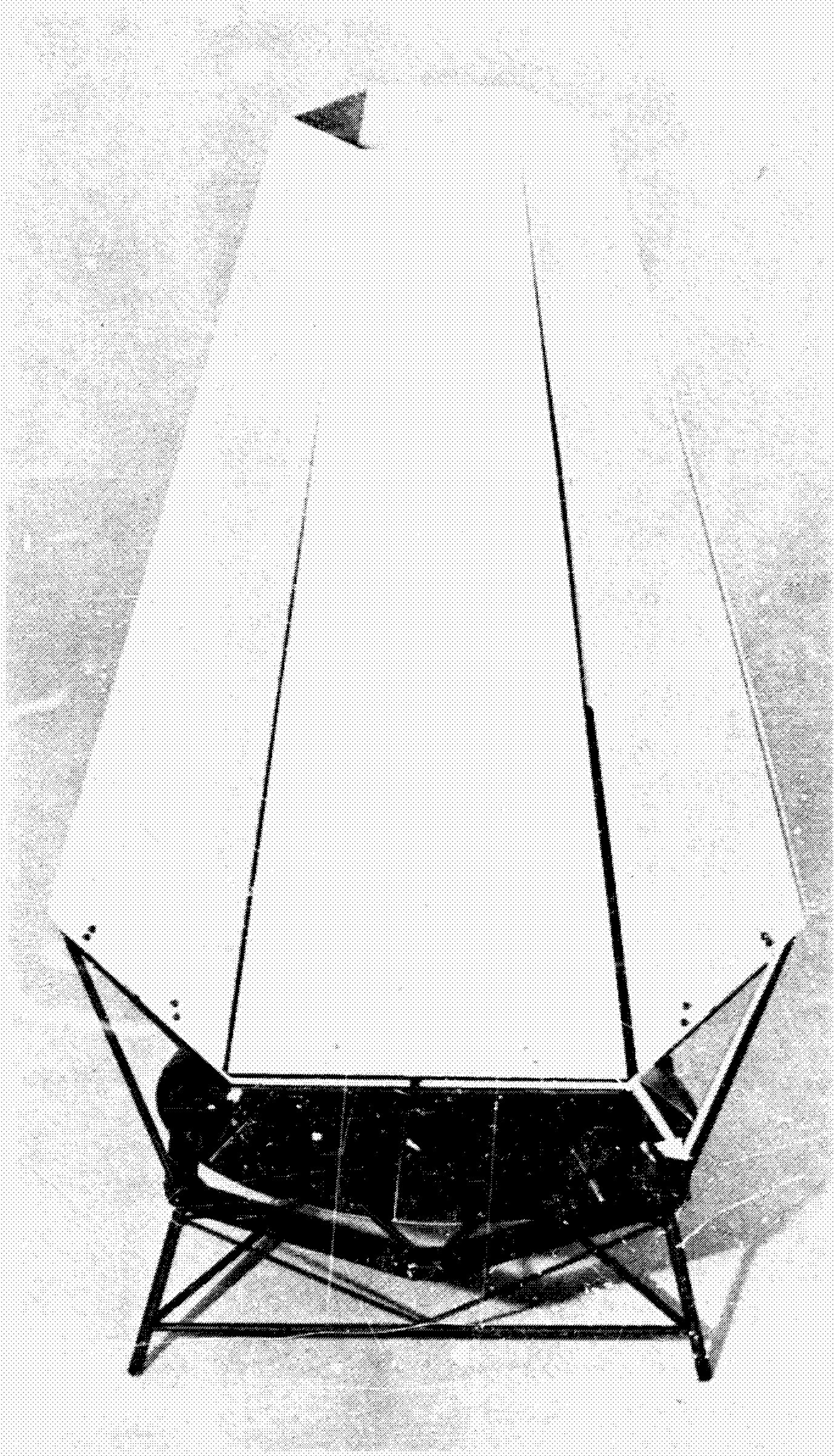

Figure 11: Proposed Vega 6 spacecraft design, in launch position.

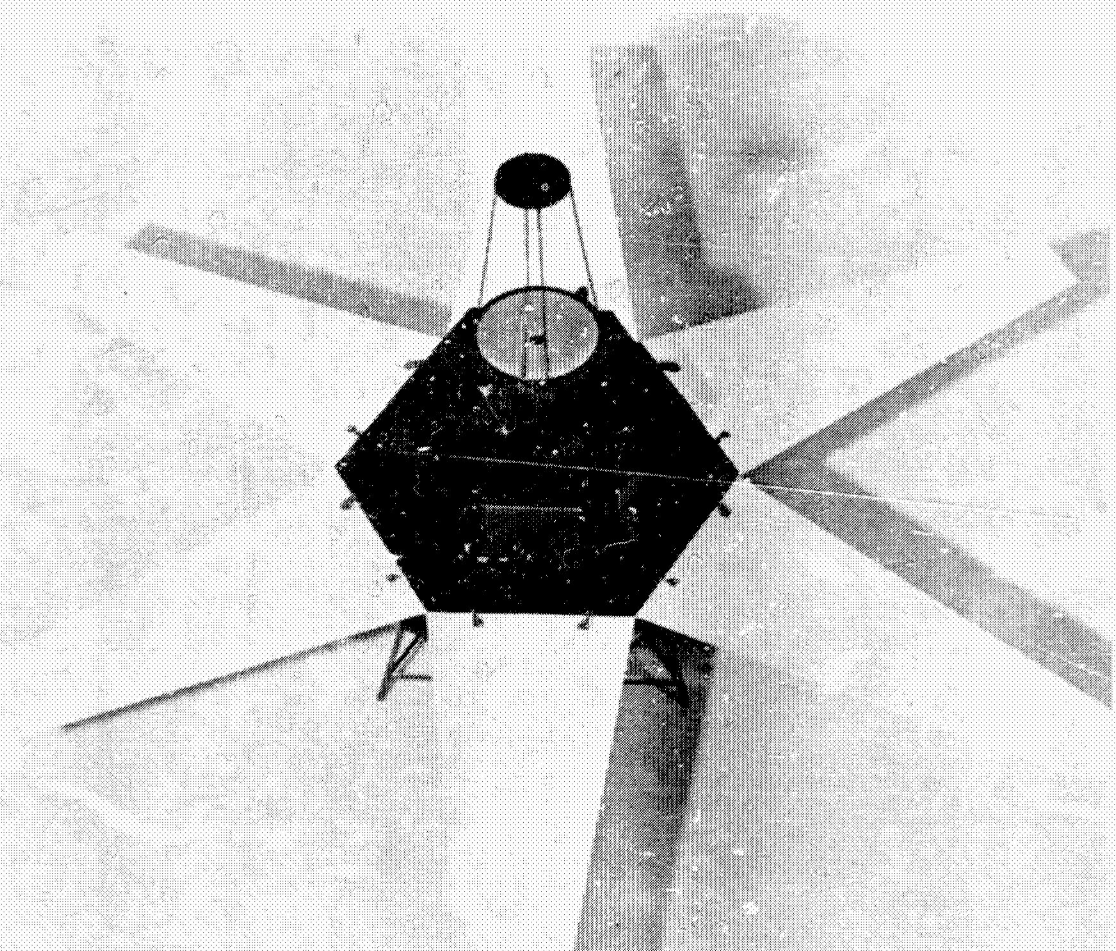

Figure 12: Proposed Vega 6 spacecraft design, in cruise position.

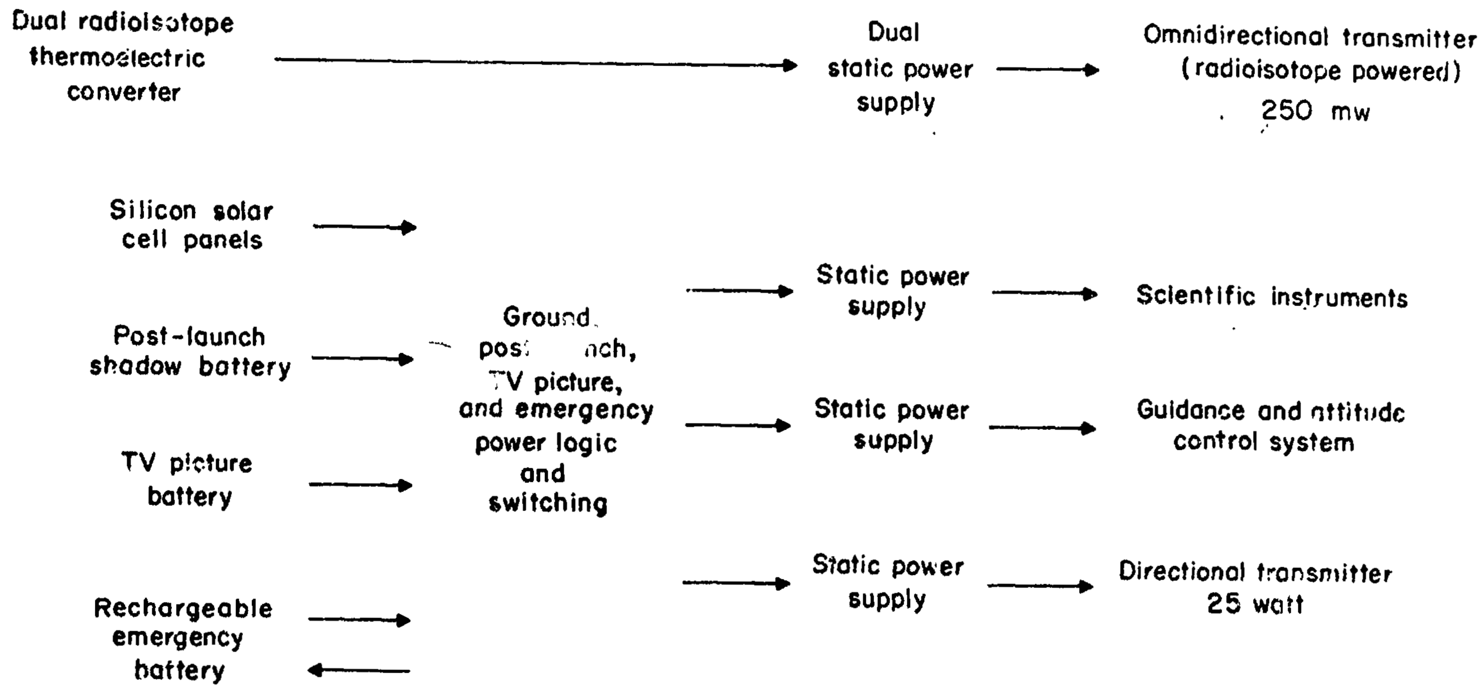

Figure 13: Proposed Vega spacecraft electrical power system.

1959

June 10 The Air Force let a contract for construction of an additional Atlas launch stand at Cape Canaveral; the new facility was scheduled to be completed in eighteen months. (Review of the Canceled Atlas-Vega, op. cit., 20.)

June 12 Following discussions with NASA personnel in late May, Lockheed Missiles and Space Division submitted a proposal to NASA Headquarters for a complete unmanned lunar probe program consisting of four flights during fiscal year 1961 (based on a go-ahead of August 1, 1959), using a new uprated second stage booster, to be called Agena, being developed for use in the Air Force satellite program.

Lockheed proposed to launch four separable lunar probes during the last half of 1960, of which two were scheduled as orbiter photo-mapping missions, followed by two soft-landing missions. A gross probe weight of 750 pounds was specified for each flight. No midcourse maneuver capability was planned for the lunar probes since "the proposed ascent guidance design [in the Atlas and Agena stages] will provide a powered flight trajectory sufficient to land a probe on the moon within 300 miles of a predicted point. . . ." (p. vi) In addition, "a solar-cell array and storage battery (especially needed for operation in the shadow of the moon) will permit operation in excess of three years." (Ibid.) Lockheed also suggested that the program could be augmented by inclusion of instrumented impact flights for gathering data en route to the moon: "an example of such an experiment is the examination of the lunar surface during descent, possibly by utilizing a television camera and a high data rate transmission system." (p. 2-6) In mid-1959 LMSD had sketched the rough outline for what was to become essentially the NASA unmanned lunar program within the next four years. All but the soft-lander probe, eventually known as Surveyor, would in fact be launched by Atlas/Agenas. (Lockheed Aircraft Corporation, Missiles and Space Division, Proposal for a Lunar Probe, LMSD-49800, June 12, 1959.) (See corresponding JPL deep space exploration survey, April 30, 1959.)

June 15 McKinsey and Company began a separate study of JPL organization and management under a JPL contract. (IOM from W.H. Pickering to Distribution, June 1, 1959, JPLHF 3-222a.)

June 19 AFBMD sent a teletype message to NASA Headquarters noting that, because of continuing construction on Atlas stand 36, December 1960 was "'the first possible launching date for Vega,'" and asked that NASA reissue its Vega procurement requests to allow for this consideration. (Review of the Canceled Atlas-Vega, op. cit., 21,22.) (See During June, 1959.)

1959

During June	At NASA request, JPL began a study of earth satellite spacecraft that could be placed in earth orbit by a two-stage version of the Vega booster system. A modified Lockheed-Agena A was one of the candidate second-stages that was first examined. Results of this study were released in November 1959. (JPL, Agena Study Report, February 1, 1960, 1, JPLHF 2-605.)
	In light of the projected launch stand loading problems at Cape Canaveral, NASA and JPL agreed to abandon the attempt at a Mars flight in October 1960, and redirect Vega first flight efforts toward a lunar mission since the Vega spacecraft (V-1) could be readily adapted to this task and a lunar "launch window" was available once each month from AMR.* (JPL, "RA-5 Failure Investigating Committee Reports," testimony of J.D. Burke, loc. cit.) (See May 25, 1959.)
	NASA and the Air Force reached tentative agreement to make the new AMR Launch Complex No. 36 the Vega stand. R. Horner, of NASA Headquarters, was responsible for the negotiations. (Letter, W.H. Pickering to A. Silverstein, July 10, 1959, JPLHF 2-835.)
July 6-8	The SSB *ad hoc* Biology Panel, chaired by Dr. Joshua Lederberg, met to consider methods and techniques for sterilization of space probes (see May 7-9). The committee prepared a report for the SSB indicating that such sterilization was feasible, and that necessary procedures and hardware could be developed if a priority was assigned to this problem. This report and its recommendations were adopted by the SSB and later transmitted to the responsible Federal agencies on September 15, 1959. (A Review of Space Research, loc. cit.)
July 8	JPL tentatively assigned space allocations for the various subsystems in the Vega spacecraft. (IOM from D. Schneiderman to Distribution, July 8, 1959, JPLHF 2-1004.)

*The spacecraft high gain antenna, rather than being employed for long-range, narrow-band communications, could be used at lunar distances for relatively wide-band transmissions, such as television. The solar power supply system was also retained, although the number of arrays could be reduced, because its use would provide development experience needed for the interplanetary flights which were scheduled to follow.

1959

July 10 Based on the recent NASA-Air Force agreement on launch stand utilization for Vega (see June 1959), JPL recommended revised Vega mission and flight dates:

Flight No.	Firing	Mission
1	11/21/60	(Space) Escape
2	1/10/61	(Space) Venus near miss
3	2/28/61	(Satellite) Meteorological
4	4/30/61	(Space) Lunar impact
5	6/30/61	(Satellite) Communications
6	8/18/61	(Space) Lunar orbit
7	10/31/61	(Satellite) Meteorological
8	1/13/62	(Space) Lunar orbit

(Letter, W.H. Pickering to A. Silverstein, July 10, 1959, JPLHF 2-835.)

July 13 Dr. Newell's Office of Space Sciences, in the NASA Office of Space Flight Development (OSFD), established a Lunar Science Group, superseding the original ad hoc Working Group on Lunar Exploration, chaired by G. Schilling. Initial members included N.W. Cunningham, Robert Jastrow, Edgar Cortright, A. Crocker, George M. Low, Milton Rosen, and M. Stoller. The primary purpose of the new group was to concentrate the efforts of all divisions of the Office of Space Flight Development towards the development of a realistic long-range plan for lunar and planetary exploration, including both manned and unmanned aspects. Members also were responsible for maintaining contact with academic scientists interested in lunar science, and selection of instruments for proposed payloads. (Interview with E.M. Cortright, loc. cit.; and G. Schilling, RAND Corp., Comment on Ranger Chronology preliminary draft, January 23, 1956; also, NASA, memo from H.E. Newell to A. Silverstein, August 26, 1959, JPLHF 2-1929.) (See January 20, 1959.)

July 14 The United Nations ad hoc Committee on the Peaceful Uses of Outer Space released a Report to the United Nations General Assembly concerning the international implications of space exploration. One of the foreseeable legal problems noted in this document involved "safeguards against contamination of or from outer space." The Committee "agreed that further study should be encouraged under appropriate auspices to specify the types of risks, the gravity of dangers, and the technical possibility, as well as the cost of preventative measures. . . ." (United Nations Doc. A/4141, July 14, 1959, Part III, B, 29.)

As a first step in a reorganization of JPL, the position of Department Chief was eliminated; all Division Chiefs now reported directly to the Director. (IOM from W.H. Pickering to Distribution, July 14, 1959, JPLHF 3-224.)

July 14 cont. The ninth meeting of the CMLC was held in Washington, D.C. Dr. Silverstein reported scheduling of Atlas launch pads at AMR was "shaping up to the satisfaction of both NASA and ARPA," and that Pad No. 36, scheduled for completion in November 1960, was to be used for Vega. The chairman, Mr. Holaday, announced that a re-evaluation of the National Space Vehicle Program appeared necessary because of the additional specialized stages that had been proposed or authorized since the President approved the program in January. (Minutes of Meeting of Civilian-Military Liaison Committee, July 14, 1959, JPLHF 2-808b.)

July 15 A Space Science Division was established at JPL to devise experiments and equipment for deep space exploration, and to analyze and report on the findings obtained from the experiments. (IOM from W.H. Pickering to Distribution, July 14, 1959, JPLHF 3-225.) (See July 13, 1959.)

JPL released Publication No. 30-8, The Jet Propulsion Laboratory's 6000-Pound Thrust Storable Propulsion System, by W.W. Smith, which described the design requirements and characteristics of the 6K propulsion system.

July 19 William Holaday, chairman of the Civilian-Military Liaison Committee (CMLC), directed a memorandum to NASA Administrator T. Keith Glennan and to the Secretary of Defense noting that Holaday's staff would review the national launch vehicle program including Atlas-Vega and the Atlas-Agena B systems. (Clark, op. cit., 66.) It was apparently during early May that NASA first became aware of an Air Force Agena B development program. (See June 12, 1959.)

July 23 A meeting of top officials from NASA, the Office of the President, and the National Security Council was held in Washington, D.C. to evaluate the status and goals of the United States space program.* Dr. Glennan and his senior associates pointed out that a launch

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*Those present were Dr. George B. Kistiakowsky, who had succeeded Killian as special assistant to the President for science and technology, Gordon Gray, special assistant to the President for national security affairs, Karl G. Harr, Jr., special assistant to the President for security operations coordination, Charles A. Sullivan of the Department of State, Foster Collins of the Central Intelligence Agency, and the three top officials of NASA, T. Keith Glennan, Hugh L. Dryden and Richard E. Horner.

1959

July 23 cont. window for lunar flights was available on a monthly basis, while Mars and Venus on the other hand, presented a launch opportunity only at intervals of about two years. They proposed to concentrate United States deep space efforts on lunar flights to achieve the short-range prestige objectives called for by a National Security Council policy paper. Following discussion, the NASA proposal was approved. "Accordingly, nine space vehicles were assigned to lunar missions from October 1958 to December 1960, and only one to interplanetary space." (T.K. Glennan, memo for File, July 24, 1959, with attachments: "Participants 23 July meeting, and excerpts from the Preliminary U.S. Policy on Outer Space for use at the 23 July meeting, JPLHF 5-180.) (See May 25 and During June, 1959.)

July 24 NASA revised the Atlas-Vega flight schedule to account for the launch stand loading problem at Cape Canaveral; the Vega first flight was slipped from August to December 1960. (<u>Review of the Cancelled Atlas-Vega</u>, <u>op. cit</u>., 22.)

July 25 At JPL the Vega mission and flight schedule for the first three vehicles was revised:

Flight No.	Firing	Mission
1	August 1960	Vehicle test, direct ascent to escape velocity
2	October 1960	Lunar impact
3	January 1961	Venus Mission, direct ascent

The spacecraft employed in these flights would be designed with a maximum similarity and with certain common features: (a) stabilized with an axis oriented toward the sun, (b) roll rate about the solar axis controlled, (c) solar cell electrical power source, (d) 25-watt transponder, (e) 1/4-watt transmitter, and (f) no midcourse rockets. The scientific payloads would measure the interplanetary environment (i.e., cosmic radiation, solar corpuscular, magnetic fields, and meteorite impacts), and provide vidicon pictures of the moon prior to impact. (JPL, IOM from W.H. Pickering to Distribution, July 25, 1959, JPLHF 2-836.)

July 31 NASA formed an <u>ad hoc</u> group to review the Vega and Centaur vehicle systems, chaired by Dr. H.J. Stewart, Director, Office of Program Planning and Evaluation. The group was directed to consider technical systems planning, scheduling, budgetary planning, and systems objectives. (Letter, R.E. Horner, Associate Administrator, NASA, to W.H. Pickering, July 31, 1959, JPLHF 2-837.)

With cancellation of the planned Vega Mars flight in October 1960, the next possible Mars mission would fall in October 1962. Therefore, in accordance with recent NASA-JPL discussions, "The entire

1959

July 31 cont. Vega missions schedule has been revised. Emphasis has now been placed on the development of payload and guidance components pertinent to lunar exploration." (JPL, Vega Letter Report No. 1, July 31, 1959, 1-2, JPLHF 2-819.) (See July 23, 1959.)

Dr. Abe Silverstein, Director of the Office of Space Flight Development, directed that Edgar M. Cortright be moved from his position in meteorological satellites and assigned the task of forming a Lunar and Planetary Program Office. Cortright assembled an initial team comprised of Gerhard Schilling, B. Milwitzky, and N.W. Cunningham. To build up the engineering side, Cortright later hired Oran Nicks and Fred Kochendorfer. This nucleus of six men were organized and working by September 1959. (Interview with E.M. Cortright, March 4, 1968, pages 1 and 13, JPLHF 2-762.)

President Eisenhower revised the charter of the Civilian-Military Liaison Committee so that it could take the initiative in dealing with disputes between NASA and the DOD. Prior to this revision the CMLC handled only those problems that were brought before it by the respective agencies. (Government Operations in Space, op. cit., 56.) (See April 15, 1959.)

At JPL the communications subsystem for the Vega V-1 spacecraft was defined to include a 250-milliwatt transmitter and a 3-watt transponder. The transmitter would telemeter engineering and scientific measurements, and afford tracking data with respect to two-angles and one-way doppler. The high-power transponder would provide two-way doppler in addition to angular information, receive commands from earth and telemeter engineering and scientific data at much greater ranges. A contract to develop the phase-coherent transponder system was awarded to Motorola Western Military Electronics Center in Phoenix, Arizona. (JPL, Space Programs Summary No. 37-2, for the period Jan. 15, 1960 to March 15, 1960, Pasadena, April 1, 1960, 21.)

NASA awarded contracts to Caltech and Columbia for the development of a single-axis seismometer for use in a hardlanding lunar capsule. (N.W. Cunningham, Ranger Program Chronology, loc. cit.; also, F.E. Lehner, E.O. Witt, W.F. Miller and R.D. Gurney, Final Report, A Seismometer for Ranger Lunar Landing, Seismological Laboratory, Caltech, May 15, 1962, 1,2, JPLHF 2-1378.)

Aug. 3 JPL released Report 30-6, The Vega Program, a survey of the flight objectives and ground and space-borne elements of the Vega system. Lunar flights were to be directed toward "improving the present understanding of the moon." This knowledge, it was hoped, "would permit far-reaching deductions as to the origin of the solar system." (p.43) Experiments were proposed to measure the properties of the moon's magnetic field and atmosphere, provide a detailed map of the complete moon, and determine the internal structure of the moon. The revised TRAC(E) deep space tracking net was now referred to as the Deep-Space Net (DSN) in support of Vega; it would consist of a station at Goldstone (California, Woomera (Australia), Johannesburg or Capetown (South Africa), and eventually a United States east coast site at Bangor (Maine). (p. 20) (J.N. James, ed., JPL Report 30-6, The Vega Program, August 3, 1959, JPLHF 2-583.) (Figure 14.)

Aug. 4 In response to a launch stand readiness date of November 1, 1960 for the new Vega Complex 36, and an established policy to emphasize lunar exploration during 1961, a revised Vega launch schedule was proposed:

Flight No.	Launch Date	Mission
1	January 10, 1961	Escape mission, vehicle test
2	March 7, 1961	Lunar near miss, same as above
3	June 5, 1961	Meteorological satellite, 2-stage vehicle
4	October 22, 1961	Lunar mission
5	January 1, 1962	Communications satellite, 2-stage vehicle
6	March 5, 1962	Lunar orbital
7	- - -	Backup for satellite mission
8	- - -	Backup for lunar mission

(Letter, W.H. Pickering to A. Silverstein, August 4, 1959, 1-2, JPLHF 2-825.)

Aug. 5 Speaking at a Space Science Seminar in Los Angeles, W.H. Pickering, Director of JPL, noted that the planned deep space program would involve far fewer flights than space booster/weapons system development projects (e.g., Atlas ICBM flight tests), and that JPL-NASA was obligated to obtain as great a scientific return as possible from each flight. He emphasized that, as a consequence, the requirement for "reliability and good engineering design is even greater in the space business than it is in the weapons [missiles] business." (JPL Publication No. 30-10, Space Science Seminar, Part I: General Introduction, Los Angeles, August 28, 1959, 18, JPLHF 2-588.)

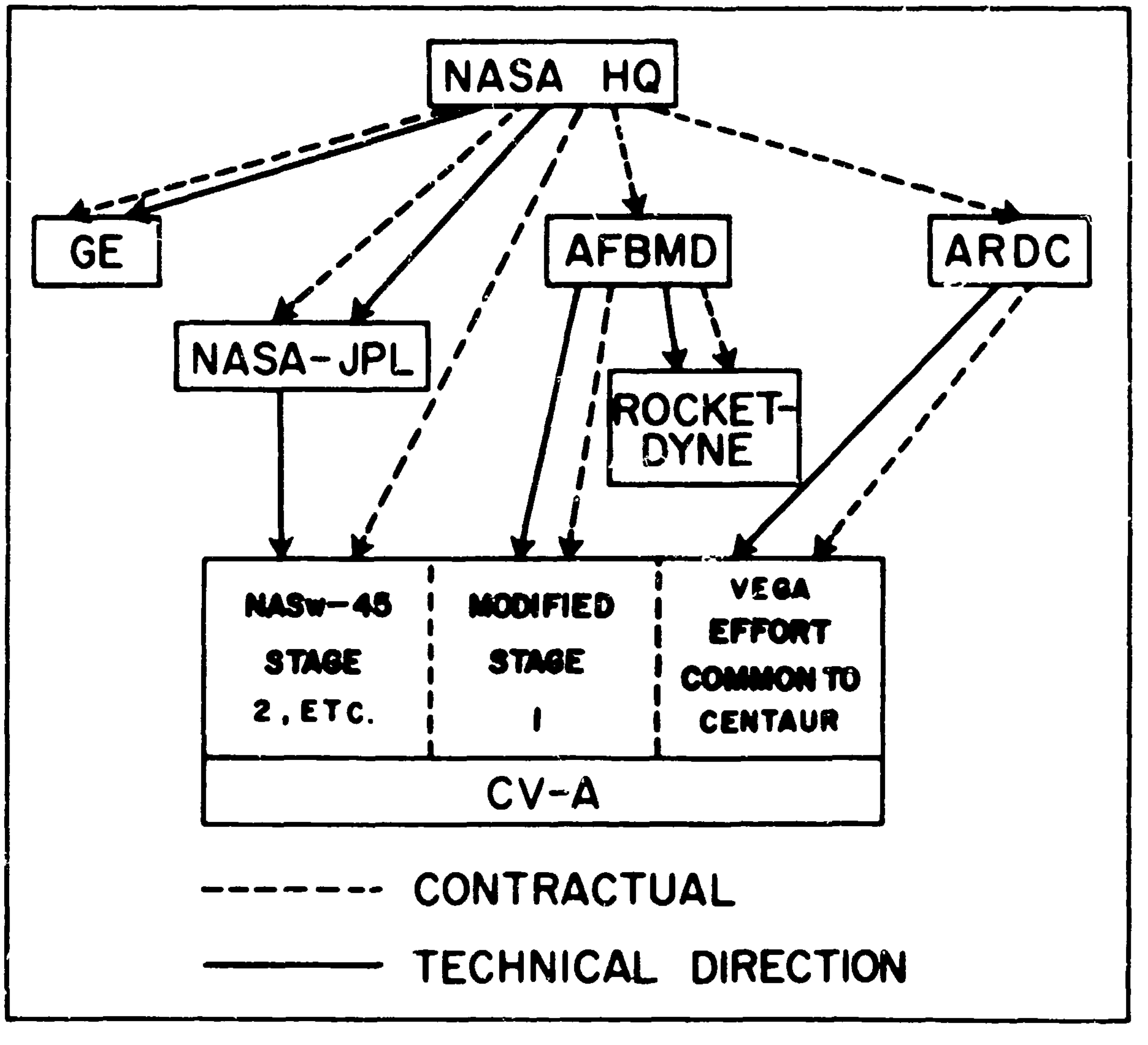

Figure 14: Contractual and technical direction for Vega program.

Aug. 6-7 A NASA conference was held in Monterey, California, attended by top Headquarters personnel and directors of NASA field centers. JPL was notified that a decision had been made to set a ceiling on personnel employed at the Laboratory: 2400 by June 30, 1960. (Letter from T.K. Glennan to L.A. DuBridge, August 10, 1959; and, letter from L.A. DuBridge to T.K. Glennan, August 14, 1959, JPLHF 2-864a and 2-864b.)

Aug. 10 NASA revised the Vega launch schedule for the second time (see July 24, 1959). The plans slipped the first launch from December 1960 to January 1961; subsequent flight dates were stretched out with the result that the eighth vehicle slipped an additional nine months, thereby allowing time between shots to study the data and make any necessary modifications. (Review of Canceled Atlas-Vega, loc. cit.)

G.E. performed a full duration test of the Vega second stage engine. "The engine was operated at full thrust for 50 seconds followed by a shutdown period of three hours and a restart run of 250 seconds." (NASA, memo from A. Hyatt to The Administrator, et. al., August 13, 1959, JPLHF 2-1496.)

Aug. 11 Due to changes in schedule and mission assignment, the preliminary design of the Vega spacecraft was not as advanced as the remainder of the system. Primary attention was being devoted to functional design of the lunar payloads. (JPL, Vega Letter Report No. 2, August 11, 1959, JPLHF 2-820.)

Collins Radio was authorized to proceed on the minimum deep space net. (IOM from J.H. Keyser to Distribution, August 11, 1959, JPLHF 2-1009.)

Aug. 12 C.I. Cummings was appointed Vega Program Director at JPL. (IOM from W.H. Pickering to Distribution, August 12, 1959, JPLHF 3-228.)

Aug. 18 Construction of Launch Complex 36 was running one month behind schedule. This time was expected to be recovered by the commitment to overtime for the contractor. (JPL, Vega Letter Report No. 3, August 18, 1959, 1, JPLHF 2-821.)

Aug. 20 OSFD planning at NASA Headquarters released a new, tentative Vega

Aug. 20 cont.

flight schedule:

Flight No.	Firing	Mission
1	January 1961	Test vehicle, lunar miss
2	April 1961	Lunar miss
3	July 1961	Backup (lunar miss)
4	October 1961	Lunar orbiter
5	January 1962	Meteorological satellite
6	April 1962	Lunar orbiter
7	July 1962	Communication satellite
8	October 1962	Backup

(JPL, IOM from F.E. Goddard to C.I. Cummings, August 20, 1959, JPLHF 2-839.)

The NASA ad hoc Vega-Centaur Vehicle Review Group visited JPL to review the Vega program. JPL took the position of not defending Vega, but only described the system and expected performance. (IOM from J.H. Keyser to Distribution, loc. cit.)

Aug. 21

Dr. H.J. Stewart and other members of the NASA ad hoc Vega-Centaur Vehicle Review Group were briefed on the DOD Agena B injection vehicle at the NASA Western Operations Office by Lockheed and BMD staff members. (NASA, Report to the Administrator from the Ad Hoc Vega-Centaur Vehicle Review Group, Aug. 31, 1959, 2, JPLHF 2-809.) (See July 31, 1959.)

The JPL Functional Design Group released the Payload Functional Description, Vega V-6. The document was recognized as a first step toward a final design, and called for a lunar orbiting spacecraft employing rotatable solar panels and a 3-4 foot high-gain antenna fixed at the base of the payload. (JPLHF 2-945.)

Aug. 31

The NASA ad hoc Vega-Centaur Vehicle Review Group submitted its initial report to Dr. T.K. Glennan; a final report was promised at the end of September. The major question under investigation was whether it was sound to pursue all of the existing vehicle programs--Centaur, Vega, and Agena B. (NASA, Report to the Administrator, loc. cit.)

R.W. Davies and M.G. Comuntzis presented a paper on The Sterilization of Space Vehicles to Prevent Extraterrestrial Biological Contamination at the Xth Congress of the International Astronautical Federation, in London. The authors reviewed the work of CETEX, the consensus regarding probabilities of landing viable organisms on the moon and planets, and suggested that "pollution be kept less than 10° dead organisms per probe for moon and planetary shots." (JPL External Publication No. 698, August 31, 1959, 13, JPLHF 2-575.)

During August — With the DSN scheduled to support both NASA and the DOD space programs, JPL recommended that a single agency, the Army Signal Corps, be assigned responsibility for providing the necessary communications between all stations in the Net, with ARPA and NASA providing funds and direction. "This approach to establishing communications is under consideration by the Space Flight Operations Division of NASA Headquarters, pending a decision on the overall NASA communications problem." (JPL Report No. 30-6, op. cit., 27.)

The initial plan for launch-to-injection tracking of early Vega flights was completed. Stations were to be located at Cape Canaveral, Bermuda, and a downrange station (location unspecified). "On northeast direct-ascent trajectories, such as the first Vega firings, this [latter] station will be located at Newfoundland. . . ." (JPL, Space Programs Summary No. 5 for the period July 15 1959 to September 15, 1959, Pasadena, October 1, 1959, 33.)

The ICSU met in The Hague, Netherlands, to conclude affairs related to the IGY. The CSAGI was disbanded, and four new committees assumed its work: COSPAR (space research), SCOR (oceanographic), SCAR (Antarctic), and the International Geophysical Co-operation of 1959 (IGC-1959). The last organization was later reconstituted as the Committee on International Geophysics (CIG). (J. Tuzo Wilson, op. cit., 320-321.) (See October 2-4, 1958.)

Fabrication of the first static test model of the JPL 6K propulsion system was completed. (A. Briglio, Jr., loc. cit.)

Sept. 8 — CMLC Chairman William Holaday informed the committee that his staff was evaluating the national space vehicle program, with special attention given to competing NASA-DOD launch systems (see July 19, 1959). (Clark, op. cit., 66.)

Sept. 9 — JPL submitted a proposed "Flight Test Responsibilities and Organization for Launch Phase of the Vega Program at AMR" to NASA OSFD, outlining management and technical responsibilities for all participants during launchings. (Letter and enclosure from C.I. Cummings, JPL Vega Program Director, to A. Silverstein, September 9, 1959, JPLHF 2-838.)

The JPL Functional Design Group released the Payload Functional Description, Vega V-1. This spacecraft, also designed for a lunar orbiter mission, embodied a simplified V-6 configuration weighing approximately 596 pounds. (JPLHF 2-946) (Figure 15.)

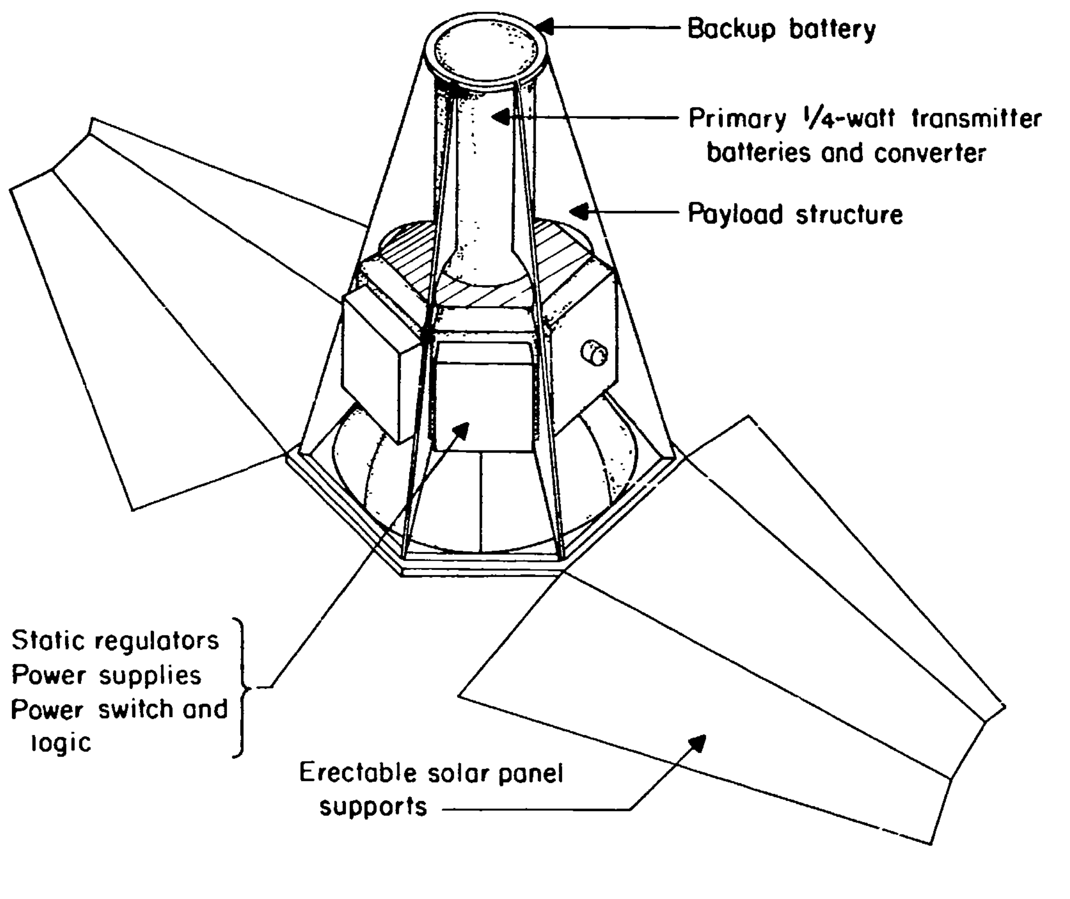

Figure 15: Proposed Vega 1 Lunar Orbiter spacecraft design showing power system.

1959

Sept. 12 The Soviet Union launched Luna II toward the moon. The 858-pound lunar probe carried pennants and instruments similar to those on the first flight (January 2, 1959) and, perhaps to avoid further contention, the USSR provided information to the British astronomers at the Jodrell Bank radio telescope which allowed them to track the vehicle until it impacted the moon. (J.T. Wilson, IGY, the Year of the New Moons, New York, 1961, 72-73.) The feat demonstrated very precise guidance inasmuch as this craft, like its predecessor, was placed on a lunar trajectory by the launch vehicle and did not make a midcourse maneuver. (Cf. "What Moon Shot Means," Business Week, September 19, 1959, 32-33.) The vehicle made the first attempt to detect the moon's magnetic field, and its magnetometer functioned down to 55 kilometers of the lunar surface. No field was observed. (Nature, February 1, 1969, 415.) (This flight and a subsequent lunar flight in October coincided with Party Chairman Khruschev's visit to the United States for a summit meeting with President Eisenhower at Camp David.) ("Exploring the Moon from Baikonur and Cape Kennedy," op. cit., 55.)

Sept. 14 Dr. Hugh Odishaw, Executive Director of the SSB, directed a letter to Dr. T.K. Glennan of NASA and Mr. Roy Johnson of ARPA which communicated the recommendations of the Lederberg ad hoc committee (July 6-8, 1959) and the SSB regarding sterilization of space probes. (C.M. Atkins, NASA and the Space Science Board of the National Academy of Sciences, op. cit., 108, 109.)

NASA and the DOD signed an agreement "governing the reimbursement of costs incurred by DOD or NASA in providing for use by the other of its services, equipment, personnel and facilities and in transferring equipment and supplies." (Document entitled "Agreement Between the Department of Defense and the National Aeronautics and Space Administration, Concerning Principles Governing Reimbursement of Costs," September 14, 1959, JPLHF 2-1149.)

Sept. 16 A revised edition of Payload Functional Description, Vega V-6 was released at JPL (JPLHF 2-947.)

Sept. 17 JPL requested tracking and telemetry coverage from NASA's Bermuda station for Vega direct ascent missions. (Letter from C.I. Cummings to E.C. Buckley, Assistant Director of Space Flight Operations, NASA, September 17, 1959, JPLHF 2-840.)

Sept. 18 Secretary of Defense Neil H. McElroy issued a DOD order entitled "Satellite and Space Vehicle Operations," which served as an outline for reorienting the space activities performed by the organizational elements of DOD. The USAF was given responsibility for nearly all military space missions, ARPA was relegated to a research and development function. (Historical Origins of NASA's Launch Operations Center, op. cit., 59.)

1959

Sept. 21 A special JPL Functional Design Group reported to C.I. Cummings on the results of their studies and presented a spacecraft functional description for Vega vehicles V-1 and V-6, with emphasis placed on lunar exploration. Functional specifications were scheduled for completion by October 1. J.D. Burke was assigned responsibility for organizing, coordinating, and integrating this continuing preliminary design effort. (JPL, IOM from C.I. Cummings to Distribution, September 22, 1959, JPLHF 2-841.)

Sept. 22-23 Based on the McKinsey management study as well as inhouse reviews, JPL began an extensive internal reorganization which was completed in November 1959. (IOM from W.H. Pickering to Distribution, September 22, 1959, JPLHF 3-231; IOM from W.H. Pickering to Distribution, September 23, 1959, JPLHF 3-232; and, IOM from W.H. Pickering to Distribution, September 24, 1959, JPLHF 3-233.)

Sept. 24 The first NASA-Air Force Atlas Able-4 lunar launch vehicle exploded during static tests at the launch stand at Cape Canaveral. It was being prepared for a planned launch in October. (Emme, Aeronautics and Astronautics, op. cit., 13.)

Sept. 26 The McKinsey final report on JPL management and organization was released. (McKinsey & Company, Improving Organizational Structure and Administrative Processes, Jet Propulsion Laboratory, September 1959, JPLHF 3-182; also, IOM from W.H. Pickering to Distribution, September 15, 1959, JPLHF 3-229.)

Sept. 28 J.D. Burke was appointed Vega Deputy Director at JPL. (JPL, IOM from W.H. Pickering to All Personnel, September 24, 1959, JPLHF 3-242.)

The NASA ad hoc Vega-Centaur Vehicle Review Group concluded its work. Dr. H.J. Stewart, Director of Office of Program Planning and Evaluation, NASA, submitted a memo to Dr. T.K. Glennan summarizing the background of the DOD Agena Program, and the advantages and disadvantages of the Agena B and Vega. (Memo for the Administrator NASA, from Homer J. Stewart, Director, Office of Program Planning and Evaluation, September 28, 1959, JPLHF 2-922.)

Sept. 29 In an address before the American Institute of Chemical Engineers in St. Paul, Minnesota, JPL Director W.H. Pickering emphasized the need for a well planned national space program with rational goals that would allow this country to surpass the Soviet Union in space exploration. The principal reason for a vigorous space

Sept. 29 cont. program at this point in time, during a "cold war," was asserted to be national prestige. (Text of address, "Space--The New Scientific Frontier," September 29, 1959, JPLHF 2-922.)

Sept. 30 Following review of the JPL Vega Mission Plan dated September 15, 1959, the following missions were established: Vegas 1, 2, and 3 would have identical test missions, to be fired on direct ascent trajectories beginning in January 1961. Vegas 4, 6, and 8 would be nearly identical lunar orbiting vehicles with a first launch in October 1961. Vegas 5 and 7 would be a meteorological and communications satellite, respectively, the former launched in January 1962 and the latter in July 1962. (JPL, Vega Letter Report No. 6, September 30, 1959, 1-2, JPLHF 2-823.)

BMD contractually allocated the first two Atlas boosters to the Vega program. The remaining Vega boosters were scheduled but not yet contractually implemented. (Ibid., 3.)

Following review of the national space vehicle program, CMLC Chairman William Holaday submitted a memo to the Director of NASA and the Secretary of Defense recommending that the NASA G.E.-powered second stage for Vega be eliminated and replaced by the Air Force Lockheed Agena B. (Clark, loc. cit.)

During September JPL plans for the Vega V-1 spacecraft environmental and system tests at the Laboratory and at Cape Canaveral were completed. The heart of the V-1 spacecraft, a device to receive, route, process, and generate intersystem commands onboard, was designated the "spacecraft controller;" preliminary functional design of this unit was begun. (JPL, Space Programs Summary No. 6 for the period September 15, 1959 to November 15, 1959, Pasadena, December 1, 1959, 10-11, 9.)

Oct. 2 Dr. H.J. Stewart submitted final recommendations to Dr. Glennan on the Vega and Agena: "as two-stage vehicles, Agena B and Vega will have about the same payload weight capabilities and acceptable guidance capabilities for earth orbit. Vega will have the guidance capacity for deep space injection and will have a third stage to provide reasonable payload capacity for such missions. Agena B could be similarly altered and have similar capabilities. Cancelling one or the other vehicles should, therefore, be considered. To adequately make the decision, an analysis must be made of the results of cancellation of either Vega or Agena B on the programs of both NASA and DOD." (Memo to the Administrator, from H.J. Stewart, October 2, 1959, 4, JPLHF 2-811.)

1959

Oct. 2 cont.	A meeting was convened at JPL to consider potential missions for the upcoming lunar and interplanetary flight program. Attendees included top engineering and scientific personnel at the Laboratory, and the topic selected for discussion was: "What kind of a space spectacular might the United States perform that the Soviet Union was incapable of doing." One of those present later recalled that a representative from the Space Science Division "made an overwhelming case for photographing the back side of the moon because, while the Soviets obviously had the launch capability, they just as obviously did not have the instrumentation capability to handle such a complex payload." (JPL, memo from J.H. Keyser to R.C. Hall, Comments on Preliminary Draft of Ranger Chronology, January 7, 1969.)
Oct. 4	On the second anniversary of Sputnik I, the Soviet Union launched Luna III on a circumlunar trajectory. Several days later the spacecraft photographed and subsequently transmitted to earth the first pictures of the hidden side of the moon, showing 60 percent of this yet unseen hemisphere. ("Exploring the Moon from Baikonur and Cape Kennedy," op. cit., 55.) This success, following the earlier success of Luna II, had a profound effect in mobilizing JPL sentiment to "beat the Russians" in space exploration, and caused an increase in NASA efforts directed towards an unmanned lunar exploration program. (Figure 16.)
Oct. 5	Dan Schneiderman was assigned continuing responsibility for coordinating the various JPL groups involved in the Vega spacecraft design effort, and for resolving differences in engineering criteria. (JPL, IOM from J.D. Burke to Distribution, October 5, 1959, JPLHF 2-842.)
Oct. 7	The NASA launch operations group notified officials at AMR that the facilities at Hangar H would be sufficient to their needs pending proposed modification. (NASA, memo from AMROO to Deputy Commander/Tests and Deputy Commander/Range, October 7, 1959, JPLHF 2-1168.)
Oct. 8	NASA notified JPL that it had adopted a "policy that payloads which might impact a celestial body must be sterilized. . ." Plans to carry out this policy were delineated. (NASA, letter from A. Silverstein to W.H. Pickering, October 8, 1959, JPLHF 2-862.)
Oct. 13	The 11th meeting of the CMLC was held in Washington, D.C. Chairman Holaday reviewed for the Committee his study and

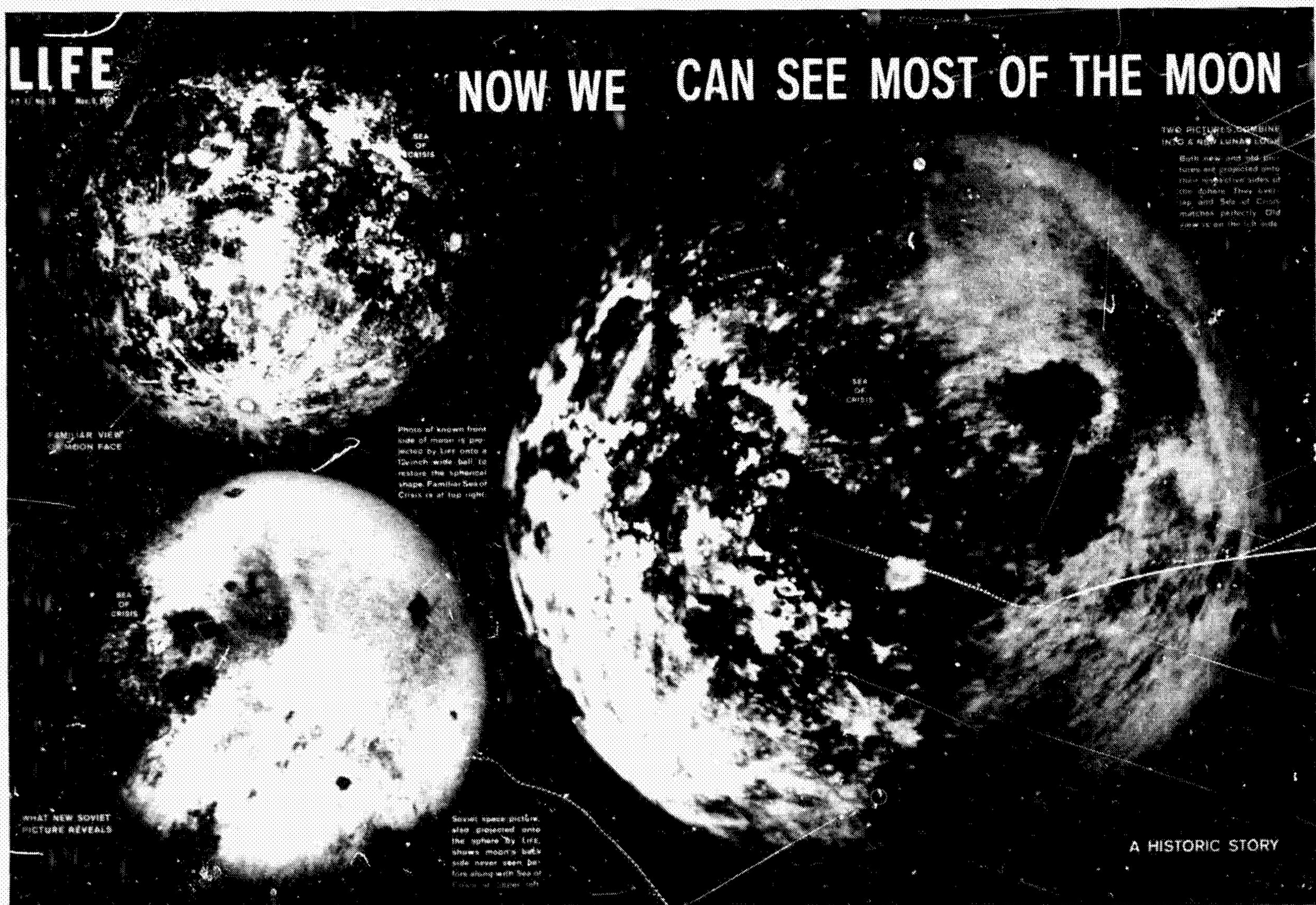

Figure 16: Luna III photographs of the far side of the Moon.

1959

Oct. 13 cont. recommendations concerning the National Space Vehicle Program. The major recommendation was the replacement of the G.E. second stage of the Vega with the Lockheed Agena B. He noted that the Atlas-Agena B combined with the JPL-6K Vega third had about the same payload capability as the original Vega. Since this report had been submitted to the DOD and NASA on September 30, the Committee did not take a formal position on the study. (Minutes of Civilian-Military Liaison Committee meeting, October 13, 1959, 3-4, JPLHF 2-814.) (See September 30, 1959.)

Dr. T. Keith Glennan responded to Dr. Hugh Odishaw's letter of September 14. He concurred with SSB recommendations regarding the requirements for sterilization of United States space probes, and noted that the instructions had been sent to field centers and laboratories involved in deep space exploration to develop procedures for sterilization and to compile an inventory of spacecraft components. (NASA, letter from T.K. Glennan to H. Odishaw, October 13, 1959, JPLHF 2-871b.) (See October 8, 1959.)

Oct. 15 NASA Headquarters informed field centers of a requirement to sterilize payloads that might impact a celestial body. "Of the several means of sterilization proposed, NASA considers the use of ethylene oxide in its gaseous phase as the most feasible agent at this time." (NASA, memo from A. Silverstein to the Director, Goddard SFC, October 15, 1959, JPLHF 2-1930.)

Oct. 16 Dr. T. Keith Glennan, in a memorandum, instructed the NASA associate administrator to establish a formal, NASA-wide reliability program. An Office of Reliability and Systems Analysis was created in the Office of the Associate Administrator shortly thereafter. (Statement of Dr. Golovin at Monterey, California, Third Semi-Annual NASA Staff Conference Program Formulation and Status of Activities, March 3-5, 1960, 50-51, JPLHF 2-472.)

Oct. 20 The Science Office in NASA OSFD issued a proposed list of experiments to be discussed with JPL for inclusion in lunar mission Vegas. (NASA, memo from H.E. Newell to J. Clark, October 20, 1959, JPLHF 2-1931.)

Oct. 21 NASA and the DOD signed an agreement in which NASA assumed responsibility for the development of very high-thrust space boosters. Transfer of the Development Operations Division of ABMA, Huntsville, including the Saturn Project, to NASA was authorized. The President approved the inter-agency agreement on November 2, 1959. (Government Operations in Space, op. cit., 124.)

1959

Oct. 22 NASA Administrator T.K. Glennan, accompanied by members of his staff, arrived at Huntsville, Alabama, to discuss tentative plans for the ABMA organizational elements included in the proposed transfer to NASA. Some of the major points emphasized by Glennan were his intentions to organize NASA into four major divisions: General Administration (Washington, D.C.), R&D center activities (Lewis, Langley, and Ames), payload and payload operations (Goddard and JPL), and vehicle systems and launching operations (Redstone Arsenal); to center at Redstone Arsenal all of NASA's broad interests in the space booster field; to have the development of NASA's large booster system program accomplished by the Redstone group; and to combine the Saturn and Nova programs into a single long-range program. Mr. A.F. Siepert, Director of the NASA Office of Business Administration, was appointed by Dr. Glennan to have overall responsibility for NASA in negotiating and planning for the transfer. (Memo for the Record, Special Assistant to CG, AOMC, Subject: "Summary Notes of Dr. Glennan's Visit to AOMC on 21 [sic] October 1959," October 24, 1959, as cited in "Historical Origins of NASA's Launch Operations Center," op. cit., 60-61.)

Oct. 23-24 The NAS-SSB held its sixth meeting. Dr. Homer E. Newell of the Office of Space Flight Development (OSFD), speaking for Dr. Hugh Dryden, presented a summary of the NASA space science program. The presentation was well received and, thereafter, the OSFD made an annual report of its activities to the SSB. (C.M. Atkins, NASA and the Space Science Board of the National Academy of Sciences, op. cit., 34-35.)

Oct. 28 Vega V-1 spacecraft delivery schedule was released for one mockup, one engineering model, and one flight spacecraft; completion and delivery was scheduled for February 1960, April 1960, and September 1960, respectively. (IOM from D.F. Sherff/F.C. Smith, October 28, 1959, JPLHF 2-1006.)

During October Firing tests of the JPL 6K static test model of the Vega third stage propulsion system commenced on Stand D at the Edwards Test Station, California. (JPL, Space Programs Summary No. 6, op. cit., 82.)

The JPL Space Instruments Section released Functional Description for Typical Vega Scientific Instruments. Instruments included a photographic system, flux-gate magnetometer, pulse ionization chamber, integrating ionization chamber, solar corpuscular radiation detector, and charge measurement. (JPLHF 2-948.)

1959

Nov. 1 JPL released Publication No. 30-20, Operational and Facility Requirements Tentatively Proposed for the NASA Deep Space Instrumentation Facility Located at Island Lagoon, Woomera Range, Australia. (JPLHF 2-585)

Nov. 5-6 Dr. A. Silverstein, and a group from NASA Headquarters, visited JPL to review the Vega program. Following discussions, it was decided that:

1. Vega two-stage satellite vehicles would be cancelled, and Headquarters would employ other vehicles to fill earth satellite requirements.
2. Consequently, Vega would be reduced from an eight to a six vehicle program with four firings in 1961 and two at the planets in 1962.
3. The Laboratory would concentrate additional effort on spacecraft development; planned evolution would provide lunar, planetary, and interplanetary spacecraft for Centaur starting in late 1962 or early 1963. Additional Vegas would be procured only in the event Centaur was delayed.
4. The Laboratory would prepare a new set of missions for the six remaining Vegas and some follow-on Centaurs to provide lunar photography, lunar rough landing (as preliminaries to soft landings), and firings at the planets in the fall of 1962 and again in 1964.
5. The Space Science Division of the Laboratory would act as an experimenter with its photographic equipment on a lunar shot "performed by some other vehicle in 1960."

(JPL, letter from W.H. Pickering to A. Silverstein, November 9, 1959, JPLHF 2-843.)

Nov. 12 NASA altered the Vega Flight Schedule, slipping the first flight one month (to February 1961) and stretching out the remaining five flights. Vehicles seven and eight had been cancelled several days earlier; JPL and NASA determined to replace these Vegas only in the event Centaur was not available in 1962. JPL was requested to prepare a new set of deep-space missions for the remaining six flights. (Clark, op. cit., 65,66.)

Nov. 16 The Vega V-1 spacecraft x, y, z coordinate system or orientation was released. (JPL, IOM from F.P. Framan to Distribution, November 16, 1959, JPLHF 2-844.)

1959

Nov. 16 cont.	In a memo to the Director of Business Administration and the Director of Space Flight Development, Richard E. Horner, NASA Associate Administrator observed that "It is apparent that most of the differences which have developed between the Jet Propulsion Laboratory and the Headquarters relate directly to the Vega Program. I think that it can be safely assumed that this is in large part attributable to the fact that the Vega Project was initiated during the early formative stages of our organization and program development. . . ." (NASA, memo from R.E. Horner to Director of Business Administration and Director of Space Flight Development, November 16, 1959, JPLHF 3-314.)
Nov. 18	JPL established a Systems Division to centralize the function of spacecraft systems engineering and design, and testing of assembled spacecraft. H.M. Schurmeier was appointed Division Manager. (JPL, IOM from W.H. Pickering to Distribution, November 18, 1959, JPLHF 3-243.)
	NASA assumed technical direction of the Saturn Project pending formal transfer from the Army.
Nov. 20	JPL informed NASA that it was formally activating a new division under the name Space Science. Dr. A.R. Hibbs was appointed Division Manager. (JPL, letter from W.H. Pickering to R.L. Bell, November 20, 1959, JPLHF 2-865.) (See July 15, 1959.)
	Initial spacecraft sterilization requirements were released at JPL. The requirements were planned for implementation on the third and fourth flights; however, it was considered "desirable to incorporate as many of them as possible, on a not-to-interfere basis, in the first two [test] flights. . ." (JPL, IOM from J.D. Burke to Distribution, November 20, 1959, JPLHF 2-845.) (See October 13, 1959.)
Nov. 23	The new Vega Program and budget was presented at Headquarters by C.I. Cummings and, following discussions, was accepted. Considerable concern was expressed by Headquarters personnel regarding JPL suggested use of a nuclear power supply in lunar vehicles because of the potential for contamination of the moon; subsequently the plan was dropped. (JPL, IOM from J.H. Keyser to Distribution, November 25, 1959, JPLHF 2-1016.)
	A Telecommunications Division was established at JPL with responsibility for the DSIF and supporting research and development. (JPL, IOM from W.H. Pickering to Distribution, November 23, 1959, JPLHF 3-238.)

Nov. 23 cont. Considering recent Soviet space successes, delays in the NASA Vega program, and the attitude of the Administration towards space exploration, Dr. W.H. Pickering, speaking before a meeting of the American Rocket Society in Washington, D.C., asserted that "we should frankly admit that we are indeed in a race with the USSR, . . . we must either pursue our space developments actively and successfully, or we must declare ourselves completely out of the space race." (Aviation Week, November 23, 1959, 26, JPLHF 2-592.)

Nov. 25 At a JPL Vega Staff Meeting C.I. Cummings outlined a proposed plan for organizing the Vega Lunar Impact Capsule effort. It was hoped that a contractor could be selected, contract negotiations begun, and a project engineer assigned by the end of the year. (JPL, IOM from J.H. Keyser to Distribution, op. cit., 2.)

Nov. 26 The second NASA attempt to launch Atlas-Able Pioneer P-3 lunar probe failed (see September 24, 1959). Shortly after launch the plastic nose fairing collapsed, causing the payload to break away from the booster. (Emme, Aeronautics and Astronautics, 1915-1960, op. cit., 115.)

Nov. 30 The Space Science Division, JPL, released a list of proposed scientific experiments for all planned Vega missions including the first two test flights planned for escape trajectories. The choice of scientific packages for the first two flights was "based on the viewpoint that these packages should constitute an experiment, not merely a collection of instruments. This outlook not only is consistent with the traditions of experimental science, but also it helps ensure that spacecraft technology will develop in a direction compatible with space science." (JPL, IOM from Space Science Division to Distribution, November 30, 1959, JPLHF 2-846.)

During November JPL concluded its study of a two-stage Vega for earth orbit missions early in the month (see June 1959). An approach which would use a two-stage Vega plus a Lockheed Agena A minus the propulsion system as the attitude-stabilized platform for NASA earth satellites was examined and then rejected as unnecessarily complicated. JPL recommended that the existing Air Force Thor-Agena or Atlas-Agena be employed for earth satellite missions instead of Vega. NASA accepted this recommendation and the Vega flight schedule was redirected exclusively to deep space missions (see November 12, 1959). The study also noted that, when information on the Agena B became available in the summer, During November cont. preliminary analysis indicated performance of the Air Force two-stage Atlas-Agena B was about equal to the three-stage Vega for all but the highest energy deep space missions. (JPL, Agena Study Report, op. cit., I.a.1.)

Assembly of the Vega V-1 (redesignated S-1) flight spacecraft was rescheduled to occur in June 1960. (JPL, Space Programs Summary No. 6, op. cit., 9.)

A JPL area survey team headed by Jack N. James selected a site for the DSIF station near Johannesburg, South Africa; a mid-1961 operational date was proposed in support of the Vega lunar and planetary flight program. (DSN Facility Activation Dates, loc. cit.) (See July 1, 1958.)

Dec. 1 The NASA OSFD Lunar Science Group met in Washington, D.C. "In attendance were R. Jastrow, H. Urey, T. Gold, Harrison Brown, et. al." Following review of the NASA unmanned lunar exploration program, members of the Lunar Science Group recommended that NASA radically alter the planned sequence for lunar exploration:

> We believe that a mistake will be made in the lunar program if the instrumented [soft] landing is scheduled prior to the acquisition of preliminary surface data. In recent discussions the acquisition of surface data has been tied to the development of an advanced low altitude lunar orbiter, which represents a formidable technological achievement. However, it is not necessary to develop the advanced lunar orbiter to obtain information on surface structure. In an instrumented hard landing a series of high resolution TV images can be obtained on close approach to the moon's surface, provided $\approx$100 pounds of batteries are available to provide power for large band widths. In addition, a penetrometer may also be feasible for the hard landing package. It is recommended that serious consideration be given to the possibility of this hard landing project.

(NASA, Memo from R. Jastrow to H.E. Newell, "Report on December 1 Meeting of the Lunar Science Group," Dec. 11, 1959, JPLHF 2-1933a; and, N.W. Cunningham, Lunar Science Chronology, op. cit., 2.)

Dec. 2 The fourth hot fire system test of the 6K engine was conducted at the Edwards Test Station. The motor was operated for 190-seconds, and "the hardware was in excellent condition after the test." This was the first completely successful long duration system

1959

Dec. 2 cont.	test of a fuel-cooled 6K engine. (JPL, letter from A. Briglio Jr. to A.O. Tischler, NASA, December 11, 1959, JPLHF 2-824.)
Dec. 3	JPL released Publication No. 31-2, <u>Ten Year Plan</u>, which set forth the goal of space exploration, JPL's role in NASA, the spacecraft for deep space missions in the next decade, and the kinds of equipment and experiments that might be most most usefully employed. In the first instance, JPL adopted a goal "which is assumed to be the policy of the National Aeronautics and Space Administration: The pursuit of a vigorous space program which will result in the United States regaining and maintaining a position of world leadership in this area of technology. . . ." (p. 1) Spacecraft with similar features would evolve from S-1 through S-5 (previously called V-1 through V-5). The S-1 Vega was planned for use in intermediate lunar exploration, such as a hard landing, and for initial planetary missions, e.g., Venus or Mars fly-by probes. (JPLHF 2-607.) (Figures 17 and 18.)
Dec. 3-4	The NASA OSFD Lunar Science Group (formed July 13, 1959) submitted its deliberations on and recommendations for a NASA deep space program to NASA Administrator T. Keith Glennan (see December 1, 1959). It outlined a lunar and interplanetary flight schedule based on employing the Atlas-Agena B in place of the Vega launch vehicle program, with mission responsibility assigned to JPL (see repercussions December 9, 16, 21, and 29, 1959). This report coupled with the Stewart Committee recommendations (see October 2, 1959), launch stand readiness problems, and the Atlas-Able launch failure on November 26, caused Dr. Glennan to decide in favor of the Atlas-Agena B, and he requested that a draft TWX be prepared for dispatch to JPL. The TWX was not sent pending a proposed telephone conversation with Dr. Pickering on December 7. (Draft of TWX for T.K. Glennan by G.F. Schilling, NASA, December 4, 1959, JPLHF 2-805; also, letter from G.F. Schilling to R.C. Hall, January 23, 1969.)
Dec. 4	JPL released Publication No. 30-21, by J.R. Hall, <u>A Description of Deep Space Net Facilities, Operations, and Capabilities</u>, which summarized existing DSN capabilities and proposed future capabilities for NASA-JPL deep space missions. (JPLHF 2-587)
Dec. 7	In a telephone conversation, NASA Administrator Glennan informed JPL Director Pickering that NASA had decided to terminate the Vega launch vehicle program in favor of the Atlas-Agena B. It was agreed that work on this project would be terminated at the close of business December 11, 1959. (TWX from R.E. Cushman,

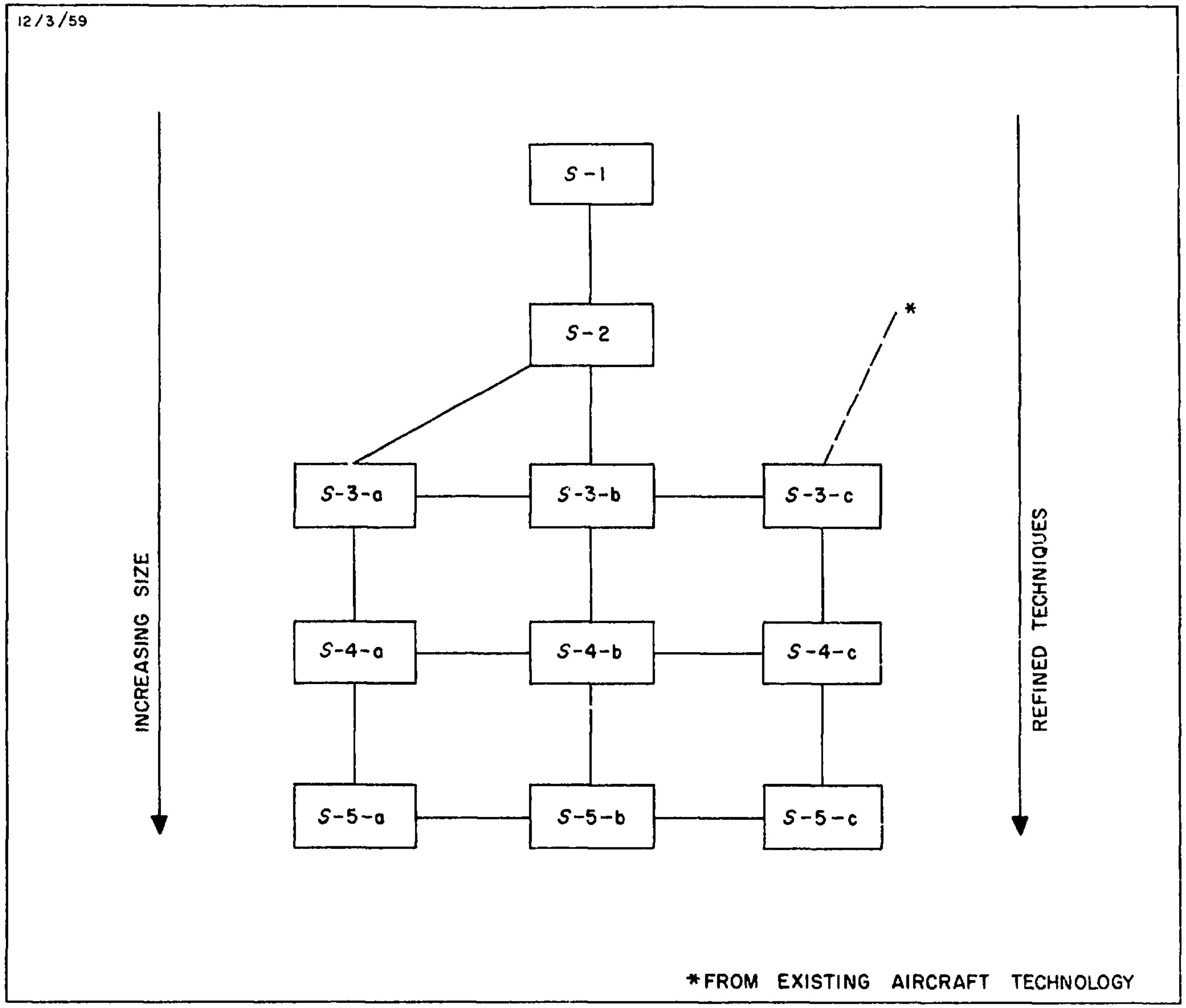

Figure 17: Proposed evolution of NASA-JPL unmanned spacecraft for deep space exploration.

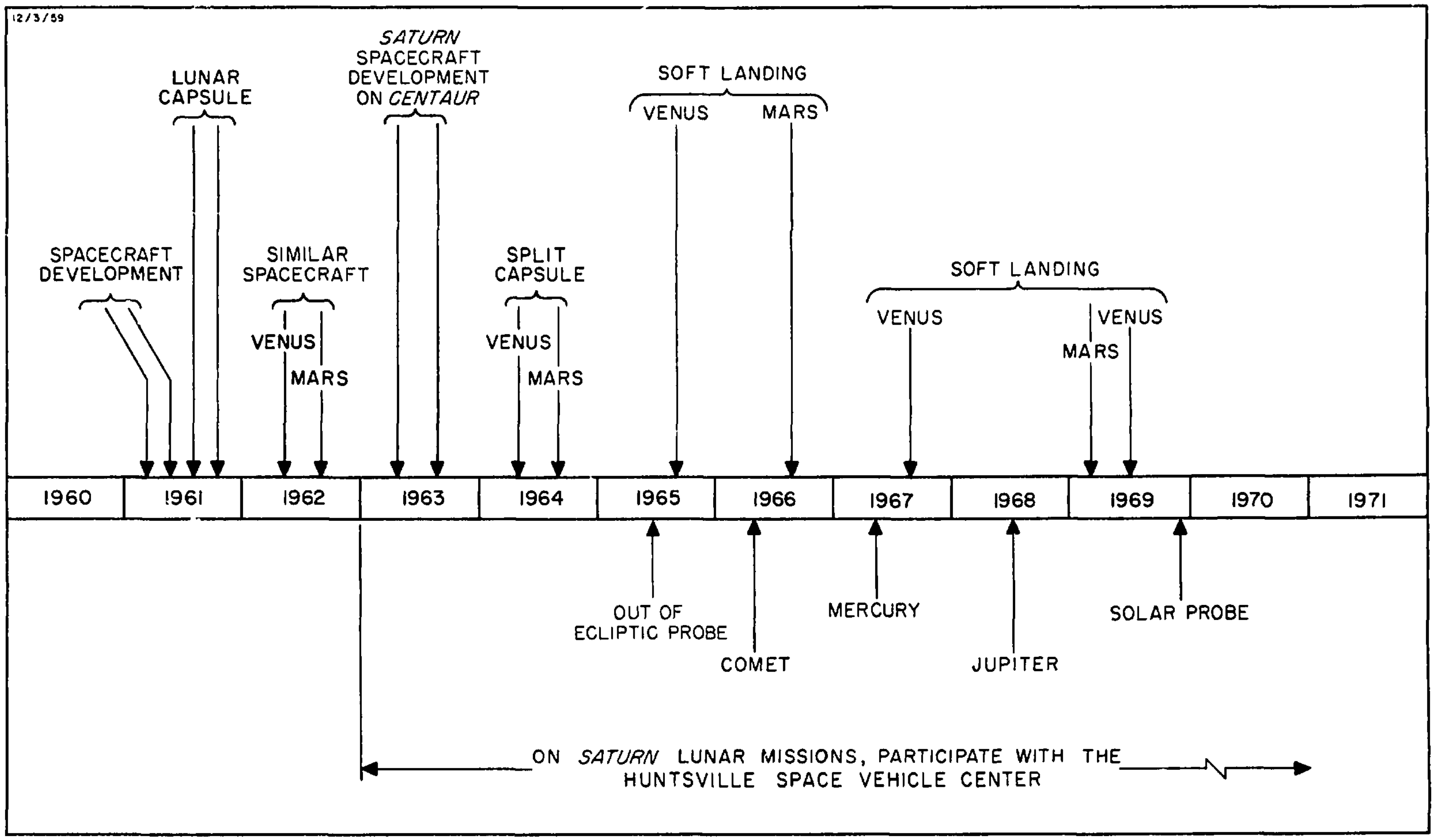

Figure 18: Deep space flight missions proposed for JPL, 1959 (by calendar year).

Dec. 7 cont. NASA Contracting Officer, to George Green of Caltech, December 14, 1959, JPLHF 2-804.)

In a paper entitled "Design Criteria for Vega Lunar Capsule," J.D. Burke of JPL affirmed that:

> One of the missions of the Vega project is to land a functioning radio transmitter on the moon, and to perform a lunar scientific experiment using the radio link. Other missions of the program require the development of an attitude-stabilized spacecraft with long-range communication capability and long equipment lifetime. In order to fit the lunar experiment into this spacecraft development program it has been decided to use a single basic spacecraft configuration for all flights, and to add a landing capsule for the lunar-impact shots.

(JPLHF 2-1349)

Dr. Thomas Gold of Cornell University urged NASA to consider a penetrometer experiment--to provide information on the lunar surface--rather than a seismometer for early lunar hard impact missions. A simple penetrometer could eliminate the need for a retro rocket, while a seismometer, moreover, might not detect any moonquake during the life of its batteries. ". . . such a negative answer would be very disappointing." (Letter from T. Gold, Director, Center for Radiophysics and Space Research, Cornell University, to R. Jastrow, December 7, 1959, JPLHF 2-1933b.)

Dec. 8 NASA Headquarters was reorganized to include ABMA's Development Operations Division under a new office (which would manage the NASA Atlas-Agena B and Centaur rockets programs). Silverstein's Office of Space Flight Development (OSFD) with four divisions (Advanced Technology, Space Sciences, Space Flight Operations, and Propulsion) was recast as the Office of Space Flight Programs (OSFP) with the first three divisions intact. A new Office of Launch Vehicle Programs (OLVP) with three major divisions (Propulsion, Vehicles, and Launch Operations) included von Braun's ABMA group. OLVP was to be headed by Air Force General Don R. Ostrander beginning January 1. (NASA Release 59-270, December 8, 1959, and 59-285, January 1, 1960.)

Dec. 9 LMSD released Agena Capabilities for NASA Missions, LMSD 446175, December 9, 1959.

Dec. 10 JPL notified the NASA Tracking Office that the latest plans called for all Vega and Agena launches from AMR to be fired in a south-east direction instead of a north-east direct ascent trajectory. "With these new launch azimuths, the requirements for tracking

1959

Dec. 10 cont. and instrumentation stations at Bermuda and Newfoundland cease to exist." (JPL, letter from C.I. Cummings to E.C. Buckley, December 10, 1959, JPLHF 2-847.)

Dec. 11 The Vega launch vehicle program was formally terminated. The Atlas order at Convair was suspended, the G.E.-405H engine development effort was cancelled, and the JPL-6K program was redirected to an experimental power plant development project which was later phased out in 1960. Work on the JPL inertial Vega injection guidance system (VIGS) was also cancelled. (JPL, IOM from Dr. W.H. Pickering to All Personnel, December 11, 1959, JPLHF 2-801; TWX to George Green of Caltech from R.E. Cushman, NASA Contracting Officer, confirming oral understanding between Dr. Pickering and T.K. Glennan terminating work on Vega as of December 11, 1959, JPLHF 2-804; JPL, Space Programs Summary No. 37-1 for the period November 15, 1959 to January 15, 1960, Pasadena, February 1, 1960, 1; and, Review of Canceled Atlas-Vega, op. cit., 24.) (Figures 19 and 20.)

Dec. 14 JPL requested that NASA establish policy guidelines to regulate the selection, design, fabrication and testing of scientific instruments developed by outside organizations for use in NASA-JPL space missions. (JPL, letter from W.H. Pickering to A. Silverstein, December 14, 1959, JPLHF 2-802.)

Dec. 16 NASA released its Long Range Plan. United States lunar and planetary exploration planned for the next ten years would initially emphasize the study of the moon. "While manned flight to the moon is not a goal expected to be achieved during the next ten years, in a sense the manned space flight program, the space vehicle development program, and the program of unmanned lunar and planetary exploration are all oriented toward the ultimate objective of manned flight to the moon and the nearby planets." (p. 33) The scientific objectives and purpose of the initial unmanned lunar and planetary exploration program were categorized as "the exploration of the surface and nearby environment of the moon and the nearer planets; and the determination of the physical and chemical properties of the lunar and planetary atmospheres, surfaces and interiors . . . both for basic scientific information and for the future selection of landing sites." (Ibid.)

With cancellation of the Vega program and announced transfer to NASA of the space component of ABMA, Huntsville, Associate Administrator Richard Horner issued a redefinition of field center responsibilities and reporting procedure. Goddard Space Flight Center and JPL would report to Dr. Silverstein's

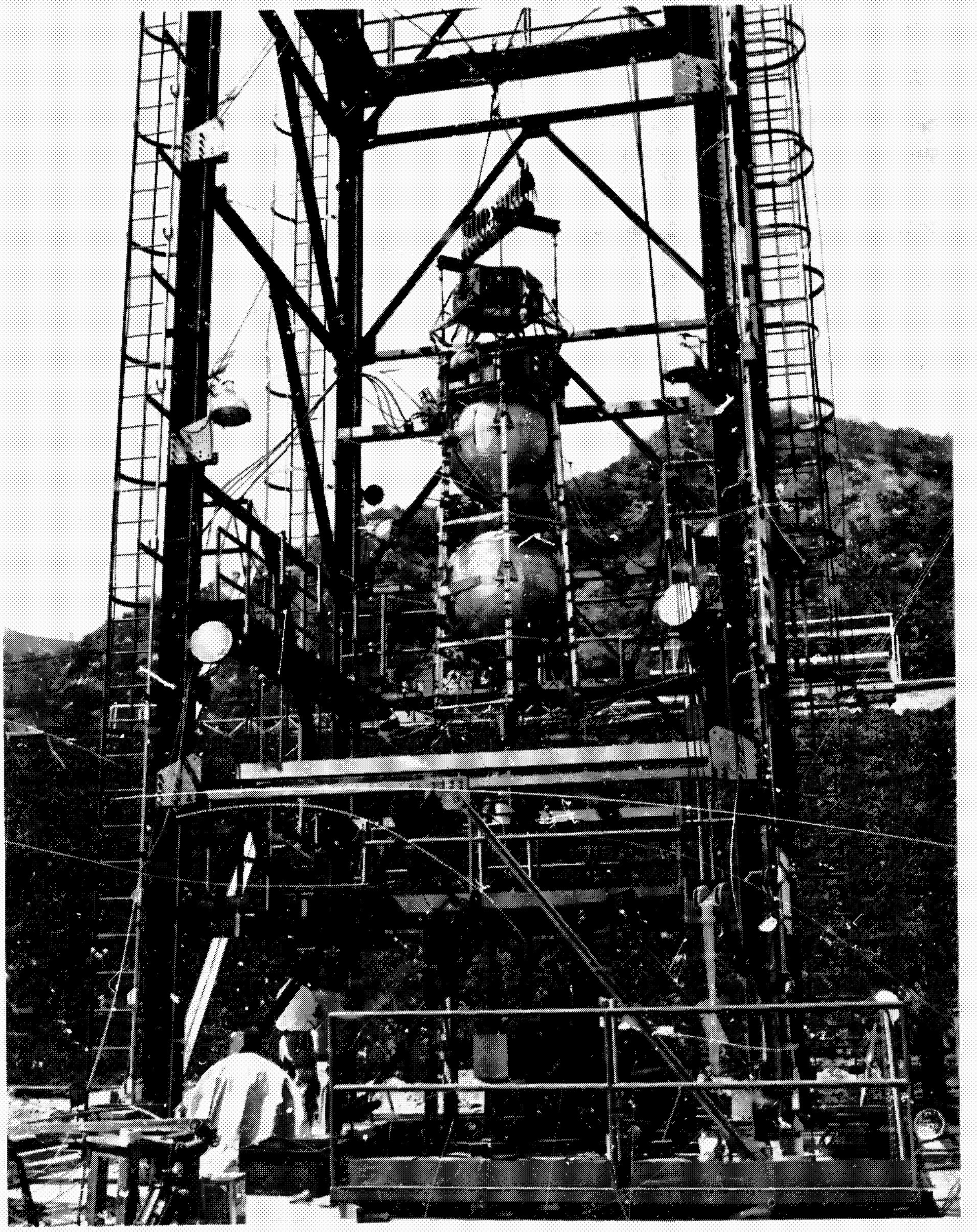

Figure 19: JPL Vega third stage in test stand, December 1959.

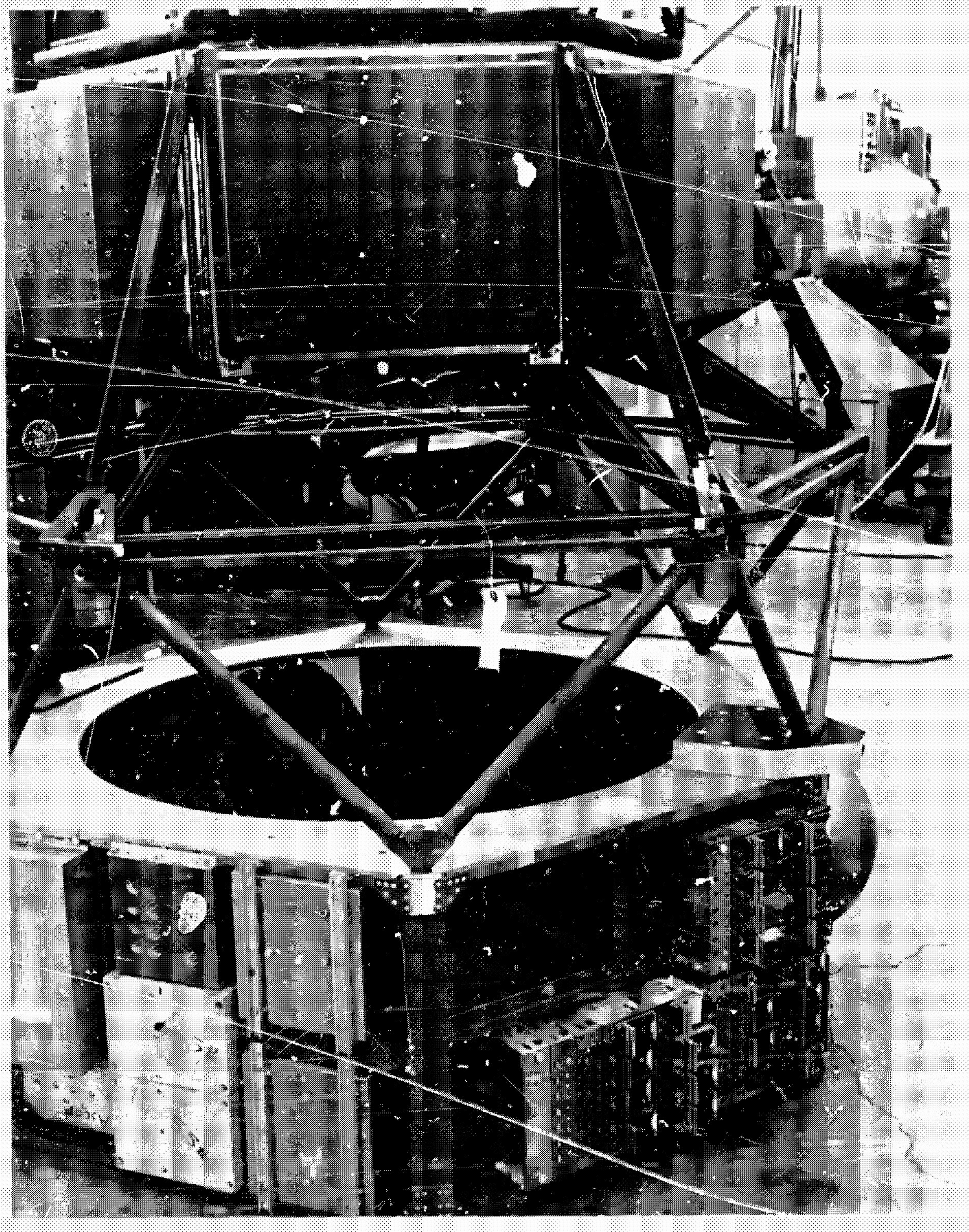

Figure 20: Vega third stage spacecraft interface, hexagonal symmetry, December 1959.

Dec. 16 cont. office. The Huntsville facility would report to the new office responsible for launch vehicle activity directed by Major General Ostrander.

> In carrying out its responsibility for planning and execution of lunar and interplanetary space exploration program, the Jet Propulsion Laboratory will accomplish detailed mission planning, develop spacecraft to carry out these missions, integrate the experiment instrumentation into the spacecraft, acquire and analyze the necessary data during the mission flight and record final results. It is apparent that at presently foreseen levels of program activity it will not be possible for the Laboratory to accomplish all of the spacecraft development solely with the use of its own staff. It is, therefore, expected that a part of the developments will be contracted with industry and the Laboratory will assume the responsibility of monitoring such contracts.

Mr. Horner also indicated that "the Administrator has decided that our efforts for the present planning period should be concentrated on lunar exploration as opposed to the exploration of the planets." (NASA, letter from R.E. Horner to W.H. Pickering, December 16, 1959, JPLHF 2-803.)

Dec. 17 JPL requested that the title, charter, and membership of the Lunar Science Group, chaired by R. Jastrow in the Office of Space Sciences, be reorganized and expanded as a scientific advisory group on lunar <u>and</u> planetary exploration. (JPL, letter from W.H. Pickering to A. Silverstein, December 17, 1959, JPLHF 2-803.)

Dec. 18 Agreement was reached with the Australian government for a deep space tracking and data acquisition station in Australia, similar to the station at Goldstone, California. (<u>The Origins of the Australian Cooperation in Space</u>, <u>op. cit</u>., 57.)

Dec. 21 Based on the recommendations of the Lunar Science Group (see December 3-4, 1959), Dr. A. Silverstein directed a letter to Dr. W.H. Pickering which established a post-Vega lunar and interplanetary flight program and missions through 1962. Seven flights were planned; the first five were to be Atlas-Agena B launched spacecraft for "lunar reconnaissance" in 1961-1962, and the last two were Atlas-Centaur missions to Mars and Venus in 1962. Of several experiments considered, lunar reconnaissance was judged the most urgent: to obtain high

Dec. 21 cont. resolution pictures of the lunar surface "in the period immediately preceding impact" for use in an integrated lunar exploration program. In addition, JPL was requested to examine the feasibility of carrying a basic group of scientific instruments on the spacecraft for use in evaluating fields and particles in cislunar space, and to reexamine its proposal for depositing an instrument package on the moon which would "survive impact and then transmit significant data." This letter constituted the basis for what subsequently became known as Project Ranger. (NASA, letter from A. Silverstein to W.H. Pickering, December 21, 1959, JPLHF 2-470.)

Dec. 27 Dr. Homer E. Newell, Director of the Office of Space Sciences in NASA OSFD, accepted appointment as Chairman of a new Planning Committee on Planetary Science of the American Geophysical Union. (NASA, letter from H.E. Newell to Lloyd V. Berkner, December 27, 1959, JPLHF 2-1938.)

Dec. 28 A meeting was held at JPL to discuss lunar and planetary missions as set forth in Dr. Silverstein's letter of December 21. In attendance were Homer E. Newell Jr., Newell Sanders, J.A. Crocker, and Morton J. Stoller representing NASA Headquarters, and W.H. Pickering, A.R. Hibbs, R.J. Parks, C.I. Cummings and R. Richter, from JPL. The basic lunar and planetary program plans and philosophy were established at this meeting. Overall NASA space flight program objectives were stated to consist of two elemental considerations: (1) the extension of the domain over which man may move and be active, and (2) the extension of human knowledge about the earth, its environment, and space and celestial bodies in space. "In the matter of Russian competition, it is clearly understood that whether it be stated openly or not, the United States is in competition with Russia, and the stakes are very high indeed. . . ." (NASA, memo for the file from H.E. Newell, December 30, 1959, JPLHF 2-1935a.)

Dec. 29 In a memorandum to Don R. Ostrander, Director of the Office of Launch Vehicle Programs, and to Abe Silverstein, Director of the Office of Space Flight Programs, NASA Associate Administrator Richard E. Horner described proposed functions for a NASA Space Exploration Program Council, concerned primarily with program development and implementation. This top-level management council would be made up of the directors of the Jet Propulsion Laboratory, The Goddard Space Flight Center, The Army Ballistic Missile Agency, the Office of Space Flight Programs, and the Office of Launch Vehicle Programs. Horner would act as Chairman of the Council which would hold a first meeting on January 28-29, 1960 [later changed to February 10-11, 1960]. (NASA, memo, Horner to Ostrander and Silverstein, December 29, 1959, cited in NASA, Apollo Spacecraft Chronology, Vol. I, p. 7.)

Dec. 29 cont. Major General Don. R. Ostrander notified Dr. von Braun at Huntsville that Atlas-Vega would be replaced by the Atlas-Agena B. "In accordance with our recent discussions regarding the role your group will play in the NASA organization, I intend to place the Agena vehicle project under your direction at the outset. . . . The Jet Propulsion Laboratory, now a field branch of Dr. Silverstein's Headquarters office, will have mission responsibility and will develop and operate the spacecraft which are to be delivered to injection by the Agena vehicle. Prior to implementation of the project, I would like you to establish a survey team to review the Agena vehicle and to report the results and your recommendations to me by January 15, 1960. . . ." (Letter from D. Ostrander to W. von Braun, December 29, 1959, JPLHF 2-582.)

In response to the guideline letter of December 21 which established the post-Vega program, Dr. W.H. Pickering notified NASA Headquarters that "any commitment to a firing schedule is very strongly dependent on the interface and peripheral work to be done by other organizations. Defendable schedules and funding requirements cannot be prepared until the responsibilities, authority, and obligations of these other organizations are mutually understood." (JPL, letter from W.H. Pickering to A. Silverstein, December 29, 1959, JPLHF 2-469.)

JPL decided in favor of continuing with preliminary design of the S-1 (formerly V-1) as a prototype spacecraft. Dan Schneiderman was placed in charge of this effort, taking into account the Agena study and current mission planning. (JPL, IOM from John Small, to All Concerned, December 29, 1959, 1-2, JPLHF 2-987.)

Dec. 30 DOD issued a directive which further modified ARPA's role as "'an operating research and development agency of the Department of Defense under the direction and supervision of the Director of Defense Research and Engineering.'" (Government Operations in Space, op. cit., 54; also, U.S. House of Representatives, 88th Congress, Second Session, Serial I, Report of the Subcommittee on NASA Oversight of the Committee on Science and Astronautics, The NASA-DOD Relationship, GPO, Washington, D.C., 1964, 82.)

IV

RANGER BLOCKS I AND II, 1960-1962

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RANGER BLOCKS I AND II, 1960-1962

1960

Jan. 1 NASA Headquarters was formally reorganized. A new Office of Lunar and Planetary Programs was established within the Office of Space Flight Programs (OSFP); Edgar Cortright was named Assistant Director, Lunar and Planetary Programs. (See July 1959.) A new Office of Launch Vehicle Programs (OLVP) was established, and AMROO was transferred to OLVP from OSFP. "The transfer eliminated the direct channel of communication between the payload groups of the OSFP Centers and AFMTC." (F.E. Jarrett and R.A. Lindemann, Historical Origins of NASA's Launch Operations Center to July 1, 1962, KSC HM-1, Comment Ed., October 1964, 65-66; also, NASA, Major Activities in the NASA Programs, October 1, 1959 - March 31, 1960, 6; also, NASA News Release 59-285, January 1, 1960.)

Jan. 7 The NASA Agena Study Committee met at JPL. Lunar objectives, established in the Silverstein letter of December 21, 1959 (high-resolution local photography of the lunar surface, and lunar landing with survival of scientific and communication equipment), were reviewed. The question next considered was whether or not there was a reasonable prospect of attaining both of these objectives during the five authorized Atlas-Agena B firings slated for 1961 and 1962.

Management would be controlled through an ABMA Project Team, under von Braun, to be headquartered at AFBMD or NASA-WOO in California. JPL would have responsibility for the spacecraft and flight mission operations. (J.D. Burke, Report on Agena Survey, January 9, 1960; see also IOM from C.R. Gates to Distribution, Minutes of Agena Study Committee Meeting, January 7, 1960, JPLHF 2-476.)

Jan. 10 NASA and the Air Force agreed to a "multi-use capability" for various Atlas-Agena programs on Atlas launch stands at AMR. (Memorandum of Agreement on Launch Pad Facilities for NASA Agena Firings, by M. Rosen, Chief of Rocket Vehicle Development, to the NASA Administrator and the Commander of ARDC, January 10, 1960, JPLHF 2-989.)

Jan. 12 A meeting was held among JPL and NASA Headquarters personnel to discuss experiments tentatively planned for inclusion in the JPL lunar spacecraft to be flown atop an Atlas-Agena B. JPL was requested to send a letter to Headquarters recommending approval of assignment of experiment responsibilities. Formal approval would then be forwarded to Dr. Pickering. (Memo to Files, from N.W. Cunningham, Subject: Atlas-Agena B Payload Experiment Meeting with JPL Personnel, January 18, 1960, JPLHF 2-667.) (See January 20, 1960.)

1960

Jan. 13 JPL completed evaluation of a Lockheed proposal for integration of the lunar payload into the Agena B, with the Agena booster acting as the attitude-stabilized platform during cislunar flights. It was determined that provision of a JPL spacecraft separable from the Agena was more desirable because it would provide a clean definition of areas of responsibility, reduce communications problems, facilitate independent testing on the "system" level, and avoid sterilization requirements for the entire Agena stage. Moreover, "there is additional desire on the part of JPL personnel to gain significant spacecraft experience prior to development of more sophisticated missions in the future such as Centaur and Saturn. This experience can only be obtained by active technical participation, and not through the process of technical monitoring of programs." (IOM, R.V. Morris/J.W. Stearns to C.R. Gates, January 13, 1960, JPLHF 2-477; also, Ranger Project Development Plan, [Revised July 5, 1961], 8.)*

JPL Director Dr. W.H. Pickering informed members at the Laboratory that adaption of the Vega S-1 spacecraft and experiments for use on the Agena vehicle was feasible, and assigned S-1 spacecraft development a priority immediately behind the Sergeant missile program. Efforts were to be directed toward meeting the launch dates previously planned for Vega. (JPL, IOM from W.H. Pickering to All Concerned, January 13, 1960, JPLHF 2-1017.)

NASA and AFBMD reached agreement on management procedures for those tasks assigned the Air Force by NASA. (NASA, Cover Document dated January 13, 1960, signed by A. Silverstein and O.J. Ritland with procedures attached for NASA/AFBMD Management Agreement; and, NASA/AFBMD Management Procedures, JPLHF 2-1396a and 2-1396b.)

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*Since the proposed Vega third stage structure had six longerons, the JPL S-1 spacecraft design, as a separable package, had hexagonal symmetry. By fortuitous circumstance this hexagonal configuration could be readily fitted to one type of forward compartment used on Agena without major modification, and work on this spacecraft continued with little disruption even though Vega was cancelled. (Testimony of Oran Nicks, Investigation of Project Ranger, Hearings before the Subcommittee on NASA Oversight of the Committee on Science and Astronautics, U.S. House of Representatives, 88th Congress, Second Session, April 27, 1964; see also, JPL, Space Programs Summary No. 37-1 for the period November 15, 1959 to January 15, 1960, February 1, 1960, 2.) (See Figures 19 and 20.)

1960

Jan. 14 President Eisenhower informed the Congress of his intention to transfer the Development Operations Division of ABMA, along with the Saturn, from the Army to NASA. Complete facility and budgetary transfer would be effected by July 1, 1960. At direction of the President, the Division's facilities together with 1,200 acres at Redstone Arsenal, Huntsville, Alabama, were to be renamed the George C. Marshall Space Flight Center. (NASA, Major Activities in the NASA Programs, op. cit., 1.)

In a message to Congress on the same day, President Eisenhower asked for a revision of the Space Act of 1958. The President disagreed with certain provisions which indicated the desirability of an integrated military and civilian space program. Accordingly, he requested that the provisions which reflected this concept of a single national program be eliminated, and that the National Space Council be abolished along with the statutory responsibility of the President and Council to formulate such a comprehensive program. (U.S. Congress, House of Representatives, Committee on Government Operations, House Report No. 445, Government Operations in Space [Analysis of Civil-Military Roles and Relationships], 89th Congress, 1st Session, June 4, 1965, 57. Hereafter referred to as Government Operations in Space.)

Jan. 15 The special committee* formed to evaluate the Agena B released its Interim Report. The conclusion reached was that utilization

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*The Agena Survey Team consisted of the following members:

Hans Hueter--Chairman
Director, Systems Support
Equipment Laboratory
Army Ballistic Missile Agency

James L. Stammy--Secretary
Chief, Systems Engineering Branch SSEL
Army Ballistic Missile Agency

Commander William Schubert
Vehicle Development Group
Headquarters, NASA

F.C. Schwenk
Analysis and Requirements
Headquarters, NASA

C.I. Cummings
Program Director
Jet Propulsion Laboratory

J.D. Burke
Deputy Program Director
Jet Propulsion Laboratory

B. Milwitzky
Staff Scientist, Lunar Missions
Headquarters, NASA

Wilfred E. Scull
Aero. Rocket Power Plant Res. Engr.
Goddard Space Flight Center, NASA

Donald R. Mulholland
Technical Division
Western Operations Office (WOO) NASA

Jan. 15 cont. of Agena B vehicles by NASA would afford "a marginal program" due primarily to "difficult managerial circumstances rather than technical drawbacks." However, since there were no other equivalent upper stages available, and Centaur would be unavailable for lunar missions for several years, the committee believed that the NASA program established in Dr. Silverstein's letter of December 21, 1959, "should be conducted. The missions outlined . . . can be accomplished with reasonable assurance, including lunar missions. The difficulties in managing such a program can be overcome when the major participating agencies agreed on the political importance of the missions." (p. 5).

The five-flight lunar program assigned for developing adequate boosters and spacecraft was considered a "minimum program, especially since the first two were planned as test vehicles without midcourse or terminal guidance, "and only on the third mission will the launching be aimed to attempt lunar impact." (Ibid.)

While a high reliability risk for the early launchings of Atlas-Agena B was recognized, emphasis remained attached to management: the need to integrate the Air Force, von Braun's group at Huntsville, JPL, and NASA Headquarters--where responsibility was now divided between spacecraft (OSFP) and launch vehicles (OLVD)--into a single team. "A suitable top level organization with sufficient authority will have to be created . . ." (p. 8). (Interim Report of the Survey Team Established to Investigate the Use of Agena for the National Aeronautics and Space Administration, January 15, 1960.)

Jan. 20 JPL acknowledged NASA selection of scientific instruments for the first two spacecraft (S-1 and S-2) in the lunar program made at the meeting of January 12. In decending order of priority, the instruments which would measure fields and particles in cislunar space were:

Solar Corpuscular Detector	Jet Propulsion Laboratory
Photoconductive Particle Detector	State University of Iowa
Magnetometer (Rb Vapor)	Goddard Space Flight Center
Vehicle Charge	Air Force Cambridge Research Center (or Goddard Space Flight Center)
Coincidence Detector	University of Chicago
Ion Chamber	California Institute of Technology/JPL

1960

Jan. 20 cont.

Lyman Alpha Scanner	Naval Research Laboratory/JPL
Micrometeorite Detectors	Goddard Space Flight Center

(Letter from W.H. Pickering to G. Schilling, NASA, January 20, 1960, JPLHF 2-668.)

NASA began presentation of its Ten-Year Plan for the exploration of outer space to the Congress. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, NASA, GPO, 1961, 118.)

Jan. 21 NASA released the first flight schedule for the new lunar program using Agena B.

Flight No. 1	Feb. 1961	Direct Ascent to approx. Escape Speed
Flight No. 2	April 1961	Direct Ascent to approx. Escape Speed
Flight No. 3	Aug. 1961	Lunar Impact
Flight No. 4	Nov. 1961	Lunar Impact
Flight No. 5	Feb. 1962	Lunar Impact

(JPL, IOM from C.I. Cummings to Division Chiefs, Table 1, January 21, 1960, JPLHF 2-993b; also, N.W. Cunningham, Ranger Program Chronology, April 22, 1964, JPLHF 2-650.)

Lockheed representatives visiting JPL made a presentation in favor of combining the spacecraft and Agena B into a single vehicle. (JPL, IOM from J.D. Burke to C.I. Cummings, H. Schurmeier, et. al., January 20, 1960.)

Jan. 25 In response to the JPL request of December 14, 1959, NASA established a statement of policy and assigned JPL responsibility for monitoring selected research and development contracts on scientific instruments intended for use on space missions in lunar and planetary exploration. (NASA, letter from A. Silverstein to W.H. Pickering, January 25, 1960, JPLHF 2-319; also supplement to that letter, same date, JPLHF 2-1395.)

Jan. 26 In response to the JPL request of December 17, 1959, NASA announced formation of a "NASA Steering Group on Lunar, Planetary, and Interplanetary Exploration" to replace the existing NASA Working Group on Lunar Exploration. (NASA, letter from A. Silverstein to W.H. Pickering, January 26, 1960, JPLHF 2-318.)

C.I. Cummings was named "Program Director" at JPL for the Agena B program, and J.D. Burke was appointed his deputy. The program was tentatively designated RANGER. (JPL, IOM from W.H. Pickering to All Concerned, January 26, 1960, JPLHF 2-233.)

Jan. 26 cont. Dr. Silverstein confirmed selection of experiments for the first two Agena B flights (see January 20, 1960), noting: "It is my understanding that requirements for technological development of the spacecraft will hold top priority on these first two Agena B flights and, hence, a final determination by JPL from the approved list of experiments must await further engineering of the spacecraft as well as further progress on the instruments themselves. . . ." (NASA, letter from A. Silverstein to W.H. Pickering, January 26, 1960, JPLHF 2-669.)

Lockheed Missiles and Space Division released Agena Reference Data for NASA, LMSD 446253-B, January 26, 1960.

Jan. 29 JPL issued the document Deep Space Communications which discussed the development of and plans for the DSIF. (W.D. Merrick, E. Rechtin, R. Stevens, and W.K. Victor, JPL Technical Release No. 34-10, January 29, 1960.)

During January In light of NASA contracting preferences and proposed manpower ceiling at the Laboratory, JPL management reached a position on the conduct of lunar and planetary programs: design and development of spacecraft in the Lunar Program would be contracted "out-of-house," and those for the Planetary Program would be developed "in-house." Inasmuch as Ranger had already begun "in-house" as an interplanetary craft and was well advanced in design for lunar applications, it was decided to continue in-house for the experience to be gained in developing this first generation vehicle. (JPL, "Comments on RA-5 Kelley Investigation," February 7, 1963, JPLHF 2-460a.)

Since one of the conclusions of the Agena Survey (January 15, 1960) was that it was technically feasible and highly desirable to fly as early as possible o an Agena B, "the development of the first model spacecraft, called Ranger A-1, is being planned for production of a flight article by early 1961." (JPL, Space Programs Summary No. 37-1, op. cit., 1.) The major functional elements of the spacecraft were: attitude control, power, communications, and environmental control. The modes of operation of these elements after separation from the Agena were already formulated. (Ibid., 2.)

In appearance of a reprint speech, Dr. W.H. Pickering contended that the most immediate United States space objective should be "to equal or exceed the achievements of Russia in space. In other words, we should frankly admit that we are indeed in a race with the U.S.S.R." (W.H. Pickering, "Do We Have A Space Program?" Astronautics, January 1960, 84, JPLHF 2-970.)

1960

Feb. 1 JPL released Agena Study Report which confirmed the technical feasibility of using the Atlas-Agena B vehicle in combination with a separable spacecraft for those lunar missions now identified as Ranger at JPL. The Atlas-Agena B boosted S-1 spacecraft, employed in the first two escape missions, was proposed to weigh 630 lbs. The S-3 spacecraft for the last three lunar impact missions would weigh in the neighborhood of 800 lbs., including a 300 lb. capsule. (p. 37)

JPL released Section Report No. 29-1, Spacecraft Design Criteria and Considerations; General Concepts, Spacecraft S-1, edited by D. Schneiderman, February 1, 19-0. The report described system and subsystem design criteria and planned modes of operation for a basic spacecraft bus for deep space exploration. The high gain antenna was now designed to pivot about the foot of one of the spaceframe supports, and fixed solar arrays had replaced rotatable solar arrays. (Figures 21, 22 and 23.

Feb. 2 Information received from NASA Headquarters indicated that the first Ranger launch could be arranged for February 1961. (JPL, IOM from C.I. Cummings to Division Chiefs, February 2, 1960, JPLHF 2-1021.)

Feb. 5 Fourteen prospective subcontractors for Ranger were briefed at JPL on the technical requirements involved in rough-landing a survivable capsule of instruments on the lunar surface. The firms were requested to submit a proposal for a six-week study of these technical problems and their approach to solving them, by February 15. (Because of JPL's commitment on Project Ranger and anticipated work load on future programs, a decision had been made to develop the lunar capsule by means of a subcontractor.) (JPL, Technical Report No. 32-241, The Ranger Project: Annual Report for 1961, June 15, 1962, 30.)

Feb. 8 JPL completed evaluation of a G.E. proposal, "Project LIVE," submitted to NASA. The proposal recommended use of a Thor-Delta booster to launch a 12-inch diameter 65 lb. sphere to lunar impact. The plastic sphere, with a specific gravity of approximately 2, contained a single channel transmitter with an antenna and sufficient mercury cell batteries to transmit radio signals to earth for about four days. G.E. suggested that the signals might be frequency modulated to indicate impact accelerations or ambient lunar temperature. JPL concluded that a simple radio beacon suitably "potted" would survive the impact loads and function for the duration of the batteries; however, NASA funding was not recommended since, to avoid conflict with the planned rough-landing program, it would have to be launched

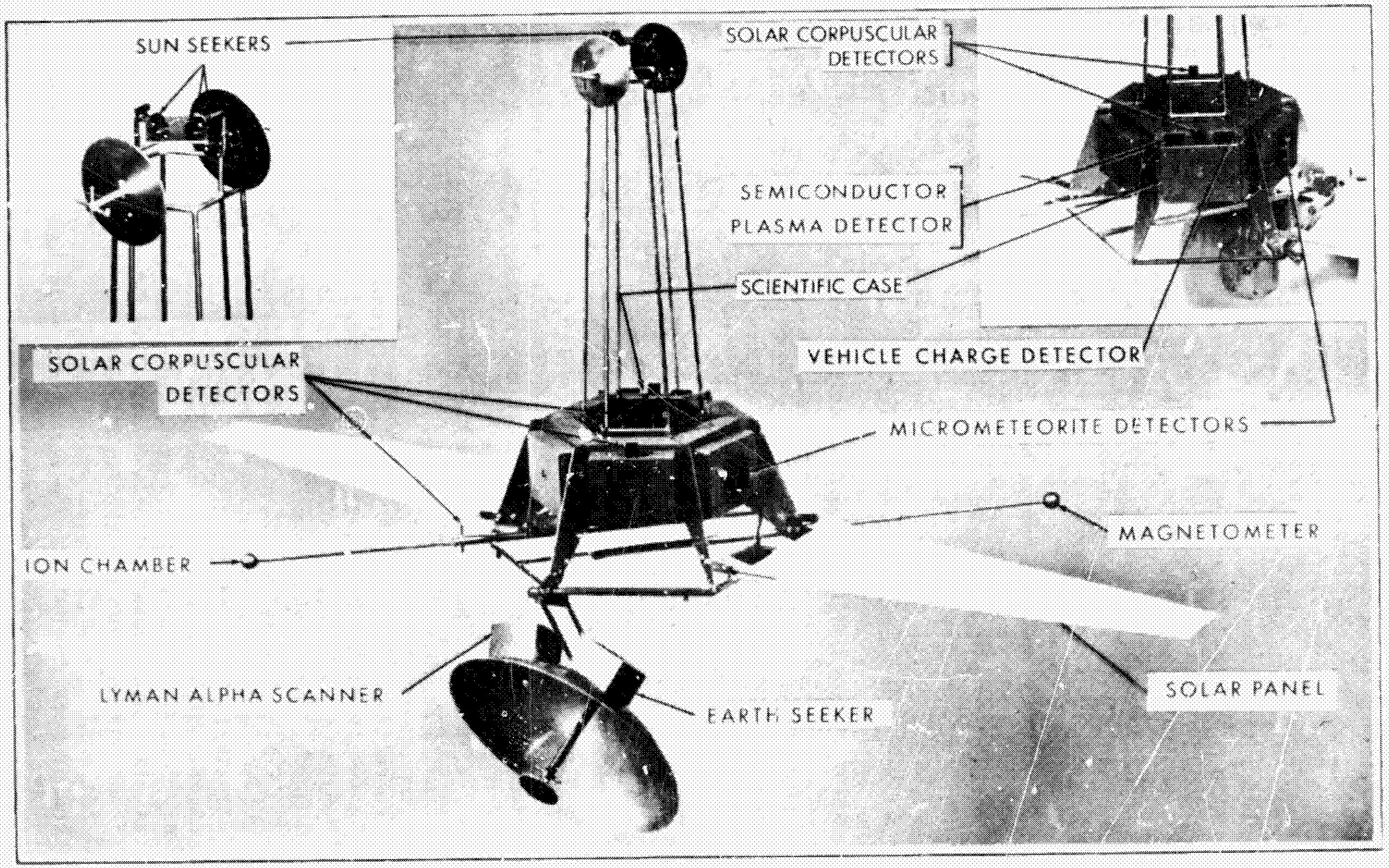

Figure 21: JPL S-1 spacecraft preliminary design (in cruise mode).

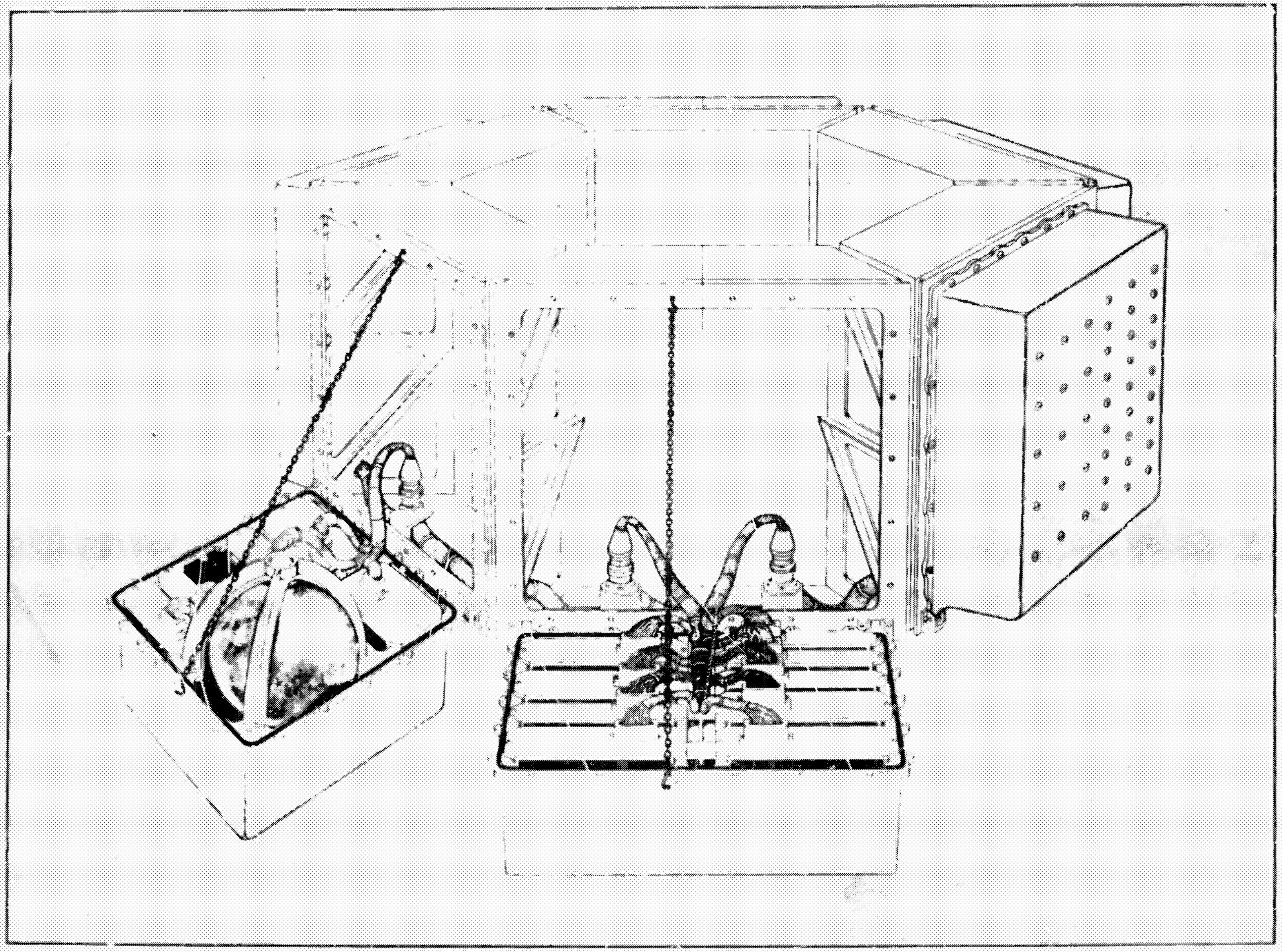

Figure 22: Spacecraft packagin..

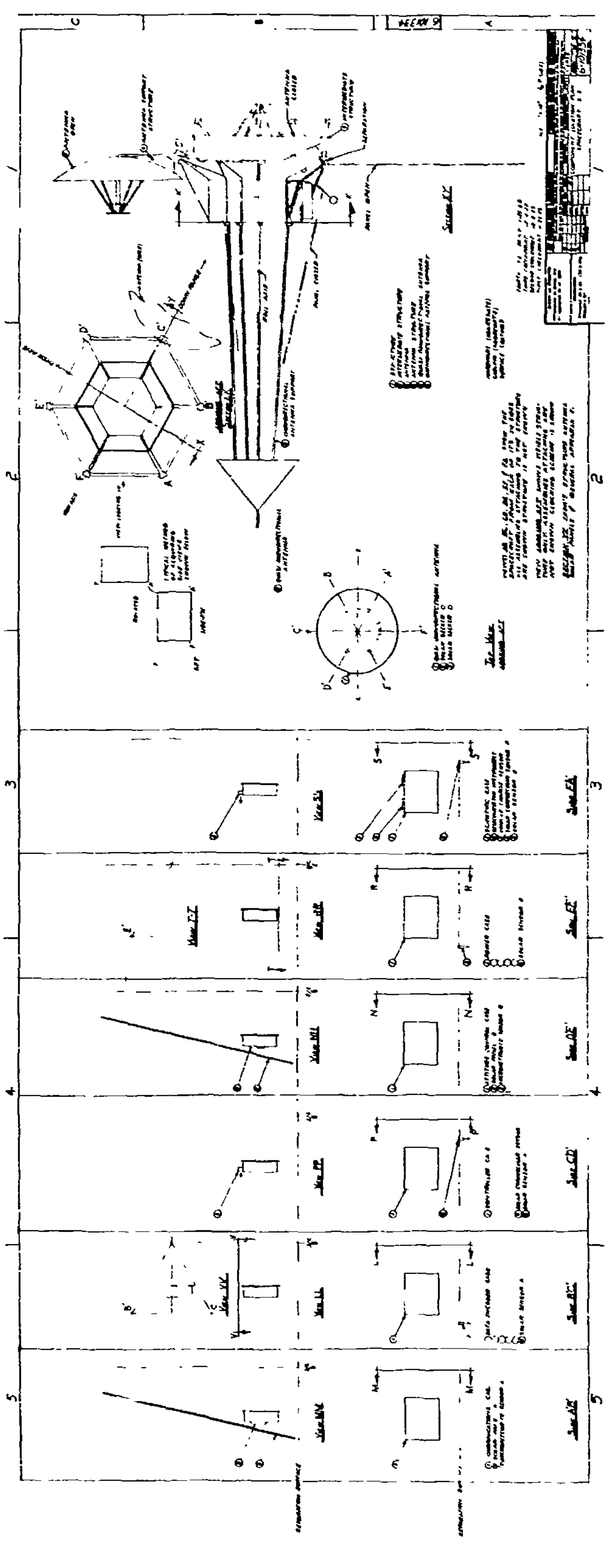

Figure 23: Component location plan, S-1 spacecraft.

1960

Feb. 8 cont. before the end of 1960, and this was not considered possible. (JPL, IOM from W. Downhower to H. Schurmeier, February 8, 1960, JPLHF 2-1400; and, NASA, Memo for Associate Director from G.W. Brooks, JPLHF 2-1399; also, letter from B. Sparks to E. Cortright, March 3, 1960, JPLHF 2-1401.)

Feb. 9 JPL established formal organization, functions and responsibilities for the Space Science Division. (JPL, IOM from W.H. Pickering to Senior Staff, February 9, 1960, JPLHF 2-234.)

JPL suggested to NASA Headquarters that it consider naming the overall lunar and interplanetary spacecraft program RANGER: "To the different groupings of spacecraft we would propose to give alphabetical designations. Thus we propose that this first series of five [lunar] spacecraft for use on the Agena B be labeled Ranger A. The various flight spacecraft within a given grouping would be given Arabic numbers. Thus, RA-3 would be the third spacecraft in the present series to go on Agenas." (JPL, letter from W.H. Pickering to A. Silverstein, February 9, 1960, JPLHF 2-252.)

Feb. 10-11 The first meeting of the NASA Space Exploration Council (SEPC) met at Headquarters in the office of the Associate Administrator. The objective of the Council was "to provide a mechanism for the timely and direct resolution of technical and managerial problems . . . common to all [NASA] Centers engaged in the space flight programs."

Mr. Richard Horner outlined two philosophical approaches that NASA was considering for management of the Agena B program: (a) Use of a Steering Committee comprised of a Headquarters chairman and representatives from each of the three affected centers--JPL, Goddard, and Huntsville. Panels would be established for the various technical areas to treat with any interface problems. (b) Two steering committees could be established--one for space flight, with technical panels, and one for launch vehicles, with technical panels, thereby approximating the new Headquarters organization structure. A decision was achieved favoring the former mode. The problem of coordinating Agena B management at BMD and at Lockheed, Sunnyvale, subsequently was raised and, following discussion, it was agreed that "a resident project engineer would be assigned to Sunnyvale from the Huntsville staff. This representative would report to Mr. Hueter of Huntsville and would be responsible for all technical matters at Sunnyvale. . . ." (Minutes of the Space Exploration Program Council Meeting, February 10-11, 1960, 7-8, JPLHF 2-1416.) (See January 15, 1960.)

Feb. 12 John Casani was assigned technical responsibility for the JPL Spacecraft Integration Group participation on S-1 and S-2 spacecraft design. (JPL, IOM from D. Schneiderman/ J. Small to Distribution, February 12, 1960, JPLHF 2-1020.)

Brian O. Sparks was appointed JPL Deputy Director, effective February 15, 1960. (JPL, IOM from W.H. Pickering to All Personnel, February 12, 1960, JPLHF 2-236.)

Feb. 13 The Final Report of the Agena Survey Team was submitted to Major General D.R. Ostrander, OLVP, NASA Headquarters. The report recommended use of the Agena vehicle for NASA missions, but reiterated several areas in which managerial difficulties could be expected with divided responsibilities (see January 15, 1960). In order to utilize the Agena as rapidly as possible, the team recommended that NASA (a) stay as close to the Air Force Agena configuration as possible (minimum changes), (b) provide spacecraft that are separable from the Agena (as opposed to an integrated system), and (c) make the most use possible of available Air Force organizations, facilities, and personnel in order to avoid duplication of effort. The tentative lunar launch schedule was proposed:

Flight No.	Date	Mission
1	May 1961	Lunar Impact
2	Aug. 1961	Lunar Impact
3	Nov. 1961	Lunar Impact
4	Feb. 1962	Lunar Impact
5	May 1962	Lunar Impact

"Discussions have been held between NASA Headquarters (Mr. Rosen) and BMD (Col. Evans) and agreement has been reached whereby NASA can have pad No. 12 available for use on 1 December 1960. This gives the required six months period pad availability for GSE [Ground Support Equipment] installation and checkout between pad access and first launch according to the tentative schedule. . . . Simultaneously, pad 36 should be converted to use both Centaur and Agena." (p. 29) (Figures 24 and 25.)

NASA Headquarters approved the Agena B program, and notified JPL to proceed with the Ranger Project. (JPL, Ranger Project Development Plan, op. cit., 9; also, J.D. Burke, "Lockheed Launch Vehicle Chronology," draft, no date, JPLHF 2-1023a.)

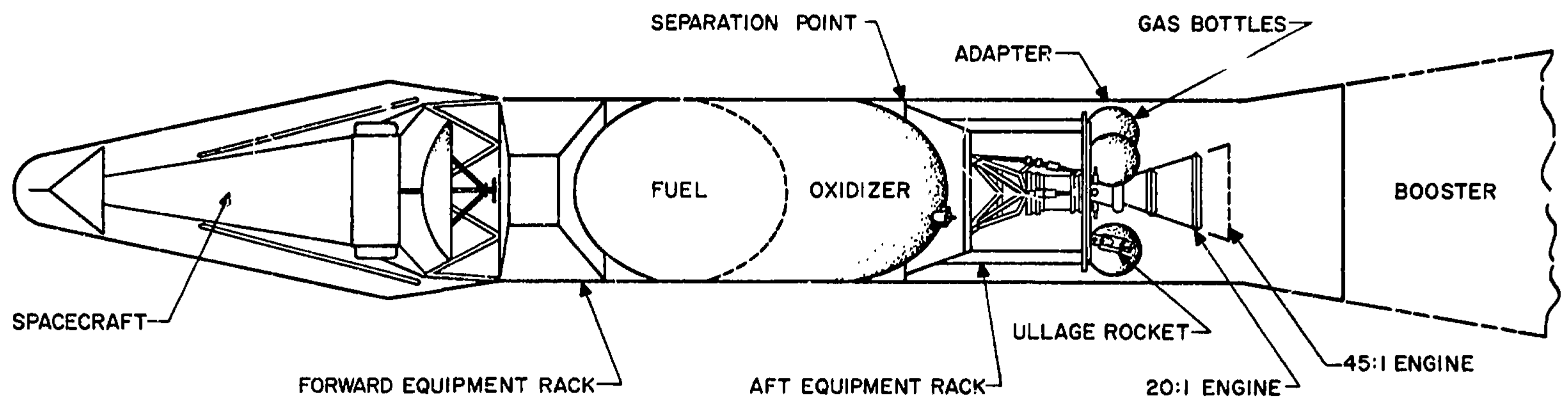

Figure 24: Agena B stage.

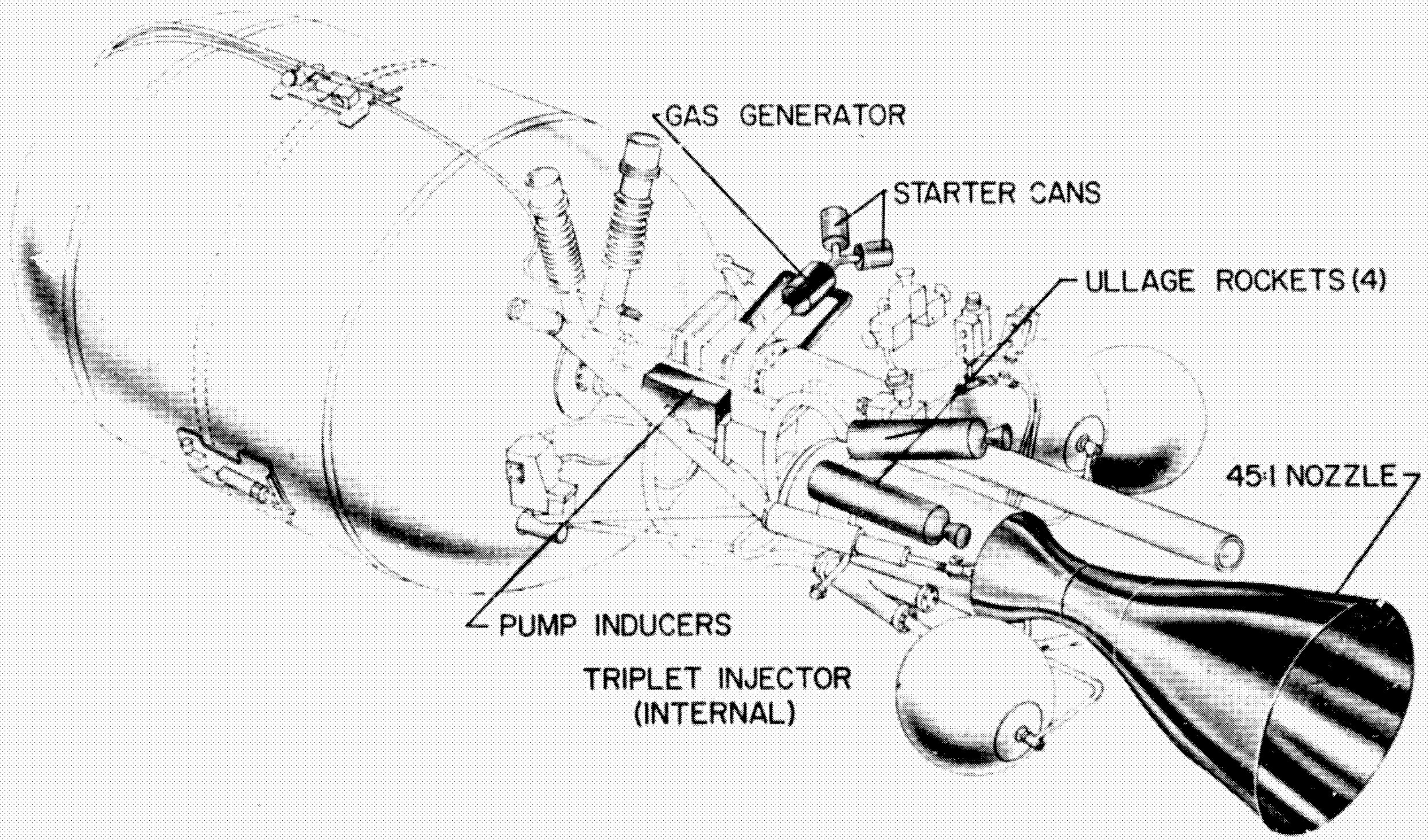

Figure 25: Agena B propulsion system.

1960

Feb. 15 Proposals for the lunar capsule study, covering a six-week period beginning March 1, 1960, were received at JPL. An eleven-man JPL evaluation committee was selected to review the proposals and select those firms which would conduct actual studies. (The Ranger Project: Annual Report for 1961, loc. cit.)

A survey team established to investigate the use of Agena for NASA estimated that "the cost of procuring and launching 8 Atlas-Agena B vehicles is $76.1 million." (Review of the Cancelled Atlas-Vega Launch Vehicle Development December 1958 - December 1959, GAO, April 30, 1960, 31.)

Feb. 16 JPL released the definition of basic authority and responsibilities for the Ranger Program Director and his Staff. The Ranger Program Director's authority and responsibilities were described as follows: "1. He is responsible to the Laboratory Director for all aspects of the Ranger Program. 2. He has authority to make assignments of tasks and responsibilities to organizational elements of the Laboratory but not to assign individuals within those elements. 3. He has authority to commit the resources of the Laboratory, as he deems necessary to accomplish the Ranger program." (JPL, IOM from W.H. Pickering to Senior Staff et. al., February 16, 1960, JPLHF 2-1022.)

Feb. 17 Relative priorities for the Ranger Project were established; in a descending order of importance they were: (a) spacecraft technology, (b) schedules, (c) developing industrial support for JPL, (d) science. A proof-test model (PTM) for Ranger spacecraft 1 and 2 was scheduled for completion by December 1960, a PTM for spacecraft 3-5 by July 1961. JPL proposed flight dates were:

Flight No.	Date	Mission
1	April 25, 1961	Engineering Test
2	July 25, 1961	Engineering Test
3	October 1961	Lunar Impact
4	January 1961	Lunar Impact
5	April 1962	Lunar Impact

(JPL, IOM from C.I. Cummings to All Division Chiefs, February 17, 1960, JPLHF 2-1024.)

Feb. 18 JPL submitted to NASA and DSIF inter-station communication and funding requirements considered necessary to support the planned deep space exploration program. (JPL, letter from W.H. Pickering to A. Silverstein, February 18, 1960, JPLHF 2-1397.)

1960

Feb. 19 The "Agena Coordination Board" was established by NASA Headquarters as the management tool to coordinate the Agena B program. (See Jan. 15, 1960.) This organization, with membership drawn from all participating agencies, would integrate the joint efforts of NASA Headquarters, JPL, AFBMD, MSFC, and Lockheed. Two permanent committees were created: Agena B Earth Satellite Committee and the Agena B Lunar Committee. (Letter from C.I. Cummings to Hans Hueter at ABMA, Subject: Agena-B Lunar Committee Technical Panels, JPL Participants, Mar. 7, 1960, JPLHF, 2-1027; also, NASA Third Semi-Annual Staff Conference Program Formulation and Status of Activities, March 3-5, 1960, 23.) (See February 10-11, 1960.)

Feb. 22 JPL notified NASA Headquarters of its intent to procure four Lunar Capsule Study Programs from among the thirteen proposals submitted on February 15. A decision on the four selected was planned by February 29, 1960. (Letter from R.A. Lawson, JPL to Earl J. Sample, NASA, February 22, 1960, JPLHF 2-321.)

Feb. 23 To avoid a recurrence of Vega problems, ARDC and NASA signed a Memorandum of Understanding which established a committee "to examine missile and space systems launch requirements and prepare launch stand loading schedules for all systems using common launch stands or pads at the Atlantic Missile Range." (See February 13, 1960.) (U.S. Congress, House of Representatives, 1963 NASA Authorization, Part 3, 87th Congress, Second Session, March 14, 1962, 1390.) (See also NASA action, December 16, 1959.)

Feb. 24 Testifying before the House Committee on Science and Astronautics, JPL Director Dr. W.H. Pickering reiterated that "we should frankly admit what the rest of the world knows--that we are indeed in a race with the U.S.S.R. in space. One can come to no other conclusion. . . ." (Report of the Committee on Science and Astronautics, U.S. House of Representatives, 86th Congress, Second Session, Space, Missiles and the Nation, July 5, 1960, 49.)

Feb. 25 The first Motorola production model of the phase-coherent transponder system for the Ranger spacecraft was delivered to JPL. (See July 1959.) (JPL, Space Programs Summary No. 37-2 for the period January 15, 1960 to March 15, 1960, April 1, 1960, 21.)

Feb. 26 The first launch of an USAF Atlas-Agena A took place at AMR. The Agena was damaged at liftoff, and did not achieve orbit. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, loc. cit.; also, Air Force Document MTP-MS-IS-61-4, December 1962, iv., JPLHF 2-1066.)

1960

Feb. 26 cont. The JPL Evaluation Committee selected North American Aviation, Hughes Aircraft and Aeronutronic Division of Ford Motor Company to carry on a design study program for the lunar capsule. (See February 5, 1960.) Study contract final reports and program technical and cost proposals were scheduled to be returned to JPL by April 15, 1960. (N.W. Cunningham, Ranger Program Chronology, loc. cit.; also, The Ranger Project: Annual Report for 1961, loc. cit.)

JPL redefined the Ranger Program as the spacecraft development and lunar rough-lander series consisting of a total of five flights. Plans and studies were underway for a lunar soft-lander program using the Centaur vehicle. (JPL, IOM from W.H. Pickering to Senior Staff, February 26, 1960, JPLHF 2-238.)

The United States and Australia signed the agreement which permitted NASA to construct and use tracking stations in Australia. (NASA, Edward M. Walters, The Origins of the Australian Co-operation in Space, HHN-82, Comment Ed., May 1969, 69.)

Feb. 29 Concepts for the JPL master plan included four principal programs: lunar, planetary, reentry, and a research and advanced development program. Agreement was reached that JPL would continue to insist on considerable in-house research and advanced development activities, that the major in-house space program would be the planetary program, and that the Laboratory would actively support the lunar program out-of-house utilizing industry, with the exception of Ranger. (See During January 1960.) (Memo, Director's Staff Meeting, Notes No. 9, February]9, 1960, 1-2, JPLHF 2-517.)

JPL was informed that NASA would not conduct business with LMSD via a letter of intent/letter contract. "Instead they [Ostrander and Hyatt] wanted to take a couple of weeks and write a definitive contract. Hueter immediately expressed the opinion that such contracts could not possibly be handled within two weeks and that it would take at least six weeks to two months. . . ." (Telephone Report RPD-2, participants, H. Hueter, ABMA; A. Silverstein; NASA; W. Fleming, NASA; and C.I. Cummings, JPL, February 29, 1960, JPLHF 2-1026.)

Mar. 1 North American Aviation, Hughes and Aeronutronics were awarded design study contracts for the lunar capsule. (See February 26, 1960.) (JPL, Space Programs Summary No. 37-2, op. cit., 1.)

Mar. 1 cont. NASA established the Office of Life Sciences which would engage in the scientific study of life processes in the United States space exploration program. Dr. Clark T. Randt was named Director. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, op. cit., 120.)

Mar. 3-5 The Third Semi-annual NASA Staff Conference was held in Monterey, California. During the sessions, Dr. W.H. Pickering outlined the launch schedule now planned for the Ranger Project:

Flight No.	Launch Date	Objectives
1	April 1961	Spacecraft engineering tests at approximately escape speed.
2	July 1961	
3	October 1961	High resolution TV photographs of the moon, landing of survivable package, and spacecraft engineering tests.
4	January 1962	
5	April 1962	

Dr. T.K. Glennan discussed the importance of establishing arbitrary manpower ceilings for the field centers noting that the rapid growth of NASA had to be carefully controlled, and that this measure would promote development of the capabilities of industrial contractors by encouraging contracting "out-of-house." (Third Semi-Annual NASA Staff Conference Program Formulation and Status of Activities, Monterey, California, op. cit., 22-23, 56; also, JPL, Memo, "Director's Staff Meeting," Notes No. 10, March 7, 1960, JPLHF 2-518.)

Mar. 8 Spacecraft sterilization guidelines and criteria for the Ranger Project were established at JPL. (JPL, IOM from J.D. Burke to All Concerned, March 8, 1960, JPLHF 2-994.)

Mar. 10 The Office of Reliability and Systems Analysis was established in NASA Headquarters. Landis S. Gephardt was named Director. (NASA, Major Activities in the NASA Programs, op. cit., 7.)

In a followup to the Monterey Conference, Dr. T.K. Glennan cautioned NASA managers that "the difficult tasks we are attempting must result, inevitably, in some failures," and that "it is perhaps a natural reaction to become overcautious. . ." He continued to emphasize that NASA must, in the near future, Mar. 10 cont. "show results commensurate with expenditures. And results do include the maintaining of schedules as well as the acquisition of scientific information. I am concerned, then, that we make our schedules realistic and that we hold to them to the greatest extent possible. Postponements should be viewed with concern, not regarded as normal procedure." (NASA, memo from T.K. Glennan to Operating Heads of Headquarters Offices and Directors, NASA Centers, March 10, 1960, JPLHF 2-323.)

Mar. 11 A Request for Proposal (RFP) was issued to Lockheed Missiles and Space Systems Division (LMSD) for Agena B vehicles for Project Ranger. (JPL, Ranger Project Development Plan, May 24, 1961 [Revised 5 July 1961], 9.)

Mar. 13 A lunar atlas prepared by G.P. Kuiper, and comprised of a collection of high-quality earth-based photographs of the visible face of the moon was published by the USAF. (See April 1, 1958.) (E.M. Emme, Aeronautics and Astronautics, 1915-1960, loc. cit.)

Mar. 14 NASA Headquarters concurred in JPL's decision to contract out lunar spacecraft development beginning with Surveyor. The Centaur-boosted lunar soft landing mission was scheduled for 1963. (NASA, letter from A. Silverstein to W.H. Pickering, March 14, 1960, JPLHF 2-1398.) (See During January and February 29, 1960.)

The Deputy Secretary of Defense reported to the House Committee on Science and Astronautics on the basic concept and structure of a DOD-NASA Aeronautics and Astronautics Coordinating Board (AACB). The new body, to supersede the CMLC, was conceived to accomplish effective coordination of programs and activities between the two agencies. (Statement of Dr. Robert C. Seamans, Jr., 1963 NASA Authorization, op. cit., 583.) (See September 13, 1960.)

Mar. 15 The George C. Marshall Space Flight Center at Huntsville, Alabama, was named by Executive Order of President Eisenhower. (David S. Akens, Historical Origins: George C. Marshall Space Flight Center, MSFC Historical Monograph No. 1, December 1960, 20.)

Mar. 18 JPL released Technical Report No. 33-4, Scientific Experiments for Rangers A-1 and A-2, including Addendum I. Instruments designed for these flights had as their primary purpose "the determination of the nature of the particles and fields in interplanetary space," with "special emphasis . . . given to

Mar. 18 cont. discovering mechanisms responsible for the many terrestrial phenomena which appear to be related to solar disturbances." (p. 1) The instruments and sponsors were:

Solar Corpuscular Radiation Electrostatic Analyzers	Jet Propulsion Laboratory M. Neugabauer and C. Snyder
Medium-Energy-Range Particle Detectors	State University of Iowa J.A. Van Allen University of Chicago J.A. Simpson
Triple-Coincidence Cosmic-Ray Telescopes	University of Chicago J.A. Simpson
Cosmic-Ray Integrating Ionization Chamber	Caltech/JPL H.V. Neher/H.R. Anderson
Magnetometer	Goddard Space Flight Center J.P. Heppner
Lyman-Alpha Scanning Telescope	Naval Research Laboratory T.A. Chubb
Dust-Particle Detectors	Goddard Space Flight Center W.M. Alexander

(Figure 26.)

Mar. 22 JPL comment on the proposed functions and responsibilities of the Space Sciences Steering Committee were submitted to NASA. (JPL, letter from W.H. Pickering to H.E. Newell, March 22, 1960, JPLHF 2-1402.) (See January 26, 1960.)

Mar. 25 JPL Letter Contract M-48068, "Lunar Impact TV Camera," was awarded to RCA, Astro-Electronics Division, Princeton, New Jersey, to design, construct, test and deliver nine TV cameras for the Ranger lunar impact probes, RA-3, 4, and 5. Delivery of the last flight units would be completed by November 1961.* (JPL Contract Closeout Records.) (Figure 27.)

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*The camera system employed in Rangers 3-5 was designed to transmit a picture every 13 seconds, for a total of 100 pictures during descent toward the moon. The first picture, taken from approximately 2,500 miles altitude, would encompass a 25-square-mile area and show objects 650 feet across; the final picture would cover an area about 2,000 square feet and reveal objects 10 feet across. Moon photographs from observatories on earth could distinguish features no smaller than 2,000 feet across.

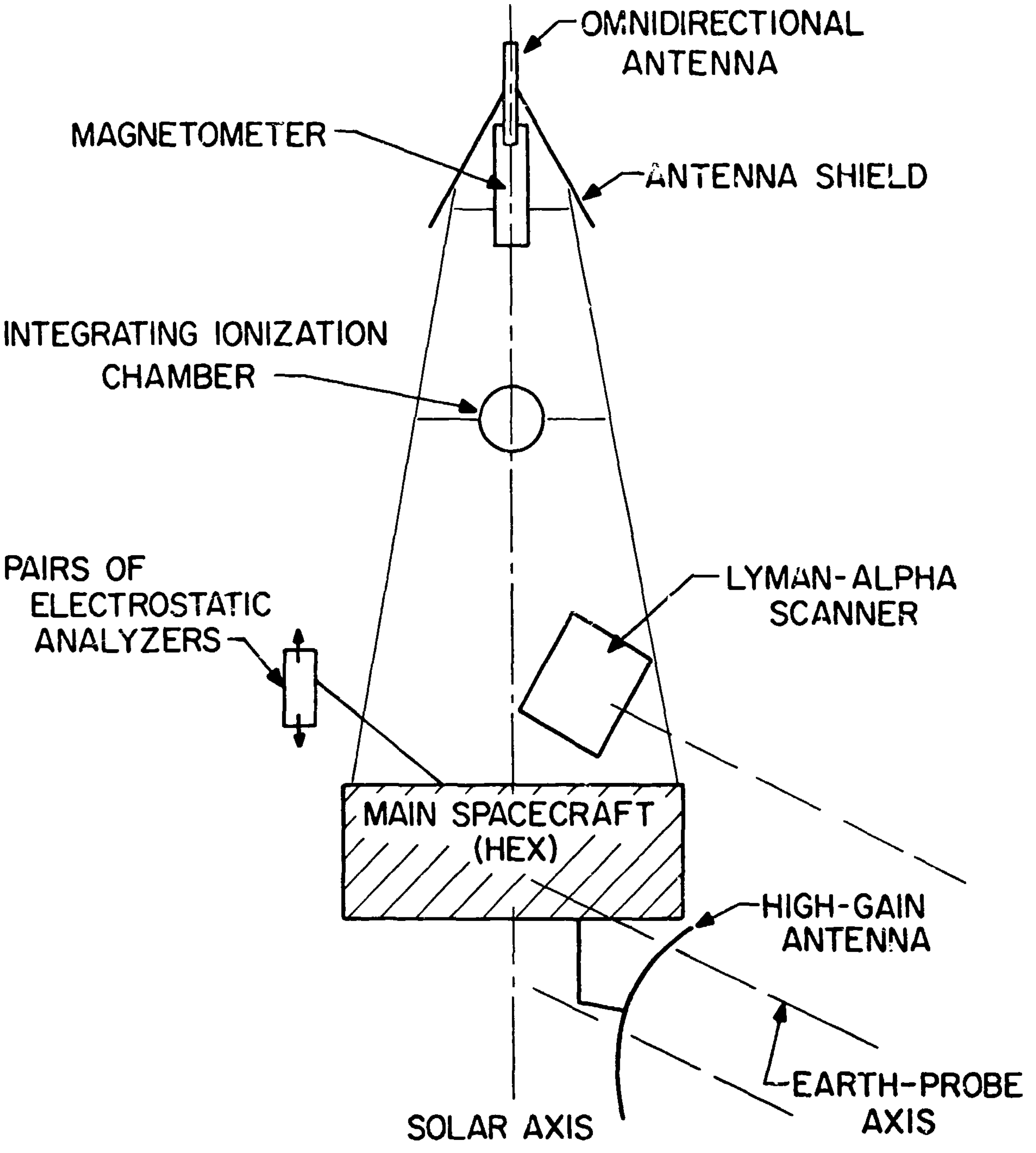

Figure 26: Ranger 1 and 2 scientific instrumentation plans.

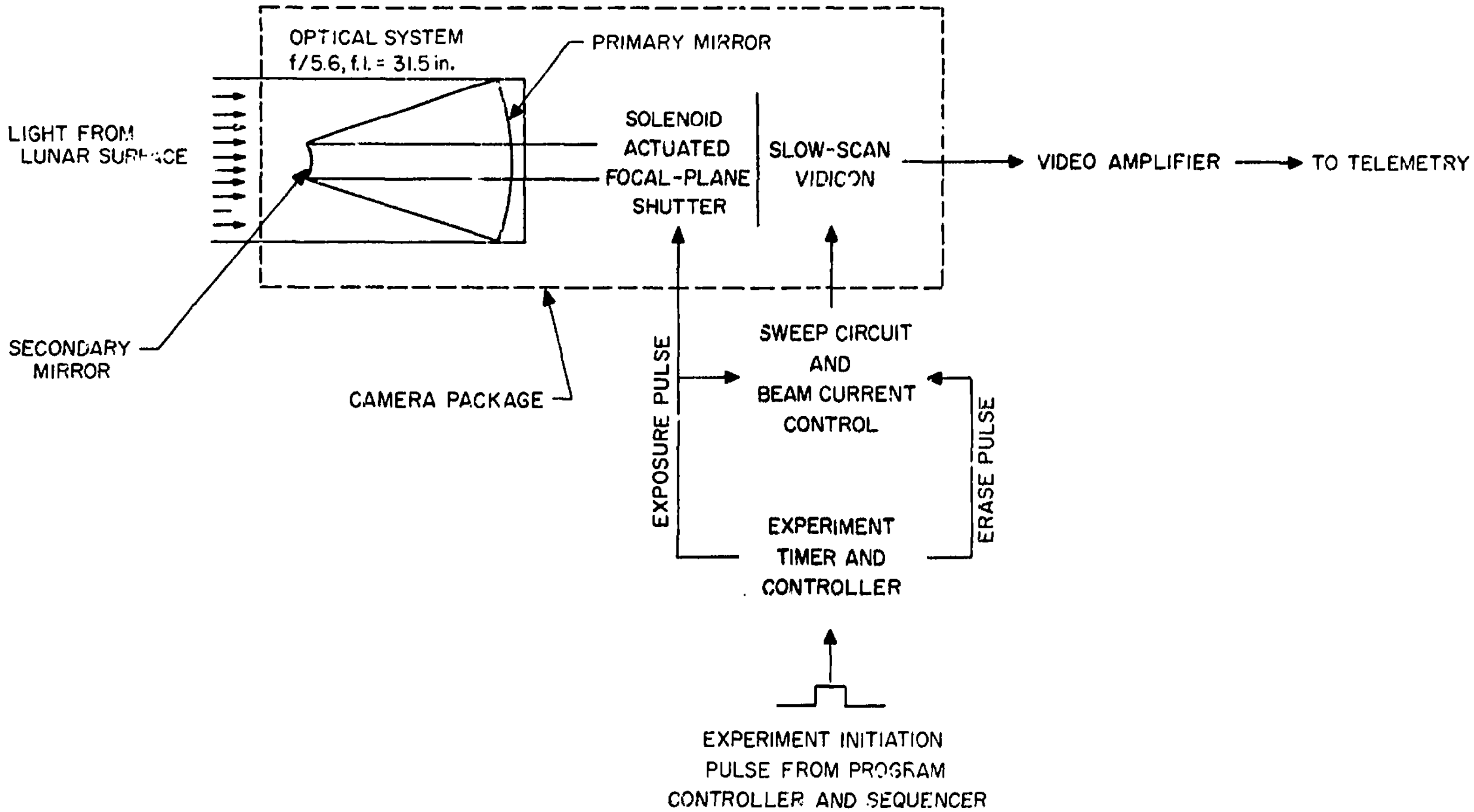

Figure 27: Ranger 3, 4, and 5 TV experiment diagram.

1960

Mar. 26 LMSD submitted a Rough Order of Magnitude (ROM) Proposal for Agena-B's for Project Ranger. (JPL, Ranger Project Development Plan, loc. cit.)

During March Construction of the transmitting antenna station at Goldstone was completed. The transmitter and receiving antennas were located seven miles apart to minimize electrical interference, and were linked by a wide-band (10-megacycle) microwave communication system to transmit pointing data, tracking information, etc. between stations. (NASA, Major Activities in the NASA Programs, op. cit., 76.) In Australia, construction began on the Woomera tracking station and antenna. (JPL, DSN Facility Activation Dates, chart, n.d., JPLHF, 2-141.)

Design of the Ranger 1 and 2 spacecraft electrical system (consisting of two oriented solar panels, a battery, a power switching system, and five static regulated power supplies) was completed; design of the solar panels had been frozen and units were already being fabricated. The spacecraft launch and maneuver battery was procured from Eagle-Picher. In the communications subsystem, design of the high-gain antenna was completed. "A prototype reflector has been received and as soon as fabrication of a prototype feed structure is completed, evaluation of the high-gain antenna will commence. The low-gain omni-directional antenna is still under development and the final configuration will not be established for another month." Contemporary estimates placed the weight of RA-1 at 630 pounds. (JPL, Space Programs Summary No. 37-2, op. cit., 38-39, 24, 64.)

In order to maintain planned schedules and avoid major redesign of the upper-stage Agena, the basic Air Force Discoverer Agena B configuration was selected for NASA missions. With a few exceptions these vehicles were essentially standard from the forward equipment rack back to the end of the rocket engine. A spacecraft adapter and a separable nose fairing (or shroud, which protected the spacecraft during ascent through the atmosphere) were to be new items. Of several possible shrouds, an all-metal, single-piece, forward separating nose cone was selected for development and application in Ranger missions. (JPL, rough draft of Ranger Final Report, 6, JPLHF 2-122; also, Ranger Project Development Plan, op. cit., 12.)

Oran W. Nicks joined NASA as Head of the Lunar Flight Systems, Office of Lunar and Planetary Programs in OSFP. He had previously been associated with Chance-Vought Aircraft, Inc., of Dallas, Texas. (NASA Biographical Data, January, 1968, O.W. Nicks.)

1960

Apr. 1 The NASA weather satellite TIROS I (Television Infra-Red Observation Satellite), employing an RCA TV system, was successfully placed in orbit by an Air Force Thor-Able booster combination. The satellite returned pictures of the earth's cloud cover until June 20, 1960. (John H. Ashby, A Preliminary History of the Evolution of the Tiros Weather Satellite Program, NASA, August 1964, 49.)

Apr. 4 NASA Headquarters released a detailed statement (tentative) of the "Role" for the Jet Propulsion Laboratory in the nation's civilian space program. The statement, as an elaboration of earlier proposed roles, assigned JPL mission planning and development of payloads for lunar and interplanetary exploration. (JPL, IOM from Brian Sparks to Senior Staff, April 11, 1960, JPLHF 2-239; also, NASA, Major Activities in the NASA Programs, op. cit., 121.)

Apr. 12 Air Force letter contract (AF-592) funded by NASA was awarded to LMSD for the fabrication of Agena B vehicles for NASA missions. (Ranger Project Development Plan, loc. cit.; also, Minutes, Space Exploration Program Council Meeting, April 25-26, 1960, 11, JPLHF 2-1406.)

Apr. 13 The first meeting of the Lunar Science Subcommittee of the newly established NASA Steering Group on Lunar, Planetary, and Interplanetary Exploration (see January 26, 1960) was held in Washington D.C. Dr. A.R. Hibbs of JPL was requested to furnish a description of the scientific experiments planned for the lunar rough lander missions (Rangers 3, 4 and 5). (NASA, Lunar Science Chronology, "Lunar Sciences Subcommittee," January 15, 1965, 1, JPLHF 2-652.)

A Spacecraft Sterilization Panel meeting at JPL defined the sterilization objectives for Project Ranger:

Ranger A-1 - generate necessary techniques and procedures and implement them as far as practical.
Ranger A-2 - perfect necessary techniques and procedures.
Ranger A-3 through A-5 - utilize techniques and procedures developed on A-1 and A-2 which comply with Headquarters requirements dated October 8, 1959, and which could then be employed on other NASA deep space projects.

(C.F. Mohl, "Sterilization Panel Meeting," April 13, 1960, JPLHF 2-996.)

A contingent of AEC scientists from Los Alamos and Sandia Base, New Mexico, visited JPL to explore the prospect of placing Vela

Apr. 13 cont. Hotel experiments* on early Ranger spacecraft. The JPL Ranger Project Office "told the visitors about Ranger, showed them hardware, and gave them copies of documents describing the scientific experiments [see January 20, 1960] and telemetry system. We told them that no additional experiments could be accommodated in the program as now planned, but that they would of course be welcome to examine any results that we get with our instruments. Unfortunately the things that they are looking for are mostly different from the things we intend to measure." (JPL, Conference Report of Visit by Los Alamos and Sandia People, by J.D. Burke, April 14, 1960, JPLHF 2-478.)

Apr. 14 The resignation of William M. Holaday as Chairman of the CMLC was accepted by the President. (See March 14, 1960.) (New York Times, April 15, 1960, 3, JPLHF 2-977.)

Air Force General Thomas D. White directed a letter to General Landon and General Wilson urging full Air Force cooperation with NASA, but with the forecast that NASA would "eventually [be] combined with the military." (U.S. House of Representatives, 87th Congress, Hearings before the Committee on Science and Astronautics, Defense Space Interests, Mar. 17, 18, 20, 21, and 23, 1961, GPO, Washington, 92.)

Apr. 15 General A.W. Betts, Director of ARPA, sent a letter to NASA requesting assignment of as much space, weight, power and communications channels as possibl be made available to accommodate Vela Hotel experiments n Ranger spacecrafts 1 and 2. ". . . . Anything over fifteen pounds (not including power and telemetry) will be useful." (See April 13. 1960.) (Letter from A.W. Betts to Dr. Clark of NASA, April 15, 1960, JPLHF 2-481a.)

NASA OSFP released Technical Management Instruction 37-1-1, Establishment and Conduct of Space Sciences Program - Selection of Scientific Experiments. The document notes creation of a

*The purpose of this AEC experiment was to determine whether the sun was a source of microsecond bursts of certain X-rays. Data obtained would be used in the development of a Scintex X-ray detection system that could detect nuclear explosions above ground. Successful operation was dependent upon the absence of a natural background source of X-ray bursts that might simulate a nuclear detonation in space.

1960

Apr. 15 cont. Space Sciences Steering Committee (SSSC) and subcommittees, to serve "as the focal point for space sciences activities and is responsible for the review and approval for submission to the Director of Space Flight Programs of: (1) Proposed short and long range space sciences programs; (2) Proposed experiments, experimenters and contractors; . . . ." (1-4) The new group would be formed from the NASA Steering Group on Lunar, Planetary and Interplanetary Exploration. (JPLHF 2-447.) (See January 26, 1960.) Roles were also established for the Assistant Directors of Space Flight Programs and for field centers.

NASA Headquarters notified JPL that it would make source selection decisions on all contracts over one million dollars, beginning immediately with the moon capsule proposals. Source Evaluation Boards would be established by the Director of JPL and include NASA representatives Oran Nicks and Earl Sample. (JPL, IOM from Brian Sparks to C.I. Cummings, April 15, 1960, JPLHF 2-322.)

The moon capsule study-contract final reports and program technical and cost proposals were received from NAA, Hughes and Aeronutronics (ADF). (See March 1, 1960.) The last firm proposed to fabricate, assemble, checkout and deliver five lunar rough-landing capsules for an estimated cost-plus-fixed-fee of $3,619,023 on the following schedule:

2 Capsules	May 1, 1961
2 Capsules	July 1, 1961
1 Capsule	September 1, 1961

(Proposal for Development of a Lunar Capsule, Volume III, Contractual and Cost Summary, Publication No. P10610(U), prepared under Contract M48024, Aeronutronic, A Division of Ford Motor Company, April 15, 1960, 2, 5, JPLHF 2-703.)

Mr. Frank Denison, who was in charge of the ADF Lunar Capsule preliminary design team, would assume responsibility of Manager, Lunar Systems, and direct the Lunar Capsule development at ADF if that firm was selected.

The conceptual design proposed by ADF for a 300 pound capsule incorporated a radar altimeter that signaled separation, spin up, and retro firing of the capsule's solid propellant motor, a crushable impact limiter to absorb residual velocity, and a spherical survival package. The spherical survival package was fluid-floated inside the hollow, spherical, impact limiter so as to distribute the structural loads at impact and to allow erection of the package to local vertical by moon-gravity after the assembly

Apr. 15 cont. came to rest. Erection to local vertical would permit the sensitive axis of the seismometer to be positioned as desired, and allow for the use of a modest directional transmitting antenna. Contemporary Aeronutronic thinking for the preliminary design favored an outer spherical shell for the impact limiter made of dielectric structural plastic enclosing a solid main sphere which would contain the active survival experiments. (Proposal for Development of a Lunar Capsule, Volume II, Organization and Capabilities, Publication No. P10610(U), prepared under Contract M48024, Aeronutronic, A Division of Ford Motor Company, April 15, 1960, 11; and, Volume I, Development Plan, April 15, 1960, 13, JPLHF 702 and 702a.) (Figure 28.)

Apr. 17 The JPL Spacecraft Design Specification Book was released for Ranger Flights 1 and 2. Mission objectives and design criteria iterated that the basic objective of these flights was spacecraft technology--by preparing for subsequent lunar flights (RA 3, 4 and 5) and interplanetary missions. Specifically, the objectives were: (a) To test some basic elements of the spacecraft and the Deep Space Instrumentation Facility. (b) To ascertain performance and to gain operating experience with the Atlas-Agena B vehicle and associated systems. (c) To test scientific measurement equipment and to measure phenomena of interest along the selected trajectory. Priority among the various science passengers in these two flights was assigned as follows: (1) Solar Corpuscular Detector, (2) Rb Vapor Magnetometer, (3) Semiconductor Detectors and Thin-Walled Geiger Counters, (4) Ionization Chamber, (5) Triple Coincidence Telescopes, and (6) Lyman Alpha Scanner. (JPL, Specification No. RA12-2-110, JPLHF 2-1094a.) (Figure 29.)

Apr. 18 The NASA SEPC informed Administrator T. Keith Glennan that the proposed advance of the first Atlas-Agena B flight mission (Ranger 1) to February 1961 was abandoned as impractical. (See February 2, 1960.) (Memo, Robert L. King to T.K. Glennan via Richard E. Horner, Subject: "SEPC Meeting of February 10-11, 1960--Status of Actions," April 18, 1960, cited in Apollo Spacecraft Chronology, Vol. I, p. 42.)

Apr. 19 Mission objectives and design criteria for Ranger Flights 3, 4 and 5 were released for the Spacecraft Design Specification Book. In the order described, general objectives were: (a) To continue development of basic spacecraft technology. (b) To experiment with a trajectory error correction [mid-course maneuver]. (c) To experiment with a terminal attitude maneuver and lunar picture transmission system. (d) To rough-land a few pounds of instruments and a transmitter on the moon. (e) To transmit after

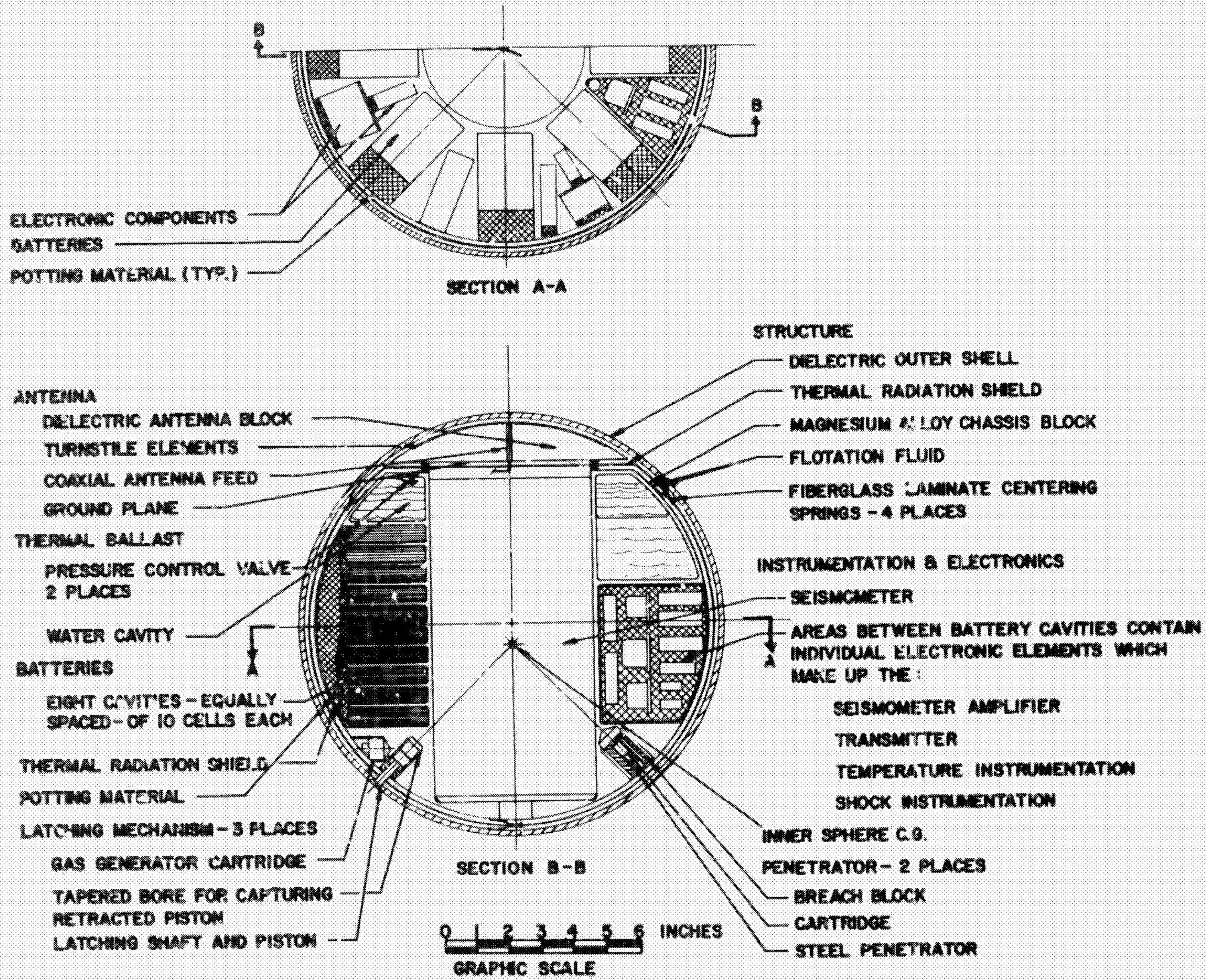

Figure 28: Proposed ADF Lunar Capsule Survival Sphere.

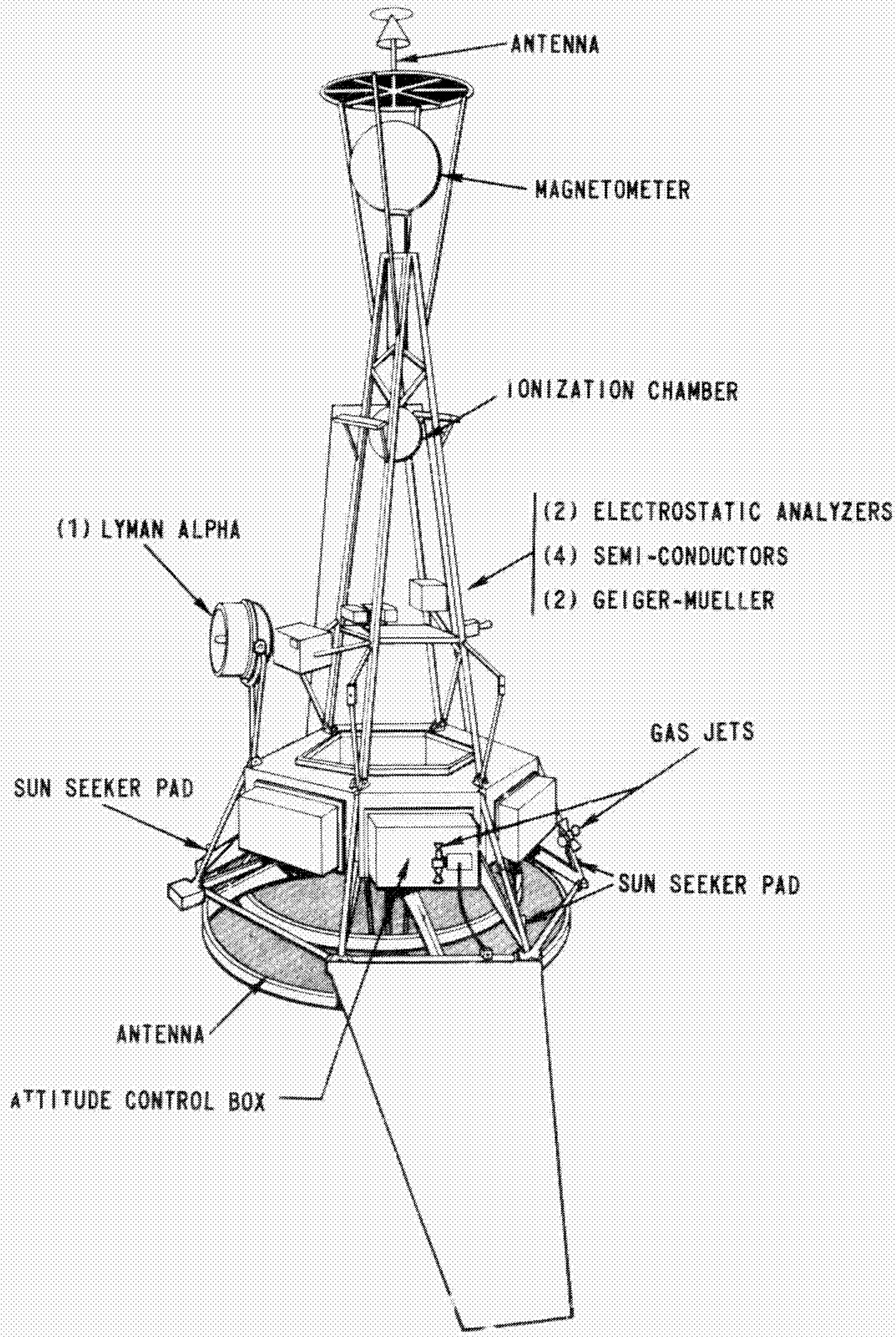

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Figure 29· Ranger 1 and 2 spacecraft design, April 1960.

Apr. 19 cont. landing, lunar seismic data to the extent practical. The priority of scientific experiments was established as: (1) Television, (2) Seismometer, (3) Gamma Ray Spectrometer, (4) Thermometers, (5) Impact Accelerometers, and (6) Cosmic Ray Telescope. (JPL, Specification RA345-2-110, JPLHF 2-1095a.)

Apr. 20 NASA Headquarters established July 1 as the target date for field centers (and JPL) to meet manpower ceilings. (JPL, IOM from W.H. Pickering to Senior Staff, JPLHF 3-198.) (See March 3-5, 1960.)

Apr. 25 Following an oral presentation by the Lunar Capsule Source Evaluation Board at Headquarters, Dr. T.K. Glennan selected Aeronutronics to develop the lunar capsule. (See April 15, 1960.) (NASA, T.K. Glennan, "Decision to Negotiate on the Lunar Capsule," April 27, 1960, JPLHF 2-320.)

JPL issued Technical Memorandum No. 33-9, Statement of Work for a Rough Landing Lunar Capsule developed for the lunar capsule contract.

Further NASA consideration of a 13 watt modified SNAP III Radio-isotope Thermal Electric Generator (RTG) for use in lunar spacecraft through 1962 was abandoned. (JPL, letter from W.H. Pickering to A. Silverstein, April 25, 1960, JPLHF 2-1407.)

Apr. 25-26 The second meeting of the SEPC was held at NASA Headquarters. Dr. A. Silverstein informed the Council that:

> With the exception of the Mercury and Delta projects, the relations between OLVP and OSFP have been established for the NASA launch program at AMR. Working directly under the MSFC, the Director of the NASA Launch Operations Center (Mr. Debus) is responsible for all launch operations with direct access to the Commander, AMR. The Director of NASA Test Support (Col. Gibbs), recently transferred from the Air Force to NASA, is responsible under Mr. Debus for coordinating NASA range support requirements with AMR.
>
> The Office of Flight Missions [OFM] at AMR (responsible to the Director, OSFP) will coordinate support requirements including those for the payload and other related aspects, and will also provide administrative and logistic support to all NASA elements.

(Minutes, Space Exploration Program Council Meeting, April 25-26, 1960, loc. cit.)

1960

Apr. 25-26 cont. In May the OFM came under the administrative control of LOA, although it remained the local representative for payload groups in OSFP at the Cape. (F.E. Jarrett and R.A. Lindemann, Historical Origins of NASA's Launch Operations Center to July 1, 1962, op. cit., 66-67.)

Apr. 26 JPL released detailed in-house procedures for Ranger spacecraft sterilization; the operation was divided into five phases: component and material testing, sub-structure assembly, transportation of structures to launch site, final assembly, and terminal sterilization. (JPL, IOM from G.L. Hobby to C.F. Mohl, April 26, 1960, JPLHF 2-997.)

Apr. 27 JPL Contract N-21453 was awarded to ADF for development of five lunar rough landing capsules, in the amount of $4.8 million. (JPL, The Ranger Project: Annual Report for 1961, loc. cit.)

Apr. 28 JPL initiated work on the Ranger Program Management Plan. (Ranger Project Development Plan, op. cit., 9.)

NASA Headquarters released internal Designations for Missions and Payloads in the Satellite, Lunar and Planetary Programs. The five flights in the Ranger Project (apparently at this date the term Ranger was still only employed at JPL, but not yet at Headquarters--see February 9, 1960) were designated:

P-32 Spacecraft Engineering Development with Inter-
P-33 planetary Science

P-34
P-35 Lunar Reconnaissance and Rough Landing
P-36

(Memo from A. Silverstein of NASA establishing procedure for establishment of official code names, April 12, 1960, JPLHF 2-1405a. Actual designation for missions and payloads dated April 28, 1960, JPLHF 2-420.)

During April The JPL Systems Division issued the Ranger RA-1 through RA-5 Spacecraft Design Specifications Book. This JPL-conceived document contained a listing of mission objectives, system design constraints (weight, power, etc.) and the subsystem and designs. (See April 17, 19, 1960.)

Two scientific instruments were added to those currently planned for the RA-1 and RA-2 flights: a JPL friction device to test various means of lubricating bearings and gear surfaces in space,

During April cont.

and, rescheduled for inclusion, the Goddard Space Flight Center composite micrometeorite detector to determine the density of cosmic dust as a function of its mass and velocity. (JPL, Space Programs Summary No. 37-3, op. cit., 4.) (See basic list at January 20, 1960.)

Experiments planned for Rangers RA-3 through 5 included (1) the separable lunar rough landing capsule and (2) two instruments mounted on the spacecraft hexagonal structure, or bus: a TV camera to obtain high resolution photographs of the lunar surface prior to impact, and a University of California gamma ray spectrometer to measure radioactive properties of the moon's surface that would relate to its structure and composition. The photographic experiment would be comprised of four main elements: an optical telescope, a shutter mechanism, a slow-scan vidicon with deflection and focus coils, and an electronics package. "The specific vidicon tube has not been selected due to the lack of information at this time on extended slow-scan properties. Also, several sizes and types of tubes must be evaluated for general performance as well as for target storage and readout properties. . ." (Ibid., 6.)

May 1

Dr. Carl Sagan of the University of Chicago, speaking before the NAS, observed that any biological contamination of celestial bodies by earth organisms "would be an 'unparalleled scientific disaster.' It could wipe out important chances to study the early history of the solar system and the origin of life on Earth, and even to assess the possibilities of life beyond Earth." (Proceedings of the NAS as reported in the New York Times, May 1, 1960, E9, JPLHF 2-976.)

May 3

The Los Alamos Scientific Laboratory (LASL) and the Sandia Cor ration released "A LASL-Sandia Proposed Vela Hotel Experiment the Ranger A-1 and A-2 Probes." Recognizing that engineering planning for the first two Ranger spacecraft was well advanced, the AEC proposal was directed toward minimizing subsystem interface problems. 'The AEC package would consist of a primary battery source, a DC-DC converter, two radiation detectors, data handling and logic, and the necessary packaging and shielding. Total payload weight was estimated "in the neighborhood of 6 pounds." (p. 3) (JPLHF 2-479) (See April 13, 15, 1960.)

1960

May 3 cont. JPL issued Specification 30331, Vehicle System Integration, Requirements and Restraints for Ranger Spacecraft A-1 through A-5, which defined the Ranger spacecraft and system requirements necessary to establish the interface design between the Atlas-Agena B and the spacecraft. A definition of the points of interface had already been agreed upon by JPL, MSFC, and LMSD. (JPLHF 2-1292.)

May 4 JPL Program Director for the Agena, Clifford I. Cummings, announced at a meeting of the Aviation Writers Association in Los Angeles, California, that the spacecraft which would carry television and a detachable capsule to the surface of the moon would be called "Ranger." (Baltimore Sun, May 5, 1960; cited in Apollo Spacecraft Chronology, Vol. I, op. cit., 44.)

May 5 JPL recommended scientific experiments for Ranger Flights 3, 4, and 5 to NASA. They were:

A. Spacecraft Bus

(1) A vidicon camera system which will take approximately 100 pictures, at a rate of one picture every twelve seconds, of the landing region during the terminal maneuver phase.

(2) A gamma ray spectrometer which, after having established background counting rates during transit, will have an unobstructed view of the moon for at least 25 minutes preceding impact.

B. Rough Landing Capsule

(1) A single axis seismometer with a sensitivity of at least one microvolt per microinch deflection at a natural frequency of one cps.

(2) A measurement of the maximum deceleration at impact.

(3) A measurement of the internal temperature during the lifetime of the seismometer experiment.

(Letter from W.H. Pickering to G.F. Schilling, May 5, 1960, JPLHF 2-671.)

May 6 JPL released an "Outline of the JPL Ten-Year Plan" which reflected an earlier decision to contract with industry for lunar projects, while maintaining development of planetary projects largely in-house. (See During January 1960.) (JPL, IOM from W.H. Pickering to Senior Staff, May 6, 1960, JPLHF 2-243.)

May 6 cont. — C.I. Cummings was appointed Lunar Program Director; J.D. Burke was appointed Deputy Director of the Lunar Program at JPL. (JPL, IOM from W.H. Pickering to Senior Staff, et. al., May 6, 1960, JPLHF 2-241.)

May 7 — The Ranger launch schedule (see March 3-5, 1960) was revised by NASA and JPL, slipping the flight dates by three months. (Ranger Project Development Plan, loc. cit.)

Flight No.	Launch Date	Objectives
1 (P-32)	July 1961	Spacecraft engineering tests at
2 (P-33)	Oct. 1961	approximately escape speed.
3 (P-34)	Jan. 1962	High resolution TV photographs of the
4 (P-35)	April 1962	moon, landing of survivable package,
5 (P-36)	July 1962	and spacecraft engineering tests.

May 9 — At JPL Dr. E. Rechtin was appointed Program Director of the Deep Space Instrumentation Facility (DSIF); Dr. N.A. Renzetti was appointed Deputy Program Director for Engineering and Operations for the DSIF. (JPL, IOM from W.H. Pickering to Senior Staff, et. al., May 6, 1960, JPLHF 2-242.)

The NASA Space Science Committee approved the JPL-recommended experiments for the second group of Ranger flights, RA-3, RA-4 and RA-5. (See May 5, 1960.) Edgar Cortright indicated that he would see if the mission of the second Agena probe could be altered to a lunar trajectory. (Summary Minutes of the Space Sciences Steering Committee of May 9, 1960, JPLHF 2-1411b.)

May 10 — NASA Headquarters issued an approved numbering system for satellite and space probes to field centers. (See April 28, 1960.) Agena B lunar probes were designated P-32 and P-33, Spacecraft Development; and P-34 through P-36, Lunar Reconnaissance and Rough Landing. (NASA, letter from O.W. Nicks to C.I. Cummings, May 10, 1960, JPLHF 2-1405b; also, letter from A. Silverstein to W.H. Pickering, May 16, 1960, JPLHF 2-1405c.)

NASA Headquarters requested that JPL consider whether the P-33 mission (RA-2) could be changed from an earth orbit to a lunar near miss "to acquire lunar magnetic field measurements in addition to the data already anticipated?" Also, inquiry was made whether an alternate capsule could be carried in P-36 (RA-5) in the event the seismometer proved defective. (NASA, letter from A. Silverstein to W.H. Pickering, May 10, 1960, JPLHF 2-1408.)

1960

May 13 R.J. Parks was appointed JPL Planetary Program Director, with J.N. James as Deputy Director. (JPL, IOM from W.H. Pickering to Senior Staff, et. al., May 13, 1960, JPLHF 2-244.)

May 16 The second meeting of the Lunar Sciences Subcommittee, NASA Steering Group on Lunar, Planetary, and Interplanetary Exploration, convened in Washington, D.C. Experiments for the first five Ranger spacecraft and the planned Centaur lunar soft landing vehicle (Surveyor) were discussed. (NASA, Lunar Science Chronology, loc. cit.)

Dr. Homer E. Newell, Jr. outlined the primary objectives of the NASA Space Science Program:

1. Investigation of the relationships between the sun and the earth.
2. Investigation of the nature of the universe.
3. Study of the origin and distribution of life.

(Draft of speech "The NASA Space Sciences Program," by Homer E. Newell, Jr., May 16, 1960, 5, JPLHF 2-1941.)

May 17 The third meeting of the NASA Lunar Sciences Subcommittee was held; discussion concerned review of the scientific aims established for United States lunar and planetary programs. Drs. T. Gold and H. Urey emphasized that the purpose of the manned Mercury Program should be publicized as one of research and exploration, not as an engineering tour de force or propaganda stunt. (NASA, Lunar Science Chronology, op. cit., 1.)

May 18 NASA released proposed names for lunar and interplanetary missions, with lunar mission groups patterned after land exploration activities, and planetary missions patterned along nautical lines conveying the impression of travel to great distances and remote places. They were: Lunar Impact--Ranger; Lunar Soft Lander--Surveyor; Lunar Soft Landing (mobile)--Prospector; Lunar Orbiter--Pioneer; Venus and Mars Probes 1962--Mariner; Venus and Mars Orbiters 1965--Voyager. (E. M. Cortright, Memorandum for Ad Hoc Committee to Name Space Science Projects and Objects, May 18, 1960, JPLHF 2-245b.)

May 19 A meeting among representatives from LMSD, MSFC, JPL, AF, and NASA Headquarters was held at LMSD, Sunnyvale, California. Dr. Albert Kelley announced "that it was not NASA's policy--basically due to severe fiscal difficulties--to do business on an open ended letter contract. Therefore, Headquarters wanted a definitized contract in sixty days--by 17 July. . . . Albert and Gibson [AF] said this was

May 19 cont. impossible; that no LMSD-BMC contract had ever been consumated in anywhere close to this time. . . . Lockheed had previously been advised of the three month schedule slip; however, they were not prepared for Kelley's shock that the level of effort would be maintained at the current level of engineering tasks only. . . until a definitized contract could be issued." (JPL, Trip Report No. 311-612, Gordon Kautz, Subject: NASA Agena Program, May 19, 1960, JPLHF 2-1033, 1-2.)

May 20 NASA Headquarters decided in favor of funding LMSD on the Letter Contract, rather than waiting for conclusion of a Definitive Contract, for $6.1 million. Date for conclusion of a Definitive Contract was set at August 7, 1960. (J.D. Burke, "Lockheed Launch Vehicle Chronology," loc. cit.)

May 23 A seismometer developed by the California Institute of Technology (see During July 1959) was approved for use in the lunar capsule on Rangers 3, 4 and 5 by the NASA Steering Group on Lunar, Planetary, and Interplanetary Exploration.* (N.W. Cunningham, Ranger Program Chronology, loc. cit.)

May 24 An Air Force Atlas-Agena A was successfully launched from AMR into earth orbit for the first time (see February 26, 1960). (E.M. Emme, Aeronautics and Astronautics, 1915-1960, op. cit., 123.)

JPL requested a freqency allocation of the entire 10 MC bandwidth between 2290 MC and 2300 MC be assigned for future use by the DSIF as a permanent replacement for the present assignment of 960.05 MC. (JPL, letter from E. Rechtin to E.C. Buckley, NASA, May 24, 1960, JPLHF 2-1410.)

May 25 JPL began preparations to accommodate the Vela Hotel experiment on Ranger A-1 and A-2 in the event NASA directed the inclusion of this experiment. (J.D. Burke, Conference Report, Subject: Vela Hotel Status, May 25, 1960, JPLHF 2-1000.) (See June 8, 1960.)

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*Under NASA contract, Caltech's Seismological Laboratory had been assigned the task of designing and fabricating a single-axis lunar seismometer capable of withstanding a high shock of impact, for use on a lunar vehicle. Caltech, together with the Lamont Geophysical Observatory of Columbia University, would reduce, analyze, and interpret subsequent seismograph data. JPL was responsible for technically monitoring the Contract and for ensuring the proper integration of the seismometer into the lunar capsule, supplied under a JPL subcontract by the Aeronutronic Division of Ford Motor Co.

1960

May 27 The NASA Space Sciences Steering Committee (SSSC) and subcommittes were formally established, and NASA Steering Group on Lunar, Planetary, and Interplanetary Exploration was abolished. (SSSC responsibilities as outlined at April 15, 1960.) (NASA, Lunar Science Chronology, loc. cit.; also, NASA, Fourth Semi-annual Report to the Congress, April 1, 1960 - September 30, 1960, January 18, 1961, 241.)

Aeronutronic, Division of Ford, released Publication U-902, Lunar Capsule, Master Program Plan. (JPLHF, 2-1290.)

During May The Centaur lunar soft-landing project (later known as Surveyor) and a Venus interplanetary fly-by project (later known as Mariner A) were approved by NASA Headquarters with JPL as Project Manager. As this lunar mission was to be contracted out-of-house, JPL distributed a Design Study Requirements document to industry and, late in May, held a bidders' conference at the Laboratory. Funding for these programs was to be made available beginning in FY1961. (Project Surveyor: Report of the Subcommittee on NASA Oversight of the Committee on Science and Astronautics, U.S. House of Representatives, Eighty-ninth Congress, First Session, Washington, D.C., 1965, 15; also, JPL, Space Program Summary No. 37-5 for the period July 15, 1960 to September 15, 1960, 2.) (See March 14, 1960.)

JPL began detailed studies of the most efficient means to exercise remote control over the maneuverable Ranger spacecraft after launch, as well as for methods to receive and process data. (Initial United States space probes were primarily passive in nature and little if any active control could be exercised from the ground.) Plans for the necessary facilities, spacecraft control operations, and data readout and processing were completed by November 1960, when the aggregate effort was designated the Ranger Spaceflight Operations System. (JPL, The Ranger Project: Annual Report for 1961, op. cit., 3.)

With completion of the preliminary design of the RA-1 attitude control subsystem, Dan Schneiderman obtained Preliminary Design sign-off for the Ranger spacecraft. (Testimony of J.D. Burke, RA-5 Failure Investigating Committee Report, November 2, 1962, 1, JPLHF 2-460b; also, JPL, Space Programs Summary No. 37-3, op. cit., 26.)

1960

June 1 In response to a JPL request to isolate potential problem areas in lunar capsule development, and to recommend plans for resolving these problems in light of planned flight schedules, ADF proposed that NASA authorize backup subcontracts for (a) parallel solid rocket motor development, (b) parallel altimeter development, and (c) seismometer amplifier development. (Aeronutronic, Lunar Capsule Supplementary Project Plan, June 1, 1960, 1-2, JPLHF 2-1291.)

June 2 Technical monitoring of NASA Order HS-219 with ABMA for lunar studies was transferred to JPL in keeping with the Laboratory's mission responsibilities. (NASA, letter from A. Silverstein to E. Stuhlinger of the Development Operations Division of ABMA, June 2, 1960, JPLHF 2-327.)

June 6 A meeting was convened among representatives of JPL, LASL, and the Sandia Corporation which determined that, with some alterations, the Vela Hotel experiment was compatible with Ranger spacecraft A-1 and A-2. (Letter from H.H. Patterson of Sandia Corp. to D. Sale of U.S. Atomic Energy Commission, June 20, 1960, JPLHF 2-1043a.)

June 7 "NASA has requested that JPL, Sandia and Los Alamos jointly prepare a report describing the manner in which JPL would accommodate a Vela Hotel experiment if we were required to do so. . . . Although we do not expect to hear from NASA Headquarters until about July 1, 1960, it is probable that we will be requested to incorporate the experiment." (JPL, IOM from J.D. Burke to Distribution, June 7, 1960, JPLHF 2-1038.)

JPL submitted the results of a brief study on a revised mission for RA-2 to NASA. It was determined that a lunar near miss would be included as an alternate mission on current schedules. (JPL, letter from J.D. Burke to E.M. Cortright, June 7, 1960, JPLHF 2-1413.)

June 8 JPL notified NASA Headquarters that, upon further evaluation, the 12-lb. Vela Hotel experiment was technically compatible with the Ranger 1 and 2 spacecraft. (JPL, letter from C.I. Cummings to E.M. Cortright, June 8, 1960, cited in letter from A. Silverstein to W.H. Pickering, June 29, 1960, JPLHF 2-480; also, JPL, IOM from J.D. Burke to Distribution, June 7, 1960, loc. cit.)

1960

June 10 Due to confusion over the precise role of MSFC in the Agena program and the degree of support expected from that organization, Maj. Gen. D.R. Ostrander, OLVP, NASA Headquarters, released a statement of MSFC responsibilities. (NASA, letter from D.R. Ostrander to W. von Braun, MSFC, June 10, 1960, JPLHF 2-1040.)

June 14 NASA announced creation of a Launch Operations Directorate (LOD), and appointed Dr. Kurt Debus of MSFC as director, effective July 1, 1960. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, op. cit., 124.)

June 15 LMSD received $6.1 million from NASA via BMC for the Agena program. Completion of a definitive contract was now scheduled for August 17, 1960. (J.D. Burke, "Lockheed Launch Vehicle Chronology," loc. cit.)

A NASA flight schedule was released, and called for the launch of Ranger spacecraft as follows:

RA-1	(P-32)	7/61
RA-2	(P-33)	10/61
RA-3	(P-34)	1/62
RA-4	(P-35)	4/62
RA-5	(P-36)	7/62

(Data from NASA PMP Chart 11-0, dated August 10, 1960, citing schedule of June 15, 1960, JPLHF 2-968.) (See January 21, 1960.)

June 16 In a memo reaffirming a previous memo on September 18, 1959, Secretary of Defense McElroy stated that "the establishment of a joint military organization for control over operational space systems does not appear necessary or desirable at this time." (Defense Space Interests, op. cit., 11.)

June 17 NASA Administrator T. Keith Glennan assured JPL Director W.H. Pickering that he shared in the concern over delay in the first launch of the Agena program. Dr. Glennan believed that, even if funds were made available the launch vehicle contractors could not meet an earlier launch date. Consequently, every effort should be made to assure the integrity of the revised schedule. (NASA, letter from T.K. Glennan to W.H. Pickering, June 17, 1960, JPLHF 2-1236.)

The revised LASL-Sandia Proposed Vela Hotel Experiment for the Ranger A-1 and A-2 Probes was released by the Los Alamos Scientific Laboratory and the Sandia Corp. (JPLHF 2-1043b.)

1960

June 20	Vendor proposals on the two major Lunar Capsule subcontracts (the altimeter and retromotor) were received by Aeronutronics. Evaluation of these proposals were completed and and a recommendation for selection of subcontractors was made to JPL on June 28. (JPL, Space Programs Summary No. 37-4 for the period May 15, 1960 to July 15, 1960, August 1, 1960, 6.)
June 27	LMSD submitted a firm cost proposal to NASA for sixteen Agena B vehicles (see April 12, 1960). (Ranger Project Development Plan, op. cit., 9.)
June 28	Following review of the Aeronutronic recommendations for capsule subcontracts (see June 20, 1960), JPL endorsed selection of Hercules Powder Company as fabricator for the capsule solid propellant retromotor, and of Ryan Aeronautical Company to produce the radar altimeter, and authorized Aeronutronics to proceed with initiation of order placement for these subsystems. (JPL, Space Programs Summary No. 37-4, loc. cit.)
June 29	In response to the JPL letter of June 8, NASA authorized JPL to proceed with plans to integrate the AEC Vela Hotel experiment into Ranger Spacecraft 1 and 2. "It is understood that the experiment will not compromise the ultimate objectives of the Ranger program and that all constraints essential to this end can be met. . ." (NASA, letter from A. Silverstein to W.H. Pickering, dated June 29, 1960, loc. cit. at June 8.)
June 30	Cognizance over the Sergeant Missile Program was transferred from JPL to Sperry Gyroscope, Utah, where production of the missiles for the United States Army was to be undertaken. Except for minor activities, this action signified an end of the Sergeant R & D phase which began in the early 1950's; it was the last major JPL effort under Army contract. (JPL, IOM from W.H. Pickering, to All Personnel, July 22, 1960, JPLHF 2-301.)
During June	Space Technology Laboratories (STL) was assigned responsibility by JPL for performing Atlas/Agena B-Ranger ascent guidance equation work by means of a subcontract through Aerospace, with technical monitoring by MSFC. JPL was to be responsible for the post-injection trajectory. (JPL, IOM from C.G. Pfeiffer to J.D. Burke, January 16, 1961, 1.)

1960

During June cont.

ADF was assigned additional responsibility for developing the amplifiers and related ground equipment needed to integrate the Caltech seismometer into the lunar capsule, and to provide support at launch. (Originally JPL had planned to supply the amplifier final design.) JPL also notified ADF that delays in the Atlas/Agena vehicle program would necessitate a slip in the September 1961 launch date for RA-3 to late January 1962. (JPL, The Ranger Project: Annual Report for 1961, op. cit., 37.)

JPL awarded a subcontract to the Northrop Corporation to supply electro-optical earth sensors for the Ranger attitude control system. (Investigation of Project Ranger: Hearings Before the Subcommittee on NASA Oversight of the Committee on Science and Astronautics, U.S. House of Representatives, 88th Congress, Second Session, Washington, D.C., 1964, Testimony of Richard E. Horner, 203.)

M.E. Davies reported in the June 1960 issue of Astronautics that the Lunik III moon photos were composites formed by statistical incorporation of pieces of several authentic pictures. The enhancement technique, a common photographic practice, was blamed for speculation over the authenticity of the pictures. (pp. 47, 49, JPLHF 5-250.)

July 1

AFSSD allocated space vehicles (Atlas and Agena) to NASA for Project Ranger; Hangar E at AMR which had been assigned to Ranger, was also turned over to NASA. (Ranger Project Development Plan, op. cit., 68, 9.)

The George C. Marshall Space Flight Center (MSFC) was formally transferred to NASA from ABMA at Redstone Arsenal, Huntsville, Alabama. Dr. Wernher von Braun was named Director of the new center. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, loc. cit.)

In the lunar capsule development program for Rangers 3-5, the first helicopter drop test was carried out by ADF to investigate the specific energy absorption properties of natural balsa wood. Results indicated that balsa wood was superior to plastic in dynamic energy absorption, and the wood was selected as the outer casing material for the capsule. (JPL, Space Programs Summary No. 37-5, op. cit., 29.)

July 5 The House Committee on Science and Astronautics released Space, Missiles and the Nation, a summary of authorization hearings. The Committee recommended that NASA undertake a high priority program to land a manned expedition on the moon during the 1960's, and urged NASA to submit such a plan to Congress. Mr. Richard E. Horner, Associate Administrator of NASA, "forecast a manned landing on the moon 'in the time period beyond 1970.' When beyond 1970, he did not say. Whether the Russians will wait 'beyond 1970' for manned exploration of the moon is highly problematical." (U.S. Congress, House Committee on Science and Astronautics, Space, Missiles and the Nation, Washington, D.C., 1960, 55-56, and 12.)

JPL was notified that the NASA Office of Lunar and Planetary Programs, (headed by Edgar Cortright) in the Office of Space Flight Programs would serve as the principal coordinating group between JPL and NASA Headquarters. (NASA, letter from A. Silverstein to W.H. Pickering, July 5, 1960, JPLHF 2-328.) (See January 1, 1960.)

JPL Lunar Program Chief C.I. Cummings submitted his recommendations to Director W.H. Pickering for discussion at the next meeting of the NASA SEPC. They were (1) that the Agena B Coordination Board be dissolved and program directors be delegated necessary authority and responsibility for program management, and (2) request that Dr. von Braun provide more support to the Agena program. (JPL, IOM from C.I. Cummings to W.H. Pickering, July 5, 1960, JPLHF 2-1242.)

July 10 JPL Contract M-48068, "Lunar Impact TV Camera," with RCA-AED, was definitized (see March 25, 1960). Period of performance ran through completion of work and submittal of a final engineering report on June 21, 1963. Richard Heyser was appointed JPL Cognizant Engineer on this effort. (JPL Contract Closeout Records.)

July 11 JPL concluded an investigation to determine why LMSD Agena performance projections for Flights 3-5 were below the capability specified by the Ranger Project. It was determined that the performance calculations drawn from pre-injection trajectories supplied to JPL by Convair were at variance with trajectories developed by LMSD. "In comparing performance of the Convair and LMSD trajectories, a significant difference is noted. Namely, the CVA trajectories provide 230 lbs. more into the parking orbit, or 75 lbs. more payload than the LMSD trajectories." Using LMSD figures as a baseline, this report triggered a major

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July 11 cont. — weight reduction campaign for Ranger spacecraft 3-5. (JPL, IOM from V.C. Clarke to J.D. Burke, July 14, 1960, JPLHF 2-562.)

NASA Headquarters requested that JPL establish a single group responsible for spacecraft sterilization and decontamination procedures, and recommended that Dr. George Hobby be placed in charge of this effort. (NASA, letter from A. Silverstein to W.H. Pickering, July 11, 1960, JPLHF 2-325.)

JPL awarded partially funded study contracts to four industrial firms for the Surveyor lunar soft-lander follow-on program. The firms were North American Aviation, Hughes Aircraft, McDonnell Aviation, and STL.

July 12 — NASA approved a JPL contract with the RAND Corporation for a one-year study of the properties of the moon, planets, and interplanetary space. (NASA, letter from A. Silverstein to W.H. Pickering, July 12, 1960, JPLHF 2-1419.)

July 14 — JPL released Preliminary Design Estimate for a Planetary Spacecraft. The spacecraft, proposed for launch on Centaur vehicles, embodied a basic Ranger design extension, including the hexagonal bus and science passenger concept. (JPL, Planetary Program Briefing Summary, July 8, 1960, revised July 14, 1960, 32.)

July 14-15 — The NASA SEPC met in Washington, D.C. Discussion of the Agena B Coordination Board (Agenda Item 9) largely centered on problems in the division of responsibility between program personnel and the Board. It was decided that the Board would be retained. "Mr. Horner noted that the membership of the Board, its Committees and Panels, is comprised of program personnel and that this should make possible the normal resolution of problems at the working level without recourse to the Board for decision. . . . It was agreed, however, that the functions and authority of the Agena-B Coordination Board, as spelled out by the document establishing the Board, should be reviewed for possible clarification." (Minutes, Space Exploration Program Council Meeting, July 14-15, 1960, JPLHF 2-1418b.) (See July 5, 1960.)

July 18 — Dr. Robert C. Seamans, Jr. was named Associate Administrator of NASA, replacing Richard E. Horner. He would formally assume his new duties on September 1, 1960. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, op. cit., 125.)

1960

July 20 J.D. Burke, Ranger Project Manager at JPL, observed that project technical and management exigencies might soon force ". . . a choice between further [schedule] slippage or a downgrading of [mission] objectives. All our experience dictates that the choice should be weighted heavily toward holding the flight dates at the expense of other things. But we detect some sentiment the other way in Headquarters. This difference in viewpoint adds vigor to the technology-science controversy and encourages undisciplined efforts by our own [JPL] science people to get Headquarters to order us to wait for them if necessary. . . ." Furthermore, "internal to NASA, we are still having trouble identifying the individuals with responsibility and authority for various program items. . . . currently most of the difficulty seems to involve the AMR situation and the apparent absence of one individual charged with complete operational command. . . ." (JPL, IOM from J.D. Burke to B.O. Sparks, July 22, 1960, Subject: Visit by Dr. Glennan, JPLHF 2-519.) (See Appendix G)

July 21 Responsibility for preliminary design of all JPL spacecraft was assigned to the Systems Design Section of the Systems Division. John Small was appointed to head the preliminary design team for the 1962 Venus shot. (JPL, IOM from B. Sparks to Senior Staff, July 21, 1960, JPLHF 2-300.)

July 25 NASA and the Air Force began negotiations with LMSD for a Definitive Contract for NASA Agena B vehicles. (J.D. Burke, "Lockheed Launch Vehicle Chronology," loc. cit.)

Decisions in favor of constructing a large vacuum Environmental Test Chamber at JPL had been reached. "The SEB [Source Evaluation Board] has concluded its findings and is recommending that a contract be awarded to Consolidated Vacuum of Rochester, New York. . . . Silverstein has tentatively approved this choice and it is expected that negotiations for a contract will be completed in August and that the chamber will be operational by August of 1961." (JPL, Notes No. 27 of Director's Staff Meeting, July 25, 1960, 2, JPLHF 2-1049.)

July 26 In the event the flight of RA-1 was completely successful, an initial study of a revised RA-2 mission as a lunar near-miss was concluded at JPL. To obtain data on the lunar magnetic field and to avoid complete sterilization of the spacecraft, the flight would pass the moon on the dark side by a wide margin. Trajectory considerations for the proposed mission were found to be feasible, although on board science packaging, commands and control were found marginal. (JPL, "Study of Alternate RA-2 Trajectory," July 26, 1960, JPLHF 2-1070b.) (See January 23, 1961.)

July 28-29 The first NASA-Insustry Program Plans Conference was held in Washington, D.C. Edgar Cortright of the Office of Space Flight Programs postulated four basic scientific objectives for NASA's unmanned deep space exploration program: (1) physics of the moon and planets, (2) solar and interplanetary physics, (3) biosciences and extraterrestrial life, and (4) cosmology. Later at the same conference, and reflecting the Congressional sentiment expressed on July 5, George M. Low of the NASA Research Steering Committee on Manned Space Flight announced that principal manned program to follow Mercury had been named Apollo, with the eventual objective of a manned landing on the moon and return to earth sometime after 1970. (NASA, NASA-Industry Program Plans Conference, July 28-29, 1960, 68, and 79-81, JPLHF 2-859.)

July 29 Test requirements for the Ranger PTM were outlined. (JPL, IOM from W.R. Woods to Distribution, July 29, 1960, JPLHF 2-1707.)

During July JPL completed construction of the Mesa Antenna Range. Operated by the Telecommunications Division, the range was employed for supporting research and advanced development for the DSIF and spacecraft telecommunications. (JPL, Space Programs Summary No. 37-10, Vol. I, for the period May 1, 1961 to July 1, 1961, August 1, 1961, 82; also, JPL, Space Programs Summary No. 37-5, op. cit., 7-8.)

ADF awarded subcontracts to Ryan Aeronautical Company to develop the altimeter, and to Hercules Powder Company to develop the lunar capsule retro-motor, for Ranger spacecraft 3-5. (JPL, The Ranger Project: Annual Report for 1961, op. cit., 37-38.) (See June 28, 1960.)

Construction of a full scale mockup of the Ranger spacecraft model for Flights 1 and 2 was completed and utilized for cabling and equipment layout. The primary structural components for a proof test model (PTM)* had also been completed although the PTM was not yet assembled at this date. (JPL, Space Programs Summary No. 37-4, op. cit., 1.) (Figure 30.)

Planning for the complex of earth-based facilities required to conduct NASA's deep space flight operations was about two-thirds complete. (See During May, 1960.) The entire system was termed the Space Flight Operations Complex (SFOC) and consisted of the

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*The PTM was designed to duplicate the flight item as nearly as possible, and was designed to be subjected to testing beyond flight acceptance levels.

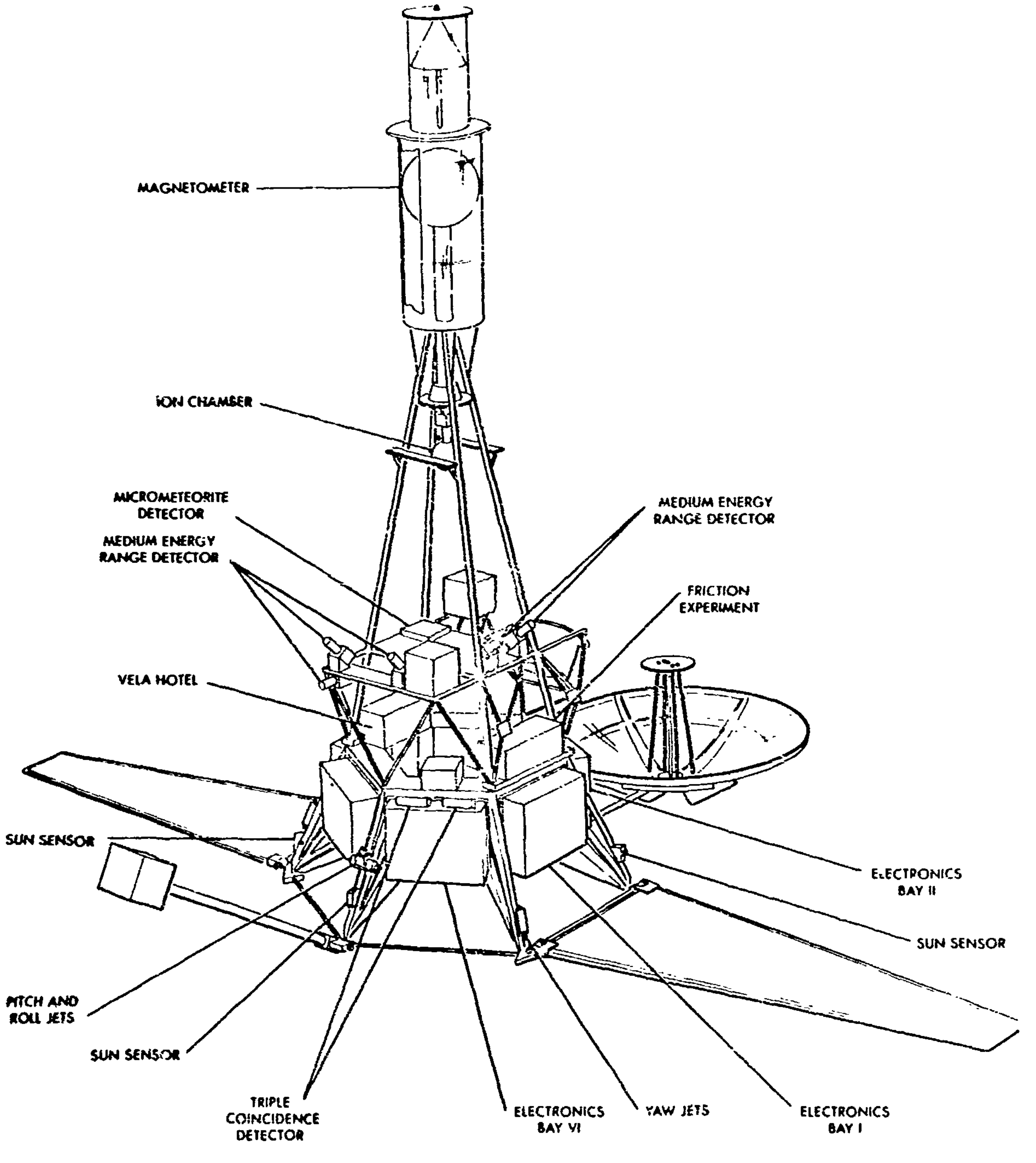

Figure 30: Ranger 1 and 2 spacecraft design, July 1960.

1960

During July cont.

DSIF, a central flight control point from which space flight operations would be conducted, and the communications net that linked the various DSIF stations and the central control point. A decision had been reached to establish central control at JPL in Pasadena, rather than at the DSIF station at Goldstone; however, the problem of developing the control area remained to be resolved. Projected AMR and downrange tracking, telemetry instrumentation, and computation requirements had been released in the Agena Program Requirements Document on July 29, 1960. (JPL, Ranger Final Report, rough draft, April 25, 1967, 35-36, JPLHF 2-473.)

Aug. 2

General Management Instruction (GMI) 2-2-11, NASA-JPL Relationships was released by NASA Headquarters. A document of the same title was signed by NASA Administrator T. Keith Glennan and Caltech President L.A. DuBridge. (JPLHF 2-963.)

Aug. 3

An early draft of NASA Agena B Launch Vehicle Program Management Organization and Procedures was sent to the Air Force. (Letter from Brig. Gen. H.W. Powell, USAF, to Maj. Gen. D.R. Ostrander, NASA, September 8, 1960, JPLHF 2-1075.) (See January 3, 1961.)

NASA Headquarters reduced the scope of the LMSD Agena contract from 16 to 9 vehicles. (Ranger Project Development Plan, loc. cit.) The date for completion of a definitive contract slipped to September 15, 1960. (J.D. Burke, "Lockheed Launch Vehicle Chronology," loc. cit.)

Aug. 5

Details of environmental testing, guidance, and control equipment for RA-1 and RA-2 were specified. (JPL, IOM from W.E. Giberson to Division 34 Engineers, August 5, 1960, JPLHF 2-1534.)

Aug. 10

Lockheed released LMSD/447172, "Final Report of NASA TAD002 Study, Agena/Spacecraft Shroud Separation."

Aug. 11

JPL informed NASA that an RA-2 lunar near-miss mission was feasible and probably desirable in the event RA-1 was successful. (JPL, letter from J.D. Burke to E.M. Cortright, enclosing "Study of Alternate RA-2 trajectory," August 11, 1960, JPLHF 2-1070.) (See July 26, 1960.)

Aug. 12

USAF Air Research and Development Command (ARDC) released their development plan, NASA Agena B Program, to NASA. (Ranger Project Development Plan, loc. cit.)

Aug. 13 The U.S. Army announced completion of a lunar map project covering the visible face of the moon. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, op. cit., 126.)

Aug. 19 C.I. Cummings was notified that unless increased priority was assigned JPL spacecraft sterilization efforts, the Ranger impact vehicles 3-5 would not be sterile in conformance with NASA requirements. (JPL, IOM from J.H. Gerpheide to C.I. Cummings, August 19, 1960, JPLHF 2-1069.)

Proposed completion of a final draft of the Agena Program requirements document acceptable to all parties slipped from August 22 to September 9, 1960. (J.D. Burke, "Lockheed Launch Vehicle Chronology," loc. cit.)

Los Alamos Scientific Laboratory and the Sandia Corporation released A LASL-Sandia Proposed Vela Hotel Experiment for RA-3, 4, 5. Although effort was underway at JPL to incorporate this experiment on the first two Ranger test flights in earth orbit, no plans had been made for Vela on the subsequent lunar impact flights.

Aug. 24 The Ranger Design Review for RA-3, the first lunar impact spacecraft, was conducted at JPL. (JPL, Minutes of Ranger Program Design Review Meeting on RA-3 held August 24, 1960, JPLHF 2-1073.)

During August Block I Spacecraft. (Ranger Flights 1-2)* Design of the spacecraft electrical power system was completed and the breadboard regulated power supplies, several primary batteries, and a type approval solar panel had been fabricated and tested at JPL. (JPL, Space Programs Summary No. 37-4, op. cit., 30.)

Initial thermal tests on chassis assembly equipment contained within instrument compartments were conducted in a small vacuum chamber at JPL. Tests indicated that passive techniques for spacecraft temperature control (i.e., radiation and conduction) of the instrument compartment assemblies were adequate, provided that distribution of power dissipation between various compartments was achieved. (Ibid., 34.)

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*The terms Block I, Block II, etc. refer to a grouping of Ranger flights having similar missions. These terms did not come into general use until January of 1963 when, at one point, twenty-four Ranger flights were planned. They are introduced here to order discussion of flight spacecraft developments.

During August cont.

Block II Spacecraft. (Ranger Flights 3, 4 and 5) The first rough layout of the spacecraft instrument compartment for RA-3 was completed, and design of the midcourse rocket engine was underway. While the configuration of the Block II spacecraft was similar to Block I and plans called for duplicating many features, it differed substantially in carrying a science instrumented package for lunar impact, a midcourse propulsion system, and a refined central computer and sequencer (CC&S).* (Ibid.; and, Minutes of Ranger Program Design Review Meeting on RA-3 held August 24, loc. cit.) (Figure 31.)

Development of the CC&S was being carried out jointly by American Bosch ARMA Corporation and JPL; the units would be fabricated by ARMA to a JPL design. (JPL, Space Programs Summary No. 37-5, op. cit., 12.)

Block II Lunar Capsule. Further drop tests of full-scale lunar capsule impact limiters confirmed that balsa wood had a far better impact absorbing efficiency than nylon honeycomb and plastics. Study of the modulation scheme proposed for capsule communications revealed that one segment was unfeasible, and doubling of the RF output from the moon was required. The capsule design was modified to reflect these findings. (JPL, Space Programs Summary No. 37-4, op. cit., 4; also, Space Programs Summary No. 37-5, op. cit., 29.) (Figure 32.)

The Hercules Powder Company completed preliminary design of the case, nozzle, and grain of the solid propellant retro-rocket for the Lunar Capsule. (Ibid., 31.)

Sept. 6

Mission objectives and design criteria for Ranger Flights 3, 4, and 5 were modified by adding the requirement "To collect gamma-ray data both in flight and at the vicinity of the moon." Accordingly, priority of the scientific experiments was also revised to accord the Gamma Ray Spectrometer the first position, followed by the TV and seismometer experiment, etc. (see April 19, 1960). (JPL Specification No. RA345-2-110B, JPLHF 2-1095c.)

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*The Block II CC&S had two classes of function: initiating sequential spacecraft events (for example, solar panel deployment) during the mission, and controlling the midcourse and terminal maneuvers according to commands from Earth. The subsystem was contracted initially, but flight articles were ultimately built at JPL.

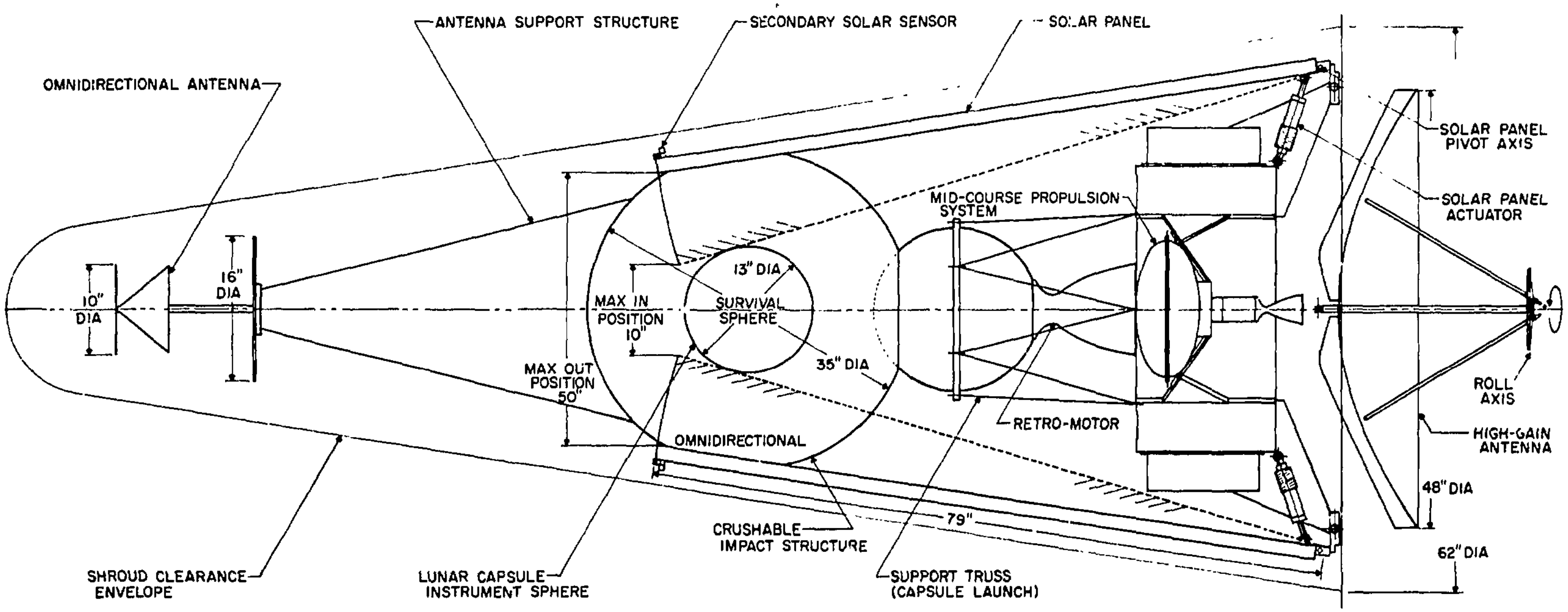

Figure 31: Ranger 3, 4, and 5 spacecraft inboard profile, July-August 1960.

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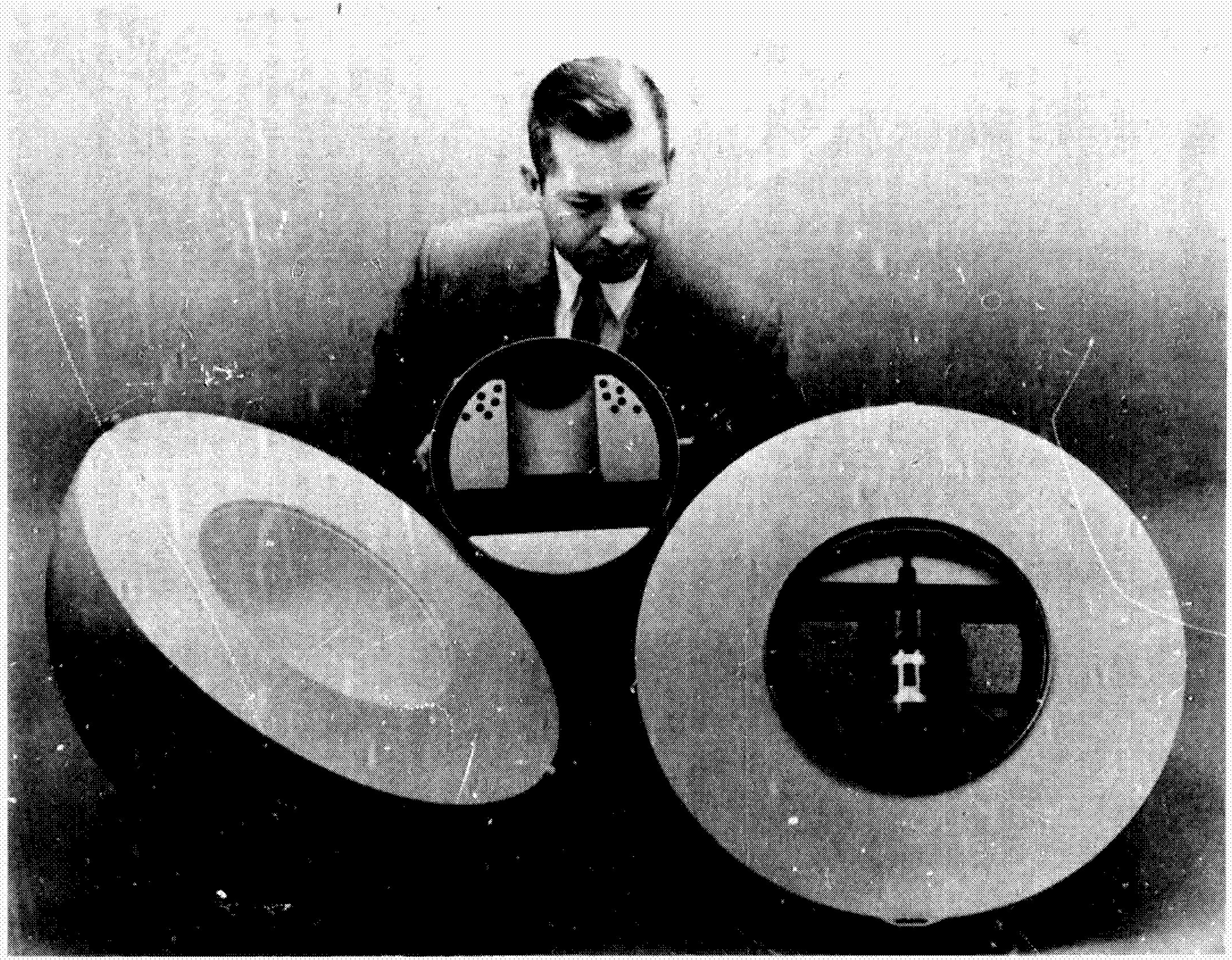

Figure 32: Lunar capsule mockup showing instrumentation in the Survival Sphere. Seismometer and related equipment appear in the sphere on the right.

1960

Sept. 9 Brig. Gen. Harvard Powell of AFBMD responded to the proposed NASA Agena B Launch Vehicle Program Management Organization and Procedures document (see August 3, 1960). He submitted a counter-proposal which, in essence, recommended that NASA delegate to the Air Force responsibility for all operations from launch to orbit injection. (Letter, from Brig. Gen. H.W. Powell, to Maj. Gen. D.R. Ostrander, loc. cit.)

The fourth meeting of the SSSC Lunar Sciences Subcommittee convened. M. Eimer reviewed the status of the Ranger Project and described the science instruments for Ranger Flights 1 and 2. Robert Jastrow discussed the feasibility of using a single-axis seismometer on Rangers 3-5. (NASA, Lunar Science Chronology, loc. cit.)

JPL notified NASA Headquarters that, because of the advanced state of spacecraft design, weight problems, personnel shortages, and schedule commitments, it would be virtually impossible to accommodate the AEC Vela Hotel experiment on Ranger Flights 3-5 "on any basis not involving gross interference with [flight] objectives." (See August 19, 1960.) (JPL, letter J.D. Burke to E. Cortright, September 9, 1960, JPLHF 2-1078; see also, letter from C.I. Cummings to E.M. Cortright, September 16, 1960, JPLHF 2-1424.)

Sept. 13 The NASA-DOD Aeronautics and Astronautics Coordinating Board (AACB) was formally established--replacing the CMLC--by an agreement between the Secretary of Defense and the Administrator of NASA. The Board's purpose was to review planning, avoid duplication, coordinate activities of common interest, identify problems requiring solution either by NASA or the DOD, and ensure a steady exchange of information. The Deputy Administrator of NASA and the Director of Defense Research and Engineering served as Co-chairmen of the AACB which was composed of six panels with equal representation from both agencies. (Agreement printed in Defense Space Interests, op. cit., 25-26; see also, Willis H. Shapley, "U.S. Space Program," The Challenges of Space, edited by Hugh Odishaw, Chicago & London, University of Chicago Press, 1962, 171.)

Sept. 14 The AEC withdrew its request for Vela Hotel on Ranger Flights 3-5. (Letter from R.F. Taschek of Los Alamos to E.M. Cortright of NASA, September 14, 1960, JPLHF 2-1079.) (See September 9, 1960.)

Sept. 25 Atlas-Able Pioneer (P-30), a spin stabilized lunar orbiter, was launched from AMR under NASA auspices. The flight was aborted when the second stage booster engine failed. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, op. cit., 128.)

1960

Sept. 30 In response to a JPL request, Lockheed released Proposal for the Development and Fabrication of a Mobile Sterilization Gas Transfer System (LMSD 288731). The system would provide for prelaunch terminal sterilization of the spacecraft inside the shroud.

During September Ranger Block I. A mockup of the spacecraft adapter, shroud, and forward portion of the Agena were received at JPL, but were returned to LMSD because of inconsistencies in design and construction. (JPL, The Ranger Project: Annual Report for 1961, op. cit., 87.)

The purpose of the Ranger Program, as stated in a contemporary NASA report, "is to (1) investigate the surface of the moon as the spacecraft approaches it, and (2) land the first U.S. survivable payloads on the surface." (NASA, Fourth Semiannual Report to the Congress, April 1, 1960 - September 30, 1960, January 18, 1961, 58.) (See April 19, 1960.)

Oct. 7 An Agena B meeting was held at STL. AFBMD indicated that STL preparation of ascent guidance equations for NASA-Agena B missions was still being handled on a subcontract from the Aerospace Corp. working under an Air Force contract, but that a more permanent NASA-Air Force contractual arrangement with STL would be worked out during the month. The Air Force also "announced that JPL deal with STL via Lockheed only, although AFBMD recommended that JPL receive information copies of correspondence between Lockheed and STL." (Memo to File from J.L. Norton of STL, "Minutes of Agena-B Meeting at STL October 7, 1960," 4.) (See During June, and July 11, 1960.)

Oct. 10 A.E. Wolfe notified J.D. Burke that, because of the small size and technical limitations inherent in the interim space simulation chamber at the Laboratory, temperature control and calibration testing of the Ranger 1 and 2 PTM would be delayed one to two weeks. (JPL, IOM from A.E. Wolf to J.D. Burke, October 10, 1960, JPLHF 2-1080.)

Oct. 11 The third launch of an Atlas-Agena A took place at AMR. The Agena nitrogen gas attitude control system was ruptured at liftoff and the vehicle did not attain orbit. (Air Force Document MTP-MS-IS-61-4, loc. cit.)

Oct. 13 The sixth meeting of the NASA Agena B Coordinating Board took place at NASA Headquarters. C.I. Cummings reported that JPL was very concerned about the overweight conditions of Rangers 3, 4, and 5. "In spite of the fact that various measures, including the drilling of holes in the instrument boxes, have been taken to lighten the spacecraft, the weight has increased by about 15 pounds during the past six weeks. . . ." Subsequently, J.D. Burke indicated that JPL had been unable to obtain definitive calculations from LMSD that would clarify the divergence in performance capability previously computed for Agena B by Convair and LMSD (see July 11, 1960). "He is concerned that the [LMSD] data available to JPL from BMD may have been 'de-rated' somewhat arbitrarily by the Air Force, and may not represent the true capability of the vehicle." (Minutes of Sixth Meeting Agena-B Coordinating Board, October 13, 1960, 4.)

JPL released to NASA "Operational Policy - Lunar Program" which affirmed that "in future lunar projects, beyond Ranger, for which JPL has project management responsibility, the Laboratory will achieve project objectives through the utilization of a prime contractor, who will act as Spacecraft Systems Manager. . . ." The document defined the functions, authority, responsibilities and relationships of the various Laboratory elements. The "Lunar Program" included all space missions involving lunar exploration; a project was defined as "a major element of a program which is expected to extend over a considerable period of time, expend significant sums of money, and require extensive coordination internal and/or external to the Laboratory." (JPL, "Role of the Lunar Project Manager," October 13, 1960, JPLHF 2-303c; also, "Operational Policy - Lunar Program," October 13, 1960, JPLHF 2-303b.)

Oct. 14 J.D. Burke was appointed Ranger Project Manager in the Lunar Program. C.I. Cummings remained as head of the Laboratory's Lunar Program (which now included plans for Surveyor, Prospector, and Orbiter Projects). (JPL, IOM from W.H. Pickering to Senior Staff, et. al., October 14, 1960, JPLHF 2-303a.

JPL requested that the flight date of Ranger 5 be advanced one month from July to June 1962, for "better utilization of Jet Propulsion Laboratory manpower in both the lunar and planetary programs. . . ." The change was approved and reflected in the Official NASA Flight Schedule of October 14, 1960. (JPL, letter from C.I. Cummings to William Fleming, Chairman of Agena-B Coordination Board, October 14, 1960, JPLHF 2-1151; and, Official NASA Flight Schedules, JPLHF 2-968.)

1960

Oct. 16 JPL released Technical Memorandum No. 33-32, Lunar Program Operating Policy, Organization, and Functions, which described the Laboratory's Lunar Program staff organization, the functions of staff members, and their relationship to each other. (JPLHF 2-1148.)

Oct. 16-19 The NASA "Williamsburg Conference" was held. At this meeting, Al Siepert, Director of NASA's Office of Business Administration, first released his staff paper "A NASA Structure for Project Management." This document contained the substance of what was to become NASA General Management Instruction 4-1-1--judged by many to be the single most important management concept generated and adopted by NASA in its formative years--which abolished the Agena B Coordination Board method of managing space projects, and delegated the necessary authority to the respective field centers and Headquarters offices charged with these tasks. (NASA, memo from T. K. Glennan to Participants at the Williamsburg Conference, October 14, 1960, JPLHF 2-1083a; and, NASA, "Organization and Functions of AACB," Fourth Semi-annual Staff Conference, October 16-19, 1960, JPLHF 2-1428.)

Oct. 18 The JPL Sterilization Committee recommended immediate initiation of a program to develop "the sealed shroud concept for using ethylene oxide gas in the surface decontamination of spacecraft." A Lockheed proposal for this system was judged acceptable. (See September 30, 1960.) (JPL, letter from G.L. Hobby to J. Posner, NASA, October 18, 1960, JPLHF 2-1429.)

Oct. 19 Dr. Albert J. Kelley, Agena Vehicle Program Manager at NASA, requested that the Air Force advise "as to what action is being taken by BMD and LMSD to improve the emphasis being put on the NASA program by LMSD, as well as the predicted effects on the NASA program of the introduction of the Advent and Saint programs into an apparently already overlaoded plant." (NASA, letter from A.J. Kelley to Major Albert of AFBMD, October 19, 1960, JPLHF 2-1152.)

Oct. 24 NASA released a draft of General Management Instruction (GMI) 4-2-1, Reliability Policy as Applied to NASA Programs. In his cover letter Robert Seamans noted that, "basically, the reliability assessment program seeks to estimate the system reliability a development program will achieve by a combined application of advanced statistical methods and sound engineering judgment." (NASA, memo from R.C. Seamans Jr. to Directors of Program Offices, Headquarters and Field Centers, October 24, 1960, JPLHF 2-1081a.)

Oct. 24 cont.	JPL informed NASA that 19 lunar capsule retro motors being developed by Hercules would be fired in acceptance tests at simulated altitude conditions in the Arnold Engineering Development Center. Current schedules indicated that the motors should be ready for tests by April 15, 1961. (TWX from J.D. Burke to E.M. Cortright, October 24, 1960, JPLHF 2-1431.)
Oct. 25-26	LMSD made a detailed oral presentation to MSFC and JPL covering all aspects of its design and development of the aerodynamic shroud, the spacecraft adapter section, and the mechanization required to separate the shroud and the spacecraft. During the meetings it became apparent that there were a number of deficiencies in the design, development and test areas. These problems "were pointed out to LMSD by MSFC and JPL, and several subsequent meetings on this subject were held in an effort to resolve the deficiencies. . . ." (JPL, J.Q. Spaulding and F.A. Goodwin, "Report to JPL Management on Ranger-Agena Interface," December 20, 1960, 1-2, JPLHF 2-1063.)
Oct. 26	First launch of an Agena B second stage rocket took place at PMR on a Thor missile. The vehicle did not attain orbit due to an Agena failure.
	JPL hosted an industry conference in Pasadena; representatives from 450 companies attended the conference which was devoted to describing business opportunities and the technical problems involved in the NASA-JPL Lunar and Planetary Program. (JPL-Industry Conference Proceedings, October 26, 1960, JPLHF 3-78.)
During October	Ranger Block I. Assembly and subsystem testing of the PTM were completed. (JPL Space Programs Summary No. 37-6 for the period September 15, 1960 to November 15, 1960, December 1, 1960, 1.)
	Ranger Block II. Following a detailed review of the preliminary design for the capsule radar altimeter under development by the Electronics Division of Ryan Aeronautical Company, JPL requested three design changes: (1) antenna reflector diameter increased from 18 to 20 inches; (2) peak transmitter power increased from 1 watt to 2.5 watts; and (3) altitude computer to include a master clock instead of a gated crystal oscillator. (JPL, Space Programs Summary No. 37-5, loc. cit.)

1960

During October cont.

Ranger Block II Lunar Capsule. Additional drop and Dynapak tests of the balsa wood impact limiter confirmed that greatest energy absorption was achieved when the wood grain was oriented in a radial direction. (JPL, Space Programs Summary No. 37-6, op. cit., 54.)

Studies. The NASA Advisory Committee on Organization submitted its report in accordance with a directive from NASA Administrator T.K. Glennan, dated March 18, 1960. Among other things, the report recommends increased contracting outside NASA, and ways for resolving the most significant organizational problem; definition of the responsibilities of the Headquarters technical offices and of the space flight centers. ("National Aeronautics and Space Administration, Its Organization and Management," October 12, 1960, JPLHF 2-1426.)

Nov. 1

AFBMD established a Board of Inquiry to investigate LMSD-Agena engineering, testing and delivery schedules for NASA programs. "Positive corrective action will be directed to LMSD top management if required in order that the NASA Agena B program schedule can be maintained." MSFC representatives were included on the Board. (Letter from Col. R.M. Herrington, Jr., USAF to H. Hueter, MSFC, November 10, 1960, JPLHF 2-1086.)

Due to a substantial increase in projected costs, JPL terminated its contract with American Bosch ARMA for development of the CC&S for Ranger Flights 3, 4 and 5. A decision was made to replace these units with a modified version of the CC&S being developed at JPL for use on Ranger Flights 1 and 2. (TWX from D.S. Bourquin, JPL Contract Administrator to E.D. Gittens, Vice-President, General Manager, American Bosch ARMA, November 1, 1960, JPLHF 2-1082; also, JPL, Space Programs Summary No. 37-6, op. cit., 1.)

The Agena Program Requirements Document (PRD) was accepted by AMR. It was distributed on November 18. (Minutes of Seventh Meeting, Agena-B Coordination Board, November 30, 1960, 2, JPLHF 2-487.)

The mission objectives and design criteria for Ranger Flights 1 and 2 were modified, under priority of scientific experiments, by adding a Micrometeorite Detector. The new experiment assumed the last position in the scale of priorities (see April 17, 1960 for complete list). (JPL, Specification No. RA12-2-110A, JPLHF 2-1094b.)

Nov. 1 cont.	The DSIF 85-ft. diameter receiving antenna at Woomera, Australia, became operational. (E.M. Walters, The Origins of the Australian Cooperation in Space, op. cit., 51.)
Nov. 2	An "Orthographic Atlas of the Moon" was released by the USAF. The atlas was prepared by a team under the direction of G.P. Kuiper. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, op. cit., 130.)
Nov. 8	JPL submitted its comments to NASA on the proposed agency-wide reliability program. (JPL, letter from W.H. Pickering to R.C. Seamans, November 8, 1960, JPLHF 2-1433.)
Nov. 9	In conjunction with acceptance of the PRD, the policy and procedure for Space Flight Operations (SFO) for lunar and planetary programs was established at JPL. The procedure defined planned operations for processing spacecraft information and commands from launch to conclusion of a mission, and established the roles for various personnel involved in the tasks. (JPL, IOM from W.H. Pickering to Senior Staff, et. al., November 9, 1960, JPLHF 2-305.)
Nov. 10	Gordon P. Kautz was appointed Assistant Project Manager at JPL for the Ranger Project. (JPL, IOM from C.I. Cummings to Senior Staff, et. al., November 10, 1960, JPLHF 2-1087.)
Nov. 12	The USAF launched a Thor-Agena B into a polar orbit from PMR. This was the first successful flight of the dual-burn Agena B booster. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, loc. cit.)
Nov. 14	NASA awarded a contract to RCA for DAMP Ship Tracking at AMR. (Ranger Project Development Plan, op. cit., 9.)
Nov. 15	Dr. Abe Silverstein informed JPL that Dr. Bernard Lovell had indicated he would like to participate in the deep space program with the 250 foot antenna at Jodrell Bank if NASA would furnish the necessary receiving equipment and technical direction. (NASA, letter from A. Silverstein to W.H. Pickering, November 15, 1960, JPLHF 2-257a.)
Nov. 17	The NASA Launch Operations Directorate released a new version of NASA-Atlas Agena B Launch Operations Management Organization and Procedures, AMR. The document defined the authority and responsibility for all anticipated participants involved in launch operations at AMR. (JPLHF 2-1088b.)

1960

Nov. 22 Dr. Pickering, Director of JPL, wrote to Dr. von Braun, Director of MSFC, summarizing the management and technical difficulties encountered in obtaining Agena vehicles for Project Ranger, and requesting additional MSFC support for Hans Heuter's efforts on the Agena Program. (JPL, letter from W.H. Pickering to W. von Braun, November 22, 1960, JPLHF 2-523.) (See also July 5, 1960.)

Nov. 27 The report of President Eisenhower's Commission on National Goals was released. It stated, among other things, that the United States "should be highly selective in our space objectives. . . . Prestige arises from sound accomplishment, not from the merely spectacular, and we must not be driven by nationalistic competition into programs so extravagant as to divert funds and talents from programs of equal or greater importance. . . ." (New York Times, November 28, 1960.)

Nov. 30 The seventh meeting of the Agena B Coordinating Board was held. NASA members of the Board advanced an Instrumentation Support Manager (ISM) concept which recommended establishment of a single point of contact (manager) for overseeing the ground-based instrumentation net and to receive flight and scientific data for each NASA space mission. In addition, a change in the launch date for RA-5 from July to June 1962 was approved by Headquarters. The existing inter-agency arrangement for Ranger trajectory and guidance computation broke down completely. (See December 14, 1960.) (Minutes of the Seventh Meeting, Agena-B Coordination Board, loc. cit.; also, IOM from C.G. Pfeiffer to J.D. Burke, loc. cit.)

During November Ranger Block I. A system test of the PTM was completed with all items except the solar corpuscular experiment installed and functioning. Following alignment, weight and balance measurements, the PTM was scheduled to proceed to vibration, vacuum and temperature testing. (JPL, Space Programs Summary No. 37-6, op. cit., 1.) (Figure 33.)

Mechanical assembly of the RA-1 spacecraft began on schedule during the first week of the month. "Enough equipment is on hand so that the RA-1 assembly and test schedule can be met, barring design changes which may be required after the PTM tests." (Ibid.)

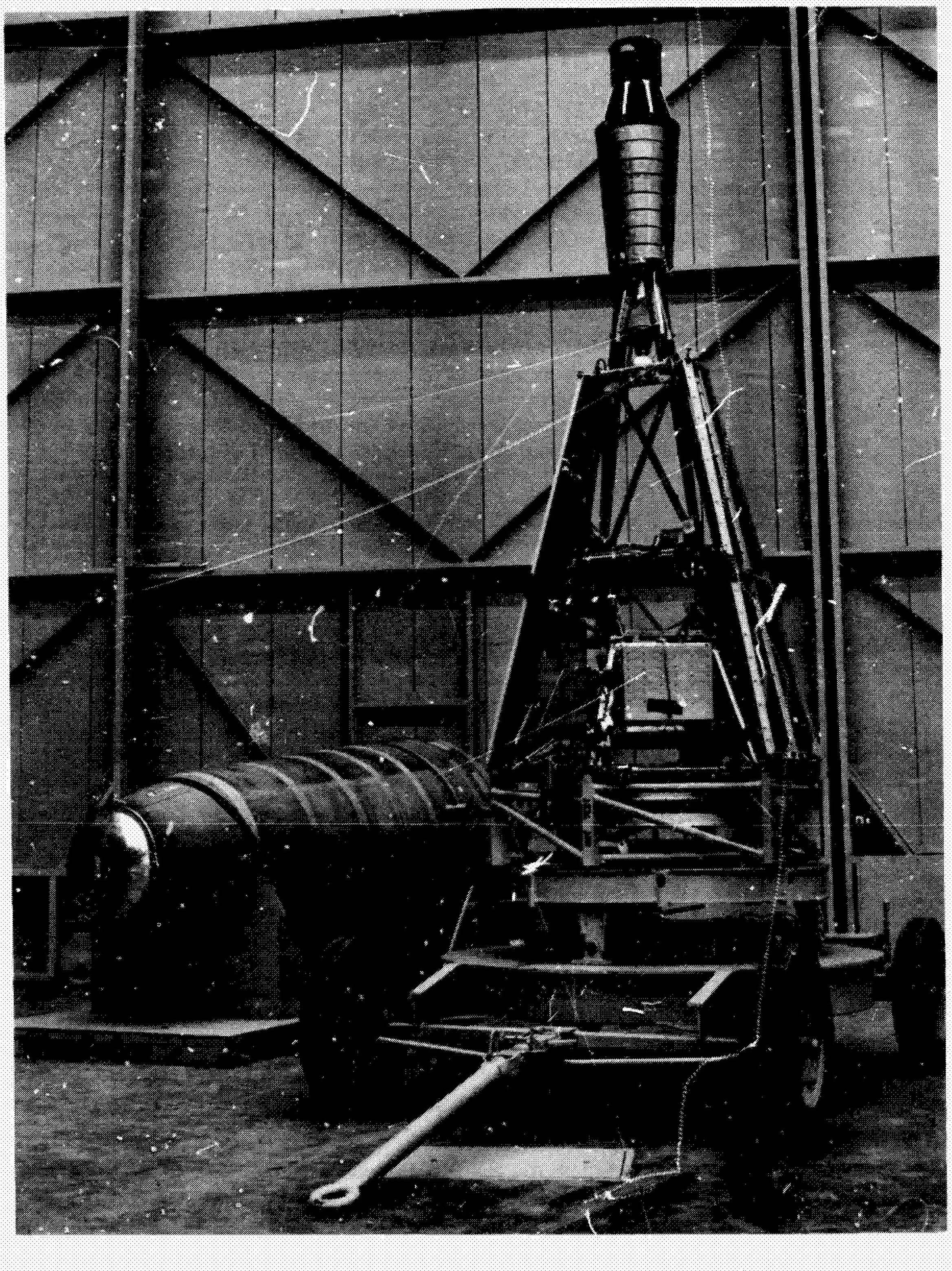

Figure 33: Ranger Block I PTM and noseshroud mockup.

1960

During November cont.

Ranger Block II. Although the design freeze date for the Block II spacecraft had passed (November 30, 1960), a project decision had not yet been reached on the exact location of the omnidirectional antenna; possibilities included location on a solar panel, fixed above the lunar capsule, or attached to an extendible boom. (Figure 34.)

ADF evaluation of progress on the lunar capsule radar altimeter, under development by Ryan Aeronautical Company, indicated that a schedule slip and substantial cost overrun was going to occur. As a result, Ryan was requested to review the work and cost status, and submit a proposal reflecting actual and projected cost and a revised schedule for altimeter development. (JPL, Space Programs Summary No. 37-10, Volume II, for the period May 1, 1961 to July 1, 1961, Pasadena, 35.)

Dec. 1

NASA Headquarters reevaluated sterilization requirements for interplanetary spacecraft due to confusion over directives which called for "sterilization before launch" and "sterilization to the extent feasible." In a review of a proposed new directive, Edgar Cortright observed: ". . . I do not feel that the memorandum proposed for Dr. Glennan's signature clarifies this ambiguity. . . . If what we really mean is sterilization to some accepted level of contamination in terms of living organisms per square centimeters, then we should say so." (NASA Memo, from E. Cortright to Dr. Randt, December 1, 1960, JPLHF 2-456.)

JPL Functional Design Specification, Revision B, for Block II spacecraft was released. Gross weight for Ranger spacecraft 3, 4, and 5 was now established at 803.22 lbs. (JPL Specification RA345-4-120B, Functional Specification Design Parameters, December 1, 1960, 15, JPLHF 2-1122.)

Dr. Pickering responded to Dr. Silverstein's letter of November 15, indicating that JPL favored expenditure of NASA funds at the existing DSIF stations rather than at Jodrell Bank, unless diplomatic or political considerations dictated otherwise. (JPL, letter from W.H. Pickering to A. Silverstein, December 1, 1960, JPLHF 2-257c.)

The USAF delivered the first 1:1,000,000 scale map of the visible lunar hemisphere to JPL. The map was produced on an Air Force contract in response to NASA requirements. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, op. cit., 132.)

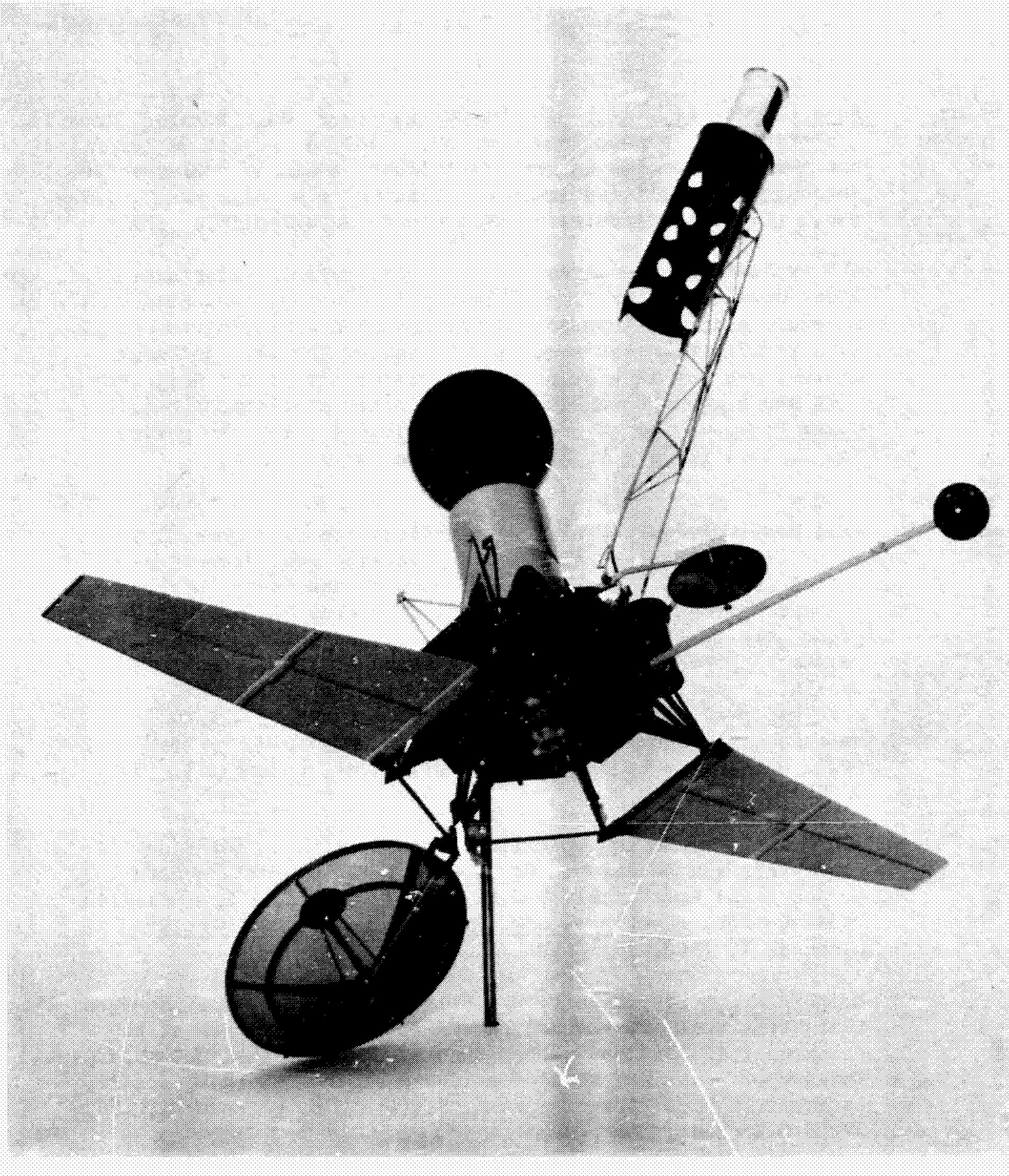

Figure 34: Proposed Ranger Block II spacecraft configuration, terminal descent mode, November 1960.

1960

Dec. 7 A design review was held among representatives from LMSD, MSFC, and JPL. The review considered the Ranger Block I communications system including (1) omniantenna coupler system, (2) high-gain antenna coupler system, and (3) Pad 12 RF data link system. (JPL, Space Programs Summary No. 37-7, for the period November 15, 1960 to January 15, 1961, Pasadena, 6.)

Dec. 9 The proposed concept for an Instrumentation Support Manager for Ranger, advanced on November 30, 1960, was rejected by J.D. Burke, JPL Ranger Project Manager and by Hans Hueter, MSFC Agena Program Director. (JPL-MSFC Document, "Comments on Ranger ISM Proposal as Reviewed by Agena B Coordination Board, November 30, 1960," December 9, 1960, JPLHF 2-1058a.)

Dec. 10 Ranger Block I spacecraft "structural review" was held at JPL. (J.D. Burke, "Lockheed Luanch Vehicle Chronology," loc. cit.)

Dec. 13 L.M. Bronstein advanced a forceful reason for deploying the Ranger Block II omni antenna away from the lunar capsule. (See During November 1960.)

> It would be desirable to listen to the RA-3-4-5 spacecraft bus radio signal when the bus impacts the moon. Observation of the time at which the spacecraft impacted along with the time of capsule motor ignition will make it possible to determine the altitude at which the motor ignited. (The spacecraft velocity will be known.)
>
> If the omni antenna is being deployed instead of ejected [from atop the capsule] at the start of terminal maneuver, it will be possible to accomplish this objective by switching the transponder back to the omni antenna sometime before impact. . . .

(JPL, IOM from L.M. Bronstein to M.R. Mesnard, December 13, 1960, JPLHF 2-1059.)

Dec. 14 JPL released the work statement governing a proposed subcontract to STL via LMSD for guidance and trajectory work in the Ranger Program (since the prior arrangement proved unworkable, see November 30, 1960). The statement had been agreed upon by JPL, BMD, LMSD, and MSFC on December 9. Essentially, the preinjection trajectory (through Agena second burn) would be computed by LMSD in conformance with the conditions contained in JPL Specification 30217. The post-injection trajectory (from Agena second burn to completion of the mission) would be prepared by JPL. Finally, integration of the pre- and post-injection trajectories and generation of accurate Firing Tables would be conducted by STL. (JPL, IOM from C.G. Pfeiffer to All Concerned, December 14, 1960, JPLHF 2-1060.)

Dec. 15 An Atlas-Able Pioneer Lunar Orbiter was launched from AMR. The vehicle was destroyed 70 seconds after lift-off when the Atlas exploded. (NASA, Fifth Semiannual Report to the Congress, October 1, 1960 - June 30, 1961, July 11, 1962, 52.)

The reworked LMSD spacecraft adapter and shroud mockup (see During September 1960) scheduled for delivery to JPL this date, was postponed to January 13, 1961. (Document, "Current Status JPL - MSFC - LMSD," December 23, 1960, JPLHF 2-1099.)

Dec. 17 A NASA Executive Seminar was held, attended by field center and Headquarters top management. Space project difficulties were reviewed and management concepts proposed by Al Siepert in "A NASA Structure for Project Management" (see October 16-19, 1960) were accepted.

Dec. 19 The mission objectives and design criteria for Ranger Flights 3, 4, and 5 were revised at JPL to deemphasize advanced space flight technology. General flight objectives, as specified on April 19, 1960, were completely reversed, with "development of basic spacecraft technology" moving from first to last place. In addition, a new paragraph was inserted: "1.3 Scientific experiments are an integral part of the planned program. The setting up of scientific objectives for each round forces the consideration of system interactions that would not otherwise be apparent, thereby aiding the development of kinds of equipment needed in the future. Scientific experiments on RA1 and RA2 are carried on a not-to-interfere basis; on RA345 they are the primary mission objective." (JPL Specification No. RA345-2-110C, Mission Objectives and Design Criteria, Ranger Spacecraft, December 19, 1960, JPLHF 2-1095d.) (See July 20, 1960.)

Dec. 20 The complete NASA-Agena Management Document, as finally agreed to by NASA and ARDC-BMD, was sent to Air Force General Bernard Schriever by NASA Associate Administrator Robert Seamans, Jr. (Statement by A.J. Kelley, Minutes of Eighth Meeting Agena-B Coordination Board, January 18, 1961, 4-5.)

In a TWX to MSFC, the LMSD attitude expressed in participation on the Agena-B Coordinating Board, Vehicle Integration Panel, and in responding to NASA requests, was severely criticized by the panel member from Goddard Space Flight Center. He observed that ". . . unless they [LMSD] change their attitude and get to work, we [GSFC] will find ourselves in the same schedule difficulties facing JPL, i.e., being forced to accept hardware and

Dec. 20 cont. analyses that are technically questionable because of schedule considerations." (TWX from G.W. Ousley, GSFC Vehicle Integration Panel member, to F. Duerr, Chairman, Vehicle Integration Panel, December 20, 1960, JPLHF 2-1061; also, JPL, J.Q. Spaulding and F.A. Goodwin, "Report to JPL Management on Ranger-Agena Interface," loc. cit.)

JPL informed OSFP of its great concern over repeated failures in Atlas boosters, and requested that copies of NASA studies of this question be furnished JPL. (JPL, letter from C.I. Cummings to E.M. Cortright, December 22, 1960, JPLHF 2-1437.)

Dec. 23 A revised NASA guideline for decontamination and sterilization procedures was released. The document did not set specific limits for sterility, as recommended by Cortright (see December 1, 1960), but rather directed that "for each lunar and planetary mission, the Headquarters Program Director having overall responsibility will recommend to the Associate Administrator decontamination and sterilization procedures to be used. The mission will not be flown until the Associate Administrator has approved the planned procedures." (NASA memo from T.K. Glennan, to Program Directors, et. al., December 23, 1960, JPLHF 2-1064.) This responsibility was subsequently delegated to the Director of the Office of Space Science Programs. (National Academy of Sciences-National Research Council, A Review of Space Research, Publication 1079, Washington, D.C. 1962, 10-25.)

Dec. 27 Ranger Agena B, Vehicle 6001, completed manufacture at LMSD and was later transferred to the systems test complex. (LMSD Master Scheduling Records.)

Dec. 28 Dr. W. von Braun directed a letter to Herschel J. Brown, President, Lockheed Missiles and Space Division, enclosing the findings of the Board of Inquiry (see November 1 and November 22, 1960). The enclosure, "Summation of Problem Areas Encountered with LMSD," was prepared by Hans Hueter, described four principal problem areas: Program Office, Engineering, System Integration, and Performance Analysis. (JPLHF 2-1153.)

Dec. 29 Dr. T. Keith Glennan, NASA Administrator, tended his resignation to be effective with the change of administration on January 20, 1961. (E.M. Emme, Aeronautics and Astronautics, 1915-1960, loc. cit.)

1960

Dec. 29 cont. LMSD completed Phase I study of a terminal spacecraft sterilization system, (Phase I Final Report, Ranger Sterilization Gas Transfer System, LMSD/917481, December 30, 1960) and submitted a Phase II Proposal for the Development and Fabrication of a Mobil Gas Transfer System (LMSD/602195, December 28, 1960).

Dec. 30 A Phase I prototype spacecraft sterilization cart, for fumigating the shroud-encapsulated spacecraft with ethylene oxide, was delivered to JPL on December 30, 1960 by LMSD. (Letter from T. Anderson of LMSD to D.S. Bourquin, JPL Contract Administrator, January 4, 1961, 1961, JPLHF 2-1097.)

During December Ranger Block I. System tests on the PTM revealed a number of system interactions, electrical interferences, etc., that were corrected on the first flight model. "Further changes may be necessary based on results of the current tests of the PTM under vibration, vacuum and simulated solar radiation environments. Because of delays in the installation of the vacuum chamber, the thermal design of the PTM has not yet been proved adequate." (JPL Space Programs Summary No. 37-6, op. cit., 4.)

JPL replaced its IBM 704 computer facility with an IBM 7090 computer facility for the approaching Ranger and Mariner space flights, and for increased general computer applications. (Ranger Project Development Plan, op. cit., 94.)

In an article for publication, Dr. H.J. Stewart observed that NASA's Long Range Plan "is based upon the premise that manned space flight is feasible and that man can perform useful functions in space. . . ." As for lunar exploration, the most rewarding phase was seen to follow manned landings on that body, "probably between 1970 and 1980." According to DeMarquis D. Wyatt, NASA Assistant Director of Program Planning and Coordination, "instruments on the moon and these planets will not tell the full story about them. They can tell only of the phenomena in their immediate vicinity--in short, give a tiny glimpse of a vast expanse. Ideally, we need men on these explorations. . . ." (H.J. Stewart and Peter Chew, "Space Exploration, the U.S. Long Range Plan," in Arthur Garratt, ed., Science Survey, 1961, Part I, London: Penguin Books, pp. 190 and 192.)

F. Zwicky, "Some Possible Operations on the Moon," appeared in the American Rocket Society Journal, December 1960, pp. 1177-1180. Zwicky reiterated the proposal for spectroscopic observation of the flashes of sufficiently large artificial meteors impacting the moon as a direct means for analyses of the physico-chemical structure of the moon's surface layers. He also outlined a portable solar furnace for use in manned operations on the lunar surface "to produce water, oxygen, nitrogen, foodstuffs, propellants, and power."

1961

Jan. 3 A new agreement on Agena B Launch Operations Management was established in a joint NASA-USAF meeting. Final wording was agreed upon by all parties on January 16, and the revised document was sent to Dr. Seamans for his signature on January 17, 1961. (Statement of Albert Kelley, "Minutes of Eighth Meeting Agena-B Coordination Board," January 18, 1961, 4-5, JPLHF 2-489.) (See November 17, 1960.)

JPL issued Technical Report No. 32-55, Scientific Experiments for Ranger 1 and 2.

Jan. 4 A meeting was convened at JPL to determine the location of the omni-antenna on Rangers 3, 4 and 5. The choice was narrowed to either a single antenna installation on one of the solar panel tips or positioning the antenna on the roll axis above the survival capsule. Following discussion of the pros and cons for each location, the Spacecraft Integration Group decided in favor of mounting the antenna above the ADF survivable capsule. Another meeting was planned to determine the manner in which the antenna would be mounted. (JPL, IOM from M.R. Mesnard to Distribution, January 6, 1961, JPLHF 2-1096.)

Jan. 5-6 A design review of the spacecraft adapter and shroud was held by representatives from LMSD, MSFC, and JPL. Various representatives suggested possible design improvements which were agreed upon and subsequently were incorporated in the mockup. (JPL, Space Programs Summary No. 37-7, op. cit., 4-5.)

Jan. 9 NASA Assistant Director for Launch Operations, Samuel Snyder, visited JPL. Following discussions with project personnel he agreed to consider faborably locating the Ranger "Mission Director" in the blockhouse at the Cape, rather than at some other location, during launch operations. (JPL, Conference Report No. LPD-3, C.I. Cummings, January 9, 1961, JPLHF 2-1098.)

Jan. 11 A meeting was convened at JPL to establish the mounting for omni-antennas on Block II Rangers (RA-3, 4, and 5). The decision in favor of locating the antenna above the survival capsule on the roll axis of the spacecraft was confirmed and, following discussion, it was decided that a mounting which could be deployed on a boom, rather than ejected, met a majority of requirements. E. Framan and A. Klumpp were assigned to develop information on moments of inertia and maximum rates of deployment. (JPL, IOM from M.R. Mesnard to Distribution, January 12, 1961, JPLHF 2-1099.) (Figures 35 and 36.)

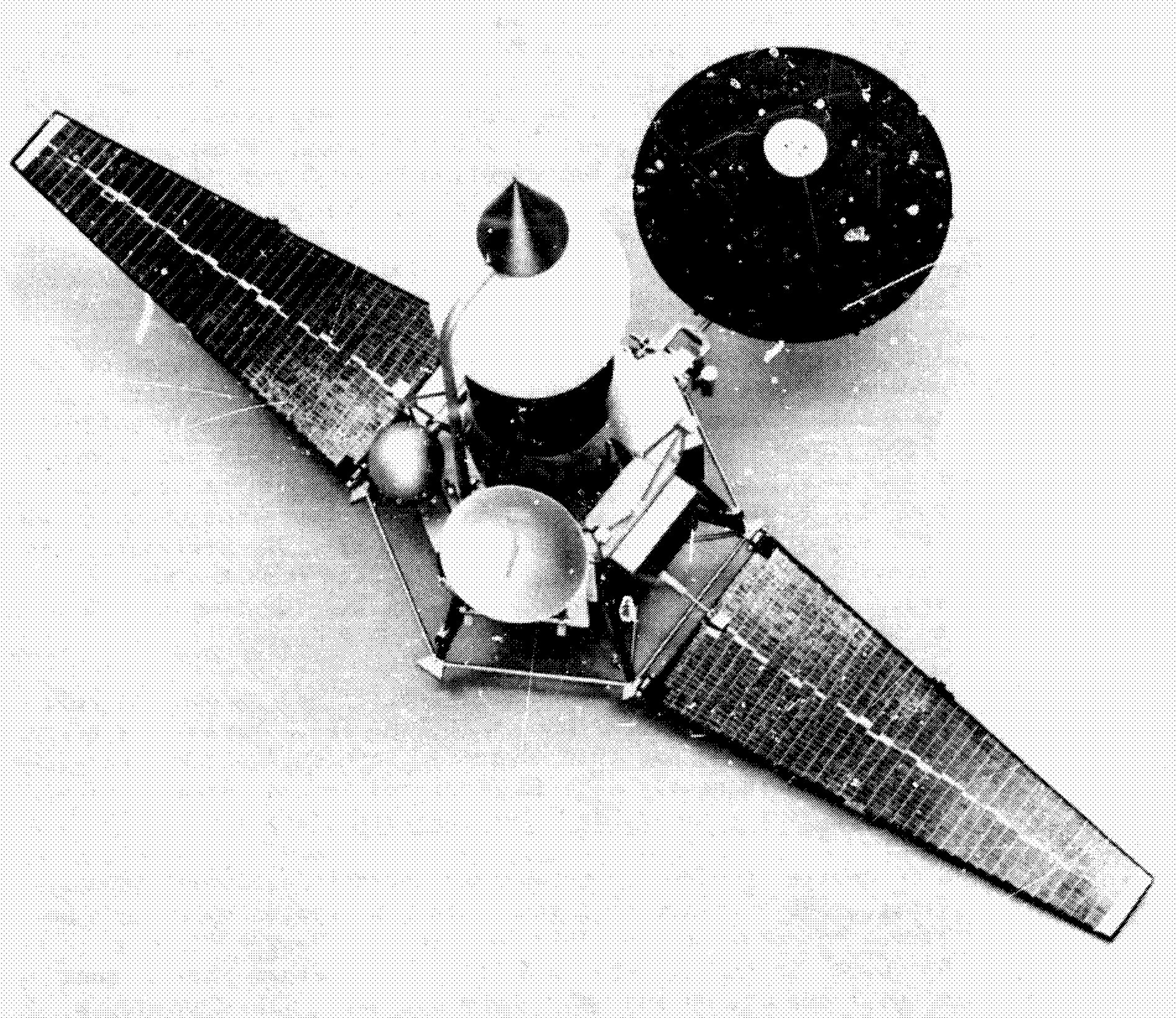

Figure 35: Proposed Ranger Block II spacecraft configuration, cruise mode, February–March 1961.

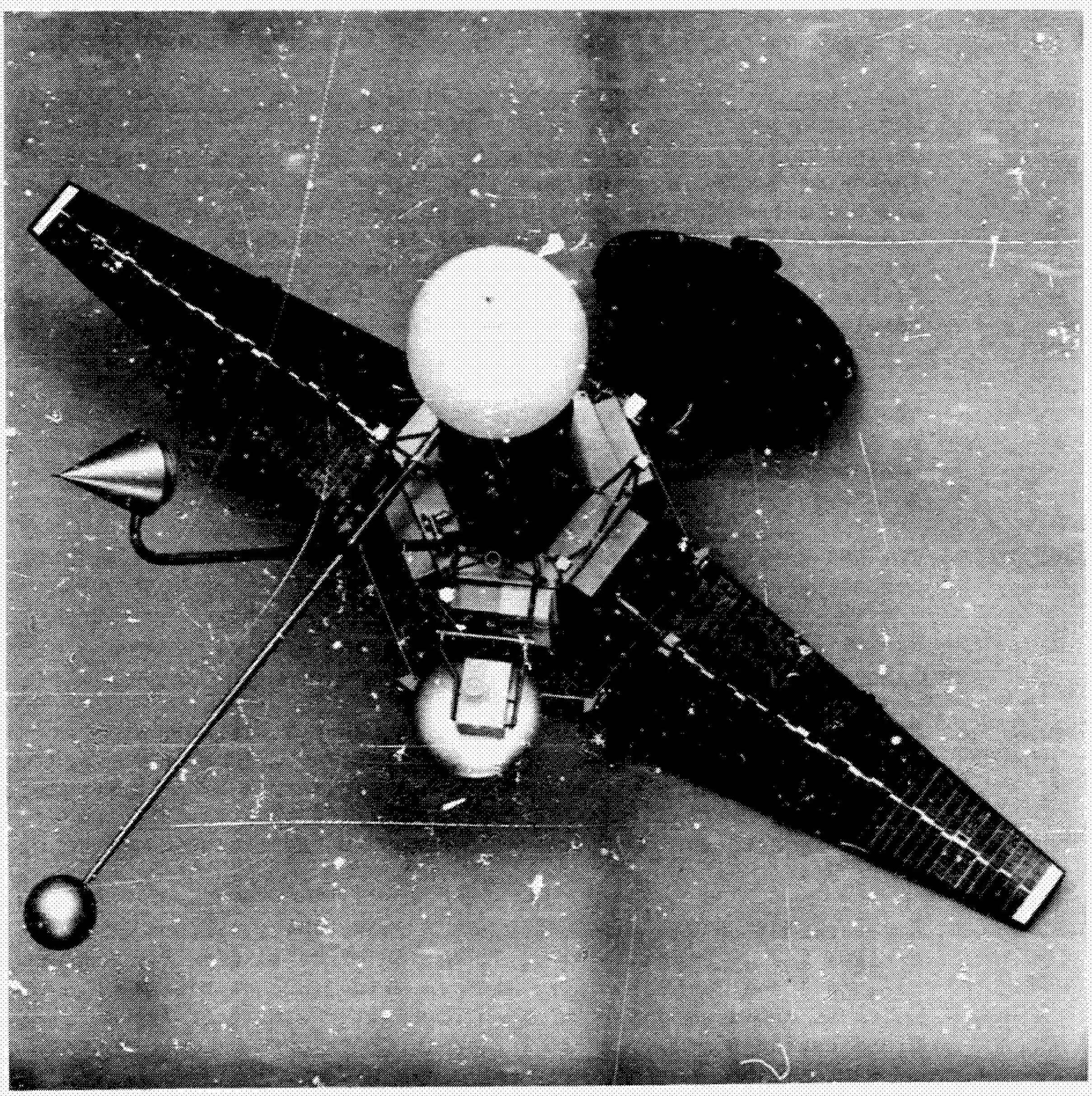

Figure 36: Proposed Ranger Block II spacecraft configuration, terminal descent mode, February-March 1961.

Jan. 12 The Report to the President-Elect of the Ad Hoc Committee on Space (Wiesner Report) was released. The report cited five principal motivations for the space program; first of those listed was "the factor of national prestige." The report was critical of NASA but did not recommend any specific space project, although space exploration was arbitrarily separated into five categories of activity. Vigorous management in each area was recommended. (Cf. Pickering, During January 1960; Report of President Eisenhower's Commission on National Goals, November 27, 1960; and, A Statement by the President and Introduction to Outer Space, March 26, 1958.)

Jan. 14 The reworked spacecraft adapter and shroud mockup were delivered to JPL by LMSD. Match-mate tests of the spacecraft and this equipment began shortly thereafter. (JPL, Space Programs Summary No. 37-7, op. cit., 5.) (See December 15, 1960.)

Jan. 15 The AMR Hangar AE assigned for Ranger spacecraft became available for occupancy. (Ranger Project Development Plan, op. cit., 9.)

Ranger Agena-B launch control equipment was shipped to AMR. (Ibid.)

Jan. 17 NASA and JPL announced selection of the Hughes Aircraft Company as prime system contractor for Project Surveyor lunar soft-landing vehicle, the next step in lunar exploration after Project Ranger. (E.M. Emme, Aeronautical and Astronautical Events of 1961, Report of the NASA to the Committee on Science and Astronautics, June 7, 1962, 3.)

Jan. 18 A determination was reached that the radar installations at Antigua and in Puerto Rico would not be ready in time for Ranger Flights 1 and 2. Plans were made to bring in portable radar units as replacements. (Minutes of Eighth Meeting of Agena-B Coordination Board, op. cit., 8.)

Jan. 19 NASA General Management Instruction (GMI) 4-1-1, Planning and Implementation of NASA Projects was issued (see October 16-19, 1960). The document established the policies and procedures for project management within NASA. Following adoption of this GMI, the Agena Coordinating Board, established February 19, 1960, was at first reoriented as an advisory body, and then disbanded. For Project Ranger, the effect of this new policy was to place overall cognizance in the NASA Office of Space Flight Programs, and JPL became the Project Management Center with formal responsibility for three of the project's four main components: the spacecraft itself, the Deep Space Instrumentation Facility, and the Space Flight Operations System. Responsibility for the fourth component, Jan. 19 cont. the Atlas-Agena B launch vehicle and associated facilities, including launch-to-injection range support, was assigned to MSFC in Huntsville, Alabama. Overall direction and evaluation of the MSFC effort, however, remained the responsibility of the NASA Office of Launch Vehicle Programs, which also reported to the Associated Administrator. (NASA, GMI-4-1-1; also, JPL, The Ranger Project: Annual Report for 1961, op. cit., 11.)

Jan. 23 JPL concluded a second evaluation of a RA-2 lunar fly-by mission. The general conclusion was that the mission was not feasible due to the shortness of time and technical considerations. (JPL, IOM from V.C. Clarke to J.D. Burke, January 23, 1961, JPLHF 2-1100.)

Jan. 24 Air Force Launch Complex 12, to be used for NASA Atlas-Agena launches at AMR, was made available for NASA occupancy.

Jan. 26 The JPL Systems Division recommended that the DSIF be equipped with a command capability at overseas stations. "If standard [spacecraft] operation based on preliminary design is achieved, command capability overseas is not required. If any particular departures from standard operation occur, effective and efficient execution of the space flight operations is marginal when command capability is limited to Goldstone." (JPL, IOM from H.M. Schurmeier to E. Rechtin, January 26, 1961, JPLHF 2-1101.)

Speaking before the Pacific Southwest Regional Meeting of the American Geophysical Union Dr. Albert R. Hibbs of the JPL Science Division outlined the lunar and interplanetary program currently planned by NASA. He indicated that the lunar program "begins in 1961 with [Ranger] spacecraft developmental flights and continues in 1962 with 'rough landing' missions." Next would come lunar orbiters and "lunar soft landers, capable of exploring their immediate environs, occur in the period from '63 to '65." Finally, during the second half of the decade, larger vehicles would be employed ". . . capable of returning samples of lunar material to the earth and roving over the surface to extend the exploration program to a much more diversified type of lunar material and surface." He also observed that in the first two program flights, Ranger 2 was now scheduled for an escape trajectory. (Text of Speech, A.R. Hibbs, Technical Release No. 34-241, The National Program for Lunar and Planetary Exploration, presented at Pacific Southwest Regional Meeting, American Geophysical Union, January 26, 1961 at Berkeley, California, 2, 3.) (See first generation plans at April 30, 1959.)

1961

Jan. 30	James E. Webb was nominated by President Kennedy as Administrator of NASA, replacing Dr. T.K. Glennan, Hugh Dryden remained as Deputy Administrator and Robert Seamans remained Associate Administrator. (NASA, R.L. Rosholt, An Administrative History of NASA, 1958-1963, 1966, 187.)
During January	Ranger Block I. Assembly of the Ranger 1 flight spacecraft was completed at JPL. (Ranger Project Development Plan, loc. cit.)
	Ranger Block II. Ryan Aeronautical Company submitted a work and cost evaluation of its development effort on the capsule radar altimeter, as requested in November 1960. The report projected substantially increased costs on a schedule which provided little margin for correcting any technical difficulties which might be encountered. (JPL, Space Programs Summary No. 37-10, Vol. II, loc. cit.)
	T.K. Glennan issued a memorandum for his successor, noting From the beginning, it has been the policy of the Administrator that additions to the Federal payroll be kept at a minimum. Clearly, the carrying forward of a program in aeronautical research and space exploration and applications funded at a level of more than one billion dollars annually must involve the participation of industry and of universities and other private research and development institutions. Thus, the NASA organization has been structured to reflect both its mission and the manner in which that mission was to be accomplished. (Transition Memorandum prepared by T. Keith Glennan, January 1961, 5, JPLHF 2-1755.)
Feb. 1	NASA issued GMI 4-2-1, Reliability Policy as Applied to NASA Programs. (See October 24, 1960.)
Feb. 2	With release of NASA GMI 4-1-1 (see January 19, 1961), Dr. R.C. Seamans, NASA Associate Administrator, recommended that the role of the Agena B Coordinating Board be altered to one of coordinating activities among the various projects which utilize Agena-B vehicles. (Seaman's memo cited in "Minutes of Ninth Meeting, Agena-B Coordinating Board," March 1, 1961, 7, JPLHF 2-491.)
Feb. 6	The NASA-funded Air Force letter contract (AF-592) awarded to LMSD in April 1960 for production of Agena-B vehicles for NASA was definitized as NASA Contract NAS 3-3800. (See July 25, 1960.)

1961

Feb. 10 The Woomera, Australia, DSIF tracking station was dedicated. With completion of the South African station, scheduled for the summer of 1961, the network would be fully operational. (NASA, Fifth Semiannual Report to the Congress, op. cit., 55-56.)

Feb. 10-11 A recommendation of the Space Science Board of the NAS was that "scientific exploration of the Moon and planets should be clearly stated as the ultimate objective of the U.S. space program for the foreseeable future." It was submitted to the President March 31 and released publicly August 6. (Aeronautical and Astronautical Events of 1961, op. cit., 6.)

Feb. 13 JPL informed NASA of the negative results of the RA-2 lunar fly-by study, and that the mission would, accordingly, not be considered further by JPL. (JPL, letter from J.D. Burke to O.W. Nicks, February 13, 1961, JPLHF 2-1441.) (See January 23, 1961.)

Feb. 14 The NASA/Air Force agreement for Agena-B Launch Vehicle Program Management was formally released (see January 15, 1960 and January 3, 1961). The document provided for direct contact between personnel in NASA, the Air Force, and at contractor facilities, and assigned a NASA representative on the Agena Configuration Control Board. (NASA Agena B Launch Vehicle Program Management Organization and Procedures, February 14, 1961, JPLHF 2-1102.) (See also, September 9, 1960.)

NASA and the DOD released a National Launch Vehicle Program Summary. This document superseded the report of January 27, 1959, and described a national launch vehicle program "based on the fundamental premise that the nation's program for the exploitation of space . . . will be best served by providing a minimum number of different types of launch vehicles, thereby increasing the frequency with which each type is used. . . ." (p. 5)

Feb. 16 NASA notified JPL that under the terms of GMI 4-1-1 concerning field center roles, "we have reached the following decisions. (a) The Jet Propulsion Laboratory will be designated Project Manager for the complete Ranger series, with the Marshall Space Flight Center being designated Systems Manager for the Atlas AGENA launch vehicle. The AGENA Coordinating Board will have its charter revised so as to perform the function of coordinating inter-center problems and deliberating on problems which are referred to Headquarters by the field. . . . (c) On subsequent

Feb. 16 cont. Mariner launches utilizing the Centaur, and all Surveyor launches utilizing Centaur, the Jet Propulsion Laboratory will serve as Project Manager." (NASA, letter from A. Silverstein to W.H. Pickering, February 16, 1961, JPLHF 2-344.)

J.D. Burke, Ranger Project Manager at JPL, notified H.M. Schurmeier in the Systems Division that the weight problem on RA-3 (see October 13, 1960) had reached a point where ". . . we must begin removing items from the spacecraft. . . . " He instructed that the 1/4-watt transmitter, the instrumentation gyros and associated equipment be removed. In addition, "review the entire instrumentation schedule and remove a portion of the equipment so as to save weight at the expense of creating a higher-risk situation" and "continue to insist that the capsule, which is currently overweight, must meet its weight goal of 300 pounds or not fly." (JPL, IOM from J.D. Burke to H.M. Schurmeier, February 16, 1961, JPLHF 2-563.)

Feb. 17 The draft of a new NASA contract with Caltech for operation of the Jet Propulsion Laboratory was directed to Caltech President, Dr. L.A. DuBridge. (The existing contract, NASw-6, was scheduled to expire at the end of calendar year 1961.) In his cover letter NASA Deputy Administrator Dr. Hugh Dryden noted that "under the revised arrangements contemplated by NASA, JPL would not necessarily be assured of every project within the Lunar and Planetary Programs. We would, however, desire that JPL remain a principal participant in these programs even if some projects involved are not assigned to JPL. . . ." Dryden went on to reaffirm that the new contract "attempts to make clear that the tasks that JPL is to perform in the area of lunar and interplanetary exploration shall be those mutually agreed upon between us. . . . We feel that these revisions to the contract more effectively accomplish our mutual desire that JPL be treated by NASA in much the same way as it treats other prime contractors undertaking work involving major hardware development. A primary point that we must emphasize is that, just like other major contractors of NASA, JPL must be responsive to overall technical direction and guidance from NASA Headquarters in order that NASA program needs may be best served. We recognize that this calls for understanding and forbearance by both NASA and JPL." (NASA, letter from H. Dryden to L.A. DuBridge, February 17, 1961, JPLHF 2-407b.)

Feb. 18 An Agena B vehicle, launched by a USAF Thor booster from PMR, successfully performed two engine ignitions in space, thus demonstrating the capability required for Project Ranger. An Atlas-Agena B still had not been launched.

1961

Feb. 20 The Ryan altimeter development had deteriorated to an unacceptable condition. The altimeter could not meet (a) performance checks, (b) schedule, and (c) cost commitments. (J.D. Burke, "Lockheed Launch Vehicle Chronology," loc. cit.)

Feb. 21 Dr. DuBridge responded to Dr. Dryden's letter of the 17th. "This is to confirm the fact that the conditions set forth for the relations between NASA and JPL in your letter of February 17, 1961 are in line with our previous understanding, are in conformity with recent conversations, and are satisfactory to the California Institute of Technology. We believe that these new arrangements offer the possibility of proceeding expeditiously with the tasks which, by mutual agreement, have now been undertaken by the Jet Propulsion Laboratory." (Caltech, letter from L.A. DuBridge to H. Dryden, February 21, 1961, JPLHF 2-407d.)

Feb. 23 Agreement between NASA and the DOD was confirmed on a unified National Space Vehicle Program. The document provided for the development and procurement of launch vehicles for mutual use, that neither organization would begin development of space boosters without consent of the other party, and it delegated specific interagency planning responsibilities to the AACB. (Letter of Agreement signed by Roswell Gilpatric for DOD, and Administrator James Webb for NASA, reprinted in National Launch Vehicle Summary, prepared by the DOD-NASA, Aeronautics and Astronautics Coordinating Board, Washington, D.C., February 14, 1961, 2.)

During February Ranger Block I. The PTM was moved from the system test area to the environmental test laboratory for vibration and vacuum-temperature tests. With all subsystems except the solar corpuscular experiment installed the PTM was vibrated in axial and transverse planes. Malfunctions were detected at the subsystem and the system level during these environmental tests: in the launch and backup battery,* occasional loss of sync in the data automation system, pulsing in the data encoder, and scientific

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*The Ranger 1 and 2 launch and backup battery was comprised of seventeen silver-zinc primary cells produced by the Eagle Picher Company of Joplin, Missouri. Environmental tests demonstrated that maintenance of the battery at temperatures below 120° F. was of primary importance in preventing battery deterioration.

During February cont.

power operating in an overloaded condition. Corrective action was initiated. (JPL, Space Programs Summary No. 37-7, op. cit., 2.)

Following these tests the PTM was assembled with the Agena adapter and shroud and subjected to a series of dummy run (mock flight) tests. Subsequently, the PTM was shipped to the Space Technology Laboratories (STL) magnetic test facility at Malibu where the magnetometer was tested and spacecraft magnetic fields were mapped in a controlled environment. (These tests were required because a spacecraft which carries a magnetometer must be calibrated for the interference field created by the spacecraft itself in order that the experiment results obtained in space can be correctly interpreted.) (JPL, Space Programs Summary No. 37-8, Vol. I for the period January 15, 1961 to March 1, 1961, 4.)

Ranger Block II. Six firms were contacted in regard to fabricating the batteries for Ranger Flights 3, 4 and 5 (Yardney, Eagle Picher, Gulton, Gould-National, Cook and Electric Storage). A decision was planned by April, pending evaluation of the engineering proposals against JPL specifications. Fabrication of the spacecraft rocket engine to be used for the midcourse maneuver also began at JPL. The small pressure-fed, constant thrust, monopropellant-hydrazine fueled unit was designed to produce 50 pounds of thrust at vacuum pressure and deliver a variable total impulse in conjunction with an integrating accelerometer system. (JPL, Space Programs Summary No. 37-7, op. cit., 22-23.)

Fabrication of breadboard components of the Block II CC&S was completed at JPL. Following cancellation of the digital computer CC&S system under development by American Bosch ARMA, in November 1960, the JPL study of a RA-3, 4 and 5 CC&S system, proceeding from the RA-1 and RA-2 controller model, was expanded to program status. The new CC&S system consisted of eight subsystem elements. (Ibid., 19.)

A meeting was held between representatives of JPL and the AMR range safety group. The design of Rangers 3, 4 and 5 were tentatively accepted as "safe." AMR representatives also outlined what methods were recommended for loading and storing liquid and solid propellant rocket engines, squibs, etc. (JPL, Space Programs Summary No. 37-8, Vol. I, op. cit., 4.

Special Studies. Projected spacecraft data handling and processing requirements for NASA lunar and planetary projects exceeded existing JPL equipment and procedural capabilities. JPL established a Data Handling Committee composed of representatives from

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During February cont. — all affected JPL divisions to study and plan for the handling and processing of the large volume of diagnostic and scientific information that would be generated by these spacecraft. The Committee examined the requirements of Project Ranger and explored to the extent possible the anticipated requirements of initial Mariner and Surveyor Projects over a three months period. A report of the findings and recommendations of the committee was released in June 1961. (JPL, Space Programs Summary No. 37-20, Vol. VI, for the period January 1, 1963 to March 31, 1963, 43.)

Mar. 1 — The ninth meeting of the Agena-B Coordinating Board was held. William Fleming of NASA Headquarters read the Seamans memo (see February 2, 1961) which eliminated the Board's responsibility for vehicle-spacecraft interface and assigned that role to the Project Manager. The remaining Board functions included (1) standardization of systems and components, (2) advise Headquarters on Agena policy and planning, and (3) coordination of facilities and support used by two or more Agena-based projects.

J.D. Burke, Ranger Project Manager at JPL, announced that the RA-3 configuration spacecraft was 83 pounds overweight for the 85-mile parking orbit, and that some items of equipment would be removed, thereby affording a weight saving of 31 pounds. However, he indicated that "the true status of the RA-3 weight situation will not be known until the refined performance [trajectory] calculations become available in May. The current weight of RA-3 is 772 pounds. JPL believes that the allowable weight may turn out to be more like 790 pounds." (See February 16, 1961.) Burke also reported that JPL had concluded that a lunar fly-by as an alternate mission for RA-2 (in the event RA-1 was successful) was not feasible. (Minutes of Ninth Meeting of Agena-B Coordinating Board, March 1, 1961, 6-7; and, J.D. Burke, Trip Report to Agena B Coordination Board Meeting and Visit to Bell Aerosystems Corp., Niagara Falls, New York, March 3, 1961, 3.)

Hughes Aircraft Company was awarded a letter contract for development of the Surveyor lunar soft-landing spacecraft by JPL. (Project Surveyor, loc. cit.)

Mar. 6 — The Secretary of Defense, Robert S. McNamara, released DOD Directive 5160.32 which assigned to the USAF responsibility for all future research and development of military space projects. Except for some existing projects already controlled by other

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Mar. 6 cont. services (e.g., the Navy transit navigation satellite and the Army communications satellite, Advent), the Air Force became the space agency for the Department of Defense. Any exceptions to this arrangement could be made only by the Secretary of Defense. (Cited in Defense Space Interests, op. cit., 3.)

Mar. 7 A meeting among division representatives was held at JPL to discuss the requirements for a Ranger Project Development Plan (PDP) that would be submitted to Headquarters in May. This document called for under the terms of GMI 4-1-1 (January 19, 1961), was planned as the controlling instrument in establishing technical and managerial responsibilities and procedures for all development and flight operations in the project. J.D. Burke announced "that this PDP submission to Headquarters is second in priority only to RA-1." (JPL, IOM from Burke/Kautz to Attendees, March 7, 1961, JPLHF 2-1105.)

Mar. 8-10 At the NASA Fifth Semi-Annual Staff Conference at Luray, Virginia, Dr. Hugh Dryden summarized some of the major agreements reached in the AACB: (1) that each new launch vehicle development must have the joint approval of NASA and the DOD; (2) that operation of tracking facilities would be conducted on a basis of agreed division of function between DOD and NASA; and (3) that space science activities are generally within NASA's area of activities, although piggyback launches on AF vehicles may be utilized with exchange of information. (Summary of Presentations and Discussions, Fifth Semi-Annual Staff Conference, NASA, Luray, Virginia, March 8-10, 1961, JPLHF 2-1446.)

Mar. 16 The PRD was made obsolete when the Launch Operations Directorate split into two parts. (N.W. Cunningham, Ranger Program Chronology, loc. cit.)

Mar. 23-24 The sixth meeting of the SSSC Lunar Sciences Subcommittee was held in Washington, D.C. "J. Arnold presented a description of the gamma-ray spectrometer currently under development for Rangers 3, 4 and 5, and the status of Lab work on gamma-ray analysis techniques." (NASA, Lunar Science Chronology, loc. cit.)

Mar. 25 JPL accepted the 85 ft. antenna structure as complete at the DSIF station near Johannesburg, Union of South Africa. The control building, collimation tower building, and generator building continued under construction. Completion of the entire facility was scheduled for July 1961. (JPL, Space Programs Summary No. 37-9, Vol. I, for the period March 1, 1961 to May 1, 1961, 84.)

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Mar. 27 W.E. Brown at JPL directed a memo to his associates urging that certain modifications be made in the Ranger Block II encoder to permit telemetering radar data to ground stations. (At close approach the radar unit commanded ejection, spin up and the retro-fire sequence of events for the lunar capsule. Originally, no plans were made to telemeter radar data from the spacecraft to the earth.) He averred that:

1.1. The correlation between the optical data and the Ranger 3, 4, 5 radar data will provide information about the dust or surface layer. The type of information would be a function of surface properties but could include (a) density, (b) conductivity, (c) permitivity/permeability ratio, (d) thickness of layer.

1.2 The correlation between optical data, Ranger 3, 4, 5 radar data, and earth-based radar data will provide information about (a, preferred areas for Surveyor landing, (b) radar performance, (c) preferred Surveyor landing gear configurations, (d) preferred methods for implementing electro mechanical aspects of Surveyor experiments.

(JPL, IOM from W.E. Brown Jr. to Distribution, March 27, 1961, JPLHF 2-1111b.)

Mar. 28 The memorandum of understanding between the AF and NASA, dated February 23, 1961, was amended to include consideration of NASA launch facilities at Point Arguello and Vandenburg Air Force Base as well as the Atlantic Missile Range. (Memorandum of Understanding, signed by B.A. Schreiver and Robert C. SEamans, March 28, 1961, JPLHF 2-1447.)

Mar. 29 NASA confirmed JPL project assignments as stipulated in GMI 4-1-1. J.D. Burke was the Ranger Project Manager and W.E. Giberson the Surveyor Project Manager, (NASA, Memo for Staff from A. Silverstein, March 29, 1961, JPLHF 2-347; also, Memo for Director of Launch Vehicle Programs from Silverstein, March 29, 1961, JPLHF 2-346.)

Mar. 30 PRD Revision 2 was released incorporating changes necessitated by LOD reorganization (see March 16, 1961). (J.D. Burke, "Lockheed Launch Vehicle Chronology," loc. cit.)

Mar. 31 Due to difficulties encountered in the development of a fuze type radar altimeter by the Ryan Aeronautical Company, and the potential for a forced slippage in Ranger Block II flight schedules as a consequence of late availability of these units, a backup contract for altimeters using as many standard components as possible was placed by Aeronutronics with Wiley Electronics Company in Phoenix, Mar. 31 cont. Arizona. Two prototype radar altimeters were to be constructed with provisions for extending the contract to cover flight procurement. "The schedule offered by Wiley is such that, with good technical results, the flight schedule can be maintained. As soon as it is reasonably certain that one of the contractors can meet the flight objectives, it is intended that the parallel effort be discontinued." (JPL, Space Programs Summary No. 37-9, Vol. II, op. cit., 25-26.)

The Space Science Board of the National Academy of Sciences, National Research Council, submitted documents concerning its policy position on the major objectives of space exploration and on support of basic research to the new Administrator of NASA, James Webb. In the first instance, the SSB concluded that "scientific exploration of the Moon and planets should be clearly stated as the ultimate objective of the United States space program for the foreseeable future. . . ." The Board also "concluded that it is not now possible to decide whether man will accompany early expeditions to the Moon and planets. . . ." However, the Board went on to urge that planning should proceed "on the premise that man will be included."

In the second instance, support of basic research for space science, the SSB noted that the method of experimenting--mechanized and conducted at great distances--had fundamentally altered the traditional conditions between the scientist and his experiment apparatus. Therefore, the Board recommended, inter alia, new programs directed toward adaptation of old and devising of new experimental concepts and techniques appropriate to space research. The role of NASA and the universities was considered vital "and probably decisive." (Letter from L.V. Berkner, Chairman of the Space Science Board of NAS to Mr. Webb of NASA, enclosing two policy position papers: "Support of Basic Research for Space Science," and "Man's Role in the National Space Program," March 31, 1961, JPLHF 2-932a, b, and c.)*

During March Ranger Block I. The RA-1 PTM and associated Ground Support Equipment (GSE) were shipped to LMSD in Sunnyvale, California to be used in compatibility tests with the Agena-B vehicle. JPL, Space Programs Summary No. 37-8, Vol. I, op. cit., 3.)

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*At about the same time Dr. Harold C. Urey proposed experimental investigation of the moon in the following order of priorities: (1) lunar orbiter, (2) lunar hard lander (Ranger), (3) lunar soft lander (Surveyor), (4) return of lunar samples (Prospector), and (5) manned landing by "a hard-rock geologist." (Urey, "The Moon," in Lloyd V. Berkner and Hugh Odishaw, eds., Science in Space, New York: McGraw-Hill Book Co., 1961, 195-197.)

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During March cont.	The RA-1 PTM and Agena vehicle 6001 were mated at LMSD and a successful compatibility test was conducted. Atlas and Agena RF sources were simulated and on-board systems were operated to uncover any interference effects. Apart from some undesired modulation of spacecraft telemetry data, no major problems were encountered. (JPL, Space Programs Summary No. 37-9, op. cit., 3.)
	Ranger Block II. JPL selected the Electric Storage Battery Co. of Raleigh, North Carolina, to develop the battery for Ranger spacecraft RA-3, 4, and 5. One noteworthy requirement specified for this sealed silver-zinc battery was that it be sterilized. Absolute temperature constraints were set at 50° to 130° F. (JPL, Space Programs Summary No. 37-8, Vol. I, op. cit., 14; also, JPL, IOM from G.E. Sweetnam to J.H. Gerpheide, March 13, 1961, JPLHF 2-1107.)
	Testifying before the House Space Committee during NASA authorization hearings, Dr. Abe Silverstein indicated that the projected cost for the complete Ranger Project of five firings over a 14-month period would be on the order of $100 million. (U.S. Congress, House of Representatives, Committee on Science and Astronautics and Subcommittees No. 1, 3 and 4, 1962 NASA Authorization, 87th Congress, First Session, March 13, 14, 22, 23, April 10, 11, 14 and 17, 1961, GPO, Washington, D.C. 1961, 77.)
Apr. 4	The design of Ranger Block II spacecraft (RA-3, 4 and 5) and all subsystems was frozen. "Subsequent to this date any proposed changes regardless of their nature must be evaluated and approved by the Systems Division Spacecraft Integration Group," (JPL, IOM from J.D. Burke to Distribution, Subject: Ranger Project Review Meeting for May 3, 1961, April 28, 1961, JPLHF 2-1114.)
Apr. 5	In response to suggestions from NASA and JPL personnel, Aeronutronic Division of Ford Motor Company submitted proposals to JPL for employing the basic Ranger spacecraft in a variety of different missions to obtain background engineering information about the moon. These were (1) a Ranger Lunar Orbiter, (2) a variety of rough-landing capsule extensions including a penetrometer capsule to test the strength of the lunar surface, and (3) a facsimile capsule to televise photos of the lunar surface back to earth. (Aeronutronic, Division of Ford Motor Company, "Proposal for Lunar Capsule Extensions," Publication No. P10631(U),

Apr. 5 cont. "Electro-Optical Device," Publication No. P11001(U), and "Proposal for a Design Study of the Ranger Lunar Orbiting Spacecraft," Publication No. P10671(U), all May 5, 1961.)

Apr. 10 A.R. Hibbs, Chief of the JPL Science Division, notified J.D. Burke, Ranger Project Manager, of Walter Brown's proposal to obtain radar data from the moon from Block II spacecraft. (See March 27, 1961.) "I would appreciate it if the program office could look into this matter and decide whether or not such modifications would be in the best interest of Ranger 3, 4, 5 program. . . ." (JPL, IOM from A.R. Hibbs to J.D. Burke, April 10, 1961, JPLHF 2-1111a.)

Apr. 12 Soviet Major Yuri A. Gargarin made the first successful manned space flight in a 108-minute circumnavigation of the earth aboard a 5-ton Vostok spaceship. (Aeronautical and Astronautical Events of 1961, op. cit., 15.)

Apr. 18 Responding to a request from the Ranger Project Manager, the Spacecraft Integration Group informed J.D. Burke that after evaluation of the radar telemetry proposal, two options were indicated: (1) modify affected equipment to permit commutation of the altimeter telemetry, this would involve a substantial slip in the flight of RA-3; and (2) with difficulty, some schedule delay, and a decision by April 24, it would be possible to modify the data encoder to switch out the gamma-ray experiment and switch in the altimeter telemetry for the last sixty seconds of flight. (JPL, IOM from Schneiderman/Mesnard to J.D. Burke, April 18, 1961, JPLHF 2-1111c.)

Apr. 24 Upon a request from J.D. Burke, William Fleming of NASA Headquarters furnished him a list of names of individuals who were, in his opinion, empowered to generate a late "scrub order" (delay of launch) for Project Ranger. In washington, D.C. they were James Webb, Hugh Dryden, Robert Seamans, Abe Silverstein, and General Don Ostrander. In the field they were W.H. Pickering, W. von Braun, J.D. Burke, K. Debus, H. Hueter, and the AMR Range Safety Officer. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 3, April 24, 1961, JPLHF 2-1314.)

Apr. 25 JPL Director W.H. Pickering requested the Senior Staff to reexamine the question of "how to reduce the space gap, relative to the achievements of the Russians," and that any practical approaches advanced for attaining this objective would be forwarded to Washington, D.C. (See April 12, 1961.) "We are aware, from conversations with a number of you, that most of

Apr. 25 cont. you share our conviction that this is a critical problem of national importance; further, that we can no longer afford to approach it passively or to attempt to rationalize it away through arguments that no serious gap exists when purely scientific achievements or a multiplicity of space events are considered. . . ." (JPL, IOM from W.H. Pickering to Senior Staff, April 25, 1961, JPLHF 2-1112.)*

Apr. 28 Mr. Harry Wagner of JPL Division 32, Space Sciences, formulated a simplified method for commutating radio altimeter reflectivity data on Ranger Block II spacecraft that would not interfere with the gamma-ray experiment. Therefore, M.R. Mesnard recommended that J.D. Burke immediately authorize the necessary modifications in affected spacecraft equipment. (JPL, IOM from M.R. Mesnard to J.D. Burke, April 28, 1961, JPLHF 2-1113.)

During April Ranger Block I. The Ranger Block I PTM spacecraft was returned to JPL after successful compatibility tests with Agena vehicle 6001. (JPL, IOM from J.D. Burke to B. Sparks, Project Status Report No. 1, April 6, 1961, JPLHF 2-1314.)

JPL furnished a dynamic model of the spacecraft to LMSD to run a composite vibration test of Agena-spacecraft adapter, the spacecraft and the shroud. Tests were conducted to check the structural integrity of the assembly under simulated vehicle vibration. Results indicated that the assembly was structurally sound, and the spacecraft dynamic model was sent to LMSD's Santa Cruz test base for use in Agena static firing tests. (The Ranger Project: Annual Report for 1961, op. cit., 90.)

A demonstration of ground cooling of the shroud under simulated spacecraft power dissipation was given at Lockheed (Van Nuys) using a cooling blanket and a convection system. (JPL, Engineering Document No. 333, Revised, Ranger Launch Vehicle Integration Summary, W.J. Lane, D.J. Stelma, June 27, 1967, 16.)

Assembly and testing of the RA-2 spacecraft proceeded smoothly several weeks ahead of schedule. By this date it had completed system testing, and accumulated approximately 100 hours of

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*Surveying this period from other sources some years later, Vernon Van Dyke reflected: "My impression is that the wound inflicted by the Sputniks on our national pride came to smart more and more as the months went by, becoming unbearable in the spring of 1961 when Kennedy--also influenced by other motives--recommended the expansion and acceleration of the [space] program." (Vernon Van Dyke, Pride and Power: The Rationale of the Space Program, Urbana, Illinois: University of Illinois Press, 1964, 144.)

During April cont.

operation time. Two malfunctions in the power system were uncovered during these tests: "The first . . . was a transistor failure in the telemetry circuitry of the power switch-logic subassembly. The second was caused by a cover mounting screw which was longer than clearances allowed. The screw intermittently touched a terminal and caused the communications converter to go into its overload mode of operation. . . ." At the end of the month RA-2 was transferred to the STL magnet test facility at Malibu and spacecraft magnetic field calibration was accomplished. (JPL, Space Programs Summary No. 37-9, Vol. I, op. cit., 13.)

Ranger Block II. Assembly of the RA-3 PTM was begun. The JPL liquid-propellant mid-course motor and the ADF lunar capsule were available; however, other components remained in qualification test. "Some late deliveries are now expected and it is likely that a part of the value of the RA-3 PTM will be lost because there will not be enough time to incorporate changes between tests of the PTM and [assembly] of the actual RA-3 flight spacecraft." (JPL Space Programs Summary No. 37-9, Vol. II, op. cit., 4.) (Figure 37.)

The Aeronutronic capsule project for Ranger Block II spacecraft was "approximately one month late [behind schedule] and $300,000 overrun; we are prepared to cover the overrun and ADF expects to recover the slip." (JPL, Project Status Report No. 1, loc. cit.)

The first three static tests of the luna capsule solid-propellant retro-motor were conducted by the Hercule firm. Although one test was successful, difficulties were encountered with the engine throat and rocket casing. (JPL, Space Programs Summary No. 37-9, Vol. II, op. cit., 23.)

May 1

Samuel Snyder, NASA Headquarters, requested DOD downrange support of Project Ranger from a DOD-furnished instrumented ship. (Snyder's letter cited in letter from Harold Brown, Director of Defense Research and Engineering, to Robert C. Seamans, July 10, 1961.)

JPL awarded a contract to American Missile Products Corp. for the fabrication of subassemblies for five CC&S systems for Block II Ranger spacecraft. Four of the JPL-designed units had already been fabricated in-house. (See During February 1961.) (JPL, Space Programs Summary No. 37-11, Vol. II, for the period July 1, 1961 to September 1, 1961, 7.)

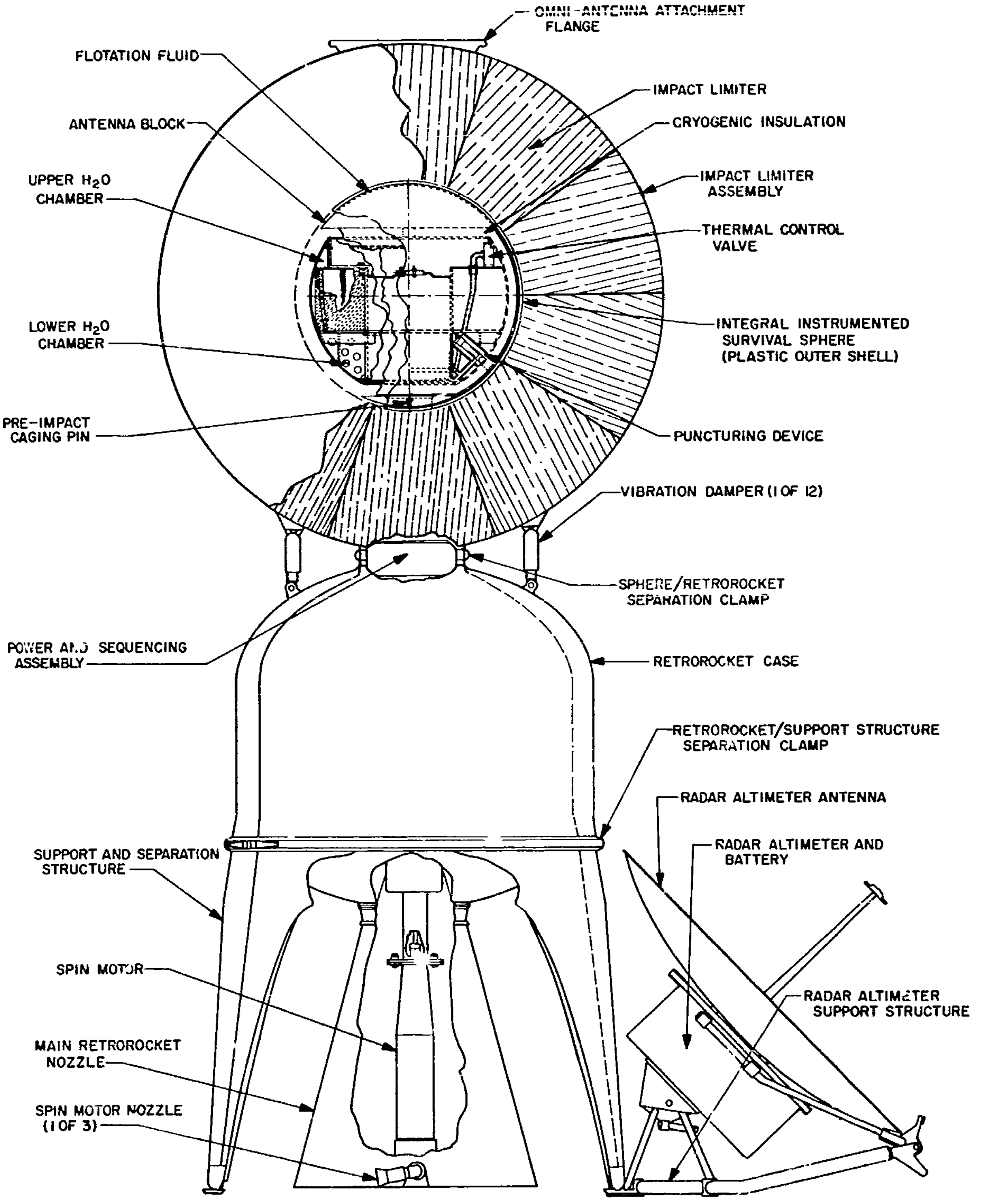

Figure 37: Ranger Block II lunar capsule system.

May 1 cont. A JPL contract was awarded to Hallamore Electronics Division to design, fabricate, test and install a DSIF prototype S-band radio system at the Goldstone station. The objective of the prototype program was to test and verify an RF system translation from L-band to S-band that was planned for eventual incorporation at all DSIF stations. (JPL, Space Programs Summary No. 37-15, Vol. III, for the period March 1, 1962 to May 1, 1962, 14.)

Total additional cost in overrun for the ADF lunar capsule development effort, including four subcontracts was estimated at $963,068. (JPL Conference at Aeronutronic, Conference Report dated May 1, 1961 by L.C. Pehl, JPL, JPLHF 2-1204.)

May 2 Ground rules for a JPL study on accelerating the National Space Program were established. The study was scheduled for completion by June 1, 1961. (JPL, IOM from W.H. Pickering to Senior Staff, May 2, 1961, JPLHF 2-294.)

May 4 Ranger Agena-B vehicle 6002 completed the manufacturing cycle at LMSD.

May 5 Systems tests of the Ranger 1 spacecraft were completed at JPL. (Aeronautical and Astronautical Events of 1961, op. cit., 20.) (Figure 38.)

May 7 Oran Nicks and Ben Milwitzky of OSFP in NASA Headquarters visited JPL for a review of the flight readiness of Ranger 1. The vehicle was accepted by NASA for shipment to AMR. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 5, May 8, 1961, JPLHF 2-1314.)

May 8 Ranger 1 spacecraft was unloaded at AFMTC and transferred to the systems test area at Hangar AE. "Initial tests disclosed a number of minor problems, some of which were recurrences of previous trouble and some of which, chiefly in GSE, were the result of transport damage. . . ." (JPL, Space Programs Summary No. 37-10, Vol. I, op. cit., 3.)

May 9 In order to overcome a continuing manpower shortage, the Systems Division at JPL was assigned responsibility for guiding and coordinating the Laboratory's spacecraft sterilization program. (JPL, IOM from B. Sparks to Senior Staff, May 9, 1961, JPLHF 2-295.)

May 10 JPL recommended to NASA that Contract NASw-81, with the California Institute of Technology, for "theoretical and experimental research directed toward design, construction, and testing of a lunar seismograph system, including study of active systems for use in

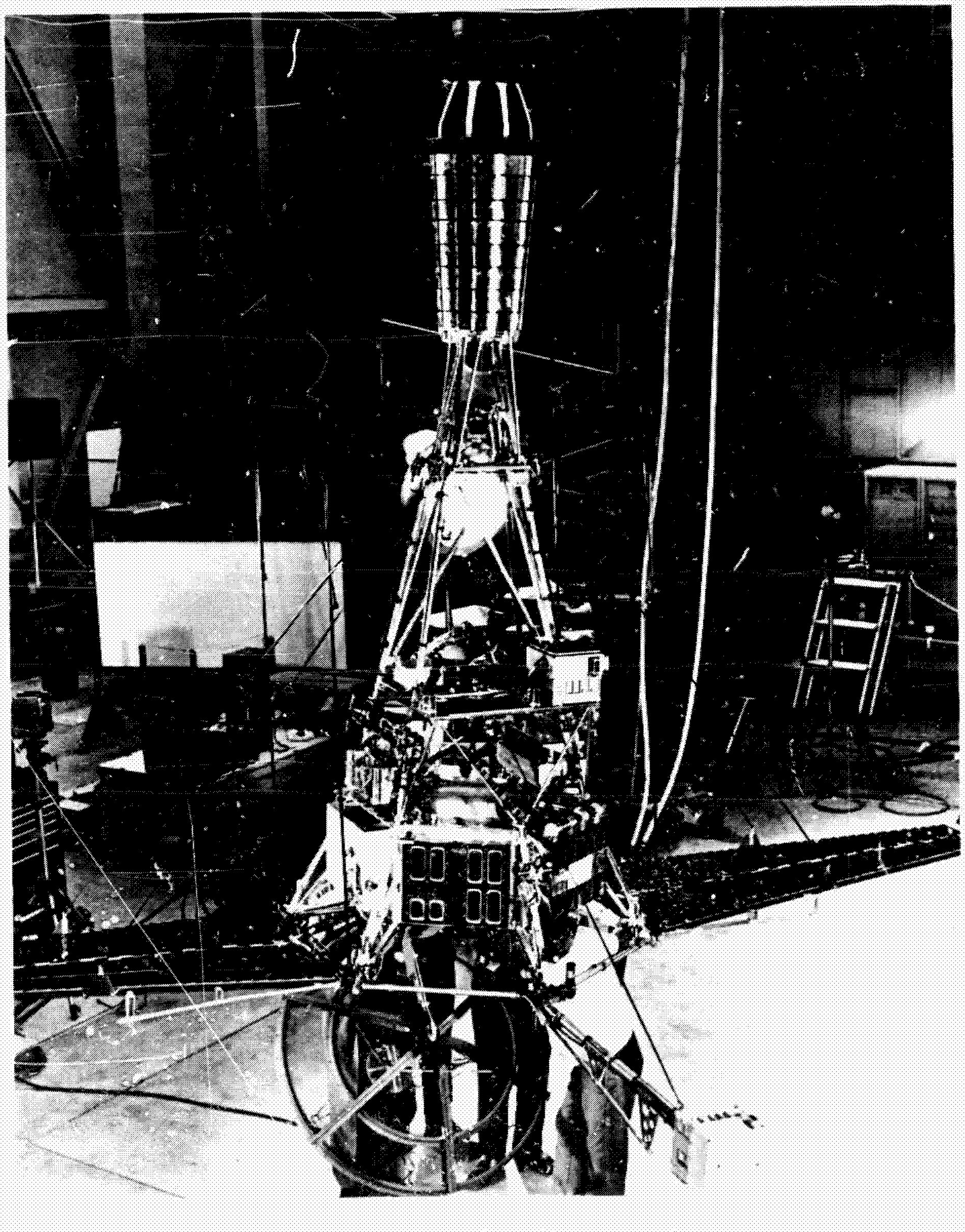

Figure 38: Ranger 1 in JPL test complex.

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May 10 cont. conjunction with roving vehicles . . ." receive additional funding for the next fiscal year with no change in the scope of work. (JPL, letter from Dr. Hibbs to Dr. Sonett, NASA OSFP, May 10, 1961, JPLHF 2-1116a.)

President John F. Kennedy approved an administration program which set a manned lunar landing goal as its central feature. (Historical Origins of NASA's Launch Operations Center to July 1, 1962, op. cit., 225.)

May 12 A NASA Agena-B Management Meeting was held at Marshall Space Flight Center. A portion of the conference was devoted to inter- and intra-agency management realignment occasioned by GMI 4-1-1 (see January 19, 1961), and discussion indicated that new working relationships were not yet firm: "MSFC stated that the relationship between MSFC and JPL has not yet been established. Major Albert reiterated repeatedly that the Air Force wants to see the PDP before formal submission to NASA Headquarters. No one on the NASA side of the house acknowledged this desire. Also stated in the meeting by Marshall was the fact that they had a long process to go through before they could submit their portion of the PDP to the Project Manager. . . . GSFC has not yet resolved how they will handle the Project managers. . . .(Trip Report by Gordon Kautz, NASA Agena-B Management Meeting held at Marshall Space Flight Center, May 12, 1961, JPLHF 2-493.)

May 15 JPL informed LMSD that in the event of disagreement between STL and LMSD over computed Ranger trajectories and guidance settings, the STL figures would have precedence. Final figures would have to be certified by MSFC; release of these figures was now one month late. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 6, May 15, 1961, JPLHF 2-1314.)

May 16 JPL revised project priorities. First priority was accorded Ranger Flights 1, 2, 3, and Mariner [Centaur] 1962--Venus; second priority was assigned Ranger Flights 4 and 5, and Surveyor; and third priority was Mariner B. (JPL, IOM from B. Sparks to All Personnel, May 16, 1961, JPLHF 2-296.)

May 20 JPL Functional Design Specification, Revision C, for Block II spacecraft, was released. Gross weight now established for Rangers 3, 4, and 5 was 724.25 lbs. (See March 1, 1961 and December 1, 1960.) (JPL Specification RA345-4-120C, Functional Specification Design Parameters, May 20, 1961, 15.)

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May 22 The NASA Space Sciences Steering Committee met in Washington, D.C. "to enable a group of selected consultants to review the projected expansion of the space program at an early stage of the thinking, and to give NASA the benefit of their ideas before the new program has been frozen." Basic physical science policy was evaluated. (NASA, "Notes on a Meeting of the Space Sciences Steering Committee with Selected Consultants to Review a Proposed Expansion of the Space Program," May 22, 1961, JPLHF 2-1945; also, Memo for the Administrator from H.E. Newell, enclosing Report [of Consultants], May 24, 1961, JPLHF 2-1946a and 2-1946b.)

May 24 "Headquarters advised four more Rangers to be done in-house at JPL." (N.W. Cunningham, Ranger Program Chronology, loc. cit.)

Ranger Project Development Plan (PDP) was released in conformance with requirements of GMI 4-1-1. Total cost of the existing five-flight program was estimated at $100 million. Primary objectives of the project were specified as: "(a) to create and test a new spacecraft design whose features can be exploited in the performance of lunar and interplanetary flight missions, and (b) using this spacecraft to perform two classes of scientific experiments: first a group of measurements dealing with particles, fields and the solar atmosphere within one million miles of the Earth; and second, a group of measurements of lunar characteristics close to and on the surface of the moon." The assumed reliability factor estimated for combined launching vehicle and spacecraft performance in five flights were 0.15, 0.35, 0.24, 0.40, and 0.56, respectively. (Ranger Project Development Plan, op. cit., 1-2, and 35.)

R.C. Hastrup notified affected JPL personnel that experience with the three-step spacecraft sterilization program indicated that future developments should be geared toward a reduction of steps, eventually by heating the entire assembled spacecraft "although such a procedure is not feasible for Ranger spacecraft due to the state-of-the-art and schedule limitations, continued emphasis should be placed on the use of heat for sterilization, especially as applied to gross assemblies containing as many components as possible. In this way the difficult and time consuming methods of [liquid treatment in] sterile assembly can be minimized and we will be in a much better position to accomplish the ultimate goal of planetary spacecraft sterilization." (JPL, IOM from R.C. Hastrup to Distribution, May 24, 1961, JPLHF 2-1118.)

May 25 JPL notified NASA of the sterilization procedures intended for use on the RA-3 mission. "These procedures are submitted for the approval of the Associate Administrator in accordance with NASA memorandum from the Office of the Administrator, dated 23 December, 1960." (JPL, letter from C.I. Cummings to Dr. R.C. Seamans, May 25, 1961, JPLHF 2-1119.)

In a special message delivered before a joint session of Congress, President Kennedy called for a national decision for "achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth."

May 26 Atlas booster 111-D was delivered to AMR for the Ranger 1 launch. (NASA-Agena-B Management Meeting #2, MSFC, June 6, 1961, JPLHF 2-1131, 2.)

May 29 Using LMSD and Convair inputs, initial STL Ranger trajectory calculations were released. Findings indicated that for Ranger Block II trajectories, a 106-lb payload (spacecraft) weight increase for the RA-3 Agena vehicle could be accommodated. The JPL Block II weight reduction effort had been, for the most part, unnecessary (see March 1 and May 20, 1961). (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 8, May 29, 1961, JPLHF 2-1314.)

Agena B vehicle 6001 completed systems test and was accepted by the Air Force at LMSD.

May 30 Agena B vehicle 6001 was delivered at AMR and transferred to Hangar E. (NASA-Agena-B Management Meeting #2, MSFC, _loc. cit._)

During May Ranger Block II. Assembly of the RA-3 spacecraft bus structure began. (JPL, _Space Programs Summary No. 37-10, Vol. I_, _op. cit._, 7-8.)

Simulated lunar landing tests were conducted at Goldstone Lake with ADF lunar capsules. Five drops were made from a T-28 aircraft using both dummy and operating landing spheres at a velocity of 200 ft/sec, 20 and 45 degree impact, on both hard flat and rocky surfaces. Landing spheres did not operate after drops into a rocky area; however, after drops onto the flat desert floor "all three impact limiters performed their required function, that of protecting everything within." (JPL, _Space Programs Summary No. 37-10, Vol. II_, _op. cit._, 19, 23.)

During May cont.	At the end of the month a visit was conducted at the Wiley and Ryan facilities to review progress on the radio altimeter. (See March 31, 1961.) The Wiley altimeter was found to be approximately two weeks ahead of schedule, and an altimeter in a near-flight configuration operated satisfactorily during tests. Consequently, a decision was made to discontinue the parallel development program; the Ryan work was terminated on June 2, and Wiley Electronics was directed to proceed with fabrication of the necessary flight units. (Ibid., 35.)
	DSIF. A mobile tracking station, consisting of several trailers housing electronic equipment and a small trailer-mounted antenna, to be used for obtaining tracking data on Ranger orbital injection, was positioned at its site near the DSIF Johannesburg station. (JPL, Space Programs Summary No. 37-10, Vol. I, op. cit., 66.)
During May cont.	Facilities. A Spacecraft Assembly Facility (SAF) containing necessary air conditioning and specialized testing equipment was completed at JPL. Ranger operations were transferred to the new building from the temporary facilities where assembly and testing had been conducted. (The Ranger Project: Annual Report for 1961, op. cit., 331.)
June 1	NASA Headquarters completed guidelines for proceeding "with plans for additional Ranger missions." Formal NASA approval of this project extension was tentatively scheduled for June 26, 1961. (NASA, Memo for Assistant Director of Lunar & Planetary Programs from O.W. Nicks, Chief, Flight Systems, Office of Lunar & Planetary Programs, June 1, 1961, JPLHF 2-1487a and 2-1487b.)
June 2	NASA Headquarters requested that JPL review plans for a possible extension of the Ranger Program, Ranger alternate capsules and orbital capabilities, guidelines for payload developments, and flight schedules. (NASA, TWX from E.M. Cortright to W.H. Pickering, June 2, 1961, JPLHF 2-1486.)
June 5	In the Ranger Project Status Report to the Laboratory Deputy Director, J.D. Burke stated that a special performance meeting held at LMSD confirmed that an additional 164 lbs were now available on RA-1 and 116 lbs on RA-3 (Block I and Block II Ranger spacecraft) resulting in total spacecraft weights of 824 lbs and 841 lbs respectively. This additional "capability is unexploitable. . . at this late date." (See March 1, 1961.) He also noted that the program for the RA-3 terminal yaw maneuver had

June 5 cont. been increased from 60 - 120° "to aid vidicon pointing in case of inadvertent [lunar] flyby." (JPL, IOM from J.D. Burke/ G.P. Kautz, to B. Sparks, Ranger Project Status Report No. 9, June 5, 1961, JPLHF 2-1314.)

June 8 Dr. Abe Silverstein, NASA Director of the Office of Space Flight Programs, testified before the Senate Committee on Aeronautical and Space Sciences that the emphasis in NASA's unmanned lunar program was to support a manned lunar landing program: "Before we land man on the moon, it is extremely important that we find out what there is on the surface of the moon, what radiations might be encountered there, the type of geographical contours we will find, the materials, whether the lunar surface is dust, whether there are any active materials on the moon's surface. To do this we are sending up a series of spacecraft in this order: first, the Ranger, then Surveyor, and then the Prospector, in chronological order." (NASA Authorization for Fiscal Year 1962, op. cit., 64.)

June 9 Dr. Abe Silverstein, Director of the NASA Office of Space Flight Programs, informed JPL Director, Dr. William Pickering, that "increased national emphasis on the steps leading to a manned lunar landing may make additional funding available in FY 1962 for current lunar projects." Silverstein indicated that a four-flight extension of the Ranger Program was contemplated by Headquarters; one flight to occur in late calendar year 1962, and the remaining three in 1963. He observed that the decision to pursue a United States manned lunar landing program had created "a need for early data on the surface topography and hardness of the moon, and it is deemed desirable to extend the use of Ranger developments toward this end. In addition to obtaining useful data at an earlier date, the four-shot extension should afford a better opportunity for Ranger project success, and a corresponding contribution to national prestige during the early phase of our lunar program." JPL was directed to examine two types of payloads for the Ranger follow-on: (1) a high-powered television system "capable of producing very high-resolution pictures of the lunar surface as the Ranger spacecraft approaches the moon," and (2) one that would produce data on the hardness of the lunar surface, such as a penetrometer capsule. Recommendations on these payloads, alternate bus experiments, and estimates on costs and level of effort were to be presented to Headquarters personnel at a meeting scheduled for June 21. (NASA, letter from A. Silverstein to W.H. Pickering, June 9, 1961, JPLHF 2-350; also, letter from A. Silverstein to W.H. Pickering, June 14, 1961, JPLHF 2-1129.)

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June 9 cont. JPL requested clarification of existing launch scheduling support commitments by AFMTC, and for a NASA-DOD agreement to resolve conflicts in commitments, particularly where they involve Air Force projects. (JPL, letter from W.H. Pickering to R.C. Seamans, June 9, 1961, JPLHF 2-1451.)

June 14 Operational procedures for a Spacecraft Data Analysis Team (SDAT) for the RA-1 spaceflight were established at JPL. (JPL, IOM from A.E. Dickinson to M.S. Johnson, June 14, 1961, JPLHF 2-1130.)

June 19 NASA consultant Dr. Harold Urey of the University of California in San Diego, informed Dr. Homer E. Newell, Director of OSS, that scientists would like to see a Ranger "land inside a large crater or perhaps more than one large crater." His first candidate was "Alphonsus . . . a very interesting crater because Kozyrev has observed gases coming from its interior. . . ." (Letter from Harold C. Urey to Homer E. Newell, June 19, 1961, JPLHF 2-1948.) (See November 3, 1958.)

June 21 A meeting was held with representatives of NASA and C.I. Cummings and P. Eckman of JPL, in Washington, D.C. to evaluate those aspects of the proposed Ranger follow-on program cited in Silverstein's letter of June 9. The extension was approved. A decision was reached that, given the constraints imposed in the use of the Atlas-Agena-Ranger configuration, the most timely contribution Ranger could make to the manned lunar program was to implement a high resolution television impacting mission, using a standard Ranger bus, from which sufficient knowledge of the lunar topography could be gained to allow a determination of the gross effects on lunar landing vehicles. And in light of the short development time proposed, and the considerable work that had already been done on vidicon equipment for Ranger Block II spacecraft by RCA and JPL, a decision was also made that a development program with RCA would probably result in achieving the desired TV subsystem at the earliest date. (JPL, "Ranger History," prepared for Congressional Hearings, transmitted April 23, 1964 to W.H. Pickering from J.W. McGarrity, 18, JPLHF 2-458; also, JPL, IOM from C.I. Cummings to J.D. Burke, July 5, 1961, JPLHF 2-1157.)

June 22 C.I. Cummings notified J.D. Burke that tentative flight schedule established for the Ranger follow-on flights was:

RA-6	December 1962
RA-7	February 1963
RA-8	April 1963
RA-9	June 1963

(JPL, IOM from C.I. Cummings to J.D. Burke, June 22, 1961, JPLHF 2-1132. At this time lunar soft-landing Surveyor flights were scheduled to begin in August 1963.)

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June 22 cont. The JPL Data Handling Committee (see During February 1961) released its report on data handling requirements and capabilities at JPL. An accompanying oral report made to the Director of the Laboratory recommended that (1) JPL obtain a greater data processing capability, (2) a new facility be constructed which would be designed for operational data handling and flight operations, (3) the entire facility be housed in a single building, (4) work on the new facility be initiated immediately because of the shortness of time remaining before existing JPL capabilities would be overtaxed, and (5) an organization be created to plan, organize and manage future systematic growth in JPL data handling operations. These recommendations, coupled with an established Surveyor Project requirement for a Data Operations and Command Facility, resulted in a firm JPL commitment to establish a single, centralized, Space Flight Operations Facility (SFOF) at the Laboratory. (JPL, Space Programs Summary No. 37-20, Vol. VI., loc. cit.)

June 23 J.D. Burke notified the Laboratory Deputy Director that recent meetings revealed continuing difficulties in the management of Ranger trajectory affairs. "The interfaces among GD-A, Burroughs, GE, LMSD, STL, AFSSD, MSFC, JPL, and AFMTC are pretty complicated and misunderstandings and delays are frequent. It will be a tight squeeze to get the final RA-1 trajectory wrung out and certified in time for the shoot." (RA-1 was still scheduled to be launched in July as established on June 15, 1960.) (JPL, IOM from J.D. Burke to B. Sparks, Project Status Report No. 12, June 23, 1961, JPLHF 2-1314.)

June 26 NASA Headquarters approved the JPL sterilization procedures proposed for the RA-3 mission on the condition that "one of the several available sporicidal agents superior to alcohol be employed for decontamination of mating surfaces during the course of final assembly and testing operations." (NASA, letter from R.C. Seamans to W.H. Pickering, June 26, 1961, JPLHF 2-1705.) (See May 25, 1961.)

June 28 Ray Heacock informed C.I. Cummings that, since the follow-on Ranger flights were "proposed to fill the gap between the present Ranger series and Surveyor to provide information needed in the manned lunar program," the prime mission was considered to be obtaining high resolution photography of the lunar surface. "These pictures are to be taken with two cameras working alternately to insure that maximum resolution and reliability are

June 28 cont. obtained. While one camera is being readout, the other will be erased and prepared for exposure. It is proposed that the TV system have a 600 line - 0.33 second frame with a square format. A video bandwidth of at least 432 Kcps will be required for equal horizontal and vertical resolution. This system with only nominal optics and shutter speed requirements can provide pictures of the lunar surface with better than 0.5 foot resolution." Heacock continued to recommend that RCA be considered as a single source contractor for the TV system in light of the proposed accelerated flight schedule beginning in late 1962, and the importance of the mission to Apollo. (JPL, IOM from R. Heacock to C.I. Cummings, June 28, 1961, JPLHF 2-1156.)

June 30 C.I. Cummings, JPL Manager of Lunar Programs, delivered copies of the Preliminary Development Plan for the Ranger follow-on missions to NASA Headquarters. Selection of RCA for the TV subsystem was confirmed, and JPL was instructed to proceed on a direct procurement of Ranger follow-on TV subsystems from the RCA Astro-Electronics Division. (JPL, "Ranger History," prepared for Congressional Hearings, loc. cit.; and JPL, IOM from Charles Hemler to File 2647, July 14, 1961, JPLHF 2-1704.)

In response to further conversations between C.I. Cummings and Edgar Cortright concerning the degradation of Block II vidicon sensitivity occasioned by heat sterilization, Cortright authorized JPL "to utilize a more sensitive vidicon and to employ those sterilization procedures which are technically compatible with obtaining the maximum information pertaining to the lunar surface." (NASA, letter from E.M. Cortright to C.I. Cummings, June 30, 1961, JPLHF 2-1453.)

Ranger Agena B vehicle 6003 completed manufacturing at LMSC,* Sunnyvale, California.

During June Ranger Block I. The Ranger RA-1 spacecraft, Agena B 6001, and Atlas 111D were mated on Stand 12 at the Cape and preflight tests began. (Figure 39.)

Ranger Block II. The RA-3 omni-antenna design and fabrication of the first unit was completed. The design selected was based on the Pioneer IV antenna configuration, consisting of a semi-conical ground plane with a spike-like driven element. (JPL, Space Programs Summary No. 37-10, Vol. I, op. cit., 18.)

The RA-3 spacecraft bus structure was delivered to the SAF on June 14, preparatory to start of assembly operations. After fitting with the attitude control cold gas piping network, the structure was placed in a Bemco oven in the environmental test facility and heat-sterilized. (Ibid., 4.) Original sterilization

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*In June 1961 Lockheed Missiles and Space Division (LMSD) was changed to Lockheed Missiles and Space Company (LMSC), a wholly owned subsidiary of Lockheed Aircraft Company.

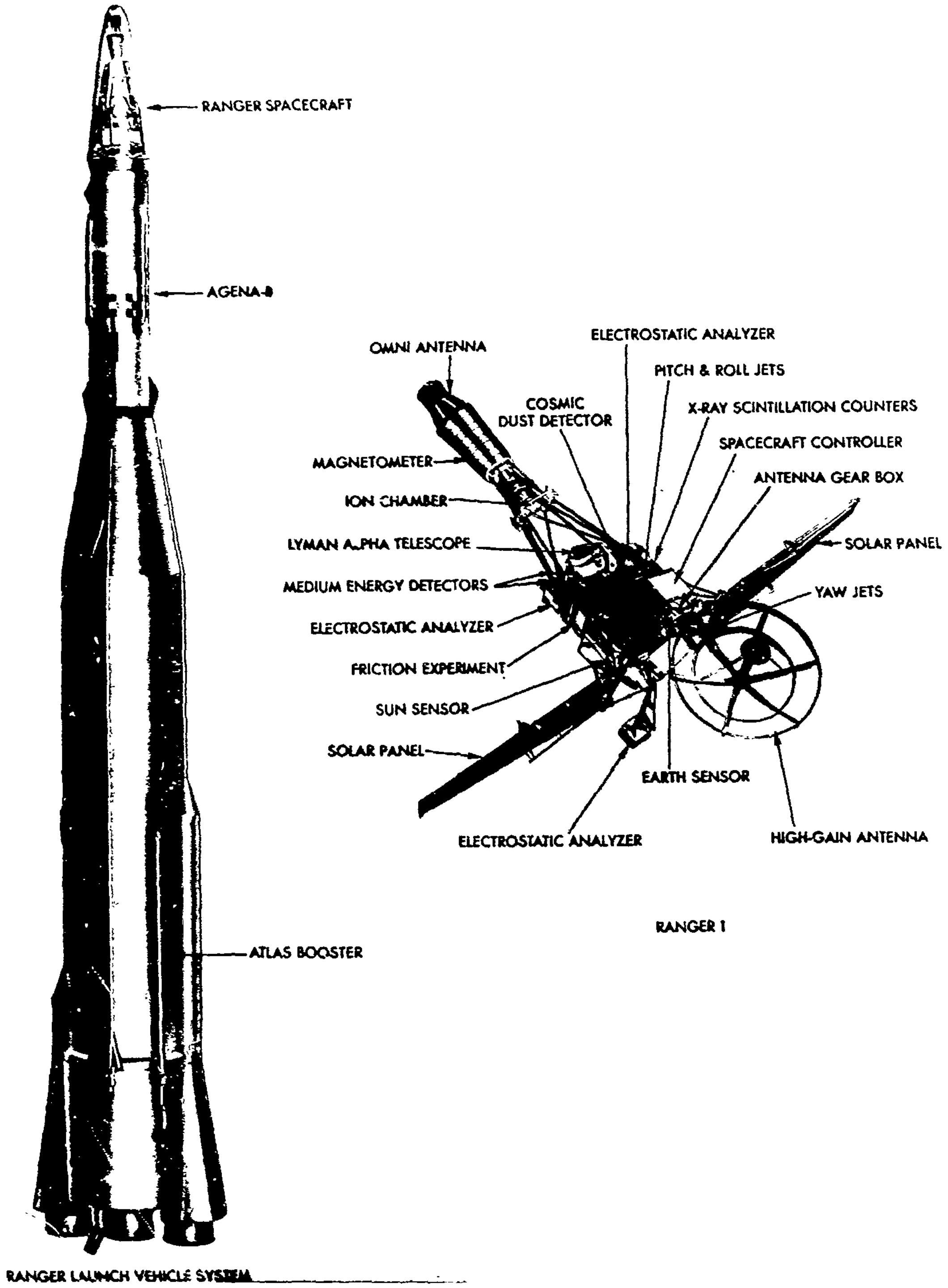

Figure 39: Ranger launch vehicle system with Ranger 1 spacecraft.

1961

During June cont.

plans called for the spaceframe (bus) with primary harness and control hardware installed, to be baked at 125° C for 24 hours. However, due to the weight savings program initiated earlier, extensive use had been made of magnesium castings and titanium fasteners, and concern was expressed that the frame might warp and have to be machined after heating. As a consequence the bus and various components were heated separately. Minor warpage did occur but no machining was required. Various components exhibited out-of-tolerance performance when tested after heating. Completion of final assembly and power turn-on was scheduled for July 24. (Ibid, 7-8, 21.)

Ranger Block III. (Proposed Ranger follow-on Flights 6, 7, 8, and 9.) While this program was not yet formally approved by NASA, the decision for a manned lunar landing program had injected a recognizable urgency into the United States unmanned lunar flight programs, and marked the beginning of a significant shift in emphasis for their objectives. Acquisition of scientific knowledge concerning the origins and constitution of the moon was slowly displaced as the major flight purpose during the next year, and future unmanned lunar flights conducted by OSFP (Ranger Block III, Lunar Orbiter and Surveyor) were reoriented to acquire data of an engineering nature for the manned space flight program. These unmanned lunar projects eventually became, for all intents and purposes, handmaidens to Project Apollo, although the idea of abandoning science for engineering goals died hard in OSFP, as events in the Block III effort were shortly to demonstrate. (Cf. Vernon Van Dyke, Pride and Power, op. cit., 101; also, Testimony of Oran Nicks, U.S. House of Representatives, Investigation of Project Ranger, 88th Congress, Second Session, Washington, D.C., 1964, 67; also, NASA, Sixth Semi-Annual Report to the Congress, op. cit., 67; and, James H. Wilson, Apollo's Minions, October 26, 1967 (unpublished), JPLHF 2-744.)

DSIF. The Goldstone, Woomera, and Johannesburg stations began systems checkout in preparation for the RA-1 flight. Construction of the Johannesburg station had been completed early in the month. Equipment checkout, performance evaluation tests, and net integration tests were conducted. (N.A. Renzetti, Technical Memorandum No. 33-174, Tracking and Data Acquisition for Ranger Missions 1-5, July 1, 1964.

Facilities. Construction of the 25-foot space simulator had reached a point where the structure rose 45 feet above ground. over half of its eventual 82-foot height. (JPL, Space Programs Summary No. 37-10, Vol. I, op. cit., 46.)

July 4 The DSIF became fully operational as a world-wide tracking network. Between this date and July 26, the first scheduled launch of Ranger 1, a series of "dummy runs" were conducted to test equipment and train operating personnel. (The Ranger Project: Annual Report for 1961, op. cit., 383.)

July 5 The first meeting of JPL and RCA personnel, concerning procurement of a TV package for the follow-on Ranger flights, took place at JPL. RCA was authorized to begin design studies of the proposed payload. (NASA, memo from O.W. Nicks to Deputy Director, OSS, January 15, 1962, JPLHF 2-336; and RCA, Ranger TV Subsystem, Block III, Final Report, July 22, 1965, 1.)

July 6 NASA Associate Administrator R.C. Seamans, Jr. established a "Manned Lunar Landing Steering Committee" to act as a top level coordinating group in NASA during the interim before the reorganization in November 1961, to provide management for the manned lunar landing. (J.M. Logsdon, NASA's Implementation of the Lunar Landing Decision, HHN-81, August 1969, Commend Edition, 25.)

JPL Lunar Program Director C.I. Cummings informed Edgar M. Cortright that "it does not appear practical to change the vidicon for Rangers 3, 4, or 5 to a new tube design with a more sensitive, but not sterilized target." He continued to indicate that a development program for a new vidicon would not be available in time for any launches except RA-5, and that a much more sensitive system was planned for the follow-on Rangers in any case. (NASA, letter from C.I. Cummings to E.M. Cortright, July 6, 1961, JPLHF 2-1454.)

July 7 Criteria for the Ranger follow-on TV subsystem development were established in a meeting at JPL. The project would provide detail on the lunar surface and on the radiation environment. Determination of lunar surface load bearing characteristics was not considered feasible. Primary data collection would be by means of a special slow-scan television system with a shuttered vidicon. Top priority was assigned to high resolution. Further, the contractor would be assigned "total subsystem responsibility." The selected contractor "will design the full system to meet total objectives . . ." TV subsystem development was to be monitored by the JPL Systems Division, with the Space Sciences Division supplying consultant support. (JPL, Minutes of Ranger TV System Meeting of July 7, 1961, JPLHF 2-1711.)

Brooks T. Morris was appointed Special Assistant to the Director for Reliability Assurance at JPL. (JPL, IOM from W.H. Pickering to Senior Staff, et. al., July 7, 1961, JPLHF 2-297a.)

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July 10	In response to the request of May 1, 1961, the DOD informed NASA that a DOD instrumented ship would be provided to support the launch of Project Ranger vehicles. (Letter from Harold Brown, Director of Defense Research and Engineering, to Robert C. Seamans, NASA, July 10, 1961.)
	Detailed procedures for the sterile assembly of the RA-3 spacecraft were released at JPL. (JPL, IOM from R.C. Hastrup to Distribution, July 10, 1961, JPLHF 2-1133.)
	JPL publicly announced that construction was underway on the first large United States space simulator, capable of testing full-scale spacecraft of the Ranger and Mariner class. ("An Interplanetary Space Simulator," Missiles and Rockets, July 10, 1961, 40, JPLHF 2-766.)
July 12	The first launch of an Atlas-Agena B took place at Cape Canaveral. The Agena B successfully executed the planned dual-burn and was injected into the desired orbit. (Air Force Document MTP-MS-IS-61-4, December 1962, VI, JPLHF 2-1066.)
July 13	The combined RA-1 spacecraft, Agena B 6001, and Atlas 111D passed the Joint Flight Acceptance Composite Test (J-FACT) at Cape Canaveral, Launch Stand 12. The following day the RA-1 spacecraft was demated and returned to Hangar AE for final launch preparation and systems test, while the Agena and Atlas completed a Flight Readiness Demonstration (FRD) test. (JPL, Space Programs Summary No. 37-11, Vol. II, op. cit., 3; also, JPL, IOM from J.D. Burke/G.P. Kautz to Brian Sparks, Ranger Project Status Report No. 15, July 17, 1961, JPLHF 2-1314.)
	A complete net integration test was conducted involving the DSIF stations, the JPL communications center, JPL computer, and the Cape Canaveral and AMR stations. Subsequently, similar tests were successfully run on July 19 and 24. "Some problems were encountered with communication links, especially those to Johannesburg, but the data handling requirements were met and the circuits considered acceptable." (JPL, Space Program Summary No. 37-11, Vol. I, for the period July 1, 1961 to September 1, 1961, 40.)
July 14	JPL authorized ADF to proceed with the development of a High Resolution Facsimile (HRF) camera system for use in a lunar capsule. The device would be demonstrated by ADF by December 1, 1961. (JPL, IOM from G. Cushing to H. Lawrence, July 25, 1961, JPLHF 2-1135.)

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July 17-21 The RCA budgetary cost estimate for the TV development program for Block III Ranger spacecraft was made available to JPL. (NASA, memo from O.W. Nicks to Deputy Director, OSS, January 15, 1962, loc. cit.) The RCA Astro-Electronics Division estimated the total Ranger follow-on program price from PERT to post impact analysis at $5,873,000 based on the following assumptions:

1. For Rangers 5 and 6, a three camera system would be used; one wide angle, one medium angle and one with a narrow angle field of view.
2. On Rangers 7 and 8, the wide and medium angle cameras would be replaced with a single camera "which will be an electrostatic storage type vidicon with 5,000 scanning line format."
3. Goldstone would be "the operational base."

(Memo to File 2647 from Charles A. Hemler, July 20, 1961, JPLHF 2-1209.)

July 20 JPL notified NASA that, pending completion of a liquid sterilant test program, to discontinue the use of alcohol as a sporicidal agent in favor of another substance during surface joining operations in the assembly of RA-3 could potentially jeopardize spacecraft reliability. (JPL, letter from C.I. Cummings to R.C. Seamans, July 20, 1961, JPLHF 2-250.)

July 21 At a meeting with R.C. Seamans and A. Silverstein, Dr. W.H. Pickering informally presented the plans of and need for a data operations command facility for deep space missions. The idea was favorably received, and a transfer of R&D funds for this purpose was subsequently authorized. (JPL, letter from V.C. Larsen Jr. to Dr. Silverstein, October 17, 1961, JPLHF 2-1460a.)

July 24 JPL requested NASA approval for issuance of a letter contract to Astro-Electronics Division of the Radio Corporation of America, Princeton, New Jersey, to develop and fabricate the high resolution TV system and associated communication and electronic equipment for the follow-on Ranger vehicles. (NASA, Sixth Semiannual Report to the Congress, op. cit., 66.)

July 29 Countdown for the launch of Ranger RA-1 began at Cape Canaveral, but had to be scrubbed at 0502 EST due to an electrical power failure at AMR. (The Ranger Project: Annual Report for 1961, op. cit., 361.)

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July 30 The second countdown for the launch of the first Ranger, RA-1, was cancelled when a leak in the spacecraft attitude control gas system was detected. The spacecraft was returned to Hangar AE where the defective equipment was replaced. (Ibid.)

July 31 RA-1 Countdown 3 was picked up at 1900 EST. This third attempt at launch was cancelled when the Atlas booster was found to have a faulty LOX tanking valve. (Ibid.)

RCA furnished the planned technical performance characteristics of the Ranger follow-on high resolution TV system to NASA. (Memo for the Record by Benjamin Milwitzky, August 1, 1961, JPLHF 2-674.)

During July Ranger Block II. Assembly of the flight hardware on the Ranger 3 bus began at JPL, and initial power turn-on took place on July 24. Subsystem and system tests were conducted thereafter through September 21. (JPL, Public Information Office Press Release, January 18, 1962, 3, JPLHF 2-796; and JPL, Space Programs Summary No. 37-12, Vol. II, for the period September 1, 1961 to November 1, 1961, 15.)

The RA-3 PTM completed system tests (electronic checkout) on July 31, 1961. The tests "were considered quite successful. The spacecraft basically performed properly from launch through lunar impact. Some design discrepancies were noted, but modifications were effected and the last of three systems tests proved the entire spacecraft design." (JPL, Space Programs Summary No. 37-11, Vol. II, op. cit., 5.) Integration design-verification tests of the RA-3 PTM and Agena interface were conducted at JPL from July 28 through August 3, 1961. The only significant change between the Ranger 1 and Ranger 3 interface was in the type and location of the omniantenna. (Ranger Launch Vehicle Integration Summary, op. cit., 31.) (Figure 40.)

Batteries for Block II spacecraft type approval tests, prototype evaluation, PTM and first systems tests were delivered to JPL by the Electric Storage Battery Company. (JPL, Space Programs Summary No. 37-11, Vol. I, op. cit., 17.)

The series of static test firings of Hercules retro rockets for the ADF lunar capsule, begun on April 6, 1961, were concluded. Of sixteen rounds tested only six were successful. (JPL, letter from J.D. Burke, to O.W. Nicks, November 9, 1961, JPLHF 2-339.)

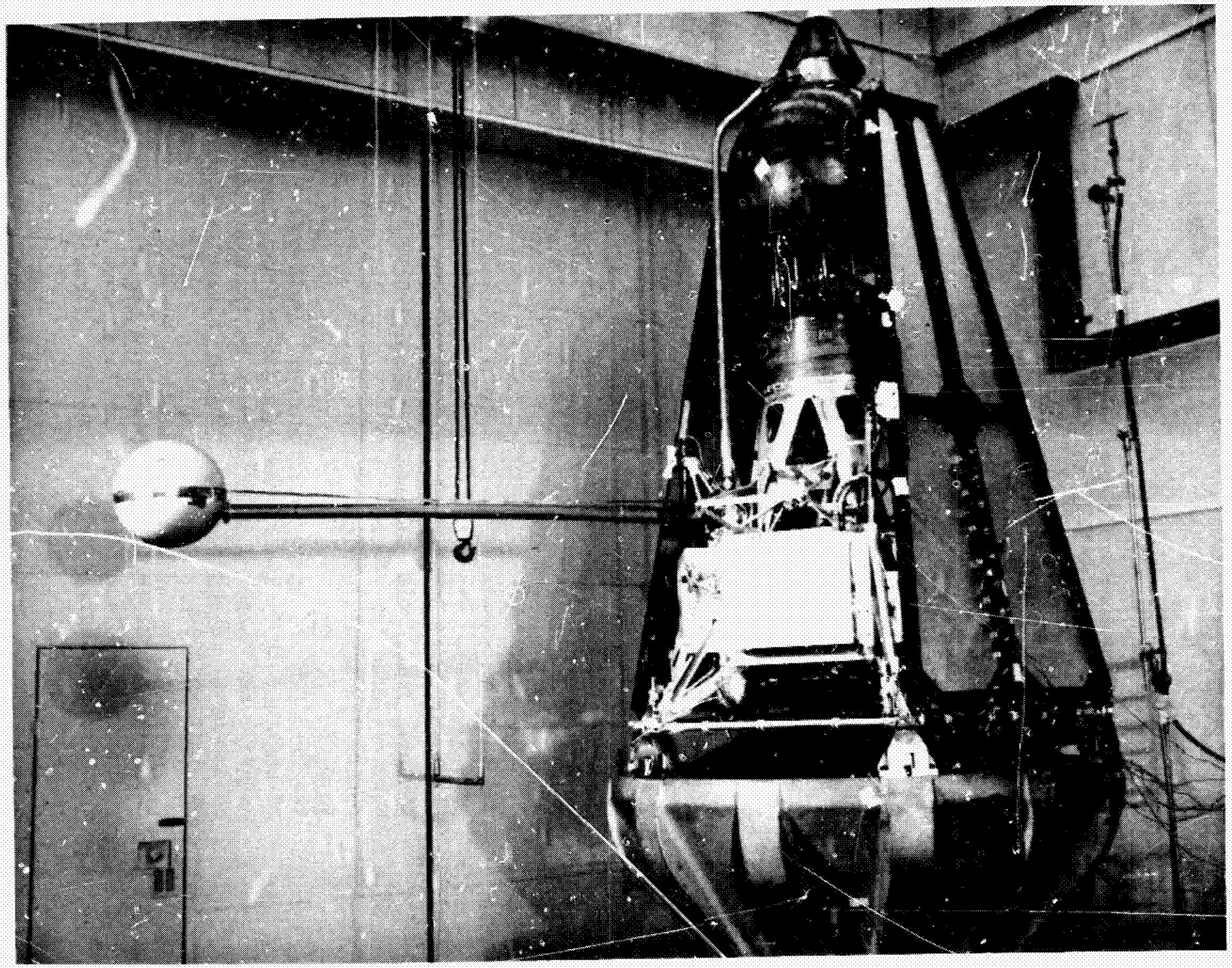

Figure 40: Block II PTM on shake table with gamma ray boom extended.

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During July cont. — Facilities. The new environmental laboratory building was completed. Some testing equipment remained to be installed. The building contained facilities for spacecraft vibration testing, static acceleration testing, and several small chambers for climatic testing, vacuum testing and space environment simulation. (JPL, Space Programs Summary No. 37-11, Vol. I, op. cit., 35.)

Interagency Agreement. The NASA and DOD established a large launch vehicle planning group to assess the long-range needs of both agencies for large launch vehicles, in conformance with the agreement of February 23, 1961. (Government Operations in Space, op. cit., 65.)

Aug. 1 — Countdown No. 4 for the launch of RA-1 commenced at AMR, but was scrubbed at T minus 150 minutes when some of the spacecraft pyrotechnics were fired. A voltage discharge to the spacecraft frame was believed to have activated the spacecraft central computer and clock sequencer, and the vehicle "turned on" as programmed on orbit. Squibs were fired, solar panels extended inside the shroud, and various other instruments commenced to operate. (Subsequent test investigations isolated a voltage discharge to the frame as the activating mechanism, but, while some of the science instruments were suspect, the source of the discharge was never determined with certainty.)

Launch of RA-1 was postponed until the next available opportunity beginning on August 22. The spacecraft was returned to Hangar AE where, after extensive investigations, system field modifications were incorporated to prevent a recurrence of this failure. (JPL, The Ranger Project: Annual Report for 1961, op. cit., 361; and, TWX from Dr. Pickering to Dr. Silverstein, August 9, 1961, JPLHF 2-1456.)

Aug. 2 — ADF made a presentation at JPL concerning lunar capsule development status. During the conference it became apparent that the Hercules Powder Company was experiencing serious technical difficulties in the development of the solid-propellant retro rocket for the lunar capsule to be used on RA-3, 4, and 5. (JPL, IOM from J.D. Burke/G.P. Kautz to B. Sparks, Ranger Project Status Report No. 17, July 31, 1961, JPLHF 2-1314.)

Aug. 3-4 — The SSSC Lunar Sciences Steering Subcommittee convened Meeting No. 7 at NASA Headquarters, Washington, D.C. The Ranger follow-on program (flights 6 through 9) was discussed: "Brown, Urey, and Doves were in favor of TV, radiation package, and a surface

Aug. 3-4 cont. penetrometer in [that] order of importance. Gold desired penetrometers second in order of importance. Sonett gave a brief review of the Ranger Program to date . . ." (NASA/SL, Lunar Sciences Subcommittee Chronology, January 15, 1965, JPLHF 2-652.)

Aug. 7 JPL established a Data Operations and Control Facility (DOCF) "to provide operational, command, data handling and display services in conjunction with the Laboratory's flight missions." The Systems Division was assigned responsibility and authority for the overall operation. (JPL, IOM from B. Sparks to Senior Staff, August 7, 1961, JPLHF 2-298.) (See June 22, 1961.)

Aug. 7-9 Speaking before an international symposium in conjunction with the XI General Assembly of the International Astronomical Union, at the California Institute of Technology, Amron Katz of the RAND Corporation praised the Soviet <u>Luna III</u> photos of the far side of the moon, despite all the picture defects. Dwelling on lunar exploration, he continued: "I noted earlier, and i will reiterate that I am always amazed by the number of experiments that can be conjured up to substitute for old fashioned, high quality photography. Photography is such a basic exploration tool that it should be one of the first things attempted before planning any other experiments. . . . It strikes me that this role of photography in the space effort is not emphasized enough. . . ." ("Space Age Astronomy," edited by Armin J. Deutsch and Wolfgang B. Klemperer, Academic Press, New York, 1962, 474, JPLHF 2-1344.)

Aug. 10 NASA authorized JPL to proceed in awarding Letter Contract No. 950137 to RCA Astro-Electronics Division for the high resolution TV package for Rangers 6 through 9. Receipt date of the RCA proposal was now established for August 25, rather than August 18, because of the delay in NASA approval. (NASA, letter from R.E. Rodney, NASA-WOO to F.H. McKibbin, JPL, August 10, 1961, JPLHF 2-1136; also, letter from G.E. Nichols Jr. to J.D. Burke, August 10, 1961, JPLHF 2-1137; and, IOM from J.D. Burke to All Concerned, August 11, 1961, JPLHF 2-314.) (See July 24, 1961.)

Aug. 11 NASA Headquarters approved the Preliminary Project Development Plan for the Ranger follow-on flights as proposed by OSFP subject to certain conditions. (NASA, Memo for Director, Office of Space Flight Progr ms, f om R.C. Seamans Jr., August 11, 1961, JPLHF 2-1139.)

Aug. 14 JPL issued the signed letter contract to RCA for development of the Ranger follow-on TV subsystem. (See August 25, 1961.)

Aug. 18 Langley Research Center submitted a Project Development Plan for a Lunar Penetrometer Capsule Experiment for the follow-on Ranger program to NASA OSFP. (Preliminary Project Development Plan for a Lunar Penetrometer Experiment for the Follow-on Ranger Program, Langley Research Center, August 18, 1961, JPLHF 2-1293b.)

Aug. 21 The NASA SSSC met at Headquarters. JPL presented a list of payloads considered for the Ranger follow-on flights 6 through 9. The proposed experiments were a TV camera to take pictures of the lunar surface, a radiation package designed to study radiation hazards at the lunar surface, and a penetrometer to determine the hardness of the lunar surface. All experiments were geared to support the manned lunar program. The SSSC requested the Office of Lunar and Planetary Programs to study these proposals and return with its recommendations. (NASA, Summary Minutes: Space Sciences Steering Committee, August 21, 1961, August 31, 1961.)

Aug. 22 OSFP notified JPL of NASA approval of the Ranger Follow-on Preliminary Project Development Plan subject to certain conditions. Among them were:

a. Development of four flight units and one PTM of the impact TV package.
b. Recommend an alternate payload to be submitted for approval in the PDP with specific mission assignment for each of the four Ranger follow-on flights.
c. A firm flight schedule was not approved at this time. However, flights were expected to extend through mid-1963.

(NASA, letter from A. Silverstein to W.H. Pickering, August 22, 1961, JPLHF 2-448.) (See August 11, 1961.)

Aug. 23 Ranger 1 (Atlas 111D, Agena B 6001) was launched on the fifth countdown from AMR Pad 12 at 5:04 a.m. EST, following solution of minor ground and launch vehicle difficulties. The planned mission was the achievement of a highly elliptical earth orbit with an apogee at approximately lunar distance. RA-1 was to be accelerated to near escape velocity (approximately 7 miles per second) by a second burn of the Agena B upper stage engine to attain this trajectory. The principal objective for this flight was the checkout of all operational system elements including tracking and operations facilities on the ground as

Aug. 23 cont. well as the spacecraft and launch vehicle. Spacecraft design at this stage did not include the equipment to conduct a mid-course trajectory correction maneuver necessary to impact the lunar surface. However, all other flight functions, including attitude acquisition and stabilization, two-way communications and tracking, the operation and control of eight scientific instruments, temperature control, and electrical power generation and distribution, were to be exercised in a thorough test of the spacecraft design. (Figure 41.)

The eccentric earth orbit planned for Ranger 1 was not achieved and the mission not carried out because the Agena B stage did not re-ignite for its second burn. The spacecraft was left in a near-earth "parking orbit" with a perigee of 105.6 n.m., an apogee of 313.3 n.m., and a period of about 90 minutes. The large DSIF antennas, designed for deep space communications, could only track Ranger 1 for a fraction of the time and with some difficulty because of the high angular rate and poor viewing angles (the spacecraft was shadowed by the earth for a significant portion of each orbital period). The spacecraft attitude control system, in turn, was soon overtaxed as the vehicle passed rapidly from the shade to the sunlit side of the earth; repeated attitude reacquisitions made abnormal demands on the control jet gas supply which was exhausted after 19 hours.

Nevertheless, Ranger 1 was judged a partial success at NASA and JPL as basic design concepts were validated by spacecraft performance. Separation from the booster and initial operations, including solar-panel deployment, were successfully demonstrated. The high-gain antenna was deployed and pointed properly, although Ranger's proximity to the earth resulted in only intermittently correct performance by the earth-sensor control loop. Commands were received and acted upon, and telemetry was transmitted to earth including some data from the scientific instruments, although few useful scientific results were claimed. (JPL, Space Programs Summary No. 37-15, Vol. VI, for the period March 1, 1962 to June 1, 1962, 3; Ranger Technical Bulletins No. 1 through No. 5, dated August 24, 1961 through September 5, 1961; Rough Draft of Ranger Final Report, April 25, 1967, 45, JPLHF 2-122; and, JPL, Space Programs Summary No. 37-11, Vol. I, op. cit., 41-45.)

Aug. 24 NASA Headquarters requested ideas for standardizing the content and structure of PDP's received from the field centers. The Ranger PDP (May 24) had proven too comprehensive and detailed for officials at the policy-making level. Subsequently, in May 1962, a change was instituted in which the operating NASA

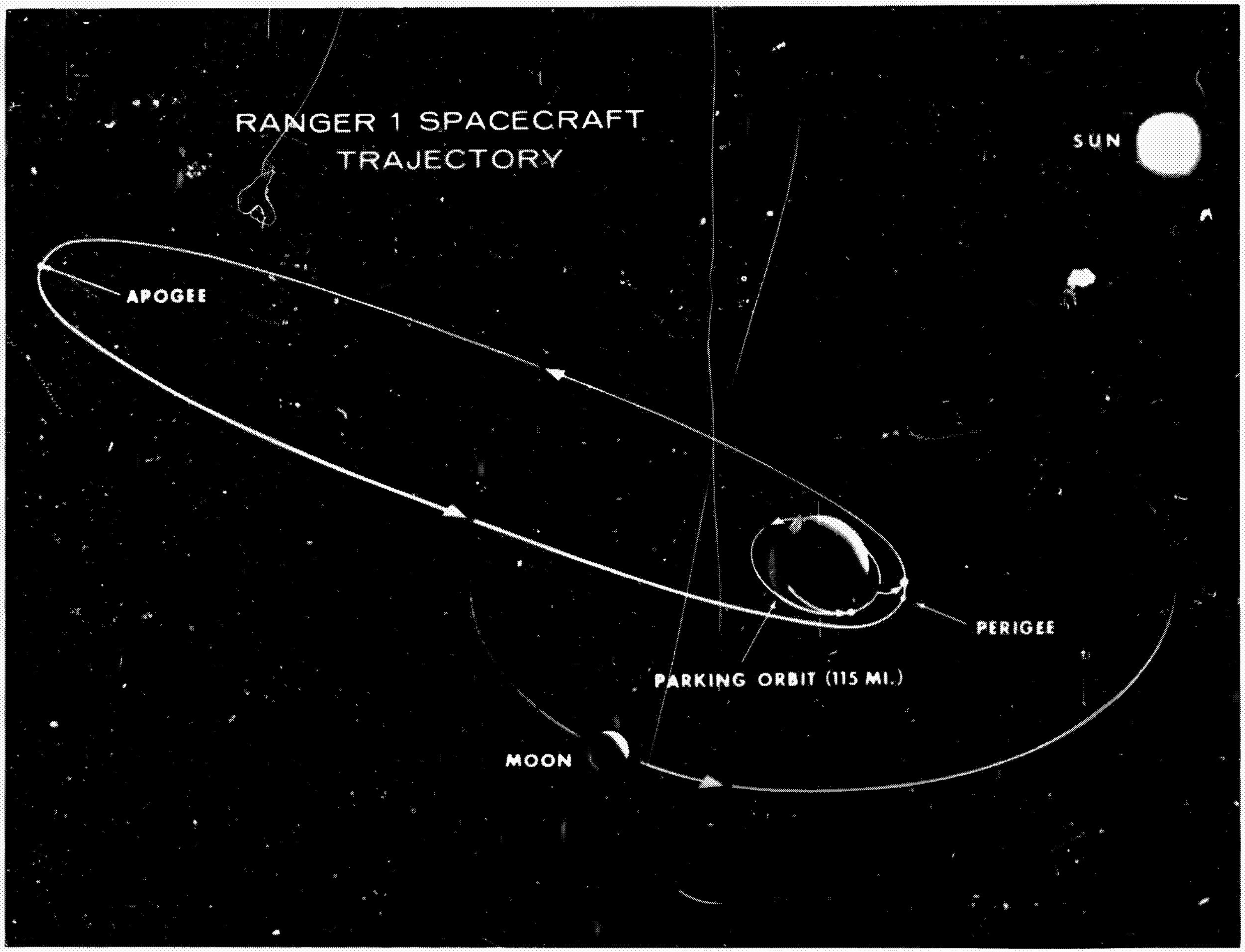

Figure 41: Planned Ranger 1 and 2 spacecraft trajectory.

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Aug. 24 cont. Headquarters technical office "would process the PDP's and submit to the Associate Administrator a summary PDP. On the basis of the summary PDP, the Associate Administrator prepared a one- or two-page Project Approval Document which then became the official authorization for inauguration of a new project." (An Administrative History of NASA, 1958-1963, op. cit., 229.)

Aug. 25 Letter Contract No. 950137 for the Ranger follow-on TV system was accepted by RCA. RCA was authorized "to (1) conduct a system analysis to provide a description of the subsystem for the Ranger high-resolution TV camera missions; (2) design, develop, fabricate, test, and deliver one PTM and four flight models of the TV subsystems based on the results of the system analysis; and (3) initiate purchasing to meet these requirements." No performance dates we initially specified. (RCA, Ranger TV Subsystem, Block III, Vol. I: Summary, Final Report, JPL Contract No. 950137, July 22, 1965, JPLHF 2-960, 25; and NASA, Memo for Deputy Director, OSS, from O.W. Nicks, Subject: Review of JPL-RCA Management of Ranger Camera Capsule, January 15, 1962, JPLHF 2-336.)

Ranger 2 spacecraft arrived at Hangar AE at AMR. (JPL, Space Programs Summary No. 37-12, Vol. II, op. cit., 10.)

The Ranger follow-on RCA TV Technical Proposal was received at JPL. The Cost Proposal was scheduled to follow on August 28. (RCA, letter from J.E. Coburn, RCA Marketing Representative to Frank H. McKibbin, JPL Contract Administrator, August 25, 1961, JPLHF 2-506.)

Aug. 28 JPL and Langley representatives met to discuss the penetrometer experiment (see August 18, 1961) proposed for incorporation on two of the follow-on Rangers. (JPL, IOM from G.P. Kautz to Distribution, August 23, 1961, JPLHF 2-1293b.)

Dr. W.H. Pickering informed Dr. A. Silverstein that, in view of the delay in the Centaur schedule, JPL would propose:

1. A 1962 Venus mission predicated upon using the Atlas-Agena and a spacecraft hybrid combining a Ranger 3 and Mariner A design;
2. Proceed with design of a Mariner B aimed at dual capability to Mars and Venus in 1964, predicated upon successful development of Centaur in 1963; and
3. Cancel the Venus Mariner A/Centaur planned for 1962.

(JPL, letter from W.H. Pickering to A. Silverstein, August 28, 1961, JPLHF 3-360.) (For the history of this development, see letter from J. James to C. Sonett, October 20, 1961, JPLHF 2-1461a.)

Aug. 29 NASA Associate Administrator Dr. Robert Seamans, Jr. announced that the Ranger Project would be expanded from five to nine flights. The increase, he stated, "is part of the general acceleration of the program to land an American in the moon by 1970." ("Ranger Project Adds Four Rockets to Televise Pictures of the Moon," New York Times, August 30, 1961, JPLHF 2-920; and, NASA, Sixth Semiannual Report to the Congress, op. cit., 67.) The day before, while speaking before a symposium conducted by the Air Force, Dr. Seamans had asserted that the politico-military initiatives which could result from U.S.S.R. maintenance of primacy in space operations was one of the reasons President Kennedy recently ordered acceleration of the United States effort to win space leadership. ("Warns on Space Race," Los Angeles Herald & Express, August 29, 1961, JPLHF 2-919.)

Aug. 30 NASA Headquarters approved the JPL recommendations made on August 28, 1961, and established associated ground rules. (NASA, letter from A. Silverstein to W.H. Pickering, September 14, 1961, JPLHF 3-361.)

After 111 orbits, Ranger 1 reentered the earth's atmosphere and burned up. (Aeronautical and Astronautical Events for 1961, op. cit., 42.)

Aug. 31 A.E. Wolfe was appointed Ranger Spacecraft System Manager. (JPL, IOM from J.D. Burke/H.M. Schurmeier to Ranger Program Distribution, August 31, 1961, JPLHF 2-1525.)

The RCA Technical Proposal for the follow-on Ranger TV system was reviewed at JPL. (NASA, Memo for Deputy Director, OSS, from O.W. Nicks, January 15, 1962, loc. cit.)

Dr. E. Rechtin proposed that S-band ranging equipment be flown on Ranger Flights 8 and 9. (JPL, IOM from E. Rechtin to R.J. Parks, August 31, 1961, JPLHF 2-1140.)

During August Ranger Block II. Installation of the RA-3 spacecraft power system was completed, and system tests began in the SAF. During the last two weeks of August, the RA-3 PTM was tested in the 6-foot space simulator to verify the spacecraft thermal design. (JPL, Space Programs Summary No. 37-11, Vol. I., op. cit., 15, 19-20.)

Ranger Block III. NASA approval was secured for Ranger Flights 6-9. Plans called for each spacecraft, which would weigh in the neighborhood of 800 pounds, to be equipped with a battery of

During August cont. three or more high-resolution RCA TV cameras. The cameras would be activated at about 800 miles above the lunar surface, and the first pictures would correspond in detail to the photographs taken from observatories on earth. The cameras would continue to operate until the craft impacted the moon, and final pictures "should distinguish features no more than 8 inches across. About 1,600 photographs are expected from each craft." In addition, it was planned that Ranger spacecraft 6 and 9 would carry an experiment to monitor radiation in the vicinity of the moon. "Principal purpose of these craft is to support the accelerated program to land an American on the moon by 1970." (NASA, Sixth Semiannual Report to the Congress, loc. cit.; see also, RCA Proposal No. 61526, Design Proposal for Ranger TV Payload, Vol. I, Technical Presentation, August 25, 1961.) (Figure 42.)

Sept. 1 Edgar Cortright, NASA Assistant Director for Lunar and Planetary Programs, informed NASA Administrator James Webb of the results of the Ranger 1 flight. He said that "although the design orbit was not achieved, the flight constituted a fairly good test of the spacecraft. In addition, it is anticipated that the Agena failure will be correctly diagnosed from the injection telemetry data, thus permitting corrective action prior to future flights." (NASA, Memo for the Administrator from E. Cortright, September 1, 1961, 2, JPLHF 2-679.)

Sept. 5 LMSC Agena B vehicle 6002 completed systems tests and was accepted by the Air Force in Sunnyvale, California.

Sept. 6 JPL personnel were informed of NASA approval for a change in flight schedules: the launch vehicle designated for RA-5 (Atlas 145D and Agena B 6005) would be used instead for a Venus flight from Pad 12, AMR, during the launch opportunity between August 3 to September 3, 1962, replacing the canceled Mariner A-Centaur Project. "We are calling this mission Mariner R." (The letter R stood for Ranger, as a modified Ranger spacecraft was planned for use in this deep space mission to Venus.) "NASA also intends to procure an additional Atlas-Agena B to replace the one taken from RA-5, so that there will still be a total of nine Rangers and one Mariner R. This will require some juggling of vehicle deliveries and the exact arrangements are not yet confirmed, but it is now certain that RA-5 cannot fly before October 1962." (JPL, IOM from R.J. Parks/C.I. Cummings, to All Concerned, September 6, 1961, JPLHF 2-1141.)

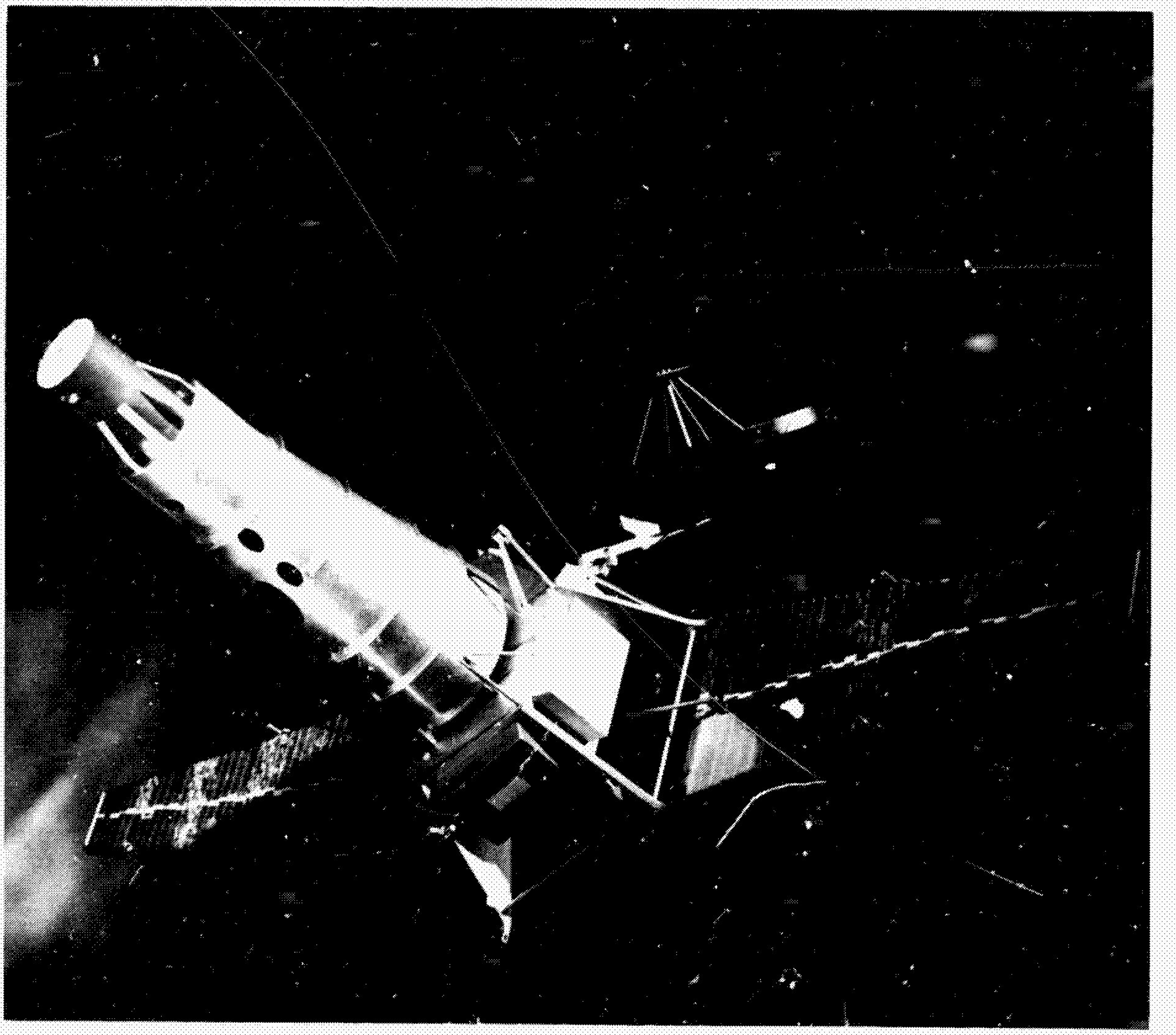

Figure 42: Ranger Block III spacecraft model in cruise mode, August–September 1961.

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Sept. 6 cont. J.D. Burke notified E. Rechtin that "your proposal for 2300-megacycle ranging experiments on Ranger follow-on flights 8 and 9, using a turn-around transponder without coding, is approved . . ." (JPL, IOM from J.D. Burke to E. Rechtin, September 6, 1961, JPLHF 2-1142.) (See August 31, 1961.)

RA-2 began systems testing at AMR. (JPL, Space Programs Summary No. 37-12, Vol. II, loc. cit.)

Sept. 8 The Johannesburg DSIF station was officially dedicated by United States and South African officials. (Aeronautical and Astronautical Events of 1961, op. cit., 45.)

Sept. 9 An Air Force Atlas-Agena B was launched at AMR. This third Atlas-Agena B vehicle suffered a main stage power shutdown due to faulty electrical umbilical ejection, settled back on to the pad and exploded. (Air Force Document MTP-MS-IS-61-4, loc. cit.)

Sept. 11 Mr. D.L. Forsythe, Agena Project Manager at NASA Headquarters, notified JPL that MSFC wished to drop the role of "technical administration direction" for the Agena, and he inquired whether JPL would and could assume this role. A response was requested by the following day. (JPL, IOM from J.W. McGarrity to B. Sparks regarding a call from NASA Headquarters, September 11, 1961, JPLHF 2-1143.)

Sept. 12 JPL informed NASA Headquarters that "JPL first preference is to continue NASA Agena procurement and direction under present MSFC systems management. However, JPL is willing to assume responsibility if NASA so requests. . . ." Details of proposed management arrangements were included. (JPL, TWX from B. Sparks to D.L. Forsythe, answering above telephone call, September 12, 1961, JPLHF 2-1144.)

Sept. 13 Design change ground rules for follow-on Block III Ranger flights were established at JPL. (JPL, IOM from J.D. Burke to C.I. Cummings, March 14, 1962, 2-1235.)

Design freeze of the TV subsystem design for Block III Ranger transpired. (JPL, IOM from D.H. Kindt to R.L. Heacock, February 15, 1962, JPLHF 2-1231.)

NASA OSFP congratulated the JPL Ranger Project team at JPL on the first flight in Project Ranger. "This flight is an extremely significant achievement as the first in a series of evolutionary steps toward our Lunar Program objectives. The timely completion

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Sept. 13 cont. of events leading to the first Ranger flight, in accordance with a schedule established more than a year ago, is a commendable record when compared with the performance of other project teams on similar efforts. Although we have had many discussions, and sometimes different views, about how to achieve such success, your results have certainly confirmed the merits of your approach." (NASA, letter from O.W. Nicks to J.D. Burke, September 13, 1961, JPLHF 2-1485.)

Sept. 18 Edgar Cortright notified A. Silverstein of the results of analysis of Ranger follow-on experiments that had been presented to the SSSC on August 21. The presentations were:

(a) JPL - Capsule TV System
(b) Langley - Multiple Penetrometer
(c) Langley - Circumlunar Photomapping
(d) GSFC - Radiation Monitor

Cortright recommended approval of a separable, unbraked, JPL-RCA TV capsule system, the remainder were not reccommended. (NASA, Memo for the Director, OSFP, from E.M. Cortright, September 18, 1961, JPLHF 2-680.)

Sept. 19 C.I. Cummings directed the JPL Systems Division to begin consideration of possible additional Ranger follow-on missions. Material was to be prepared for submission to NASA Headquarters in January 1962. (JPL, IOM from C.I. Cummings to H.M. Schurmeier, September 19, 1961, JPLHF 2-1145.)

The official flight schedule for Ranger follow-on spacecraft was released by NASA:

RA-6 (P-53) January, 1963
RA-7 (P-54) April, 1963
RA-8 (P-55) May, 1963
RA-9 (P-56) August, 1963

At the same time the launch date of RA-5 was slipped from June to November 1962. (Official NASA Flight Schedules, loc. cit.) (See NASA Flight Schedules at October 14, 1960 and June 15, 1960.)

Sept. 22 Oran Nicks, NASA Headquarters, directed J.D. Burke, Ranger Project Manager, to investigate the problems in the ADF lunar capsule effort (see During April 1961 and August 2, 1961) in greater detail, and propose a course of action as soon as possible. (NASA, letter from O.W. Nicks to J.D. Burke, September 22, 1961, JPLHF 2-341.)

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Sept. 23 Ranger Project Development Plan, Supplement A, (Follow-on Flights 6 through 9) was formally released (see May 24, 1961). Estimated total cost for these flights was $64,000,000, bringing the estimated overall project cost to $164,000,000. Tentative flight dates were established for December 17, 1962; February 11, 1963; April 15, 1963; and June 10, 1963. Each spacecraft would carry a bank of six TV cameras developed by RCA; two passenger scientific experiments were considered for assignment: a Neher ion chamber and AEC dosimeters. A telecommunications ranging experiment employing a 2300 megacycle transponder and associated equipment was approved for Flights 8 and 9 on a non-interference basis. Justification for these additional flights was "based upon the recent accent on the manned lunar exploration projects. The Ranger Project, . . . gives the first opportunity to gain valuable information about the lunar surface which is necessary for initial designs of manned lunar spacecraft. The follow-on is further justified on the basis that additional launchings of proven hardware will increase the probability of obtaining at least one successful lunar mission during the entire Ranger series." (JPL, Ranger Project Development Plan, Supplement A, September 23, 1961, II-2 and passim.) (See September 27, 1961.)

Sept. 25 JPL submitted a proposed Agena B Management Plan, in which JPL would assume direction of this effort, to NASA Headquarters. (JPL, TWX from W.H. Pickering to R.C. Seamans, September 25, 1961, JPLHF 2-1162.) (See September 11, 1961.)

Sept. 27 NASA informed JPL that "Two occurrences since the start of the Ranger project have placed even more emphasis on the value of early flight results from the Ranger project. These are (1) our Nation's avowed determination to successfully send men to the moon and return them at the earliest time, and (2) the delays in the Centaur which raise questions as to when we can be sure of getting answers from lunar experiments utilizing the Centaur vehicle. It is therefore suggested that the Ranger spacecraft and vehicle systems be studied with a view toward achieving greater returns from the Ranger project, and that an effort be exerted to get the most from existing Ranger developments." (NASA, letter from O.W. Nicks to C.I. Cummings, September 27, 1961, JPLHF 2-1147.)

Sept. 28 Dr. A. Silverstein, NASA Director of Space Flight Programs, informed NASA Associate Administrator Robert Seamans that further studies indicated that it would not be desirable to develop two or more types of payload capsules for use on Ranger

Sept. 28 cont. follow-on (Block III), and that all four missions were now planned for the TV package alone. Authorization to procure a fifth flight TV package as a spare was requested. (NASA, memo from A. Silverstein to Associate Administrator, September 28, 1961, JPLHF 2-1484.)

Sept. 29 Mission Objectives and Design Criteria for the Mariner R 1962 mission to Venus was released at JPL. (MR-2-110, September 29, 1961, JPLHF 2-1461b.)

During September Ranger Block II. Testing of the assembled RA-3 flight spacecraft revealed "component failure rates [which] are much higher on the flight spacecraft than those recorded on the [RA-3] PTM. This is almost the exact reversal of the experience noted on the Ranger RA-1 and RA-2 program. The only difference between the RA-3 PTM and the flight spacecraft is heat sterilization. Although no failures are directly traceable to heat damage, it is felt that heat sterilization does shorten the expected life of electronic components and circumstantial evidence seems to bear this out." (JPL, Space Programs Summary No. 37-12, Vol. II, op. cit., 14-15.)

Mechanical assembly and alignment of RA-4 flight spacecraft, which began on August 21, was completed to the extent that power turn-on tests were initiated on September 26. "The problems associated with the mechanical assembly were as follows: (1) Heat sterilization of the bus assembly resulted in warping the structure . . . This, however, can be compensated for by suitable shimming. (2) A wire in the ring harness was found to be parted near a splice. This damage occurred sometime during the [heat] sterilzation process." (Ibid., 16.)

Ranger Block III. As established in the PDP dated September 23, the RCA TV payload was to consist of two full scan and four partial scan cameras with one lens type (not split, separated systems). Two transmitters were employed for redundancy. Mechanical and thermal interface with the spacecraft bus was to be made as nearly as identical to the Block II seismometer capsule package as possible; the TV payload subsystem was allocated 350 pounds.

Adaptation was made in JPL management and organization for the expanded missions during the last quarter of the year:

(1) In conformance with GMI 4-1-1, a Ranger Spacecraft System Manager was established in the Systems Division whose sole responsibility was the spacecraft.

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During September cont.

(2) A modified PERT control system was adopted at JPL and RCA.
(3) Quarterly status meetings were initiated to present all aspects of the program to Headquarters personnel.
(4) A full time JPL resident engineer and quality assurance representative were assigned to RCA. (See November 27, 1961.)

("Ranger History," prepared for Congressional hearings, op. cit., 20-21.)

DSIF. An overall system test for Ranger Block II flights was performed at the Goldstone station between September 25-30, to determine the capability of the data handling link. ADF supplied the necessary capsule hardware. (JPL, Space Programs Summary No. 37-12, Vol. II, op. cit., 32.)

DSIF released a planning report outlining the projected growth and capabilities of the DSIF during the 1960's in support of the unmanned and manned deep space projects. (JPL, Space Programs Summary No. 37-12, Vol. I, op. cit., 84-85.)

Oct. 2

Match-mating of the RA-2 spacecraft with the Agena B was completed, and a "dummy run" was conducted from Hangar AE, the blockhouse at Complex 12, and the spacecraft umbilical tower. (JPL, Space Programs Summary No. 37-12, Vol. II, op. cit., 11.)

Oct. 3

Responding for Dr. Seamans to a JPL request of June 9, 1961, Dr. A. Silverstein averred that "Actual experience in operating at AMR has indicated that an excellent working relationship exists between members of NASA and the Defense organization. Specific interference problems have by-and-large been resolved expeditiously and to the satisfaction of NASA personnel in charge. It is therefore believed that the high level agreements of the sort now in force, and the proper instilling of a cooperative attitude among members of both working organizations will provide the greatest flexibility for satisfying our overall national objectives." (NASA, letter from A. Silverstein to W.H. Pickering, October 3, 1961, JPLHF 2-1457.)

Oct. 4

In a briefing for Vice President Lyndon B. Johnson, JPL Lunar Program Director C.I. Cummings observed that "originally, our lunar program had been oriented toward scientific and technological objectives, with support of the manned space effort as a secondary contribution. Now as you can see, the emphasis has been changed so that support of the manned operations is

Oct. 4 cont. the primary objective, and space technology and lunar science are secondary. We believe, however, that we can accomplish the space science and technology objectives as planned, while at the same time providing essential support to the manned effort." (Minutes of Briefing on the Occasion of the Visit of L.B. Johnson, Vice-President, October 4, 1961, JPLHF 3-322.)

Oct. 5 JPL established a Space Flight Operations section in the Systems Division. Marshall Johnson was appointed Chief of the new section, which was responsible for the overall design, management and operation of the Space Flight Operations Facility (formerly called Data Operations and Control Facility [DOCF], see August 7, 1961). The flight operations, command, data handling and display functions for the Laboratory's deep space missions would be carried out in the SFOF. (See June 22, 1961.) (JPL, IOM from W.H. Pickering to Senior Staff, et. al., October 5, 1961, JPLHF 2-299.)

Oct. 6 Following prolonged discussions at NASA Headquarters where continuing concern over NASA-JPL relationships was evident, Oran Nicks submitted a summary of the debate and recommendations for improvement at JPL which stressed the need for projectized teamwork as opposed to the tendency towards "individualism" in the management of space flight projects. (NASA, memo from O.W. Nicks to A. Silverstein, October 6, 1961, JPLHF 2-332b.)

Oct. 9 JPL submitted a formal request and justification for NASA funding of a Data Operations and Command Facility (DOCF), planned as a mission operations command center from injection to completion of unmanned lunar and planetary space exploration projects. (NASA, Fiscal Year 1962 Estimate, Data Operations Command Summary and Index, Revision October 9, 1961, JPLHF 2-1460b.) (See June 22, 1961 and July 21, 1961.)

Oct. 12 NASA informed JPL that the Laboratory manpower ceiling would be maintained "somewhat below 3500 through the next several years, with increases being limited to a rate of 5 per cent per year from the present base of 3000." (NASA, letter from A. Silverstein to W.H. Pickering, October 12, 1961, JPLHF 2-363.)

Oct. 13 NASA released GMI 4-2-2, Quality Assurance Policy as Applied to NASA Programs. The Director of each field installation was ordered to establish a single organizational point for quality assurance responsibility and authority. (GMI 4-2-2, JPLHF 2-446.)

Oct. 16 The Space Sciences Steering Committee approved the experiments for Rangers 3, 4, and 5 as well as the addition of the radar reflectivity experiment. Dr. Newell requested that a team of lunar scientists be formed to develop a plan for the analysis, use and distribution of the pictures coming from Rangers. "Further discussion led to the suggestion that there be two groups [of scientists]; one responsible for developing the Vidicon system and the second for interpreting the pictures. . . ." A.R. Hibbs, Ray L. Heacock, and Edward F. Dobies of JPL were assigned the first task; G.F. Kuiper, E.M. Shoemaker, and H.C. Urey were added as data interpreters.

The status of the experiments for Block III follow-on Rangers was listed as:

"1. Prime experiments - TV packages with improved resolution are firm.

2. Secondary experiments - These will ride on the bus and are not firmed up as yet. Cortright suggested a consideration of a gamma ray spectrometer in this category."

(NASA Summary Minutes, October 16, 1961, JPLHF 2-1215.) (See September 23, 1961.)

Oct. 18 RA-2, Agena-B 6002, and Atlas 117D were mated at Launch Complex 12. When the spacecraft power was turned on for on-pad testing a malfunction occurred in the telemetry encoder, resulting in the loss of two binary data channels. The spacecraft was returned to Hangar AE where the defective module was replaced. (JPL, Space Programs Summary No. 37-12, Vol. I, op. cit., 2.)

Oct. 19 RA-2 was remated with the booster in time for the first scheduled launch attempt. The countdown progressed smoothly until T-45 minutes, when an electrical malfunction was discovered in the Atlas and the count was terminated. The trouble was subsequently traced to a faulty cable splice.

The flight was rescheduled for October 22, however, as a result of appeals by one of the experimenters, NASA OSFP directed another one day delay until October 23. The spacecraft was returned to Hangar AE for modification and replacement of some components in an effort to reduce the magnetic field near the magnetometer caused by the introduction of an engineering friction experiment. During this period, components of the Lyman-alpha experiment were also exchanged to remove a source of intermittent noise. (Ibid.)

Oct. 23 The second countdown of RA-2 proceeded without incident until T-40 minutes, when a leak was discovered in the Atlas vernier engine hydraulic system, and another flight cancellation was required. Rescheduling was complicated by the time requirements

Oct. 23 cont. necessary for repair of the hydraulic problem and by conflicts with launch operations for other space projects at AMR. The third launch was ultimately cleared for October 25. (Ibid.)

Oct. 25 Preparations for the third countdown were underway when word was received from LMSC that the Agena B could not be cleared for launch due to the inflight failure of another Agena B launched the previous day from PMR. Telemetry data indicated that an engine hydraulic system failure had occurred and, pending further investigation of the Agena hydraulic problem, the flight of RA-2 was briefly rescheduled for November 4, and then postponed indefinitely. (Ibid.)

Dr. Hugh Dryden, Deputy Administrator of NASA, directed a letter to Dr. Lloyd V. Berkner of the National Academy of Sciences, recommending improved working arrangements be established between the NAS SSB and the scientific subcommittee of the NASA SSSC. (Cited in C.M. Atkins, NASA and the Space Science Board of the National Academy of Sciences, September 1966, 28.)

Oct. 26 In order to correct engineering deficiencies and cost overruns involved in the Ranger Block II capsule effort, NASA Headquarters requested that JPL take the following actions:

(1) Complete a "Recovery Plan" as requested on September 22, 1961.
(2) Strengthen technical direction of the capsule system development by assigning an adequate number of full-time personnel to monitor Aeronutronic and its subcontractors on a day-to-day basis.
(3) Require that Aeronutronic strengthen its project structure to achieve technical and fiscal control over its in-house and contracted efforts.

Similar steps were requested in the JPL direction of the RCA development of the Ranger follow-on TV subsystem. (NASA, letter from O.W. Nicks to C.I. Cummings, October 26, 1961, JPLHF 2-256a.)

Oct. 30 Marshall Johnson, Chief of Space Flight Operations Section, informed Al Wolfe, Ranger Spacecraft Systems Manager, that after considering development problems and the advantages and disadvantages involved in launching RA-3 on schedule, "in my opinion the advantages, probable and actual, far exceed the disadvantages and are sufficient reason for launching RA-3 on schedule . . . the advantages of not launching RA-3 are probabilistic at best, imagined at worst, whereas the disadvantages

Oct. 30 cont. — of launching RA-3 on schedule are independent of schedule, ever-present, therefore delayed or postponed but never eliminated." (JPL, IOM from Marshall Johnson to Al Wolfe, October 30, 1961, JPLHF 2-1163.)

During October — Ranger Block II. Six test firings of the Hercules retro-motor were conducted. One of these was successfully spin fired for full duration on October 16, after three days storage in vacuum. A proof test ADF lunar capsule was dropped from an aircraft at Edwards Test Station on October 12. "The erection of the antenna and transmitter operation was satisfactory [but the capsule] went dead when diode failures shorted out the battery." (JPL, TWX from J.D. Burke to B. Milwitzky, October 19, 1961, JPLHF 2-1459; see also, Aeronutronic, Division of Ford Motor Co., Final Technical Report, Lunar Rough Landing Capsule Development Program, Publication No. U-2007, February 20, 1963, 1-4, 1-5, JPLHF 2-1758.)

DSIF. Installation of an experimental Cassegrain feed system was completed on the 85-foot Ha-Dec antenna at the Goldstone Pioneer Station, and preliminary testing began. Preparations for the Ranger 2 mission began at all stations by the end of the month. (Tracking and Data Acquisition for Ranger Missions 1-5, op. cit., 22.)

Facilities. Installation of the stainless steel vacuum shell for the 25-foot diameter space simulation chamber was nearly completed. Fabrication of the dome housing and the solar simulation system was finished. "All related site work has been progressing in a normal manner with the objective of being ready for the Mariner [R] tests early in the spring of 1962." (JPL, Space Programs Summary No. 37-12, Vol. I, op. cit., 35.)

Nov. 1 — NASA was reorganized in a complete realignment of Headquarters program offices. The primary features were:

(1) All of NASA's field centers, including JPL, were placed directly under the Associate Administrator (R.C. Seamans)

(2) Headquarters program offices of Advanced Research Programs (I.H. Abbott), Space Flight Programs (A. Silverstein), Launch Vehicle Programs (D. Ostrander), and Life Science Programs (C.H. Roadman) were abolished.

(3) Four new Headquarters program offices were created: Advanced Research and Technology (I.H. Abbott), Space

Nov. 1 cont. Sciences (H.E. Newell, formerly Silverstein's deputy), Manned Space Flight (D.B. Holmes, a new apointee from RCA), and Applications (vacant).

JPL lunar and interplanetary projects were under the functional direction of the Office of Space Sciences (OSS) where Edgar Cortright moved up to become Newell's deputy, and Oran Nicks assumed the post of Director of Lunar and Planetary Programs formerly occupied by Cortright. Dr. Abe Silverstein left Washington to become Director of the Lewis Research Center in Cleveland, Ohio.

Beyond recognition of the significance of the manned space flight programs by NASA (manned space flight efforts previously had been a subdivision of the Office of Space Flight Programs), the major effect of this reorganization was to make the Office of the Associate Administrator (Robert Seamans, and which now included the new centralized Office of Tracking and Data Acquisition) general manager for the whole agency. (An Administrative History of NASA, 1958-1963, op. cit. 221-222; and Government Operations in Space, op. cit., 68.)

JPL released Technical Memorandum No. 33-32, Lunar Program, Operational Policy, Organization and Functions, which superseded a similar document of October 13, 1960, and which delineated the authority, responsibilities, functions and organizational relationships of the various Laboratory elements involved in all lunar projects.

Nov. 3 R.P. Young, Executive Assistant to the NASA Administrator, notified Mr. Webb that the planned RA-2 launch on November 4 was cancelled due to an unsolved hydraulic control fluctuation problem. Rescheduling set the new launch date tentatively at November 19. (NASA, letter from R.P. Young to J.E. Webb, November 3, 1961, JPLHF 2-1706.)

Nov. 4 Dr. J.J. Gilvarry had published a novel theory of the formation of the moon and its terrain, which included a strong case for the existence of water on the lunar surface at some prehistoric time. (J.J. Gilvarry, "How the Sky Drove the Land from the Bottom of the Sea," Saturday Review, November 4, 1961, JPLHF 5-233.)

Nov. 6 NASA Associate Administrator Robert Seamans notified JPL Director William Pickering that: "During the past several weeks a careful study has been made by NASA Headquarters of possible alternate methods for management of the Agena-B launch vehicle system. After weighing the pros and cons of the various alternatives

Nov. 6 cont. suggested with those of the present method of management, I have decided that the best interest of NASA and the flight projects dependent on the Agena-B can be served by retaining management for the Agena-B launch vehicle system at the Marshall Space Flight Center. The functions and responsibilities of MSFC as Agena-B vehicle systems manager, including the responsibility for launch operations at AMR and PMR therefore remain unchanged and the relationship between MSFC and the Agena-B flight mission project management centers, currently Jet Propulsion Laboratory and Goddard Space Flight Center, will continue as at present. (NASA, TWX from Robert Seamans to Dr. Pickering, November 6, 1961, JPLHF 2-1164.)

A recovery plan was established for the Ranger Block II capsule development effort directed by ADF. Dr. Donal B. Duncan assumed charge of the ADF program replacing Mr. Frank Denison. (JPL, IOM from J.D. Burke to B. Sparks, Project Status Report No. 31, November 6, 1961, JPLHF 2-1314.)

Nov. 7 Ranger Agena-B vehicle 6004 completed the manufacturing and assembly cycle at LMSC.

Nov. 8 Spacecraft Design Specifications book for Block III Ranger vehicles was released at JPL. Mission objectives and design criteria specified that "flights 6 through 9 are planned as repeated attempts at a single main objective; namely, the obtaining of TV pictures of the lunar surface, with definition sufficient to aid in design of manned lunar vehicles, at a date early enough to be effective in said design, and preferably at locations on the Moon near the intended point of manned landing. Other experiments that can and should be carried must not divert attention from this primary goal." Passenger scientific experiments were listed as (1) Tissue equivalent ion chambers (shielded and unshielded); (2) Ion chamber (standard); and (3) Radiation counters in that order of priority. In overall priority of competing Block III system characteristics, biological sterility was placed last. (JPL Specification RL-2-110, Mission Objectives and Design Criteria, Ranger P-53 through P-56 Spacecraft, November 8, 1961, 2, and *passim*, JPLHF 2-1124.) (See October 16, 1961.)

Nov. 9 In response to NASA Headquarters letters of September 22 and October 26, JPL submitted a detailed summary and recovery plan for the Block II capsule effort. (JPL, letter from J.D. Burke to O.W. Nicks, Subject: Aeronutronic Lunar Capsule, November 9, 1961, JPLHF 2-339.)

Nov. 12-13 The Space Science Board of the NAS met to discuss NASA proposals for establishing closer relationships with the NASA SSSC as recommended by Dr. Dryden on October 25. Several important decisions were reached including the reorganization of the Board to include a small Executive Committee which would meet more frequently and examine broad issues of present programs and future plans for scientific research in space. The size of the complete Board was reduced to 12-15 members. Moreover, the Executive Committee was conceived as the principal point of liaison between the SSB and NASA's SSSC. (C.M. Atkins, NASA and the Space Science Board, loc. cit.)

Nov. 13 The functional management structure for the Ranger follow-on (RCA TV subsystem) program was established at JPL. (JPL, IOM from J.D. Burke to Distribution, November 13, 1961, JPLHF 2-1708.)

Nov. 14-15 The Lunar Sciences Subcommittee of the SSSC met in Washington, D.C. David Margetts of JPL described the Ranger Block II television system, and a discussion of the color detection components took place. The committee decided that color detection equipment would be of little value, and recommended that it be dropped from the experiment. (NASA/SL, Lunar Science Subcommittee Chronology, op. cit., 3, 4.)

Nov. 15 Dr. W.H. Pickering informed Dr. R.C. Seamans of the status of Ranger 3 and of the possibility of delaying launching to gain increased confidence in the complete system, especially the lunar capsule. For various considerations, JPL was favorably disposed to launch on schedule. (JPL, letter from W.H. Pickering to R.C. Seamans, November 15, 1961, JPLHF 2-1464.)

Dr. A.R. Hibbs, Chief of the JPL Space Sciences Division, requested that the Ranger follow-on TV subsystem be modified in camera aiming for both full and partial-scan cameras, as well as in the area of color filters. (JPL, IOM from A.R. Hibbs to D.H. Kindt, November 15, 1961, JPLHF 2-1211.)

Nov. 16 The launch of RA-2 was officially posted as altered to the month November, 1961. (Official NASA Flight Schedules, loc. cit.)

The first of a series of design review meetings on the Ranger follow-on design was held at JPL. M.R. Mesnard, Ranger Project Engineer, informed the meeting that "RA-5 may go as a capsule mission or as a [follow-on] TV mission. Current plans are that

Nov. 16 cont. the decision will be reached by March 1, 1962. Meanwhile, all planning is to proceed as though RA-5 is to be a TV mission, with bus buildup beginning February 1 and electronic assembly deliveries tentatively scheduled for March 1." (JPL, IOM from M.R. Mesnard to Distribution, November 22, 1961, JPLHF 2-1212.)

Nov. 18 Ranger 2 (Atlas 117D, Agena B 6002) was launched on the fourth countdown from AMR Pad 12 at 3:12 a.m. EST following several minor holds. RA-2 flight equipment and planned mission objectives were identical with those of RA-1 (see August 23, 1961). The eccentric earth orbit planned for Ranger 2 was not achieved and the mission not accomplished when second burn of the Agena B again failed to take place normally. (Subsequent investigations revealed that the Agena B roll gyroscope in the attitude control package had been inoperative throughout the flight. With no roll control the Agena had exhausted its supply of attitude control gas shortly after first burn, and had begun to tumble. Second burn ignition took place as scheduled but was immediately terminated, probably as a result of gas ingestion due to the tumbling motion.)

Ranger 2 separated from the Agena but was left in a near-earth parking orbit, virtually duplicating the flight of Ranger 1, with a perigee of 111.2 miles and an apogee of 146.6 miles. As in the case of Ranger 1, Ranger 2 did stabilize on orbit, and received and executed commands sent from earth before it reentered the atmosphere and was incinerated the next day, on November 19. Little data of value was received from the scientific experiments carried by Ranger 2. (JPL, The Ranger Project: Annual Report for 1961, op. cit., 366, and JPL, Space Programs Summary No. 37-13, Vol. I, for the period November 1, 1961 to January 1, 1962, 3; also, New York Times, Nov mber 19, 1961, 42.)

Nov. 20 RCA submitted revised estimates on the cost of developing the Block III TV subsystem. (NASA, Memo for the Deputy Director, OSS, from Oran Nicks, January 15, 1962, JPLHF 2-336.)

Ranger 3 spacecraft arrived at AMR; receiving inspection showed no damage to the spacecraft, and the vehicle subsequently began preflight systems tests and calibrations. (JPL, Public Information Office Release, "Ranger 3 Spacecraft," loc. cit.)

JPL issued Specification RL-3-120, RA-6 through RA-9, Spacecraft Design Characteristics and Restraints, Design Restraints, November 20, 1961. (JPLHF 2-1574.)

1961

Nov. 22 Launch of an Air Force Atlas-Agena B took place at PMR. Orbit was not achieved due to malfunction in the flight control system which caused the loss of attitude control and Agena B tumbling. (Air Force Document MTP-MS-IS-61-4, loc. cit.)

Nov. 27 Four Hercules solid-propellant retro-rockets for the Block II lunar capsule were successfully tested at AEDC. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 34, November 27, 1961, JPLHF 2-1314.)

In an interview in Missiles and Rockets, Dr. William Pickering declared that in participating in the expanded unmanned lunar program, JPL's policy would continue to emphasize expenditure of a major portion of funds outside the Laboratory: "We have no intention of becoming engaged in production-type activities in competition with industry." ("JPL Speeds Lunar Work for Apollo," Missiles and Rockets, November 27, 1961, 100, JPLHF 2-767.)

Nov. 30 Without any further NASA spacecraft scheduled to duplicate the cislunar flights planned for Rangers 1 and 2 for at least several years, scientists pressured NASA to authorize one more vehicle. Accordingly, NASA OSS informed JPL that spares could be used to assemble one more Ranger test vehicle. Mechanical buildup of RA-2a began at JPL. (JPL, IOM from J.R. McKee to H.M. Schurmeier, December 21, 1961, JPLHF 2-1715.)

During November Ranger Block II. Subsystems testing of the RA-3 spacecraft began at AMR. The flight model TV camera-telescope was received at JPL and assembled on the RA-4 spacecraft, which continued in systems tests. (JPL, Space Programs Summary No. 37-13, Vol. I, op. cit., 8.)

Following completion of simulated lunar landing tests, mechanical modifications were made in the ADF lunar capsule and a new series of developmental tests were instituted. Capsule batteries developed leakage between cells; "the solution to this problem had not been developed by November 1." With respect to the retromotors, a production "go ahead" was given for twelve motors which would be used for flight acceptance tests. (JPL, Space Programs Summary No. 37-13, Vol. II, for the period November 1, 1961 to January 1, 1962, 10; also, TWX from J.D. Burke to B. Milwitzky, November 21, 1961, JPLHF 2-1465.)

ADF began in-house studies of a new lunar rough lander capsule configuration for possible application in Ranger follow-on programs. The capsule configuration was termed SURMEC, Surface

During November cont.

Mechanical Experiment Capsule, and was designed to employ an accelerometer, penetrometer, and geophone to yield information on the penetration resistance and crushing strength of the lunar surface, the existence and depth of possible dust layers or other soft surface structures, and the nature of the sub-surface structure. (ADF Proposal, "Summary of Ranger Payloads," Publication No. P-130139(U), June 1, 1963, 6, NHF.)

Ranger Block III. Mechanical design of the TV subsystem basic structure was completed, and final drawings were released to the Lavelle Aircraft Corporation, the structure subcontractor. (JPL, Space Programs Summary No. 37-13, Vol. II, op. cit., 28-29.)

A product assurance control program for the TV subsystem was formalized which provided for (1) a continuing series of reliability studies, (2) parts selection, evaluation, and control, and (3) analysis and reporting procedure to pinpoint components susceptible to failure. (RCA, Ranger TV Subsystem, Block III, Final Report, Volume I: Summary, op. cit., 1.)

DSIF. An experimental 960-mc maser was modified, installed, and tested with the Cassegrain system in the Ha-Dec antenna at the Goldstone Pioneer station. The maser amplifier was required to increase the sensitivity of the DSIF receiver for the Ranger Block II lunar experiments. (JPL, Space Programs Summary No. 37-12, Vol. I, op. cit., 58.)

Dec. 1

Newton W. Cunningham, Head of NASA's Lunar Sciences Program in the Office of Lunar and Planetary Programs, sent a memo to Dr. Homer E. Newell, Director of the Office of Space Sciences, notifying him of final approval of the experiments and experimenters for Ranger Flights 3 through 5 by the SSSC at its meeting on October 16. They were:

- Vidicon Camera System
  - Convener--Dr. A.R. Hibbs, JPL; with Mr. R.L. Heacock and Mr. E.F. Dobies, JPL; Dr. E.M. Shoemaker, USGS; Dr. H.C. Urey, UCSD; Dr. G.F. Kuiper, U. of Arizona.
- Gamma Ray Spectrometer
  - Lead Experimenter--Dr. J.R. Arnold, UCSD; with Dr. A.E. Metzger, JPL; Dr. M.A. Van Dilla and Dr. E.C. Anderson of LASL.
- Single-Axis Seismometer
  - Lead Experimenter--Dr. F. Press, CIT; with Dr. W.M. Ewing, Lamont Geological Observatory.

Dec. 1 cont. Radar Altimeter
Experimenter--Mr. W.E. Brown, Jr., JPL.
Cunningham noted that the major changes in the list since initial approval by the SSSC on May 9, 1960 was the increase in the number of experimenters assigned to the TV system and addition of the radar altimeter experiment. (NASA, Memorandum for Director, Office of Space Sciences, from N.W. Cunningham, December 1, 1961, JPLHF 2-682.)

Dec. 4 Testing of the solid-propellant retro-motors for the lunar capsules was completed at AEDC. Nozzle frazzling was cured by metal reinforcement. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 35, JPLHF 2-1314.) (See November 27, 1961.)

Dr. R.C. Seamans acknowledged Dr. Pickering's letter of November 15, and indicated that it was his decision to allow the Program Officers at JPL and at NASA to decide go-no-go questions. (NASA, letter from R.C. Seamans to W.H. Pickering, December 4, 1961, JPLHF 2-1466.)

Dec. 5 JPL issued Technical Report No. 32-199, Scientific Experiments for Ranger 3, 4 and 5.

Dec. 6 Oran Nicks, Director of NASA's Office of Lunar and Planetary Programs, notified Edgar Cortright, Deputy Director of the Office of Space Sciences, of potential means for improving support from unmanned lunar probes for the Apollo manned lunar landing program. Included was an estimate of the number of successful flights that could be expected based on an assessment of contemporary technology. The estimate for Project Ranger was:

Ranger Flights	1961	1962	1963
Actual (planned)	2	3	4
Successes	0	(1)	(1-2)

NASA, Memo from O.W. Nicks to E.M. Cortright, December 6, 1961, JPLHF 2-433.)

Dec. 7 C.I. Cummings, Lunar Program Director at JPL, recommended a priority in unmanned lunar mission objectives to (1) obtain a fully successful Ranger flight; (2) provide information concerning the lunar surface characteristics and environment as an aid to the earliest possible manned mission to the moon; (3) develop and qualify as much technology as possible which

Dec. 7 cont. can be met directly in performing manned lunar missions; and (4) develop and qualify equipment and techniques for logistic support of surface exploration by men on the moon. In pursuing these objectives, the priority order in compromises should be schedule, objectives, and cost. (JPL, IOM from C.I. Cummings to J. Small, December 7, 1961, JPLHF 2-1213.)

Dec. 8 Dr. Homer Newell, NASA Associate Administrator for Space Sciences, informed JPL of the approved experiments and experimenters for Block II Ranger flights (see December 1, 1961). He indicated that the same TV experimenters would be asked to participate in the Ranger Block III Flights 6 through 9. (NASA, letter from H.E. Newell to W.H. Pickering, December 8, 1961, JPLHF 2-251.)

Dec. 9 Agena B vehicle 6003 completed systems tests and was accepted by the Air Force. It was flown to AMR on December 12.

Dec. 18 JPL notified RCA of the personnel that had been appointed as official representatives in the technical and contractual areas for the Ranger Block III TV subsystem. In the technical area they were:

D.H. Kindt - Systems Design Project Engineer
R.D. Williams - Technical Analysis and Coord. of Design
D. Schneiderman - Assistant Section Chief, System Design

(JPL, letter from J.D. Burke to RCA, December 18, 1961, JPLHF 2-507.)

Dec. 19 Dr. Hugh Dryden, NASA Deputy Administrator, approved the recommendations of Dr. Lloyd Berkner to improve NASA-SSB relations. A member of the SSB Secretariat staff was appointed as liaison for the SSC subcommittee chairman. Subsequently, additional Board members were also appointed to serve as liaison to the individual SSSC subcommittees. (C.M. Atkins, NASA and the Space Science Board, op. cit., 68-70.) (See November 12-13, 1961.)

The Atlas booster for the Ranger 3 flight was shipped from Convair to AMR. (Minutes of the 16th Agena-B Coordinating Board, December 19, 1961, 3.)

Dec. 21 NASA approved the funds necessary to make up the $2.2 million overrun on the ADF lunar capsule effort for Block II Rangers. (NASA, letter from H.E. Newell to W.H. Pickering, December 21, 1961, JPLHF 2-334.)

Dec. 22 A meeting was held at the RCA Astro-Electronics Division in Princeton, New Jersey, with NASA Headquarters and JPL personnel in attendance. Progress on the camera system for Ranger Flights 6-9 and management aspects of the project were presented by Dr. Spencer Spaulding, RCA's Ranger TV Subsystem Project Manager. (NASA, Memo for Deputy Director, Office of Space Sciences, from O.W. Nicks, January 15, 1961, JPLHF 2-336.)

An Air Force Agena B booster-satellite successfully achieved earth orbit after launch from AMR. The orbit was nonstandard, however, due to a failure of the Atlas sustainer stage to shut down at the proper instant. (Air Force Document MTP-MS-IS-61-4, op. cit., VII.)

Dec. 27 O.W. Nicks notified C.I. Cummings of the selection of the experimenter team for the TV subsystem on Rangers 3 through 9 (see December 1, 1961), and directed JPL to include this group in Ranger management and show the assignment in the Project Development Plan. (NASA, letter from O.W. Nicks to C.I. Cummings, December 27, 1961, JPLHF 2-1471.)

Dec. 28 Representatives from NASA OSS met with Ranger project personnel at JPL to review the Ranger project and problem areas associated with the RA-3 spacecraft, and to decide whether or not to launch RA-3 on schedule in late January 1962. NASA and JPL agreed to proceed with the planned launch of RA-3. (See also November 15 and December 4, 1961.) (NASA, Memo from O.W. Nicks to E.M. Cortright, Subject: Plans for Ranger 3 Meeting on December 28, 1961, December 21, 1961, JPLHF 2-1483.)

Dec. 29 The Range Safety Office at AMR established the launch azimuth constraints for the flight of RA-3, still scheduled for January 1962. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 39, December 29, 1961, JPLHF 2-1314.)

During December Ranger Block I. Mechanical buildup of Ranger 2a was completed on December 12, and initial power turn-on followed two days later. Subsystem checkout occupied the remainder of the month. (JPL, IOM from J.R. McKee to H.M. Schurmeier, December 21, 1961, loc. cit.)

Ranger Block II. Pre-flight acceptance and compatibility tests were completed, and the RA-3 spacecraft was removed to the explosive safe area for final checkout prior to J-FACT at the pad. "The final checkout did not utilize live pyrotechnics,

During December cont.

fueled mid-course motor, or the flight lunar survival capsule. An electronic mockup of the capsule and retro-motor were employed, as well as a prototype radio altimeter." No serious difficulties were encountered during tests. (JPL, Space Programs Summary No. 37-13, Vol. I, op. cit., 4-5.) (Figure 43.)

During the Year

At the close of 1961 the Ranger Project was about one month behind schedule, as measured against the launch dates established on June 15, 1960. The Block I flights of Rangers 1 and 2, which demonstrated the basic engineering integrity of spacecraft design as well as many elements of the launch vehicle and spacecraft technology, yielded little or no new scientific information. The flights also indicated need for improved reliability and testing of all the newly developed unmanned lunar flight system components: launch vehicles, spacecraft and experiments, DSIF, and flight operations. Certain vital elements in flight operations, such as launch, spacecraft extended cruise mode operations, controlled midcourse and terminal maneuvers, remained to be demonstrated in flight.

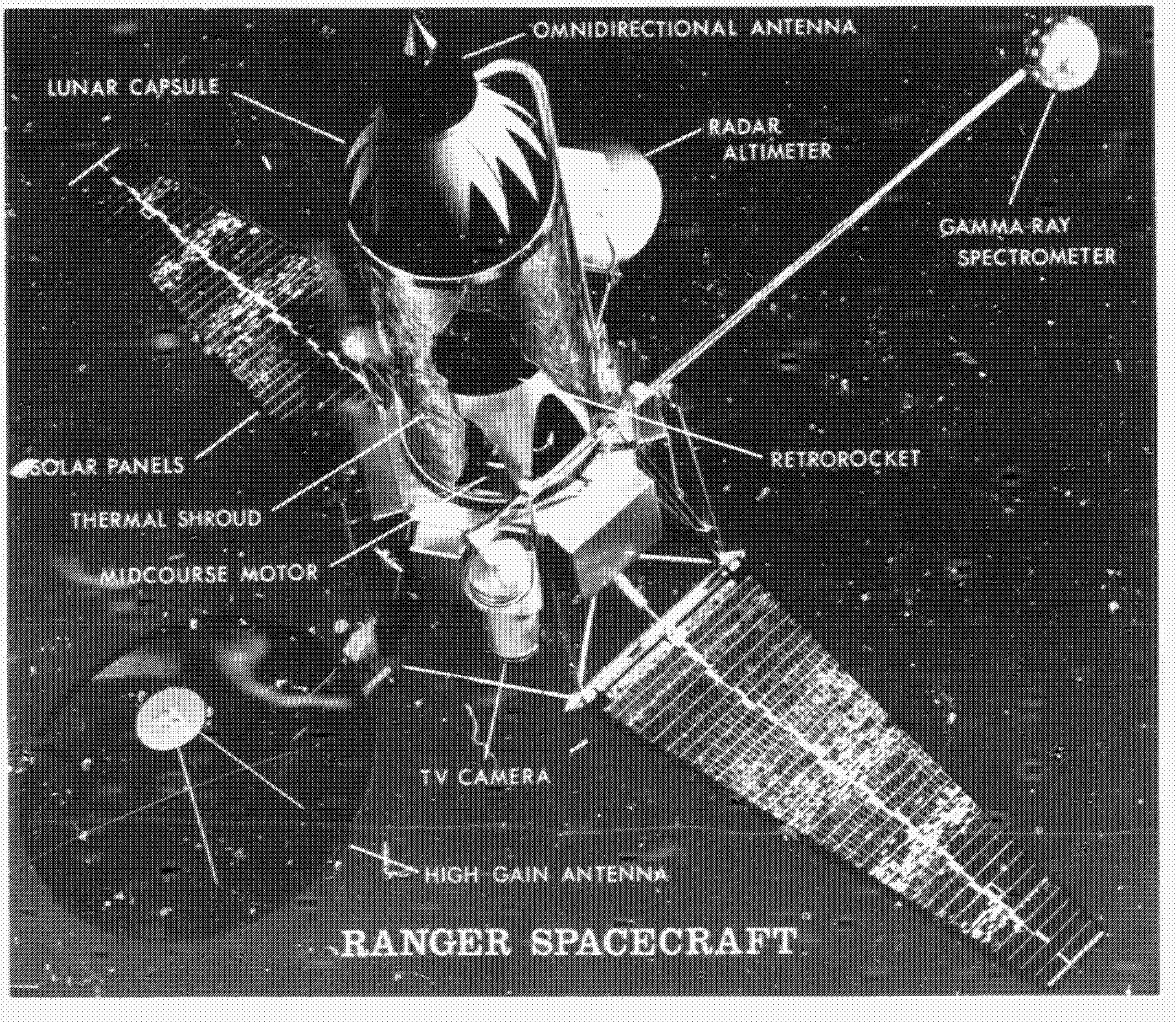

Figure 43: Ranger Block II spacecraft.

1962

Jan. 2 C.I. Cummings, Lunar Program Director at JPL, informed NASA Headquarters of the exceptions that had been made in decontamination of the Ranger 3 spacecraft. He averred that "every reasonable means has been employed to minimize the above listed exceptions and to assure that the total amount of viable contamination aboard the RA-3 spacecraft will be as small as possible. The degree of contamination attained is the result of a major effort which has added substantially to the cost and to the risk of the mission. It is likely that the sterilization procedures have compromised spacecraft reliability; however, there is insufficient data to positively confirm this suspicion." (JPL, letter from C.I. Cummings to R.C. Seamans, January 2, 1962, JPLHF 2-454b.)

R.L. Heacock, Chief of the Space Instruments Development Section at JPL, notified affected JPL divisions that, because of shortage of manpower in the Space Science Division, the proposed radiation experiments for the follow-on Block III Rangers were cancelled. (JPL, IOM from R.L. Heacock to Distribution, January 2, 1962, JPLHF 2-1219.) At the same time M. Eimer informed C.I. Cummings that the Space Science Division was concerned over the role of the Systems Division in Space Science activities for the Ranger follow-on. (JPL, IOM from M. Eimer to C.I. Cummings, January 2, 1962, JPLHF 2-1220.)

Jan. 3 RA-3 was mated to the Agena booster on the launching pad at AMR.

Jan. 4 A.R. Hibbs, Chief of the JPL Space Sciences Division, released a summary of the policy recommendations made at an Experimenter's Conference on December 9, 1961, concerning release of photographs from the RA-3 lunar impact flights to TV experimenters. Recommendations included immediate release to news media as well as to other scientists for analysis. (JPL, IOM from A.R. Hibbs to Experimenters, January 4, 1962, JPLHF 2-1221b.) (See January 27, 1959.)

A review of the Ranger Project by NASA Headquarters ended with a decision to continue the effort as presently planned. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 40, January 5, 1962, JPLHF 2-1314.)

J.D. Burke notified W.H. Pickering that, although several technical difficulties with the lunar capsule's retromotor and spin-motor remained to be resolved, the RA-3 spacecraft was flight-ready and should be launched on schedule. (JPL, IOM from J.D. Burke to W.H. Pickering, January 4, 1962, JPLHF 2-315.)

1962

Jan. 5 RA-3 spacecraft, Agena B 6003 and Atlas 117D completed J-FACT. The Aeronutronic (ADF) lunar capsule was shipped to AMR from California the same date. The following day the spacecraft was demated and returned to the hangar for disassembly prior to final buildup with the retromotor and lunar capsule. (JPL, Space Programs Summary No. 37-14, Vol. II, for the period January 1, 1962 to March 1, 1962, 22.)

Jan. 8 Using experience gained on Ranger Flights 1 and 2, a decision was reached at JPL not to check out spacecraft science experiments on the pad during countdown where high voltages were required. (JPL, IOM from M.R. Mesnard to G.F. Baker, Subject: Ranger Follow-on, Scientific Power "On" During Countdown, January 8, 1962, JPLHF 2-1224.) (See, for example, August 1, 1961.)

ADF submitted a proposal to NASA for development of a lunar Surface Measurement Capsule (SURMEC) that could be hard-landed on the moon by Ranger vehicles. The capsule would carry experiments designed to support Apollo, to provide data on lunar surface penetration resistance, load bearing characteristics, subsurface structure, and dust layer depth. (Ford Motor Company, Aeronutronic Division, Publication U-1509, A Lunar Surface Measuring Capsule, January 8, 1962, JPLHF 2-701.) (Figure 44.)

Jan. 10 At a JPL Ranger Spacecraft System Review, J.D. Burke informed attendees that Project Ranger was to be geared to support the Apollo "Man on the Moon" program, and that RA-5 would not carry any passenger scientific experiments. The cabling group in Division 31 was instructed to fabricate RA-5 cables under this criterion. (JPL, IOM from A.E. Wolfe/L.S. Stone to Distribution, Ranger Spacecraft System Review Minutes, January 10, 1962, JPLHF 2-1313.)

The DSIF began checkout of station subsystems preparatory to the launch of RA-3, and a trailer containing equipment for recording video signals was positioned at Goldstone station. "Operational readiness tests involving the entire DSIF were conducted on 16, 19 and 23 January. On 24 January the DSIF was 'in the green' for the Ranger 3 launch." (Tracking and Data Acquisition for Ranger Missions 1-5, op. cit., 27.)

Jan. 13 The complete ADF lunar capsule was balanced and made ready for installation on the RA-3 bus. Installation was finished on January 16.

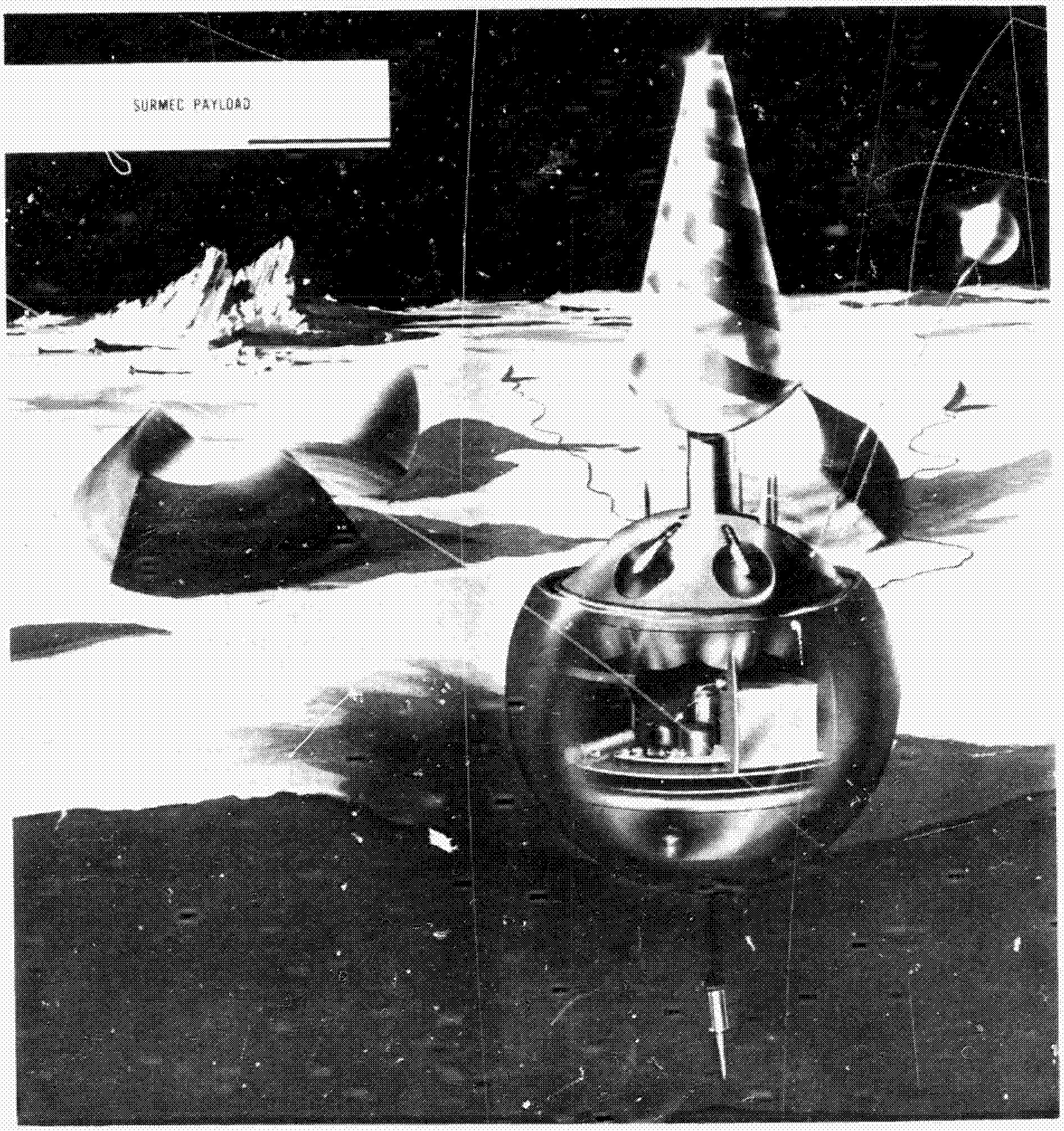

Figure 44: Proposed SURMEC payload.

1962

Jan. 15 After review of the January 2 JPL letter on RA-3 decontamination efforts, NASA Associate Administrator Robert Seamans informed Dr. Homer E. Newell, Director of the Office of Space Sciences, that "it appears to me that spacecraft decontamination is a complex business and is primarily in support of your Bioscience activity. Since space vehicle sterilization may also involve other program offices and considerable expense, my approval is required for each particular spacecraft or space vehicle series involved. (NASA, memo from R.C. Seamans to H.E. Newell, January 15, 1962,JPLHF 2-454a.)

The spare lunar capsule for RA-3 (Ser. No. 11) experienced a failure in tests. Rather than try to repair this capsule, which was nearly completely assembled, it was decided that assembly of another capsule (Ser. No. 12) would be speeded up. Because of the speed-up process, normal sterilization procedures for the inner survival sphere of capsule No. 12 were dispensed with. (JPL, letter from C.I. Cummings to R.C. Seamans, January 15, 1962, JPLHF 2-1709.)

Jan. 18 JPL issued Engineering Planning Document No. 65, Ranger Follow-on Project Policy and Requirements. The primary purpose of the Ranger Block III flights was to "obtain data on physical conditions of the lunar surface. . . . Other related scientific experiments will be carried on a basis of noninterference with the TV mission." (JPLHF 2-1538)

Details on the elimination of radiation experiments for follow-on Block III Rangers were released at JPL. Cutback was attributed to a shortage of personnel in Division 32, Space Sciences. (JPL, IOM from R.E. Pabst/W.S. McDonald to R.L. Heacock, September 18, 1962, JPLHF 2-1225.) (See January 2, 1962.)

Jan. 22 A rupture in the ellipsoidal intertank insulation bulkhead was discovered in the Atlas booster for Ranger 3 after fueling operations had begun. Working from inside of the rocket twenty-four hours per day for four days "in a race against expiration of the lunar launch period, the Atlas field crew removed the ruptured diaphragm, [and] . . . restored the Atlas to flight-ready condition. . . ." (JPL, Ranger History--working draft, op. cit., 14-15.)

Jan. 23 Final terminal sterilization operations for RA-3 began, and ended the following day. The spacecraft was bathed in a desired concentration of ethylene oxide gas inside its shroud on the pad for eleven hours. Then the mixture was purged with dry nitrogen which passed through a sterile biological filter. (JPL, Space Programs Summary No. 37-14, Vol. II, op. cit., 17.)

1962

Jan. 24 Ranger follow-on passenger science experiment objectives, revised after discussion at JPL among Project, Systems, and the Space Science Division, were established:

1. If RA-5 was assigned to carry the lunar capsule instead of an RCA TV tower, experiments would be the same as for RA-3 and 4.
2. If RA-5 carried an RCA TV subsystem, a Neher Ion Chamber would be included. RA-6 would also carry the ion chamber along with the TV subsystem.
3. RA-8 and 9 would have Geiger counters and tissue equivalent dosimeters aboard, in addition to the ion chamber.
4. RA-7 would incorporate the same science experiments as RA-8 and 9 if the item could meet the schedule.

(JPL, IOM from G.P. Kautz/L.S. Stone to Distribution, Ranger Spacecraft System Review Minutes, January 24, 1962, JPLHF 2-1313; and, IOM from G.P. Kautz to Distribution, February 2, 1962, JPLHF 2-1229.) (Contrast with science experiments for Ranger Block III as proposed in PDP, dated September 23, 1961.)

Jan. 25 JPL notified Sir Bernard Lovell at Jodrell Bank in England of the Ranger 3 post injection trajectory and spacecraft transponder frequency so the British radiotelescope might participate in tracking. (TWX from W.H. Pickering to Sir Bernard Lovell, January 25, 1962, JPLHF 2-1226.)

Jan. 26 Ranger 3 (Atlas 121D, Agena B 6003), the first lunar flight in the Block II series, was launched from AMR Pad 12 at 3:30 EST in the first countdown. The planned mission was achievement of a lunar impact trajectory, with lunar impact at a preselected site. Principal objectives for this flight involved testing of all ground and space borne operational system elements for unmanned lunar missions, including midcourse trajectory correction and terminal maneuvers performed by the spacecraft, and the conduct of scientific experiments in transit and upon the lunar surface. (Ranger Block II flights carried a single axis seismometer capsule to be rough-landed on the moon, as well as approach television, radar, and gamma-ray experiments.) (Figures 45 and 46.)

The planned lunar mission was not accomplished due to a combination of booster and spacecraft malfunctions; however, several important test objectives were achieved during the flight. The first variance in mission plans occurred less than a minute after liftoff, when the pulse beacon failed in the Atlas guidance system. The Atlas booster continued independently through engine shutdowns operating only on autopilot and internal programmed information, although the dispersion error introduced in the trajectory exceeded

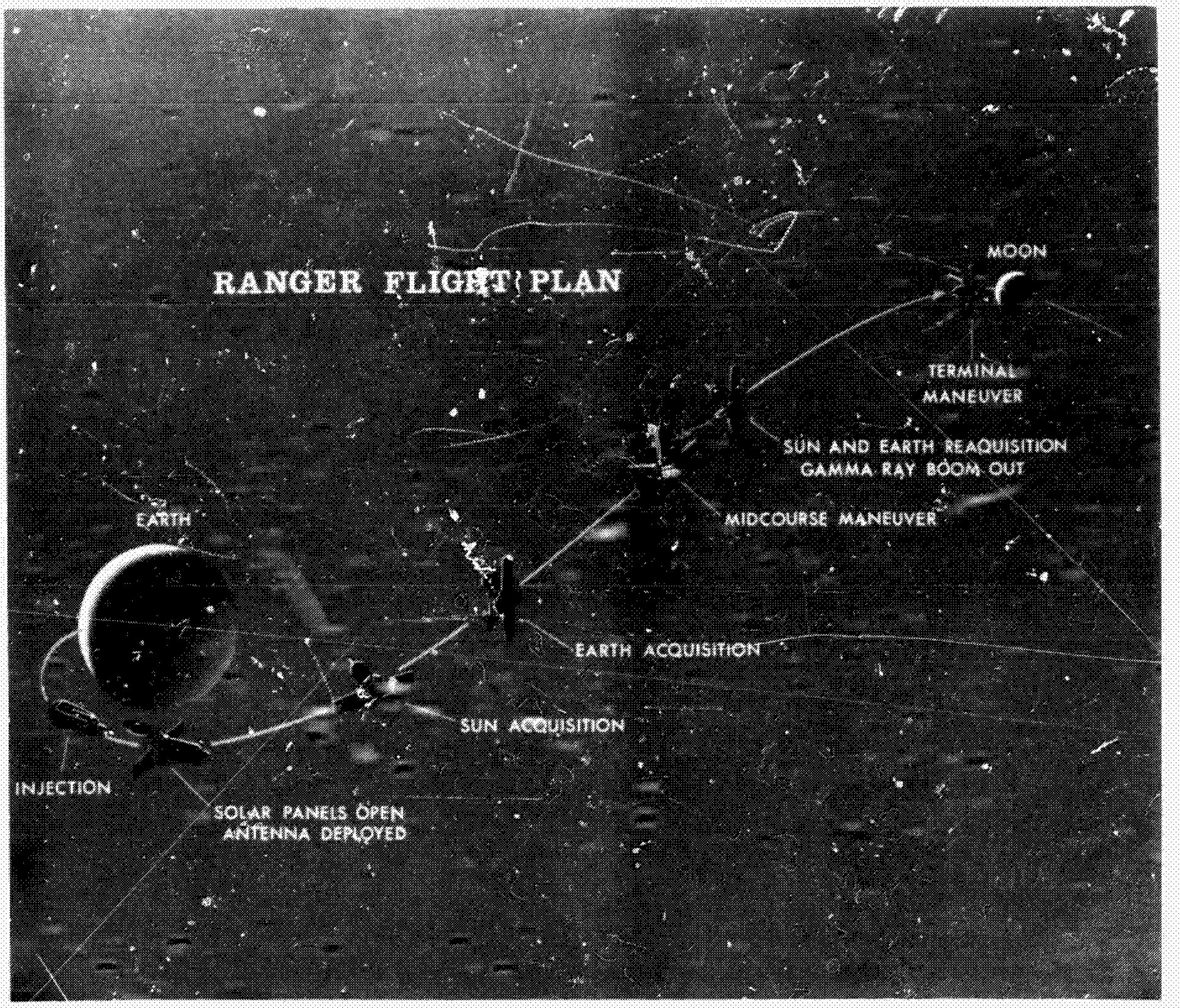

Figure 45: Ranger Block II flight plan.

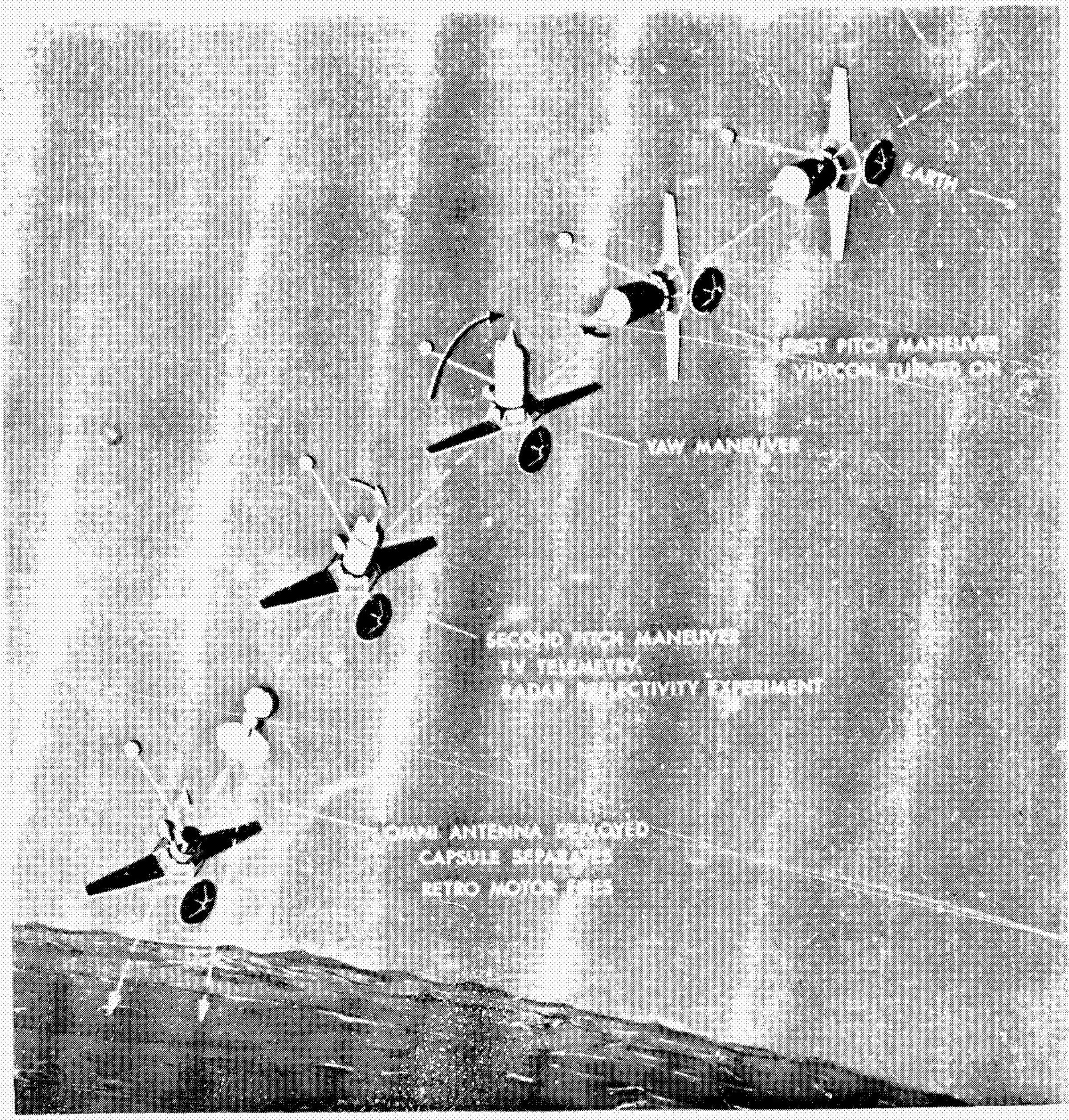

Figure 46: Ranger Block II planned terminal maneuver sequence of events.

Jan. 26 cont. the correction capability of the RA-3 midcourse propulsion system and precluded any lunar impact. The Agena B performed its programmed dual engine burns, accelerating RA-3 out of an earth parking orbit; however, an additional trajectory dispersion--later traced to a mis-set Agena guidance constant--was also introduced.

Following injection into an unplanned deep space trajectory, RA-3 properly deployed its solar arrays, acquired the sun and earth, and stabilized in attitude. Communication with the DSIF through the high-gain antenna was successfully initiated by ground command. In the Spaceflight Operations Center at JPL, members of the Ranger Project Office decided to proceed with midcourse and terminal maneuvers in order to demonstrate spacescraft propulsion system capability and to position the spacescraft for an experiment with the approach television camera. The midcourse maneuver command was transmitted from Goldstone at 5:00 p.m. EST on January 27. The spacecraft received, processed, and executed the command; upon reacquisition (following spacecraft attitude return to sun and earth-lock) by ground stations, it was soon apparent that the maneuver velocity change had been a mirror image of that desired. Within a period of about 40 hours, between the midcourse and terminal maneuvers, the fault was analyzed: a sign inversion had existed undetected between the preprogrammed digital maneuver code of the ground computer and the spacecraft computer. Preflight tests had checked only the magnitude and polarity, but not the meaning of the commands.

A terminal maneuver command with the signs reversed was sent from Goldstone to Ranger 3 at 12:21 p.m. EST on January 28, as the spacecraft neared the moon (about 20,000 miles distance at closest approach). The spacecraft commenced the terminal maneuver correctly, thus confirming the sign inversion diagnosis, but lost attitude control when the CC&S failed for an unknown cause, and the maneuver was not completed. Execution of this command would have oriented the spacecraft so that the vidicon field of view covered a well-lighted area of the far side of the moon not previously photographed, and would have allowed a viewing period of approximately 41 minutes before the second Goldstone pass ended. The terminal sequence had included programmed exposure of the vidicon and the taking of pictures. Although the vidicon apparently operated, since the fiducial marks on the face plates appeared in initial pictures, the CC&S-attitude control failure caused the high gain antenna to lose its earth orientation, and the signal strength dropped below Goldstone receiver capabilities causing the vidicon signal to be obscured by noise. Ranger 3 swept past the moon at closest approach six hours later on January 28. The DSIF continued to track the battery-powered

Jan. 26 cont. beacon in the lunar capsule to a range of 1,010,000 miles when tracking efforts were discontinued. (Figure 47.)

Performance of the passenger science experiment was acceptable under the nonstandard flight conditions. The gamma-ray boom extended properly and useful spectrometer data on radiation background were received on January 27 and 28. (This gamma ray spectrometer data provided the first identification of a diffuse flux of primary gamma rays coming from outside the solar system.)

The spacecraft temperature control system performed adequately, although the temperature rose slowly toward the upper limit as the vehicle passed the moon. As a result, plans were made to alter the thermal paint pattern on Ranger 4. While the milestone midcourse maneuver had been accomplished--albeit in reverse fashion--the various discrete flight failures, including loss of AMR-DSIF downrange telemetry data when ground equipment failed, demonstrated the importance of system-wide simulation analysis and testing. (JPL Space Programs Summary No. 37-14, Vol. I, for the period January 1, 1962 to March 1, 1962, 7-9; Ranger III Technical Bulletins 1 through 4, January 29 through February 9, 1962; and, Ranger History--working draft, op. cit., 15-16.)

ADF submitted a firm cost proposal for development of SURMEC for Ranger follow-on flights. (ADF, letter from E.L. Montgomery to L.C. Pehl of JPL, January 26, 1962, JPLHF 2-1228.) (See January 8, 1962.)

Jan. 31 The JPL Space Sciences Division issued plans and procedures for space science experiments on follow-on Block III Ranger vehicles. (JPL, IOM from M. Eimer to C.I. Cummings, January 31, 1962, JPLHF 2-1220.) (See January 24, 1962.)

During January Ranger Block II. Intensive post-flight analyses and discussions of changes that could be made in the Atlas-Agena B launch vehicles and the Ranger spacecraft to increase reliability were held at JPL and NASA during the last week of the month. The trade journal Aviation Week noted that "the [RA-3] failure has greatly aggravated the continuing controversy over reliability versus performance--particularly since malfunctions occurred in both the General Dynamics Atlas booster and the Jet Propulsion Laboratory Ranger spacecraft, and the faulty trajectory could have been rectified to a greater degree than it was except for what amounted to deficiencies in the Lockheed Agena second stage and the deep space tracking network." ("Ranger 3 Flight Stirs Reliability Question," Aviation Week, 30, February [illegible], 1962, JPLHF 2-594.)

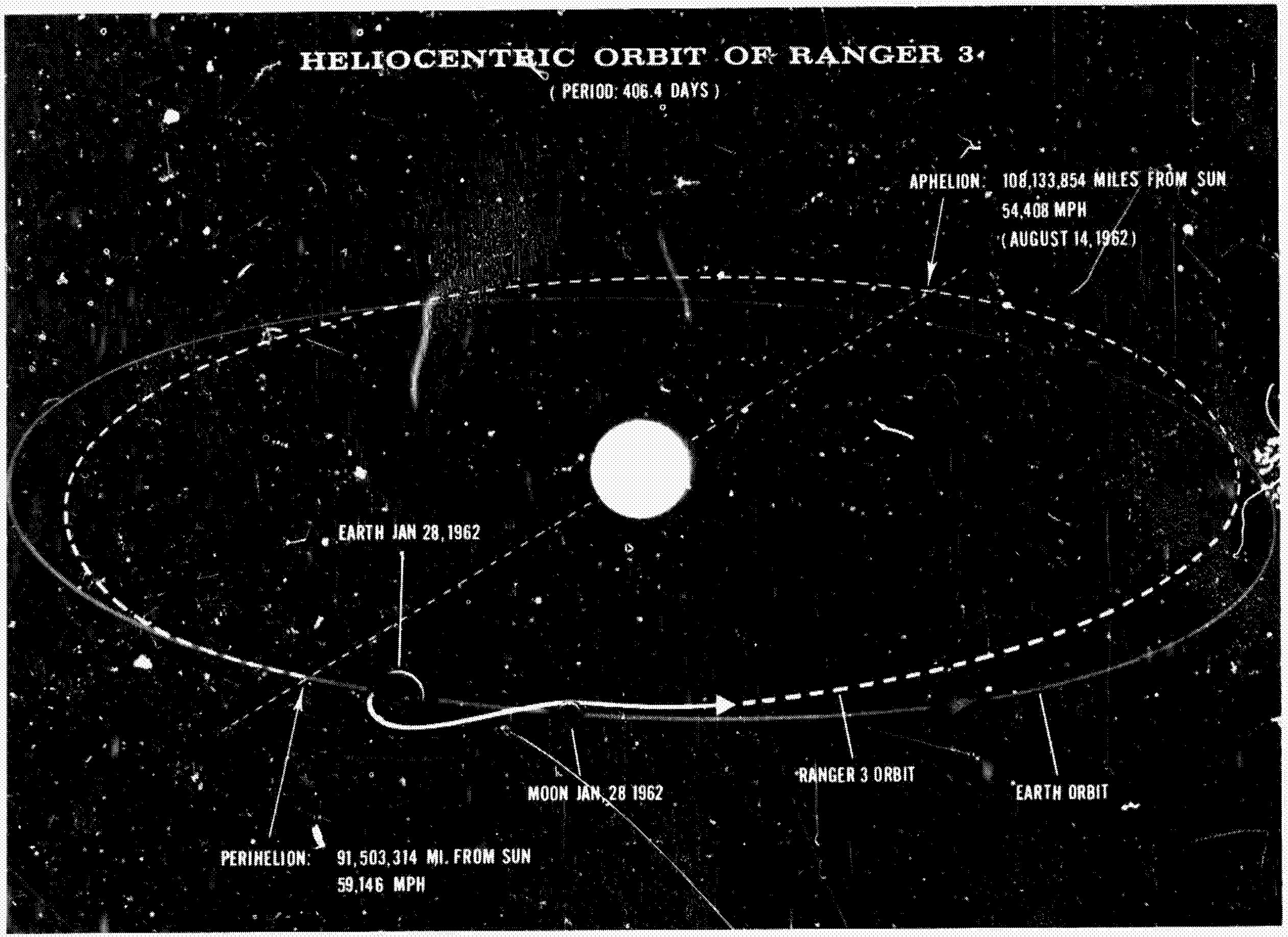

Figure 47: Heliocentric orbit of Ranger 3.

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During January	Ranger Block III. RCA completed installation, at their facilities, of the first Operational Support Equipment for the TV subsystem. (RCA, Ranger TV Subsystem, Block III, Final Report, loc. cit.)
	Dynamic tests of the RCA TV subsystem Mechanical Test Model (MTM) commenced at the RCA facility in Hightstown, New Jersey. (JPL, IOM from J.D. Burke to B. Sparks, Project Status Report No. 42, January 22, 1962, JPLHF 2-1314.)
	The RCA MTM for the follow-on Block III Rangers was delivered to JPL on January 29. Delivery of a Thermal Control Model (TCM) was postponed until March 15 since it would not begin testing in the new Space Simulator facility until March 26. (JPL, IOM from A.E. Wolfe to Distribution, Minutes of Ranger Spacecraft System Review, January 31, 1962, JPLHF 2-1313.)
Feb. 1	Revised edition of the JPL Lunar Program, Operational Policy, Organization and Functions, was released. (JPL Technical Memorandum No. 33-32, Rev. 1, February 1, 1962.)
Feb. 2	J.D. Burke notified the JPL Deputy Director that further investigation of RA-3 post-injection difficulties revealed the urgent need for (a) revision of space allocation for various groups in Building 125, which acted as the JPL command center during flight operations, and (b) observance of written procedures which established Harold Washburn as Ranger Project Scientist, responsible for coordinating all the science experiments. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 44, February 2, 1962, JPLHF 2-1314.)
	JPL released Technical Memorandum TM 33-80, Scientific Subsystem Operation: Ranger 3, 4, 5, February 2, 1962.
Feb. 1-2	The ninth meeting of the Lunar Sciences subcommittee of NASA's SSSC convened in Washington, D.C. The performance of two Ranger 3 experiments was described: Arnold (gamma ray) and Press (seismometer). The "committee suggested that a grenade experiment be considered for Rangers 4 and 5." The Ranger follow-on Block III TV subsystem was described by Eimer, and Davies (NASA) recommended that, in regard to illumination, probe-moon-sun angles be carefully considered. Color versus black and white TV pictures were discussed and Eimer was asked to report on relative merits of each and to make a recommendation. (Lunar Science Chronology, loc. cit.)

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Feb. 5 JPL recommendations for a revised list of passenger science experiments for Ranger Flights 6-9 were received at NASA Headquarters. (N.W. Cunningham, Ranger Program Chronology, loc. cit.; also, JPL, IOM from J.D. Burke to C.I. Cummings, Subject: Ranger 6-9 Scientific Experiments, March 14, 1962, JPLHF 2-1235.) (See January 24, 1962.)

JPL was notified that Dr. Homer E. Newell was now responsible for all payload decontamination matters at NASA Headquarters. "All future communications on this subject should be sent to the Office of Space Sciences." (NASA, TWX from Robert Seamans to W.H. Pickering February 5, 1962, JPLHF 2-330.) (See January 15, 1962.)

ADF submitted a combined proposal to JPL for development of a "Lunar Surface Photoreconnaissance and Lunar Surface Measurement Capsules." The former received the shorthand designation LSPC, the latter SURMEC. Development time to delivery of first flight units was estimated at eleven to twelve months. (Proposal for "Lunar Surface Photoreconnaissance and Lunar Surface Measurement Capsules," submitted by G. Lynch of Aeronutronic, A Division of Ford Motor Company, February 5, 1962.)

Feb. 7 The Lunar and Planetary Office in the NASA Office of Space Sciences was reorganized. Management positions for each flight project, including a Ranger Program Chief and Program Engineer, were established for the first time. N.W. Cunningham and W. Jakobowski, respectively, were appointed. Cunningham had previously worked in the Lunar Science Office in OSS under Dr. Charles Sonett. (NASA, memo for Lunar and Planetary Personnel from O.W. Nicks, February 7, 1962, JPLHF 2-337.)

Planned passenger science experiments, as established at the meeting of January 24, were announced at the JPL Ranger System Review meeting:

Flight 5-6	Ion Chamber
Flight 7	Ion chamber integrated with Geiger tubes
Flight 8-9	Same as 7 with possibility of dosimeters. "A DCS [Data Conditioning System] will be on 7-8-9. A detailed breakdown will be distributed by the System Design Section."

(JPL, IOM from A.E. Wolfe/J.B. Berger to Distribution, Ranger Spacecraft System Review Minutes, February 7, 1962, JPLHF 2-1313.)

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Feb. 12 JPL issued Specification RL-3-110A (to supersede Specification RL-3-110), Spacecraft Design Characteristics and Restraints Design Characteristics, which, inter alia, gave new orders for passenger science experiments to be carried on Ranger Flights 6-9. (JPLHF 2-1549.)

Feb. 14 The JPL 25-foot-diameter space simulator facility for testing spacecraft in the environment that would be encountered on trips to the moon and planets was shown to the public for the first time. Plans called for first tests of the Mariner R Temperature Control Model to begin the following week. ("JPL Simulator to Test Craft in Space Environs," The Independent, February 15, 1962, JPLHF 2-936; see also "Mariner Flying to Venus in Simulator," Missiles and Rockets, February 19, 1962, 40, JPLHF 2-768.)

Feb. 14-17 Engineering Change Orders were released at JPL for incorporation of passenger science experiments on Flights 6-9. (JPL, IOM from J.D. Burke to C.I. Cummings, Subject: Ranger 6-9 Scientific Experiments, March 14, 1962, loc. cit.) (See February 12, 1962.)

Feb. 16 NASA Headquarters informed JPL of the change in organization and creation of a Ranger Program Office, effective February 7, 1962. (NASA, letter from O.W. Nicks to W.H. Pickering, February 16, 1962, JPLHF 2-331.)

Feb. 20 The first United States manned orbital spaceflight took place. Lt. Col. John H. Glenn successfully piloted Mercury spacecraft Friendship 7 for three orbits of the earth and to a safe recovery in the Atlantic Ocean near the Bahama Islands. (NASA, Astronautical and Aeronautical Events of 1962, GPO, 1963, 18.)

Feb. 21 All hardware changes and modifications to RA-5 (occasioned by experience from the flight of RA-3) were frozen. (JPL, IOM from A.E. Wolfe/J.B. Berger/L. Stone to Distribution, Ranger Spacecraft System Review Minutes, February 14, 1962, JPLHF 2-1313.)

In conformance with recommendations from experimenters, RCA submitted a proposal to JPL to modify the alignment of the TV cameras in Ranger Block III flights. (JPL, IOM from G.P. Kautz to C.F. Campen, March 20, 1962, JPLHF 2-1237.) (See November 15, 1961.)

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Feb. 21 cont. NASA Deputy Associate Administrator Thomas F. Dixon, in a speech about the Apollo Program at San Jose, California, outlined the progression of NASA flight programs leading to and supporting the goal of man on the moon before 1970. These flight programs were the X-15, Ranger, Surveyor, Mercury and Gemini. (U.S. Congress, Committee on Aeronautical and Space Sciences, NASA Authorization for Fiscal Year 1966, Part 3, 89th Congress, First Session, U.S. Government Printing Office, Washington, D.C. 1965, 19.)

Feb. 27 Four promising liquid sterilant solutions for biological decontamination of mating surfaces on Ranger spacecraft were isolated in a JPL liquid sterilant development program. The program was undertaken in response to a NASA request that a more effective liquid sterilant be employed than the isopropyl alcohol then in use. (JPL, IOM from R.C. Hastrup to Distribution, February 27, 1962, JPLHF 2-1232.)

Following a debriefing interview with Lt. Col. John H. Glenn, Jr., the first American to orbit the earth, Maurice Dubin, Head of the Aeronomy Program in OSS, notified Dr. Homer Newell, Director of OSS, that "it is evident that the astronaut can perform various scientific experiments. He has the capability of doing so despite the many limitations imposed by the compact Mercury capsule. . . ." (NASA, Memo to Director, Office of Space Sciences, from Maurice Dubin, March 26, 1962, JPLHF 2-1491.)

Feb. 28 N.W. Cunningham, Ranger Program Chief at NASA Headquarters (see February 7, 1962) notified J.D. Burke at JPL by phone that the subject of passenger science for Flights 6-9 was not closed, and would receive attention and consideration from Headquarters personnel in the Lunar Science Office and SSSC in the next few days. (NASA, TWX from N.W. Cunningham to J.D. Burke, March 1, 1962, JPLHF 2-1233.) (See February 12, 1962.)

During February NASA Headquarters appointed Mr. Robert Rodney NASA Resident at JPL.

Ranger Block II. A change was authorized in the thermal shield structure for Rangers 4 and 5 based upon flight experience with RA-3. A new multiple layer aluminized mylar shower-curtain-type shield was employed at the end of the month, rather than the clamshell arrangement previously used. The new shield necessitated a new set of omnidirectional antenna patterns for Block II configuration. (JPL, Space Programs Summary No. 37-14, Vol. I, op. cit., 8.)

During February cont.	The Ranger 4 spacecraft completed final systems test at JPL on February 8. It was shipped to AMR on February 19, arriving there on the 26th. Preparation for systems tests of RA-4 began at AMR at the end of the month. An engineering change order authorized an increase in the telemetry measurement range of power system voltage because of insufficient telemetry data range encountered in the flight of Ranger 3. (JPL, Space Programs Summary No. 37-14, Vol. II, op. cit., 6; and, Space Programs Summary No. 37-14, Vol. I, op. cit., 11.) (Figures 48 and 49.)
	Assembly of Ranger 5 began at the JPL Spacecraft Assembly Facility during the latter part of the month, with the fitting of the attitude control gas system to the spacecraft structure (bus). (JPL, Space Programs Summary No. 37-15, Vol. VI, for the period March 1, 1962 to June 1, 1962, 10.)
Mar. 1	NASA Headquarters TWXed JPL: This will confirm our telephone conversation of February 28, 1962, concerning scientific experiments for Ranger follow-on missions. This [Ranger] office is now investigating several sources which might be capable of producing and delivering bus experiments on a time scale compatible with the existing Administrator's flight schedule for RA 6-9. In addition, we would like to see proposals for the three experiments outlined in your letter to Oran Nicks dated February 5, 1962. Since the schedule does not permit a lengthy review of the proposed experiment, we would like to have the JPL proposals by March 8. (NASA, TWX from N.W. Cunningham to J.D. Burke, March 1, 1962, loc. cit.)
	Agena B 6004 completed systems test and was accepted by the Air Force at Lockheed in Sunnyvale, California.
Mar. 2	In his Ranger Status Report, J.D. Burke notified the JPL Deputy Director under "Red Flag Events" that the "question of what auxiliary experiments Rangers 6-9 will carry has been reopened by Dr. Sonett. JPL and other [science] proposals will be competitively considered. Timing is bad because JPL schedule and documents show issue already decided, work proceeding accordingly." (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 48, March 2, 1962, JPLHF 2-1314.)
Mar. 6	JPL submitted proposals for auxiliary science experiments as requested by NASA on March 1. RCA had begun modification of the Block III TV subsystem in accordance with experimenter

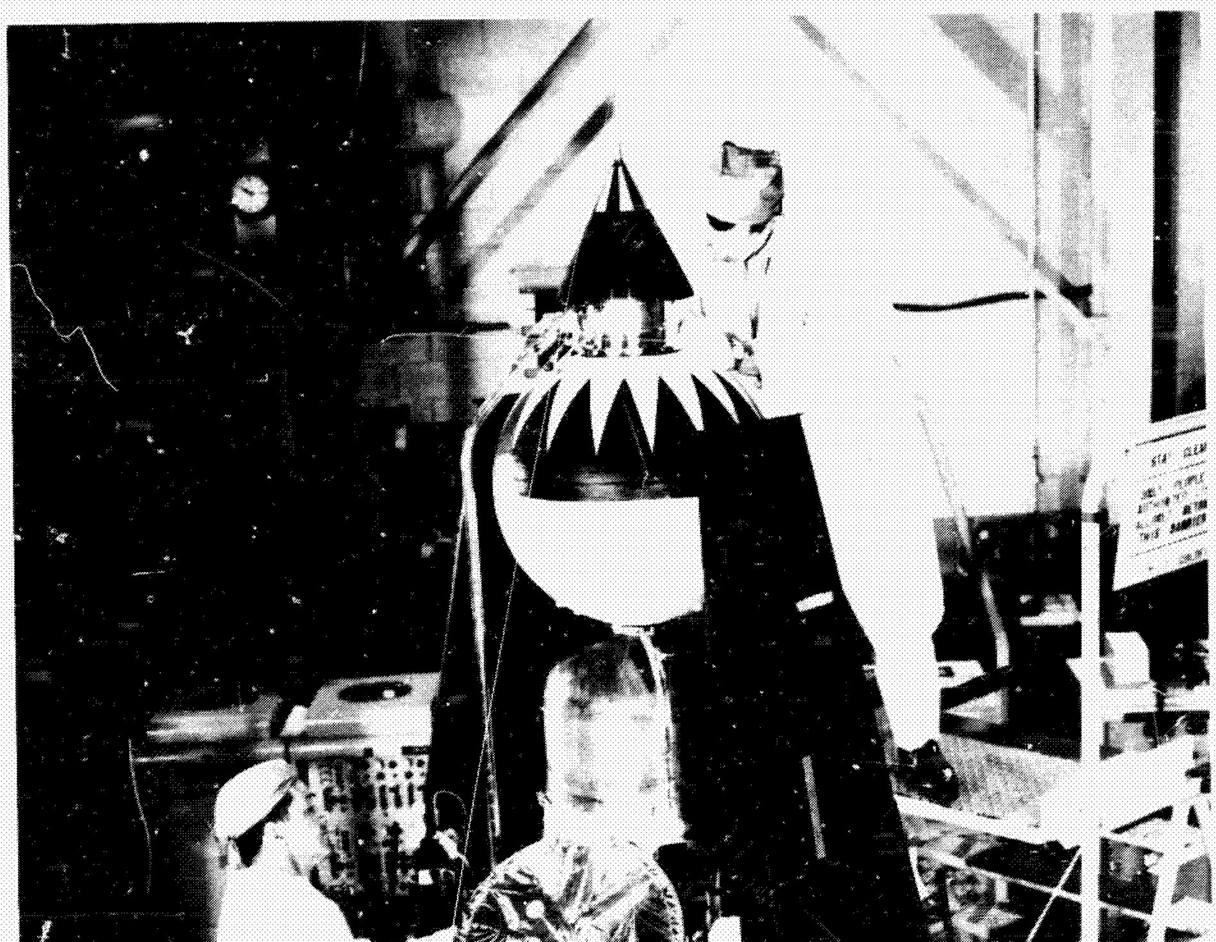

Figure 48: Ranger 4 at AMR, technicians adjusting omni antenna.

Figure 49: Ranger 4 at AMR, technicians adjusting omni antenna.

Mar. 6 cont. recommendations. This step implemented an earlier NASA request that the TV experimenters be afforded the opportunity to provide active support in the TV development. Based upon contemporary flight schedules (see September 19, 1961), nominal milestone dates for delivery of auxiliary science experiments for the Ranger Block III flights were specified:

Spacecraft	Design Freeze	Hardware Delivery
RA-6	Past	5-21-62
RA-7	Past	8-1-62
RA-8	4-1-62	10-8-62
RA-9	6-1-62	12-3-62

(NASA, letter from J.D. Burke to N.W. Cunningham, March 6, 1962, JPLHF 2-1234.)

Mar. 7 NASA abolished LOD as a component of MSFC and established the Launch Operations Center (LOC) at AMR as a separate field installation reporting to NASA Headquarters, and responsible for all NASA launch requirements at the Cape.* At the same time NASA created a Launch Vehicle Operations Division (LVOD) at MSFC to handle firings of the first Saturn boosters because Dr. von Braun, MSFC Director, expressed concern that his Center would lose authority to launch those vehicles for which it was responsible. Original plans called for Dr. Kurt Debus to become Director of LOC, while Dr. Hans Gruene would serve as Director of LVOD. However, between March 7 and July 1, 1962, when the new organizations were activated, a decision was reached in Washington D.C. that Dr. Debus would become Director of both organizations with Dr. Gruene as his Deputy Director. LVOD remained quartered at MSFC, but assumed a peculiar organizational relationship in that its Chief reported both to Dr. von Braun and to Dr. Debus. (F.A. Jarrett and R.A. Lindemann, Historical Origins of NASA's Launch Operations Center to July 1, 1962, op. cit., 79-80.)

Mar. 8 A meeting concerning the Ranger Block III TV subsystem was held at JPL among Space Science, Systems, and Project, with RCA participation for subsystem technical considerations, and resulted in several decisions:

RCA would modify the alignment of the TV cameras as previously recommended by the JPL Space Sciences Division (see November 15, 1961). The oblique alignment of one camera was eliminated.

*At this time LOC was essentially a paper work organization; actual NASA launches, other than MSFC, were conducted by contractor crews, field center project personnel together with the Goddard Field Projects Branch, and the Air Force "blue suit" monitors.

Mar. 8 cont.

Since resolution was the primary objective, this condition would be met before any change in favor of color was considered.

The color wheel would remain since it was possible to omit this feature as a last minute modification.

(JPL, IOM from G.P. Kautz to C.F. Campen, March 20, 1962, loc. cit.; IOM from D.H. Kindt to Distribution, Subject: Change in Camera Alignment of RCA TV Subsystem, March 9, 1962; also, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 49, March 9, 1962, JPLHF 2-1314.) (See also February 21, 1962.)

Mar. 13

The NASA Office of Lunar and Planetary Programs met to review the experiments submitted by JPL and others for flight on Ranger spacecraft 6 through 9. The proposals considered were:

Dr. George Pieper, Applied Physics Laboratory: Three solid state detectors to measure electron flux in the range 250 Kev to a few Mev.

Dr. M. Bader, Ames Research Center: EGO--duplicate instrument to measure low energy protons.

G.P. Serbu and R.E. Bourdeau, GSFC: Explorer XIII--duplicate instrument to measure density and energy of protons up to 100 ev.

W.M. Alexander, GSFC: An acoustic detector to measure interplanetary dust particles.

H.R. Anderson, et. al., JPL: Neher type ionization chamber.

H.R. Anderson, et. al., JPL: Three Geiger tubes to study the energetic radiation near the earth, in cislunar space, and near the moon.

G.A. Soffen, JPL: A tissue equivalent ionization chamber consisting of three Neher ion chambers surrounded by sh[illegible] of tissue-equivalent material to provide data on the b[illegible]ical hazard from energetic particle radiation during flight to the moon.

T.A. Farley and N. Sanders, UCLA: An electron-proton spectrometer.

H. Friedman, Naval Research Laboratory, and T. Gold, Cornell: Lyman-Alpha telescope capable of detecting a possible lunar hydrogen atmosphere.

The Office of Lunar and Planetary Programs concluded that the

Mar. 13 cont. tissue equivalent dosimeter in life sciences was the only experiment which could not be recommended for the Ranger follow-on missions. (NASA, Memo for Chairman, Space Science Steering Committee from N.W. Cunningham, Subject: Scientific Experiments for Ranger Missions P-53, P-54, P-55 and P-56, April 18, 1962, 1-3, JPLHF 2-646.)

Mar. 14 The Ranger experiments (above) were presented to the SSSC by the Office of Lunar and Planetary Programs. The NASA Headquarters list received tentative approval so JPL could integrate the experiments into the spacecraft. In granting approval the Committee requested that consideration also be given to two additional proposed experiments:

1. Nelson Spencer, GSFC: Redhead cold cathode discharge tube to measure lunar atmospheric pressure.

2. Charles Nelson, Naval Research Laboratory: Magnetic mass spectrometer capable of measuring the unidirectional spectral intensity of ions in a given range.

(Ibid., 4; also, N.W. Cunningham, Ranger Program Chronology, loc. cit.)

Following a telephone conversation with N.W. Cunningham at NASA Headquarters, J.D. Burke notified C.I. Cummings, JPL Director of Lunar Programs, that NASA and JPL "have still not reached a meeting of the minds on the underlying question of who decides what will fly? Cunningham says that all other satellites are handled the Sonett way [through the SSSC]. In looking over the chronology [of science events] I conclude that it may have been our January [space science] manpower flap that set all of this off . . . in fact if they wanted to do an exercise like this, they had half of 1961 . . . and now it is pretty late." (JPL, IOM from J.D. Burke to C.I. Cummings, March 14, 1962, JPLHF 2-1235.)

JPL announced selection of Military Electronics Division of Motorola, Inc. to manufacture radio equipment in two phases of a program to augment the DSIF by providing "S" band capability for stations at Goldstone, California; Woomera, Australia; and Johannesburg, South Africa. (Astronautical and Aeronautical Events of 1962, op. cit., 35.)

Mar. 15 The NASA Office of Manned Space Flight requested the assignment of JPL personnel to assist Dr. Joseph Shea in Systems Engineering at Headquarters. (JPL, Conference Report LPD-10 by C.I. Cummings, March 20, 1962, conference held at NASA Headquarters on March 15, 1962, JPLHF 2-2066.) At another Headquarters meeting, the Office of

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Mar. 15 cont. Space Sciences concluded that, for planning purposes, spacecraft assembly and final checkout operations for Ranger Block IV vehicles should be kept within JPL, and not assigned to a contractor. (JPL, Conference Report No. LPD-9 by C.I. Cummings, March 19, 1962 of conference held at NASA Headquarters on March 15 and March 16, 1962, JPLHF 6-36.)

Mar. 20 NASA Headquarters informed JPL of the list of passenger science experiments now considered by the Office of Lunar and Planetary Programs for inclusion on Ranger Flights 6 through 9. The experiments, restricted in number compared to those favorably reviewed on March 13, were specified as:

G.F. Pieper, Electron Flux experiment

M. Bader, Low Energy Solar Proton Detector

W.M. Alexander, Dust Particle experiment

Serbu and Bourdeau, Low Energy Ion measurement

G.A. Soffen, et. al., Tissue Equivalent Ionization Chamber

H.R. Anderson, et. al., Ionization Chamber and Counter experiment

Friedman and Gold, Lunar Hydrogen Atmosphere Detection

Farley and Sanders, Electron-Proton Spectrometer

The message went on:

> 2. . . . . The Space Sciences Steering Committee has reviewed all proposed experiments and we are expecting formal approval except for the tissue equivalent ionization chamber which was rejected. Additional experiments in the field of aeronomy have been proposed by the Geophysics and Astronomy Office. These are now under consideration by the Lunar and Planetary Program Office. . . .
>
> 3. In anticipation of the Steering Committee's approval, you are requested to take steps to integrate these experiments into the spacecraft bus. While it is recognized that scheduling problems exist, it is requested that every effort be made to integrate the experiments into all follow-on Rangers.
>
> 4. As soon as you have had an opportunity to review the effect of these proposals on both cost and scheduling, it would be appreciated if you would discuss the above by telephone with my office. We hope to have the entire scientific experiment problem resolved no later than 28 March.

(NASA, letter from O.W. Nicks to J.D. Burke, March 20, 1962, JPLHF 2-683.)

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Mar. 20 cont. The launch date of RA-5 was formally advanced one month from November to October, 1962, and the flight of RA-9 was slipped one month from August to September, 1963. All other flight dates remained unchanged. (See prior schedule at September 19, 1961.) (Official NASA Flight Schedules, loc. cit.)

Mar. 21 The NASA requirement for additional passenger science on Ranger Block III vehicles became known to affected divisions at JPL. C.W. Cole in Engineering Mechanics notified the Ranger Project Manager that

> . . . a state of confusion and uncertainty exists as to the type and scope of experiments to be flown on the Ranger Follow-On missions, and further, that there is a continuing effort afoot at NASA Headquarters to locate possible sources for new experiments throughout the nation.
>
> We wish to remind you that the engineering problems attendant to the locations and installations of science systems on the spacecraft are many (temperature control, structural and mechanical design, and space availability) and the constraints are usually severe. This Division has not planned for either manpower or funds to carry on either an effort to ascertain the feasibility of incorporating proposed additional experiments or the 'hard design' required for approved experiments.

(JPL, IOM from C.W. Cole to C.I. Cummings/J.D. Burke, March 21, 1962, JPLHF 2-1238; see also comments in JPL, IOM from R.L. Heacock to G. Kautz, April 13, 1962, JPLHF 2-2067.)

Mar. 26-28 Final assembly and preflight preparation of the Ranger 4 spacecraft took place in the assembly and sterilization laboratory at the Explosive Safe Area (ESA) at ETR. (JPL, Space Programs Summary No. 37-15, Vol. I, op. cit., 6.) (Figure 50.)

Mar. 28 A NASA-JPL meeting in Headquarters was attended by J.D. Burke, JPL Ranger Project Manager, and Dr. M. Eimer, of the Space Sciences Division, "to discuss problems associated with integrating these experiments [for Block III Rangers] into the spacecraft and the resulting effects on scheduling, costs, and manpower loading at JPL." It was determined that JPL would further examine the problems associated with integrating the proposed experiments into the spacecraft and deliver a report at the next Ranger Quarterly Status Review, scheduled for April 9. (NASA, Memo for Chairman, Space Science Steering Committee from N.W. Cunningham, April 18, 1962, op. cit., 4; also, N.W. Cunningham, Ranger Program Chronology, loc. cit.)

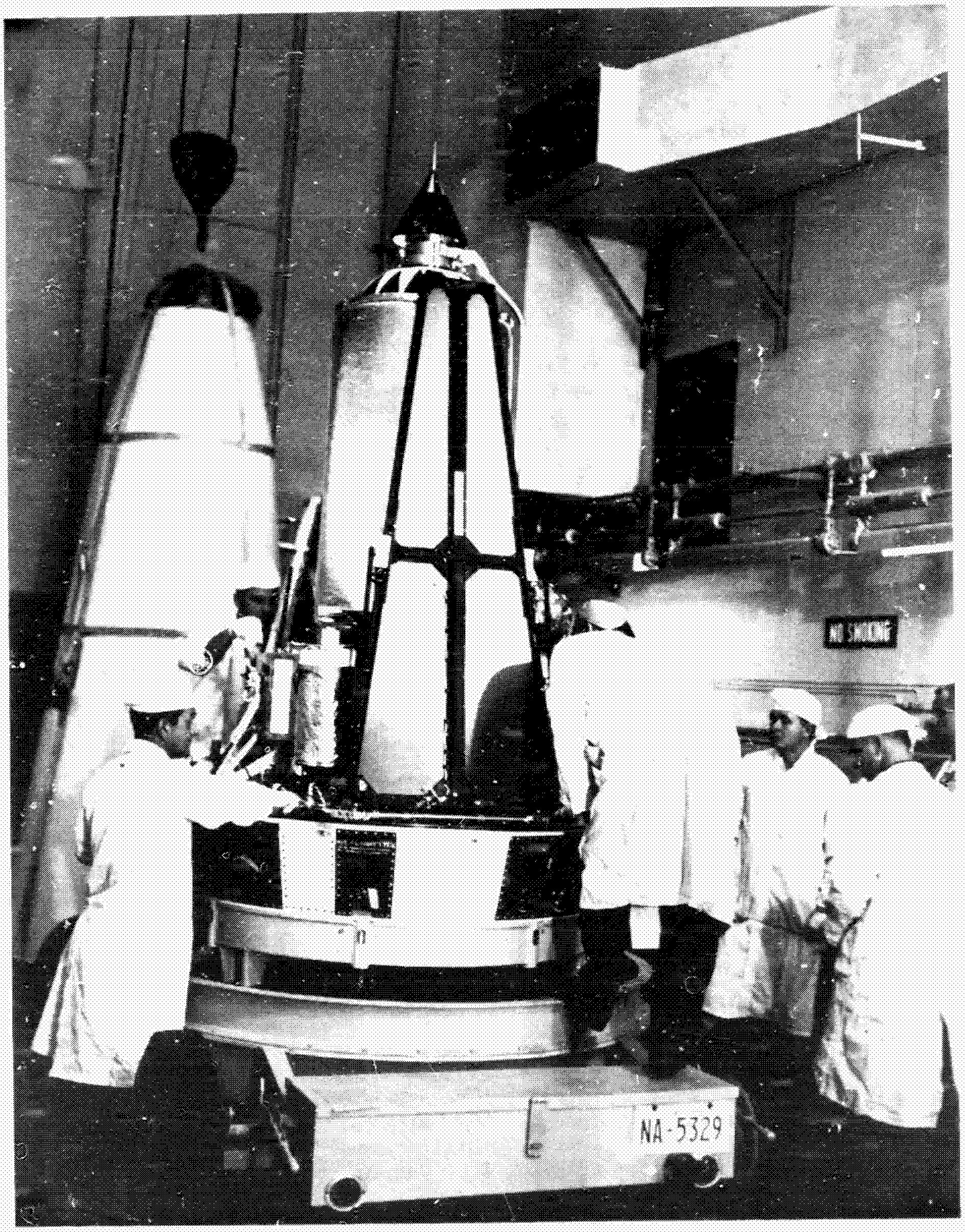

Figure 50: Final preparation of Ranger 4 for movement to Launch Complex 12 at AMR.

During March — Ranger Block III. A Mechanical Test Model (MTM) for Ranger spacecraft 6 through 9 underwent type approval vibration tests. The MTM consisted of a Ranger spacecraft and simiulated model of the high-resolution TV subsystem provided by RCA; units were structurally simulated as to mass distribution, moments of inertia, and stiffness of components. Results of the shake tests dictated an increase in spacecraft wall thickness and change in material from magnesium to aluminum for the solar panel latch support structure. With this modification the MTM satisfactorily completed vibration tests. (JPL, Space Programs Summary No. 37-15, Vol. I, op. cit., 7.)

RCA delivered the TV subsystem Thermal Control Model (TCM) to JPL. (RCA, Ranger TV Subsystem, Block III, Final Report, Summary, Vol. I, loc. cit.)

DSIF. The Johannesburg Deep Space Station was equipped with a 200 W transmitter system. This addition provided the station with an "uplink" capability for two-way communication with the spacecraft; in particular, Johannesburg was able to generate two-way doppler data vital to computation of the spacecraft orbit. (Prior to this installation, angular pointing information and one-way doppler were the only data available, neither of which was sufficient for precision orbit determination.) Shortly thereafter, Johannesburg was also equipped with a command system which made it possible to transmit commands to the Ranger 4 spacecraft. For the Ranger 4 mission, most earth based commands were to back up on-board commands issued by the CC&S, except for magnitude, direction, and correction of the trajectory course required to guide Ranger spacecraft to the moon. (N.A. Renzetti comments on draft of Ranger Chronology.)

Apr. 2 — J.D. Burke notified N.W. Cunningham at NASA Headquarters that JPL was "now considering the following list of experiments for Ranger 6-9:

Agency	Experiment	Experimenters
APL	Electronflux	Pieper
NRL	Lyman alpha	Friedman, et. al.
NRL	Mass Spectrometer	Johnson & Hoffman
GSFC	Dust	Alexander
GSFC	Low Energy ions	Serbu & Bordeau
JPL	Ion chamber & G.M. counters	Anderson, et. al.
UCLA	Electron-proton spectrometer	Farley & Sanders
Ames	Low Energy protons	Bader & Fryer

2. I will not commit further funds to a flight model tissue equivalent dosimeter, and I understand that no further consideration

Apr. 2 cont. need be given to the GSFC pressure experiment.

3. We will determine by April 9 the experiments from the above list which can replace the tissue equivalent dosimeter on Ranger 7, and I will seek your approval for the replacement on that date."

(JPL, letter from J.D. Burke to N.W. Cunningham, April 2, 1962, JPLHF 2-1241.)

Apr. 3 Following final assembly and preflight sterilization with ethylene-oxide gas, Ranger 4 was sealed in its shroud and moved to Launch Complex 12 where it was mated to the Atlas-Agena booster. (JPL, Space Program Summary No. 37-15, Vol. I, op. cit., 6.)

Apr. 6 In his weekly status report under "Red Flag Events," J.D. Burke notified the Deputy Director that "Headquarters is willing to slip schedule to get experiments aboard RA-7, 8 and 9. Letter to Pickering due soon. I am very disappointed by this evidence that there is no sense of urgency on the follow-on." (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 53, JPLHF 2-1314.)

Apr. 7 Responding to the lunar theory propounded by Dr. Gilvarry in the November 4, 1961 issue of the Saturday Review, Dr. H.C. Urey and several associates strongly criticized the journal for publishing the article, and reopened a fundamental issue in science: "When is a new idea fit to print?" The protestants opined that "there are so many serious problems entirely neglected by Dr. Gilvarry, so many over-simplified facts and even cases of misinterpreted data, that his speculations are unacceptable to most if not all competent students of the origin and history of the earth. . . . Dr. Gilvarry's ideas about the moon's surface are simply not true. . . ." (John Lear, "When is a New Idea Fit to Print?" Saturday Review, April 7, 1962, JPLHF 2-232.)

Apr. 9 Final systems test was performed on the Ranger 4 spacecraft at AMR. "All subsystem representatives reported that their subsystems were in a flight-ready condition." (JPL, Space Programs Summary No. 37-15, Vol. I, op. cit., 7.)

The Ranger Quarterly Status Review was held at JPL, attended by a delegation of NASA Headquarters personnel. The JPL Ranger Project recommended a list of passenger experiments for Block III Rangers:

RA-6 (P-53) First Quarter 1963
Neher Ionization Chamber

Apr. 9 cont.

RA-7 (P-54) Second Quarter 1963
Neher Ionization Chamber
Geiger Counter Assembly
Electron Flux
Low Energy Ions
Cosmic Dust
Search Coil Magnetometer
Electron-Proton Spectrometer
Low Energy Protons

RA-8 (P-55) Second Quarter 1963
Same as RA-7

RA-9 (P-56) Third Quarter 1963
Same as RA-7

(NASA, Memo for Chairman, Space Science Steering Committee, from N.W. Cunningham, April 18, 1962, op. cit., 5.)

J.D. Burke assured O.W. Nicks, Director of the Lunar and Planetary Programs Office in OSS, "that despite my objections to the introduction of these additional experiments at this late date, I would now proceed aggressively in the attempt to get them aboard. However, I also pointed out that by placing this additional demand on the personnel and resources of the Laboratory, we may jeopardize not only other JPL efforts but also higher-priority objectives within the Ranger Project itself. Our main goal will continue to be the production of high-resolution lunar pictures at the earliest possible date. . . ." (JPL, letter from J.D. Burke to N.W. Cunningham, April 13, 1962, JPLHF 2-684.)

NASA Headquarters informed JPL that plans for including an additional Block I spacecraft, itentified as Ranger 2A, were still indefinite and that such a craft could not be launched in November 1962, due to a shortage of funds although ". . . it might be possible to include RA-2A in the Ranger schedule at a later date." (NASA, letter from E.M. Cortright to W.H. Pickering, April 9, 1962, JPLHF 2-1492.) (See During December 1961.)

Apr. 9-10 JPL and RCA representatives met at Hightstown, New Jersey, to review progress on the TV subsystem for the follow-on Block III Rangers. RCA thought schedules could be maintained with an Engineering Test Model (ETM) of the TV experiment delivered to JPL on May 28, a Proof Test Model (PTM) on July 1, and the first flight unit on September 1, 1962. JPL personnel were concerned that recent technical problems, including video amplifier and vidicon performance difficulties, might require redesign of some components and delay delivery. (Conference at RCA, Hightstown, New Jersey, April 16, 1962, JPLHF 2-1246.)

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Apr. 10 Dr. Homer E. Newell, Director of the NASA Office of Space Sciences (OSS--See Nov. 1, 1961), sent a letter to Representative Joseph E. Karth in the House Committee on Science and Astronautics concerning authorization of FY 1963 funds for NASA's space science program. Newell observed that "space science, in addition to laying the groundwork for future activity in space, is one area in the national space program where we hold a clear lead over the Soviets, and in which we can continue to hold the lead if we maintain the vigor and breadth of our effort." He continued:

> . . . to maintain this leadership in space science requires that we continue to support the broad and advancing program that we have begun, and that we continue to support space science for the sake of science, maintaining our faith that the practical benefits thereof will assuredly accrue.
>
> With regard to this last point, I recall that during the hearings, the subcommittee seemed to show a much greater interest in what support the science program might give to the manned flight effort than in the question of whether the program represented good science. . . .

Although the importance of national prestige in the Apollo Program was acknowledged, Newell steadfastly maintained that science was inseparable from manned or unmanned space exploration, and should not be submerged in an engineering tour de force: "It is clear that the primary motive for sending men to the moon is to press forward in the competition with the U.S.S.R. Success in this mission will be of great importance in our winning the Cold War. But if we were to set this motive aside, the single greatest foreseeable reason right now for sending man to the moon and planets is to explore and investigate them. . . ." (NASA, letter from H.E. Newell to Rep. J.E. Karth, April 10, 1962, JPLHF 2-897.)

Apr. 13 JPL confirmed agreement on selection of passenger science experiments to be flown on Rangers 6 through 9, as proposed April 9. (JPL, letter from J.D. Burke to N.W. Cunningham, _loc. cit._)

Apr. 15 JPL issued EPD-78, _Space Flight Operations Plan, Ranger 6_, which defined the conduct of space flight operations in both the standard and non-standard case.

Apr. 16 JPL concluded a study of Laboratory manpower and facilities shortages and, following discussions with O.W. Nicks, submitted a recommendation to NASA Headquarters that any additional

Apr. 16 cont. follow-on Ranger spacecraft busses for future flights be contracted with industry:

> The fundamental reason for contracting the Ranger spacecraft bus is to alleviate the JPL manpower situation; however, it is anticipated that other advantages will accrue. . . .
>
> * * *
>
> In the event of an additional follow-on program, this Laboratory would immediately initiate a program to phase in a bus contractor on the RA 6-9 series, in such a fashion that the contractor could, by RA-10, assume fully the responsibility for the planned scope of work.
>
> The initial assembly and subassembly testing would definitely be done in the contractor's facility; however, it is not clear at this time whether full system testing could be done under JPL facilities or not. Not only is hardware and GSE available space unpredictable at this time, but it must be appreciated that space would be required for the prime and his subcontractor personnel.

(JPL, letter from C.I. Cummings to O.W. Nicks, April 16, 1962, JPLHF 2-685; also, Rough Draft of Ranger Final Report, 53-54, JPLHF 2-122.) (See During January 1960.)

As part of the preparations for the launch of Ranger 4, DSIF stations conducted simulated spacecraft launch and tracking operations during network integration tests on this date and on April 20. By April 23 all DSIF stations were "in the green." (Tracking and Data Acquisition for Ranger Missions 1-5, op. cit., 42.)

Apr. 18 During an interlude in RA-4 launch preparations, J.D. Burke notified C.I. Cummings of the still unresolved status of passenger science priorities for Ranger Block III flights. Following the Ranger Quarterly Status Review on April 9, "I implored Nicks and Sonett to establish a priority status for the experiments so that we could have some basis for treating interference problems. They refused, so I told them that unless ordered to do otherwise I would continue to treat the TV experiment as primary and the others as non-interfering passengers. They said that they would review any conflicts and settle each on its own merits; i.e., that they expect to take us back into the era of RA-2." [RA-2 launch was delayed due to experiment conflicts.] (JPL, IOM from J.D. Burke to Pickering/Sparks, April 18, 1962, JPLHF 2-1244.) (See precedents, for example, at April 17 and 19, 1960, and November 8, 1961.)

Apr. 18 cont. N.W. Cunningham, Ranger Program Chief at NASA Headquarters, notified the Chairman of the SSSC of the passenger science experiments for Ranger Block III vehicles agreed upon by the Office of Lunar and Planetary Science and JPL at the Ranger Quarterly Status Review meeting on April 9. "It is recommended that the proposed payloads . . . be approved for the Ranger follow-on missions." (NASA, Memo for Chairman, Space Science Steering Committee, from N.W. Cunningham, April 18, 1962, op. cit., 6.)

Modification No. 5 to the JPL contract with RCA was executed. This modification became the definitive contract for the Ranger Block III TV subsystem, meeting the requirements of JPL Specification No. 30880, Design Specification for Ranger TV Subsystem, and JPL EPD-40, Design Requirements and Restraints for Ranger TV Subsystem. (RCA, Ranger TV Subsystem, Block III, Final Report, Summary, Vol. I, op. cit., 25.)

Apr. 19 M. Eimer informed G.P. Kautz, Ranger Assistant Project Manager, that manpower exigencies and time constraints had become so severe that NASA GMI 37-1-1, which established relations between centers and experimenting scientists, could no longer be strictly adhered to:

> It is, unfortunately, necessary that in the conduct of the Ranger Follow-on space science program, the established procedure be modified. It is essential that a greater reliance be placed on the Experimenter during fabrication, testing, calibration, and checkout. . . . While it is the intention of this shift in responsibilities to decrease the workload on the Division of the Space Sciences and make possible the inclusion of instruments which could not otherwise be considered, the hazard of instruments failing to make delivery dates, pass environmental and systems tests, and operate satisfactorily during the course of the mission has been substantially increased. These increased risks may act to diminish the total scientific instrument package and thus, at least in part, nullify the advantage sought by this procedure.
>
> JPL personnel will continue to be responsible for checkout of flight instruments, integration of the experiments into the spacecraft, and participation in field operations and in the acquisition and reduction of data from measurements taken in flight.

(JPL, IOM from M. Eimer to G.P. Kautz, April 19, 1962, JPLHF, 2-1245.)

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Apr. 20 Final launch preparations for RA-4 culminated in a satisfactory Flight Readiness Test at AMR. (JPL, IOM from J.D. Burke/ G. Kautz to B. Sparks, Ranger Project Status Report No. 55, April 20, 1962, JPLHF 2-1314.)

A cost increase of $1,463,000 for the Ranger Program over the $30,903,000 authorized to date by NASA was offset at JPL by the reprogramming from Prospector and other efforts. The $1,463,000 overrun was directly attributed to the Aeronutronics Block II lunar capsule effort. (JPL, letter from C.I. Cummings to N.W. Cunningham, April 20, 1962, JPLHF 2-1247.)

Apr. 23 Ranger 4 (Atlas 133D, Agena B 6004) was launched from AMR Pad 12 at 3:50 p.m. EST, upon conclusion of the first countdown. The planned mission and objectives were identical with the flight of Ranger 3 (see January 26, 1962). Both Atlas and Agena boosters performed satisfactorily, and Ranger 4 was injected into a nearly optimal lunar trajectory that ensured impact on the moon even in the absence of a midcourse correction.

Telemetry data showed the spacecraft operating normally as the Agena carried it over the horizon, and the signal was lost by AMR and mobile tracking station some seven minutes after launch. Downrange stations confirmed Agena-spacecraft staging, but when the RA-4 signal was reacquired by the mobile tracking station in South Africa eighteen minutes later, a malfunction was apparent in the absence of any 400 cps signal to Channel 1; in addition, the telemetering decommutator was observed not to be operating. No blips were observed on Channel B-2 at the time the solar panels were to be extended, nor at the time any of the subsequent CC&S commands were scheduled. No gamma-ray readout was obtained after the time the CC&S was scheduled to have started this activity.

A number of attempts were made to transmit trouble-shooting commands to the spacecraft but without success. Changeover to the high-gain antenna could not be made because it was impossible to command the spacecraft. Contact with RA-4 was therefore confined to the omniantenna with its lower signal levels. Periodic variations in the received radio signal strength indicated that the spacecraft attitude control system had not acquired the sun and that the spacecraft was tumbling.

Post launch findings indicated that the CC&S was not generating a 25-pulse-per-second signal upon which the telemetry decommutator, gamma-ray readout, and command decoder all depend, "nor does it appear that any of the CC&S commands were given with the possible exception of the 'transmitter power-up' command which is given

Apr. 23 cont.

before DSIF [South Africa] acquisition." Later it was determined that the separation connector had voltage on the pins; some debris floating in the vacuum (e.g., foil) could have shorted the CC&S. The malfunction in the spacecraft precluded the recovery of any scientific data.

Tumbling and without solar power, RA-4 exhausted it battery ten hours and 32 minutes after liftoff and the spacecraft signal was lost by the DSIF. DSIF continued to track the ADF lunar capsule beacon, however, until that signal was lost on April 26, two minutes before RA-4 was occulted by the moon just prior to impact on the far side. (JPL Ranger IV Technical Bulletin No. 1, April 24, 1962, JPLHF 2-1312; Tracking and Data Acquisition for Ranger Missions 1-5, op. cit., 40; and, Preliminary Spacecraft Operations letter, Ranger 4, JPL, May 1962.)

The NASA Space Sciences Steering Committee convened in Washington, D.C. to pass upon the proposed passenger science experiments for Block III Rangers. N.W. Cunningham reviewed the background of non-visual bus experiments proposed for RA 6-9, and pointed out that engineering difficulties could be expected (1) in adapting the Mariner R data conditioning system to Ranger, and (2) from existing spacecraft power and telemetry format constraints. The Committee approved the experiments as agreed upon at JPL on April 9. (NASA, Summary Minutes: Space Sciences Steering Committee, April 23, 1962, JPLHF 2-647; also, N.W. Cunningham, Ranger Program Chronology, loc. cit.)

Apr. 24

O.W. Nicks, Director of Lunar and Planetary Programs in OSS, visited JPL to discuss the RA-4 failure and review effort underway on the CC&S. In addition, "the several aspects of providing additional Ranger flights to the existing program were reviewed. In particular, the pros and cons of obtaining a systems contractor for follow-on Rangers were discussed. Mr. Cummings wishes to bring in a system contractor because of laboratory manpower loading. This discussion was continued with Dr. Pickering and Mr. Sparks in addition to Messrs. Burke and Cummings because of the laboratory-wide ramifications. Dr. Pickering proposed that a more detailed review be made by the laboratory in the very near future before a decision is raached." (NASA, Memo for Files from Oran Nicks, Subject: Trip to JPL April 24-26, 1962, JPLHF 2-335.)

Apr. 25

Announcement was made that the JPL Space Simulator Facility (SSF), opened formally on February 14, would be turned back to the contractor because the facility did not fully meet performance specifications. "Availability of the facility for spacecraft testing

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Apr. 25 cont. is not expected until at least 1 August, 1962." (JPL, Minutes, Ranger Spacecraft System Review, April 25, 1962, JPLHF 2-1313.)

Apr. 26 N.W. Cunningham, Ranger Program Chief at NASA Headquarters, directed a memo to Homer E. Newell, Director of OSS, which observed that the SSSC had approved specified passenger science experiments for Rangers 6-9 on April 23: "It is recommended that the payloads . . . be approved." (NASA, Memo for Director, OSS, from N.W. Cunningham, April 26, 1962, JPLHF 2-648.) (See April 18, 1962.)

Apr. 27 Dr. G.P. Kuiper of the University of Arizona at Tuscon, TV experimenter on Block III flights, notified NASA Ranger Program Chief N.W. Cunningham that, confirming prior conversations, he was inviting Dr. Harold L. Johnson to "join me in a study of the design and effectiveness of the Ranger TV equipment and related problems." A trip to JPL on May 2 was proposed as the start of the study. This letter triggered NASA-JPL re-examination of the role and functions expected of experimenters in NASA's space science program. (Letter from G.P. Kuiper to N.W. Cunningham, April 27, 1962, JPLHF 2-410b; and, JPL, IOM from J.D. Burke to Distribution, April 30, 1962, JPLHF 2-410a.)

During April Ranger Block II. Subsystems testing of RA-5 began at JPL and was completed the first week of May, well ahead of the scheduled date. (JPL, Space Programs Summary No. 37-16, Vol. I, for the period May 1, 1962 to July 1, 1962, 28.)

Ranger Block III. Plans for incorporating more extensive passenger science experiments on Rangers 6-9 were firmed at NASA Headquarters and at JPL. A contemporary program report observed that "a second scientific objective of the Ranger 6-9 mission is now acquisition of knowledge of the 'fields and particles' environment of cislunar and lunar space which may be important to manned flights, or which may yield data pertinent to the origin of these environments. . . ." (JPL, Space Programs Summary No. 37-17, Vol. VI, for the period July 1, 1962 to October 1, 1962, 53.)

DSIF. A site for the Antenna Test Range was selected. Tests at the Range were to be initially devoted to cassegrain feed cones, RF transmitters, and L/S Band. (DSN Facility Activation Dates, loc. cit.)

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May 4 NASA Headquarters formally notified JPL of the April 23rd decision by the SSSC approving the addition of fields and particles experiments for Rangers 6 through 9, as agreed upon on April 9, and tentatively approved the additions. In response to Project requests (see April 18), "the Steering Committee also discussed the relative importance of these experiments to the stated objectives of this follow-on program. The primary objective of these flights is to obtain data of significance to the manned lunar effort, and it is believed that good measurements in cislunar space as well as in the lunar environment will be of great value in this regard. It is certain that the Space Sciences program will benefit from these added experiments." (NASA, letter from Homer E. Newell to William H. Pickering, May 4, 1962, JPLHF 2-260.)

J.D. Burke informed the JPL Deputy Director that a review of the proposed additional Ranger Flights 10-14 (called Ranger Follow-on2 at this time) indicated "mismatches among Systems, Space Sciences Division, and the Surveyor Project outlook." Space Sciences Division had requested elimination of the electron-proton spectrometer experiment for Flights 6-9 because of lack of progress in developing the instrument. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 57, May 4, 1962, JPLHF 2-1314.)

May 8 NASA Headquarters requested that Dr. Pickering implement the study on how JPL could best undertake additional flights in the Ranger Project with the projected in-house workload, as had been proposed on April 24. (NASA, letter from Oran W. Nicks to William H. Pickering, May 8, 1962, JPLHF 2-261.)

The RCA television PTM power turn-on was now scheduled for May 15, and arrival at JPL on July 4, after six weeks of testing. The ETM would be delivered to JPL on May 28 with three cameras only. (See April 9-10, 1962.) (JPL, Minutes, Ranger Spacecraft System Review, May 8, 1962, JPLHF 2-1313.)

May 10 RCA began work on a feasibility study of a Ranger Lunar Orbiter under contract to JPL. (JPL. IOM from H.R. Lawrence to Distribution; also, Statement of Work for Lunar Capsule Orbiter Feasibility Study, May 11, 1962, JPLHF 2-1252.)

In a speech to transport workers, Soviet Premier Nikita Khrushchev averred that despite American claims, no United States rocket had as yet impacted the moon: "The Americans have tried several times

May 10 cont. to hit the moon with their rockets. They have proclaimed for all the world to hear that they had launched rockets to the moon, but they missed every time. The Soviet pennant on the moon has been awaiting an American one for a long time but in vain, and is becoming lonesome."

Responding for the Laboratory as well as for NASA, Dr. William Pickering stated that "on April 26, at 4:47.50 a.m. Pacific Standard Time, Ranger 4 was tracked by the Goldstone receiver as it passed the leading edge of the moon. At 4:49.53 a.m. it crashed on the moon at a lunar longitude of 229.5 degrees East and lunar latitude of 15.5 degrees South." (Astronautical and Aeronautical Events of 1962, op. cit., 75.)

May 15 N.W. Cunningham and J.D. Burke agreed that "no further consideration will be given to flying the capsule bombs on RA-5. In view of the relatively unsuccessful lunar landing program to date, it is felt that any new developments which might adversely affect the chances of success for RA-5 should not be considered." (NASA, letter from N.W. Cunningham to J.D. Burke, May 15, 1962, JPLHF 2-1690.) (See February 1-2, 1962.)

RCA Ground Support Equipment (GSE) for the Ranger Block III TV subsystem was received at JPL. (JPL, IOM from D.H. Kindt to Distribution, July 24, 1962, JPLHF 2-1265.)

JPL began to receive information from contractors on proposed Ranger bus fabrication for additional spacecraft. (IOM from J.P. Judin of Ford Motor Co., Aeronutronic Division, to R.D. Smith, May 15, 1962, JPLHF 2-1259b.) (See May 8, 1962.)

May 17 A meeting was held at the Goldstone station between representatives of RCA Data Systems Division and JPL to discuss methods of implementing a real-time presentation of Ranger 6-9 video pictures at Goldstone. (Conference Report by D. Williams, JPL, May 21, 1962, JPLHF 2-1253.)

May 20 Dr. John F. Clark was appointed to a new position as Associate Director and Chief Scientist for the NASA Office of Space Sciences. Dr. John E. Naugle was appointed to the position of Director of Geophysics and Astronomy Programs vacated by Dr. Clark. (NASA Announcement No. 505, "Appointment of Associate Director and Chief Scientist, Office of Space Sciences," May 23, 1962.)

May 23 The flight date for Ranger 7 was moved forward from April to March 1963. The complete Ranger flight schedule was now as follows:

May 23 cont.	RA-5	October 1962
	RA-6	January 1963
	RA-7	March 1963
	RA-8	May 1963
	RA-9	September 1963

(Official NASA Flight Schedules, loc. cit.)

The recently assembled RA-6 spacecraft bus was reported damaged during heat sterilization; the bacteriological filter and Robbins valves were replaced. In addition, "warping of the bus occurred . . but it has not yet been determined if the extent of warpage has placed it out of tolerance." (JPL, Minutes, Ranger Spacecraft System Review May 23, 1962, JPLHF 2-1313.)

May 24 Astronaut Scott Carpenter flew the three-orbit Mercury-Atlas 7 mission. This was the first manned space flight "to carry some experimental equipment of at least a quasi-scientific nature." (James Grimwood, Comment Draft of Gemini narrative history, Chapter: "Planning the Experiments," July 31, 1968, 8.)

May 31 The JPL Space Sciences Division announced results expected from a small "High-Speed Impact Study" contract with General Motors. Approximately 150 aluminum projectiles of varied mass were to be fired into a variety of prepared soil materials. With analysis of impact data "it should be possible to predict the impact flash and crater likely to be observed on impact of a lunar probe on the moon's surface. . . ." (JPL IOM from R. Brereton to H. Lawrence, May 31, 1962, JPLHF 2-2068.)

During May Ranger Block II. System testing of RA-5 began in early May and time-consuming problems were uncovered which, when combined with design changes resulting from the flight of RA-4, resulted in a 2-to-3 week schedule slippage. Late delivery of the data encoder also became a pacing item. Serious problems involved a midcourse motor turn-off command failure, and spurious mode changes in the data encoder as a result of motor turn-off by the CC&S. Also, in view of the failures on RA-4 and previous Ranger flights, work was started on a Design Evaluation Vehicle (DEV) to track down the noise characteristics of the Ranger spacecraft and to check the impact that raising the voltage in one area had on neighboring areas. (JPL, Space Programs Summary No. 37-16, Vol. I, loc. cit.; Space Programs Summary No. 37-16, Vol. VI, for the period May 1, 1962 to August 1, 1962, 12; JPL, Minutes, Ranger Spacecraft System Review, June 6, 1962, JPLHF 2-1313; and, R.C. Hall Interview with Al Wolfe, 5, 6, November 6, 1969, JPLHF 2-1533.)

During May cont.

Ranger Block III. Vacuum thermal testing of the RCA TV Thermal Test Model (TTM) in the space simulator facility at RCA was completed. Vibration testing of the MTM continued at JPL and indicated satisfactory performance of the TV subsystem structure. On the strength of test operations to date, RCA began fabrication of flight models. In response to recommendations from the TV experimenters, work began on modifying camera alignment to provide additional redundancy of coverage. "Initial effort . . . [was] concentrated on the redesign of the camera bracket and field-of-view holes in the thermal shield." (See May 8, 1962.) (JPL, Space Programs Summary No. 37-15, Vol. VI, op. cit., 14; and RCA, Ranger TV Subsystem, Block III, Final Report, Summary, Vol. I, loc. cit.)

At about this period NASA/JPL funding for RCA was finally made available. For nearly a year RCA had carried Block III TV development on company funds for a total in excess of $1 million.

Sterilization. Component part sterilization studies began at JPL to better understand temperature failure modes, to select component candidates for continued studies, and to accrue test confidence at specified sterilization temperatures. Capacitors and connectors only were involved in these studies, which were completed by the end of the year. (JPL, Space Programs Summary No. 37-20, Vol. I, for the period January 1, 1963 to February 28, 1963, 14-15.)

June 4

Cancellation of the DOD Avent military communications satellite project, which would have employed Atlas-Agena B boosters, alleviated launch stand loading problems at AMR Pad 12 used by Project Ranger. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 61, June 4, 1962, JPLHF 2-1314.)

June 7

The first Senior Council Meeting of the Office of Space Sciences (OSS) in the Office of Space Flight Programs met in Washington, D.C. for the purpose of "improving communications between center directors and OSS." In attendance were John Clark, John Nicolaides, Edgar Cortright, Oran Nicks J. Alan Crocker, and John Naugle from Headquarters; and Smith J. DeFrance, Ames; William H. Pickering, JPL; Charles Donlan, Langley; and Harry J. Goett, Goddard Space Flight Center. During discussions the sentiment was expressed by center attendees that OSS was too strongly attached to lunar science goals established before announcement of the manned lunar program and that more engineering knowledge of lunar surface details were now required. Note was made that penetrometer experiments had been rejected in favor of a seismometer for Ranger flights. Headquarters personnel pointed out that it was assumed pure science experiments

June 7 cont. would provide the necessary engineering answers for the manned lunar program. A major problem was agreed to be the need for attaining reliability on new untried launch systems, such as the Atlas-Agena B and Centaur. (Minutes of the OSS Senior Council Meeting, June 7, 1962, JPLHF 2-404c, and 2-1051.)

June 8 Guideline objectives and instrumentation for the Ranger Lunar Orbiter feasibility study was released. (JPL, IOM from C. Campen to H. Lawrence, June 8, 1962, JPLHF 2-1254.)

June 11 Dr. H.J. Stewart, of JPL, completed a flight performance expectancy study for the Ranger Project Office on Block III vehicles (Flights 6-9) and concluded: "1. The probability of no successful flights (0.18) is by no means insignificant. The program would be substantially improved if the number of flights were to be increased. 2. The most likely result is that zero or one successful flight will result; the probability of two or more flights has less than an even chance of eventuating." (JPL, IOM from H.J. Stewart to G.P. Kautz, June 11, 1962, JPLHF 2-1255.)

June 12 The Lunar Sciences Subcommittee of the NASA SSSC convened in Washington, D.C. Following deliberations, the Subcommittee recommended that the gamma-ray spectrometer be seriously considered as a passenger science experiment for planned Ranger Follow-on[2] (Flights 10-13, subsequently termed Block IV), and that the color wheel be removed from the TV package on Rangers 6-9. (Lunar Science Chronology, op. cit., 4.)

June 13 The RCA Engineering Test Model (ETM) of the Ranger Block III TV subsystem was received at JPL. (IOM from D.H. Kindt to Distribution, July 24, 1962, loc. cit.)

JPL proposed to NASA Headquarters that GMI 37-1-1 (see April 15, 1960) be revised to ensure that the cognizant NASA field center have complete control over science experiments assigned to its flight programs by OSS. (JPL, letter from W.H. Pickering to O.W. Nicks, June 13, 1962, JPLHF 2-1493b; also, JPL document entitled, "Suggested Revision of NASA Management Manual, Part IV, Chapter 37, Number 37-1-1, Effective Date April 15, 1960," June 13, 1962, JPLHF 2-1493c.)

June 14 Kurt H. Debus, Director of Launch Operations Center, submitted a statement to NASA Headquarters outlining the difficulties experienced in joint launch operations with the Air Force, and

June 14 cont. recommended that LOD be assigned sole responsibility for all AMR Pad 12 launches. (NASA document entitled "Statement of LOD Position Concerning Management of Launch Operations for NASA Agena-B Program at AMR," June 14, 1962, JPLHF 2-1256a; also, Minutes of NASA AMR Agena Management Meeting of 25 June 1962, JPLHF 2-2069.)

June 15 Following the United States commitment to a manned lunar landing, formation of an office to accomplish this task, and tentative decision for Lunar Orbit Rendezvous (LOR), the Office of Manned Space Flight (OMSF) formally submitted its list of requirements for data concerning the surface characteristics of the moon to the Office of Space Sciences. The document called for technological data as design inputs by the end of 1964, as design modifications before the end of 1965, and as hardware modifications before the end of 1966. The schedule emphasized the need for early return of minimum data and for giving priority to engineering design data over passenger science. (NASA, Office of Manned Space Flight, "Requirements for Data in Support of Project Apollo," Issue No. 1, June 15, 1962, JPLHF 2-2064.)

John Small, Section Chief of System Design, recommended that one way out of the dilemma involved in an early firing date for Ranger Follow-on[2] would be to convene a JPL team, survey qualified Los Angeles area firms on the basis of past performance, management capability and manpower, and award a contract for fabrication on a sole source basis. (JPL, IOM from J.G. Small to C.I. Cummings, June 15, 1962, JPLHF 2-1257.) (See May 8, 1962.)

June 17 The NAS SSB Iowa Summer Conference on space science and exploration began; it concluded on August 10.

June 18 Ranger Agena-B vehicle 6005 completed manufacture at LMSC in Sunnyvale.

June 21 In response to a JPL query, the Bendix Corporation responded that it would be interested in participating in fabrication of vehicles for Ranger Follow-on[2].

June 25 The first draft of a proposed scope of work for Ranger Follow-on[2] contractor was released in-house by the Ranger Project Office. (JPL, "Scope of Work for RFO[2] Contractor," by J.D. Burke, June 25, 1962, JPLHF 2-1260.)

June 25 cont. A meeting was convened by Dr. Debus at AMR to discuss problems of LOC-USAF relationships for Agena launchings. (See June 14, 1962.) A decision was reached that NASA should try to assume the launch operation functions currently held by the Air Force, with the change to be effective in time for the Ranger 6 flight. A revision of the Schriever-Seamans agreement of February 1961 would be prepared by LOC for transmittal to NASA Headquarters. (JPL, trip report prepared by J.D. Burke, Subject: LOD/AMR Meeting, June 25, 1962, JPLHF 2-1261.)

JPL Ranger Project Office received status reports on all passenger science experiments for Ranger Block III flights. Project came to the conclusion that "no action to delete any experiments is required at this time." However, based on prior experience with payload science electrical difficulties which jeopardize mission success, serious consideration was given to "placing fuses in power leads to each experiment." (JPL, IOM from A.E. Wolfe to J.D. Burke, June 26, 1962, JPLHF 2-1263; see also IOM from S. Rothman to Distribution, June 22, 1962, JPLHF 2-1262.) Fuses were, in fact, adopted shortly thereafter.

June 29 JPL Lunar Program people met with members of NASA OSS to present plans for extended Ranger and Surveyor Projects in support of Project Apollo. The principal recommendation made by JPL was that OSS seek OMSF participation and support in establishing requirements and objectives for the unmanned program. (JPL, letter from W.H. Pickering to R.C. Seamans, August 15, 1962, JPLHF 2-368.)

During June Ranger Block II. Ranger 5 continued systems tests and checkout at the SAF.

Ranger Block III. Mechanical assembly of the Ranger 6 spacecraft was completed, and initial power turn-on was accomplished on June 25. A Systems Test Complex (STC) was assembled for Block III spacecraft in the SAF, and compatibility testing between TV ground support equipment and the ETM TV subsystem began. (JPL, Space Programs Summary No. 37-16, Vol. VI, op. cit., 18; and, NASA, Seventh Semiannual Report to the Congress, January 1, 1962 - June 30, 1962, March 4, 1963, 53.)

Ranger Block IV. Initial planning at JPL and NASA for four additional Ranger flights was underway, although Project details remained to be worked out. The Northrop Space Laboratory contributed a "Preliminary Design Study for a Soft Landing Lunar Instrument Capsule," NSL 62-95, during the month.

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During June cont. DSIF. Construction of a new polar-mounted 85-ft. Ha-Dec antenna and associated buildings was completed at the Goldstone Echo station. The old 85-ft. Az-El antenna was moved six miles across the desert to the Venus station. Construction of the new antenna marked standardization of the complete DSIF net in antenna characteristics. (JPL, Space Programs Summary No. 37-16, Vol. III, for the period May 1, 1962 to July 1, 1962, 10-12.) In addition, the Goldstone complex of stations began to use commercial electrical power (5,000 kw). (NASA, Seventh Semiannual Report to the Congress, op. cit., 82.)

The Woomera Deep Space Station in Australia was equipped with a 50 W transmitter and a Ranger spacecraft command system. Woomera now possessed the same "uplink" and command capability as the other stations in the DSIF. (See DSIF, During March 1962.)

July 1 A Data Analysis Unit was established at Goldstone to evaluate the performance of the DSIF during all missions, and to perform near-real-time monitoring of tracking data during critical tracking periods. (JPL, Space Programs Summary No. 37-19, Vol. III, for the period November 1, 1962 to December 31, 1962, 13.)

July 2 Aviation Week indicated that NASA's unmanned lunar exploration program was being reoriented to "provide support for the nation's accelerated effort to place a man on the moon later in this decade." Objectives of the program were now reversed, with science behind the provision of engineering information. ("Unmanned Lunar Program to Aid Apollo," Aviation Week, July 2, 1962, 160, 163, JPLHF 2-595.)

July 3 At the Ranger Spacecraft System Review meeting, Don Kindt reported that the delivery of the RCA TV subsystem PTM would be delayed due to severe failure of the unit during thermal vacuum tests at the New Jersey plant. "Due to premature system turn-on, arcing occurred which damaged quite a portion of the PTM. Failure occurred in almost every sub-assembly. The PTM is being reworked and should be ready to go back into the chamber [for thermal vacuum tests] 7 July . . ." (JPL, Minutes, Ranger Spacecraft System Review, July 3, 1962, JPLHF 2-1313.)

July 9 Gordon P. Kautz, Assistant Ranger Project Manager at JPL, was assigned responsibility to prepare a plan for contractor participation in any extension of the Ranger Project. In addition, "cognizance over the RCA TV mission package is hereby transferred

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July 9 cont. — from the Assistant Ranger Project Manager, G.P. Kautz, to the Spacecraft System Manager, A.E. Wolfe." (JPL, IOM from J.D. Burke to Distribution, July 9, 1962, JPLHF 2-1264.)

July 10 — RCA presented findings of its Ranger Lunar Orbiter feasibility study to JPL. (A similar presentation was provided to NASA OSS on August 3.) (RCA, letter from J.E. Coburn, Marketing Representative, to John Small, JPL, July 25, 1962, JPLHF 2-2070a; and, RCA, "Lunar Orbiter," brochure containing information presented to NASA on August 3, 1962, JPLHF 2-2070b.)

July 13 — Based upon review meetings held earlier in the month, A.E. Wolfe informed J.D. Burke that a serious power problem on Block III Ranger flights was forecast due to the addition of science experiments and the available power output from Block II-type trapazoidal solar panels planned for use on the Block III flights. It was believed that problems associated with adapting rectangular Mariner R type solar panels might be resolved in time for use on RA-8. If not, the remaining option was to reduce the number of planned passenger science experiments on board or otherwise compromise the mission objectives. (Given NASA Headquarters direction to fly additional science, removal or reduction of experiments was considered a "drastic option." Final review recommendations were scheduled for the JPL Project Manager on July 23. (JPL, IOM from A.E. Wolfe to J.D. Burke, July 13, 1962, JPLHF 2-1278.)

July 17 — Speaking before the American Rocket Society Lunar Missions meeting, in Cleveland, Ohio, Joseph Shea, Deputy Director for Systems, Office of Manned Space Flight, briefly described the implications of LOR for manned flight and consequent effects on data requirements from OSS. (See June 15, 1962.) Basically, Apollo was in need of information on (1) cislunar and lunar environment (e.g., micrometeoroid flux, and radiation intensity), (2) reconnaissance and topography (primarily high resolution mapping for landing areas), and (3) surface characteristics (roughness, slope, and bearing strength, etc.). Shea indicated that both Ranger and Surveyor were "expected to 'make straight the way' for the manned lunar mission." The Ranger contribution would consist of data in categories (1) and (3), with emphasis on close-up photographs of the lunar surface prior to impact. (Joseph F. Shea, "Relationship Between the Manned and Unmanned Programs," Technology of Lunar Exploration, Progress in Astronautics and Aeronautics, New York and London, 1963, Vol. 10, 971-974.)

July 19 — NASA OSS held a Program Review for Associate Administrator R.C. Seamans Jr. During the meeting, Dr. Seamans and Mr. Cortright

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July 19 cont. agreed that "JPL should carry out the complete Ranger program with minimum contracting to industry." (NASA, Minutes of Seamans' OSS Review of 19 July 1962, JPLHF 2-1759.)

July 20 In conformance with agreements reached at NASA Headquarters on July 19, NASA released Program Guidelines for Surveyor and for an expanded Project Ranger. Included were five additional flights during 1964 (Rangers 10-14) carrying an improved RCA TV package as well as non-visual bus experiments. These spacecraft were "to be assembled and tested in-house but with some increased Divisional Contractor support allowed." (NASA, TWX from O.W. Nicks to B. Sparks, June 20, 1962, JPLHF 2-1174.)

Aeronutronic released final reports on development of its follow-on SURMEC lunar rough-landing capsule, begun in late 1961, under contract to JPL. SURMEC accelerometer, penetrometer, and geophone were designed to yield data on the presence of granular or solid surfaces, penetration resistance and crushing strength of the surface, the existence and depth of a possible dust layer or other soft surface structures, and the nature of the subsurface structure. (Aeronutronic Publication Nos. U-1765, U-1778, and U-1775.) (See January 8, 1962.)

July 22 First launch of a Mariner R spacecraft toward Venus took place just eleven months after the project was authorized by NASA. Mariner 1-Atlas 145D-Agena B 3901 was launched from Pad 12, AMR, after the first countdown on July 21 had been terminated when some anomalies occurred during Range Safety system checks. Just prior to Atlas-Agena separation the vehicle was destroyed by Range Safety when it became apparent that it was on an "out-of-control condition." Findings of the Postflight Review Board released on July 27 determined that the vehicle was lost because of a paper mistake: "The failure of the Mariner 1 mission was the result of a missile-borne . . . rate beacon malfunction and the omission of a data editing function in the guidance equation, neither of which alone would have caused the failure. Because the data editing function should have been able to compensate for the rate beacon malfunction, the primary cause of mission failure is attributed to the omission in data editing." This deficiency in Atlas programming had been present in all of the early Ranger flights as well.

Work proceeded to ready the second Mariner spacecraft for launch before the close of the 50-day Venus launch window, on September 10, 1962. (JPL, Space Programs Summary No. 37-17, Vol. VI., op. cit., 23.)

July 24 The Quarterly Status Report on the RCA TV subsystem was released at JPL. Two areas of concern had developed: vidicon rejections caused by problems of low sensitivity, mesh focus, and inadequate erase; and proper camera calibration for reflected light at the lunar surface. (The latter difficulty arose over differing interpretations of expected light intensity at the lunar surface.) It was noted that the PTM had now "completed all environmental testing at RCA, including vibration, vacuum-thermal, 66-hour mission, thermal and ETO sterilization, with no major problems." (See July 3, 1962.) (JPL, IOM from D.H. Kindt to Distribution, July 24, 1962, JPLHF 2-1265.)

July 25 R.C. Hastrup at JPL recommended that lunar spacecraft sterilization requirements be relaxed, and that the effort be increased in planetary missions after appropriate refinements were incorporated: "We are presently paying a substantial price in the current effort to sterilize all of our lunar spacecraft. . . . the application of sterilization procedures such as the dry heat cycle presents a serious risk to reliability. . . . Whereas we may estimate that the direct cost of our sterilization program is no more than . . . a few hundred thousand dollars per mission, if we affect reliability such that we fail a mission, then we are accountable for a huge additional dollar cost as well as program schedule time which cannot be made up." (JPL, IOM from R.C. Hastrup to G. Hobby, July 25, 1962, JPLHF 2-1735.)

July 27 During the NAS Iowa Summer Study, Working Group 9 released draft guidelines for space probe sterilization that stated:

> 8. Contamination of the moon does not constitute as serious a problem as in the case of the planets. Nevertheless, lunar contamination should be kept at a feasible minimum. For this reason the lunar probe sterilization program should continue in order to insure that the contamination of the moon will remain below that which will seriously interfere with future biological and chemical surveys, and also to advance the art of space probe sterilization.

(NAS document entitled "Proposed Sterilization Guidelines as Modified by Working Sub-Group on Space Probe Sterilization," July 27, 1962, JPLHF 2-1266.)

J.D. Burke informed B. Sparks, JPL Deputy Director, that power available vs. demand was marginal for RA-7, and in a worse condition for RA-8 and 9. Notice was given that some or all of the science experiments and possibly the 2300 mc ranging experiment might have to be deleted. OSS would probably prefer to reverse

July 27 cont. — the order of deletion. Action was postponed pending further investigation by A.E. Wolfe.

The JPL Ranger Project Office also had "accepted a first quarter '64 launch date for RA-10 and a stretchout of subsequent shots; i.e., at least a 3-month slip relative to our June 29 proposal." (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 69, July 27, 1962, JPLHF 2-1314.)

July 31 — F.A. Goodwin notified J.D. Burke that "the Mariner R solar panel, planned for later TV capsule missions, cannot be used on lunar rough landing missions owing to the panel and fixity requirements which are incompatible with the payload structure." Missions using the lunar rough-landing capsule would require a power profile compatible with the Ranger 3-5 solar panel area. (JPL, IOM from F.A. Goodwin to J.D. Burke, July 31, 1962, JPLHF 2-1267.)

During July — Ranger Block II. The Ranger 5 spacecraft underwent flight acceptance tests in the 6-foot space simulator at JPL. Matchmate tests with the Agena adapter followed later in the month. (JPL, Space Programs Summary No. 37-17, Vol. I for the period July 1, 1962 to September 1, 1962, 3-4.)

Ranger Block III. Subsystem and system tests and calibrations were conducted with RA-6 alone and coupled with the RCA ETM. Fabrication of an enlarged (over Block II Rangers) propellant tank and tank bladder for use on Ranger Block III midcourse propulsion systems was progressing on schedule. (JPL, Space Programs Summary No. 37-16, Vol. VI, op. cit., 17; and Space Programs Summary No. 37-17, Vol. I, op. cit., 6.)

Mechanical assembly of RA-7 began on July 9. Late delivery of scientific experiments and difficulties with experiment bracket mountings caused minor slips in the schedule. (JPL, Space Programs Summary No. 37-18, Vol. I for the period September 1, 1962 to November 1, 1962, 9.)

Facilities. With funds approved for a Space Flight Operations Facility (SFOF--see proposals June 22, 1961), JPL awarded contracts to various industrial firms to analyze the total system, including the DSIF, from the standpoint of communications, operations, and status displays. ("Deep Space Tracking Network Expanding," Aviation Week, July 2, 1962, 175, JPLHF 2-596.)

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During July cont.	Organization. JPL eliminated Division 36 (Physical Sciences) and merged it with Division 32 (Space Sciences). Dr. R.V. Meghreblian was placed in charge of Division 32.
Aug. 1	During the Ranger Spacecraft System Review, Don Kindt reported that the RCA TV PTM would be delivered the following day; however, a repeat of the earlier PTM failure had occurred when battery power shorted to the chassis: "The exact cause has not been determined, but precautionary circuitry (fuses, etc.) has been added. . . . "A failure [also] occurred in the harness due to brittleness caused by heat sterilization." A.E. Wolfe announced that Mariner-type solar panels would be employed on Ranger beginning with RA-9; the status of science and ranging on RA-7 and 8 was not yet resolved. (JPL, Minutes, Ranger Spacecraft System Review, August 1, 1962, JPLHF 2-1313.) (See July 3, 1962.)
Aug. 2	A.E. Wolfe released findings on anticipated Ranger Block III spacecraft power shortages for science experiments. (JPL, IOM from A.E. Wolfe to J.D. Burke, August 2, 1962, JPLHF 2-1268.) At the Project level, NASA Headquarters became aware of the serious power problem and possible alternatives for Ranger Flights 7 and 8. (NASA, Memo to File from W. Jakobowski, Subject: Ranger Power Budget and RCA Funding Status, August 2, 1962, JPLHF 2-643.)
Aug. 7-8	N.W. Cunningham, NASA Ranger Program Chief, met with J.D. Burke, A.E. Wolfe, and G.P. Kautz at JPL. Project funding and status were reviewed, including spacecraft power difficulties on RA-7, 8, and 9. It was decided that a full report would be presented at the next meeting of the NASA SSSC, including JPL's recommended priority for passenger experiments. A meeting was also held between these individuals and Donal B. Duncan, together with members of his staff at ADF. Cunningham informed the group that in view of limited funds for FY 1963 and the small probability of support from OMSF, it was necessary to assume that an ADF effort on follow-on rough-landing lunar capsules could not be considered until FY 1964. Planned Rangers 10-14 would fly with an improved TV subsystem and passenger science. Duncan responded that without NASA assurance of future support he would have to disband and release the ADF capsule team. (NASA, Memo from N.W. Cunningham to O.W. Nicks, August 16, 1962, JPLHF 2-1175.)

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Aug. 8 Experiment priority for Ranger 5, the last Block II spacecraft remaining to be flown, was modified by eliminating the last two experiments from the list: Thermometers and Impact Accelerometers. (Contrast priority with December 19, 1960.) (JPL Specification RA345-2-110D, Functional Specification Ranger RA-3, RA-4 and RA-5 Spacecraft, Mission Objectives and Design Criteria, August 8, 1962, 5, JPLHF 2-1095e.)

Aug. 9 Brooks T. Morris, charged with Reliability Assurance at JPL, (see July 7, 1961), notified R.V. Meghreblian, Chief of JPL's Space Sciences Division, that he was, for various reasons, pessimistic about the proper functioning of scientific instruments currently being placed on spacecraft in the lunar and planetary programs. (JPL, IOM from B.T. Morris to R.V. Meghreblian, August 9, 1962, JPLHF 2-1341.)

A.E. Wolfe recommended to R.V. Meghreblian that, in view of experience gained in Project Ranger, JPL establish firm guideline procedures for dealing with future science experimenters involved in spacecraft missions. (JPL, IOM from A.E. Wolfe to R. Meghreblian/K. Coon, August 9, 1962, JPLHF 2-1270.)

Aug. 10 J.D. Burke notified N.W. Cunningham, Ranger Project Chief at NASA Headquarters, that spacecraft power limitations might require deferral or removal of passenger science experiments on Rangers 7-9. He continued: ". . . no immediate removal of experiments is recommended. I suggest, however, that you take whatever steps are necessary to prepare for the possibility of such removal in the future and in particular that we reach agreement on a priority list so that the least important instruments are removed first." Use of the Mariner R solar panels beginning with RA-9 was also outlined; to further alleviate the power shortage JPL would "fly the 2300 mc radio experiment on Rangers 9 and 10 instead of 8 and 9 as previously planned. . . ." Also included was a recommended priority for science experiments based upon (1) value to the manned lunar landing program, (2) instrument performance, and (3) suitability for removal at a late date without major disturbance to the primary mission. (JPL, letter from J.D. Burke to N.W. Cunningham, August 10, 1962, JPLHF 2-1272.)

The Space Science Board of the National Academy of Sciences concluded its summer study at the State University of Iowa. Findings of the study, released later, recommended increasing the number and information-gathering scope of unmanned lunar probes in support of Project Apollo, with "information useful for engineering design . . . given priority over information that is purely of

Aug. 10 cont. scientific interest." (p. 4-3) While the significance of Project Apollo was conceded, and it was recognized as an engineering enterprise in its initial phases, the SSB asserted that "as the engineering tasks are accomplished, however, scientific investigations and missions will also be phased into the program; and, as flexibility and sophistication are achieved, scientific investigations will become the primary goals. Appreciation of these concepts is of critical importance to the acceptance of the current Apollo program by scientists throughout the country. . . ." (p. 1-22)

Turning to questions of science in space, the SSB agreed that NASA should "allocate blocks of payload space in a satellite or series of satellites to scientists of demonstrated competence." However, those assembled could not agree upon, and did not discuss in depth, the everpresent question of just what science was important: "The assignment of relative priorities to scientific program and experiments was not adequately discussed for the space science program as a whole: their relative scientific importance, the proper time sequence for optimizing the scientific return, or the equitable and efficient distribution of funds from a limited budget. This, it is almost impossible to decide on rational grounds many questions that cut across the entire program as long as a variety of special interests are represented." Some limited recommendations were made on priorities in specific fields of activity. (pp. 1-4 and 1-5) (<u>A Review of Space Research</u>.)

Aug. 11-12 The Soviet Union launched <u>Vostok III</u> into orbit, piloted by Cosmonaut Andrian G. Nikolayev. The following day <u>Vostok IV</u>, commanded by Pavel R. Popovich, was placed in a similar orbit and performed rendezvous maneuvers with Nikolayev. This was the first flight of two manned spacecraft within a twenty-four hour period. Both craft returned safely to earth several days later. The event stirred extensive debate in Congress and in NASA over the possibility of accelerating America's manned space efforts. (<u>Astronautical and Aeronautical Events of 1962</u>, <u>op. cit</u>., 146-154.)

Aug. 12-17 The Conference on Lunar Exploration was held in Blacksburg, Virginia, by the Virginia Polytechnic Institute in cooperation with the NSF and NASA. In a description of NASA's scientific lunar program, Oran W. Nicks noted that current activity tended to give the impression of a division between manned and unmanned lunar science efforts. He affirmed that good science was the ultimate objective, and that unmanned flights would phase out as manned flights began. The two objectives of NASA's lunar

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Aug. 12-17 cont. program were considered to be scientific and technological: "however, at present, the emphasis in lunar programs is successful accomplishment of scientific experiments." Experiments would be geared to determine the characteristics of:

lunar environment
surface features
properties as a body
physical and chemical properties.

(Proceedings of the Conference on Lunar Exploration, August 12 through 17, 1962, Part C, XIII-1 and 3.)

Aug. 13 JPL requested NASA sterilization waivers for two critical items on Ranger spacecraft 6-9: (1) All electrical cable harnesses for the bus and RCA-AED TV system, and (2) All vidicons (six per spacecraft) on the RCA-AED TV subsystem. "Waivers for the above items are urgently requested as it is considered that continued heat sterilization of these items on Ranger spacecraft would seriously jeopardize attainment of the primary mission objectives." (JPL, TWX from W.H. Pickering to H.E. Newell, August 13, 1962, JPLHF 2-1273.)

RA-5 completed final systems test before shipment to AMR on August 20. (JPL, Minutes of Ranger Spacecraft System Review, August 15, 1962, JPLHF 2-1313.)

Aug. 14 JPL requested a decision from NASA Headquarters concerning the development of rough-landing capsules for follow-on Ranger spacecraft, with a go-ahead date of September 1 as established in the meeting of June 29, 1962. Aeronutronic Division of Ford would disband its capsule team after September 1 if a decision was not forthcoming. (JPL, letter from Brian Sparks to Oran W. Nicks, August 14, 1962, JPLHF 2-262.)

Aug. 15 W.H. Pickering wrote NASA Associate Administrator R.C. Seamans and recommended that they discuss a course of action on further lunar landing capsules at ADF--while leaving the problem of auxiliary science on Rangers 6-9 to personnel at the project level--as it related to unmanned lunar flight efforts in support of the manned flight program. Since the ADF SURMEC effort offered the potential of early return of information on the nature of the lunar surface (see July 20, 1962), which was directly applicable to the engineering needs of Project Apollo, OMSF might wish to support this work with CSS. In the meantime JPL was "proceeding on the basis that Rangers 10 through 14 will carry TV missions

Aug. 15 cont. only, as [now] directed by OSS. . . . If there is a serious prospect that . . . [NASA] will want them [ADF capsules] in CY 64, we should do something about it now. If not, we should terminate the Aeronutronic effort as promptly and efficiently as possible after the flight of Ranger 5." (JPL, letter from W.H. Pickering to R.C. Seamans, August 15, 1962, JPLHF 2-368.) (See June 29, 1962.)

JPL released its Lunar Program Guidelines which affirmed that the primary objectives of the lunar program were, first, to provide assistance to Project Apollo and, second, to acquire scientific information to determine the nature and origin of the moon and solar system. Scientific objectives were stacked in the same order . (See August 12-17, 1962.) (JPL, Engineering Document No. 22, Jet Propulsion Laboratory Lunar Program Guidelines, August 15, 1962, 5-6, JPLHF 2-751.)

Aug. 16 NASA informed JPL that waivers on heat sterilization of two requested items were granted. "It should be understood that these waivers apply only to heat sterilization . . . and do not affect the requirements for terminal ethylene oxide sterilization." (NASA, letter from H.E. Newell to W.H. Pickering, August 16, 1962, JPLHF 2-1274.)

British astronomer Sir Bernard Lovell declared that, in light of recent events, ". . . the Russians have demonstrated that they are so far ahead in the technique of rocketry that the possibility of America catching up within this particular sphere in the next decade is now remote." (New York Times, August 16, 1962, JPLHF 218c.)

Aug. 17 NASA Headquarters designated the NASA Launch Operations Center as the single point of contact with the Atlantic Missile Range for all NASA programs. (NASA, memo to Hans Hueter, Director of Light and Medium Vehicles Office at MSFC, from Kurt H. Debus, Director of LOC, August 17, 1962, JPLHF 2-2071.)

Aug. 23 NASA authorized JPL to procure long leadtime items necessary for maintaining the schedule established for RA-10. (First flight scheduled for February 1964.) Total expenditures were not to exceed $200,000. (NASA, TWX from N.W. Cunningham to J.D. Burke, August 23, 1962, JPLHF 2-1176.)

N.W. Cunningham, Ranger Program Chief, directed a memo to John F. Clark, Chairman of the NASA SSSC, informing the Committee of the power problems on Rangers 7-9. The alternatives were to go to larger Mariner R type solar panels or to remove some or all of the passenger science experiments. In an attachment to the memo

Aug. 23 cont. the OSS scientific objective for this block of Ranger flights was stated to be "acquisition of knowledge of lunar topography sufficient for determination of its gross effects on lunar landing vehicles" for Project Apollo, and achieved by the RCA TV subsystem. "A secondary scientific objective is the acquisition of knowledge of the "Fields and Particles' environment of cislunar and lunar space which may be of importance to manned lunar flights, or which may yield data pertinent to the origin of these environments." (Contrast with objectives at August 12-17, 1962.) (NASA, memo from N.W. Cunningham to the Chairman, Space Sciences Steering Committee, August 23, 1962, JPLHF 2-688.)

Aug. 27 Mariner II-Atlas D 179-Agena B 6902 was launched from Pad 12 at AMR, after a one-day delay occasioned by stray voltage in the command destruct system. The Atlas booster experienced a malfunction of one vernier engine which caused a hard-over roll rate at booster shutdown, but the vehicle subsequently restabilized and performed properly. The Agena also successfully completed its dual burn program achieving escape velocity, and the spacecraft was injected into a planned deep space Venus encounter trajectory. Mariner II, adapted from Ranger Block I for a deep space mission, properly performed stabilization and orientation maneuvers. Cruise science instruments were successfully turned on by the South African DSIF station on August 29. (JPL, Space Programs Summary No. 37-17, Vol. VI, op. cit., 23, 35-36.) (Figure 51.)

RA-5 was received at AMR with no shipping damage; a brief systems check indicated that the spacecraft was operating satisfactorily. (JPL, Minutes of Ranger Spacecraft System Review, August 29, 1962, JPLHF 2-1313.)

Aug. 29 J.D. Burke informed affected JPL divisions that it was the Laboratory's decision that Ranger spacecraft 10 through 14 would be handled "as additions to the present Ranger Follow-on program [RA 6-9], and, as such, will be considered an on-Lab project. Subsystem procurement from vendors will remain the responsibility of the involved divisions . . ." (JPL, IOM from J.D. Burke/G.P. Kautz to Distribution, August 29, 1962, JPLHF 2-1276.)

Aug. 30 R.C. Hastrup notified C.I. Cummings, JPL Lunar Program Director, that NASA-JPL heat-sterilization policy for lunar spacecraft was a critical determinant in recent Ranger Project reliability and schedule difficulties. He urged that, in consonance with the findings of the Ad Hoc NASA Sterilization Conference of July 9 and the Iowa summer study, basic NASA policy be modified:

1. Use of heat for sterilization of lunar spacecraft

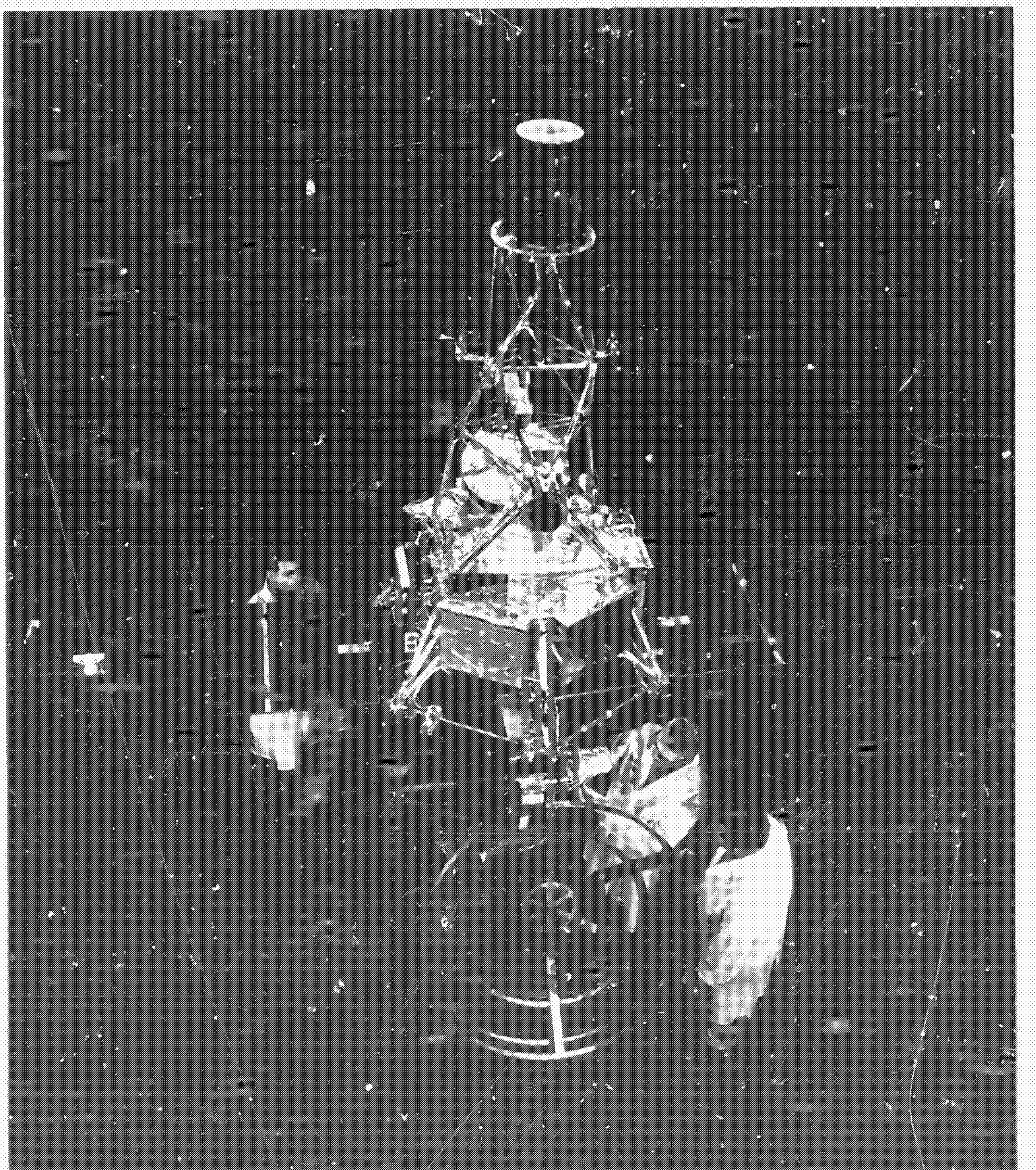

Figure 51: Mariner 2 spacecraft at JPL.

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Aug. 30 cont.

should be waived for all flight hardware to improve spacecraft reliability.

2. Use of ethylene oxide glove box assembly or other sterile manufacturing procedures should not be required as substitute for heat sterilization on lunar spacecraft because of the severe assembly and schedule problems this would create; however, cleanest possible assembly practices should be continued throughout spacecraft preparations.

3. Capability for terminal sterilization of the completed spacecraft assembly in a sealed shroud using ethylene oxide should be continued.

4. Importance of very stringent requirement for planetary spacecraft sterilization must be re-emphasized. Advantage should be taken of any relaxation in lunar sterilization requirements to divert required effort to insure development of satisfactory planetary hardware and procedures.

It is urged that NASA concurrence with the above recommendations be obtained as soon as possible. . . ." (JPL, IOM from R.C. Hastrup to C.I. Cummings, August 30, 1962, JPLHF 2-1277.) (See July 25, 1962.)

Aug. 31

JPL requested a waiver of heat sterilization for Ranger spacecraft Central Computer and Sequencers (CC&S) and associated electronic modules from NASA Headquarters: "Failures have occurred with at least seven out of eight sets of modules as a result of heat sterilization. . . . It is strongly believed the heat sterilization procedure seriously reduces the reliability of the CC&S. It may also be signific..t that the area of failure on RA-4 has been traced to the CC&S or its related power modules. This waiver would affect RA-8 and subsequent spacecraft because earlier spacecraft modules have already been sterilized. . . ." (JPL, TWX from W.H. Pickering to H.E. Newell, August 31, 1962, JPLHF 2-1280.)

During August

Ranger Block II. Ranger 5 was shipped to AMR on August 20, arriving on August 27. Thereafter the spacecraft was subject to launch preparation activities (prelaunch systems tests and checkouts) in support of an October 18 flight date. (JPL, Space Programs Summary No. 37-18, Vol. I, op. cit., 4.)

Ranger Block III. The TV PTM was received at JPL on August 2 and a series of system tests was begun. Fabrication of flight model units began at RCA. The RA-6 spacecraft completed vacuum-temperature tests in the 6-ft. space simulator, and was

During August cont. — subsequently mated to the RCA PTM for further environmental and system tests. RCA completed fabrication, assembly, and tests on all the TV recording and display equipment for use in Block III flights. The units were placed in use at RCA for the training of field personnel. (JPL, Space Programs Summary No. 37-17, Vol. VI, op. cit., 5; also, Space Programs Summary No. 37-18, Vol. VI, op. cit., 6 and 15; and, Space Programs Summary No. 37-17, Vol. I, op. cit., 64.)

Sept. 5 — NASA authorized waiver of heat sterilization for those items requested by JPL on August 31, 1962. (NASA, TWX from N.W. Cunningham to C.I. Cummings, September 5, 1962, JPLHF 2-1281.)

The JPL Space Sciences Division selected preferred lunar impact points for Ranger 6 for launch in January/February 1963.

Sept. 6 — A course of action was established at NASA Headquarters for a minimal Ranger Project extension employing rough-lander capsule missions, predicated upon four ground rules:

1. Objectives of the Office of Space Sciences (OSS) would be given first priority.
2. Ranger flights 10-14 would carry an RCA TV package with no consideration for alternate exchangeable payloads.
3. Support for the Office of Manned Space Flight (OMSF) would be limited to passenger bus science experiments.
4. Four seismometer capsule missions would be scheduled for CY 1965.

The last point "was arrived at after we had reviewed the consequences of pursuing a semi-crash effort involving alternate ADF capsules. . . . Therefore, it is suggested that consideration be given to additional seismometer capsule missions as opposed to new capsule developments. This approach has several advantages. The first and probably most important at this time is that no FY 1963 money is involved. . . ." (NASA, Memo for Director, Lunar and Planetary Programs, from N.W. Cunningham, September 6, 1962, JPLHF 2-689.)

Sept. 7 — NASA Headquarters authorized Marshall Space Flight Center to initiate procurement of Atlas boosters and Agena vehicles for the first two additional Ranger launches, RA-10 and 11. (NASA. TWX from D.L. Forsythe, Headquarters, to F. Duerr, MSFC, September 7, 1962, JPLHF 2-1316.)

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Sept. 10 The Ranger Project Office notified the JPL Deputy Director that tests at AMR had uncovered difficulties with the ADF lunar capsule "because of sterilization caused failures in squib switches." (JPL, IOM from Cummings/Wolfe to B. Sparks, Ranger Project Status Report No. 75, September 10, 1962, JPLHF 2-1314.)

Sept. 12 B.T. Morris informed J.D. Burke that continued Atlas booster failure in NASA and USAF programs raised the likelihood of another booster malfunction experience for the flight of RA-5. He recommended that the flight be delayed if necessary until Marshall Space Flight Center had furnished evidence that corrective action had been taken to improve Atlas flight control electronics. (JPL, IOM from B.T. Morris to J.D. Burke, September 12, 1962, JPLHF 2-1282.)

Sept. 17 All Sections at JPL involved in Project Ranger were instructed to perform thermal sterilization of Ranger hardware before Flight Acceptance Tests. This was to eliminate previous practices in which post-FA sterilization bypassed environmental tests of hardware. (JPL, IOM from A.E. Wolfe to Distribution, September 17, 1962, JPLHF 2-1693; also, IOM from A.P. Bowman to A.E. Wolfe, September 18, 1962, JPLHF 2-1694.)

Sept. 19 JPL released operations guidelines for DSIF handling priorities in the continuing flight of Mariner II and for Ranger 5. (JPL, IOM from P.J. Rygh to Distribution, September 19, 1962, JPLHF 2-1283.)

Sept. 20 The Planetology Subcommittee of the SSSC met and heard N.W. Cunningham discuss the status of Project Ranger and plans for the future. (Lunar Science Chronology, loc. cit.)

Sept. 21 Difficulties with development of the liquid hydrogen-oxygen Centaur upper stage vehicle led JPL to support W. von Braun, Director of MSFC, in recommending that the project be cancelled and replaced by a Saturn C1/Agena D to serve Centaur's spacecraft clients. (Centaur's spacecraft clients at this time were Surveyor and Mariner B-Mars.) (JPL, letter from B. Sparks to H.E. Newell, September 21, 1962, JPLHF 2-353.)

Sept. 24 NASA Associate Administrator R.C. Seamans, in response to the letter of August 15, informed W.H. Pickering that it was his "intent to rely upon the final judgment of Homer Newell and Brainard Holmes to determine the balance of efforts within the

Sept. 24 cont. framework of their assigned responsibilities. I hope you will be able to work out technical program details with these Directors, but I certainly want you to feel free to discuss any matters with me which you believe deserve my attention, if you are not satisfied with decisions that have been made. Your letter leads me to believe there are management problems which should be discussed, and for this reason I have arranged to meet with you, Dr. Newell, and Mr. Holmes on Thursday, October 11." (NASA, letter from R.C. Seamans to W.H. Pickering, September 24, 1962, JPLHF 2-367.)

The JPL Systems Division had recommended slipping the flight of RA-5 on grounds of a heavy work load with Mariner and demonstrated Atlas cabling faults. J.D. Burke "replied that slipping RA-6 would be a more acceptable approach and the issue was held until the end of this week." (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 77. September 24, 1962, JPLHF 2-1314.)

Sept. 25 Ranger 5 experimenters met to discuss experiment alternatives and compromises in case of nonstandard flight performance. (JPL, Summary of Experimenters Meeting on Ranger 5, held on September 25, 1962, JPLHF 2-1284.)

Sept. 26 Further analysis of an ADF test seismometer capsule indicated that the survival sphere would probably freeze up at approximately lunar midnight, assuming that it survived landing and operation during the lunar day. (JPL, Minutes of Ranger Spacecraft System Review, September 26, 1962, JPLHF 2-1313.)

An experimenters meeting for RA-6--RA-9 flights resulted in a decision to enhance the probability of useful pictures from the narrow-angle cameras by increasing the shutter speed from 2 milliseconds to 4 milliseconds. In addition, it was unanimously agreed that the color wheel (or filters) on Ranger 6 should be removed and not be replaced until it was determined their use would not seriously degrade pictures produced by the RCA system. (JPL, letter from Roy G. Brereton to Dr. G.P. Kuiper, University of Arizona, October 18, 1962, JPLHF 2-1324.) (See also February 1-2, 1962.)

Sept. 28 JPL informed NASA Headquarters of the status of Ranger 5 sterilization and decontamination measures, and components for which sterilization waivers had been granted. (JPL, letter from C.I. Cummings to H.E. Newell, September 28, 1962, JPLHF 2-1692.)

During September <u>Ranger Block II</u>. RA-5 continued prelaunch preparations at AMR.

During September cont. Ranger Block III. RA-6, mated with the RCA PTM, successfully completed vibration tests simulating the launch and ascent environment created by the Atlas and Agena. All science experiments were installed and power turned on in RA-7, and the spacecraft began system testing on September 28. Assembly of RA-8 began on September 19. The mechanical test model for Rangers 7 and 8 passed type approval vibration tests. (JPL, Space Programs Summary No. 37-18, Vol. I, op. cit., 22; also Minutes of Ranger Spacecraft System Review, loc. cit.; and, JPL, Space Programs Summary No. 37-19, Vol. VI for the period November 1, 1962 to January 31, 1963, 10.)

The assembly of the TV subsystem for RA-6, Flight Model 1 (FM1), was completed, and the unit completed environmental tests prior to shipment to JPL on October 1. RCA notified JPL that FM2 and all succeeding flight units would be delivered one month behind schedule. A "problem of shutter noise occurring in the picture and microphonic tubes has appeared. RCA believes they have means of eliminating these problems. . . ." (JPL, Minutes of Ranger Spacecraft System Review, September 12, 1962, JPLHF 2-1313; also, Space Programs Summary No. 37-18, Vol. VI, op. cit., 15-16.)

RCA issued an analysis of the Ranger Block III TV subsystem. RCA Report EM-61-421-29, Ranger Television Subsystem Analysis, September 1962, JPLHF 2-1542.)

Oct. 2 N.W. Cunningham notified O.W. Nicks, Director of Lunar and Planetary Programs, that lead times involved in the planned flight schedule for RA-10 made it necessary to authorize JPL manpower assignments for RA 10-14, and additional funding for procurement of flight hardware items. (NASA, Memo to Director, Lunar and Planetary Programs, from N.W. Cunningham, October 2, 1962, JPLHF 2-1179.)

Oct. 3 NASA authorized release of an additional $2 million to JPL for procurement of flight hardware for Rangers 10-14. (NASA, TWX from E.M. Cortright to R.E. Rodney, NASA WOO, October 3, 1962, JPLHF 2-1180.) This action authorized work to begin on five additional Ranger television missions, subsequently known as Ranger Block IV. Procurements were initiated as rapidly as possible because the funding was late in regard to desired flight dates.

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Oct. 4 A meeting was convened in JPL Lunar Program Office, attended by representatives from all Divisions, in which the rough philosophy for contracting additional Ranger spacecraft busses was agreed upon. Under a contract monitored by the Systems Division, a bus contractor would be introduced in two phases: Phase I, covering the period of RA 7-14, would consist of increased contractor participation in all areas of activity; in Phase II, covering the period RA 15-on, the contractor would assume all detail functions although final responsibility would remain with JPL. (IOM, from G.P. Kautz to Ranger Bus Contractor Committee, Subject: Divisional Ratification of Bus Contractor Concept, October 4, 1962, JPLHF 2-1475a; and, Document entitled "Ranger Project Office, Bus Contractor Philosophy," October 4, 1962, JPLHF 2-1475b.) (See July 9 and July 19, 1962.)

Oct. 5 N.W. Cunningham directed JPL to proceed with negotiations of a contract with ADF for research, development, and procurement of components for additional lunar rough-landing capsules. Ground rules specified that these capsules would "serve as alternate payload possibilities for [additional] Ranger missions beginning in January, 1965," and that "the capsule type is restricted to the Lunar Surface Photoreconnaissance Capsule (LSPC)." (NASA, TWX from N.W. Cunningham to J.D. Burke, October 5, 1962, JPLHF 2-1285.)

Oct. 8 J.D. Burke informed the JPL Deputy Director that a decision had been reached to launch RA-5 on schedule, in mid-October, and possibly slip RA-6 through 8 to allow for re-examination of the Atlas booster problems. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 79, October 8, 1962, JPLHF 2-1314.)

The JPL Lunar Program Office received word from the Space Science Division that, when a bus contractor was hired to fabricate Ranger vehicles 10-14, Space Science would expect to "let a subcontract for the complete integration and/or procurement of the instruments. It would of course be required that the Science Subcontractor work directly with the Bus Contractor in the integration of instruments. . . ." (JPL, IOM from R.V. Meghreblian to C.I. Cummings, October 8, 1962, JPLHF 2-1317.) (See October 4, 1962.)

Oct. 10 In a memo to the Ranger Project Manager, B.T. Morris recommended that J.D. Burke meet with Howard Haglund to review the CC&S design in terms of degree of risk of repeating an RA 4-type failure in the clock circuits or power unit serving it during the scheduled

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Oct. 10 cont. flight of RA-5. (Under the direction of JPL's Guidance and Control Division, Nortronics was assisting in a CC&S design review.) (JPL, IOM from B.T. Morris to J.D. Burke, October 10, 1962, JPLHF 2-1318.)

Oct. 11 A meeting was held at NASA Headquarters attended by W.H. Pickering, H.E. Newell, D.B. Holmes, J.F. Clark, O.W. Nicks, and R.A. Seamans, to consider OSS-OMSF rleations and Project Ranger activities in support of the manned lunar flight program. (See August 15 and September 24, 1962.) Dr. Seamans reiterated his delegation of responsibility for the manned and unmanned lunar program to Holmes and Newell, and "encouraged" cooperation between these gentlemen and between JPL and OSS. It was agreed by the participants that extended Ranger flights would make an important contribution to Apollo, and Mr. Nicks reported that JPL had been authorized to contract for additional rough-landing capsules. It was further agreed that Ranger 5 would be launched on schedule. Reprogramming of Ranger was assigned priority over Surveyor Orbiter, and the RCA Ranger Lunar Orbiter study was cancelled. Finally, Dr. Seamans requested that Dr. Newell maintain close coordination on project planning with JPL and OMSF. (NASA, Memo for the Record, by O.W. Nicks, Subject: Ranger Project Activities Discussion on 11 October 1962, November 15, 1962, JPLHF 2-361; and, JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 80, October 15, 1962, JPLHF 2-527.)

J.D. Burke notified N.W. Cunningham that:

> For the first time since the Ranger Project began, I believe that we can now see a potential gain which outweighs the penalty of slipping a future flight schedule. Confirming our October 9 discussion in Washington, I am therefore recommending that we immediately alter the flight dates for Rangers 6, 7 and 8 to the following schedule:
>
> Ranger 6 - February 12-15, 1963
> Ranger 7 - April 12-15, 1963
> Ranger 8 - June 10-13, 1963

The delay was considered desirable to secure time for improving booster, spacecraft, and TV system reliability. (JPL, letter from J.D. Burke to N.W. Cunningham, October 11, 1962, JPLHF 2-1319.)

JPL established priority guidelines for Space Flight Operations support of RA-5 and Mariner II which specified, inter alia, that if both vehicles were operating normally, but DSIF could support only one, RA-5 would have priority. RA-5 also was assigned complete use of all computing facilities, with the exception

Oct. 11 cont.	of PDP-1, from launch to midcourse maneuver. (JPL, IOM from B. Sparks to Senior Staff, et. al., October 11, 1962, JPLHF 2-266.)

Oct. 15 The list of observatories, instruments, and personnel cooperating in observation of the RA-5 impact on the moon was released at JPL. (JPL, IOM from J.J. Rennilson to C.I. Cummings, October 15, 1962, JPLHF 2-1321.)

NASA released the flight dates for Ranger Block IV vehicles. They were:

RA-10	February 1964
RA-11	April 1964
RA-12	June 1964
RA-13	August 1964
RA-14	September 1964

(Official NASA Flight Schedules, loc. cit.)

Oct. 16 Planned Ranger 10-14 spacecraft/Agena interface requirements were specified by JPL. (JPL, TWX from J.D. Burke to D.E. Forney of LMSC/NASA, October 16, 1962, JPLHF 2-1322.)

Oct. 18 Ranger 5 (Atlas 2150, Agena B 6005) was launched from AMR Pad 12 at 12:59 p.m. EST in the first countdown on the third day of the firing window--launch had been postponed on October 17 because of high winds associated with Hurricane Ella. Mission and flight objectives were identical with those established for Ranger 3 (see January 26, 1962). Both Atlas and Agena boosters again performed satisfactorily, and Ranger 5 was injected on a lunar trajectory thirty-five minutes after launch.

DSIF 4 in South Africa confirmed scheduled events of Ranger 5, solar panels opened and the sun was acquired at launch +48 and 51 minutes respectively. A few minutes later, as transmitter power came up at approximately 73 minutes after liftoff, a short circuit occurred in the power switching and logic unit, with total loss of solar panel power. The spacecraft continued to operate on battery power but the subsequent power drain shortened the useful life of the spacecraft to 8-3/4 hours from launch, when the battery was depleted.

Prior to battery depletion, engineering telemetry was recovered on spacecraft function, the gamma ray boom was extended and four hours of good data were received from the gamma ray experiment. An attempt was made at a midcourse correction on October 19; however, another power transient wiped out all telemetry for 13 seconds during

Oct. 18 cont. which start and stop roll turn commands should have been observed. Shortly thereafter the power supply dropped too low for continued operation. Loss of power prevented completion of the midcourse maneuver and ruled out any attempt to perform the television experiment or land the seismometer capsule on the moon. On October 21 Ranger 5 passed within 450 miles of the moon on its way into solar orbit. The DSIF continued to track the small ADF capsule transmitter, which had its own battery power supply, until its signal reached the threshold of DSIF ground antennas 11 days after launch. (JPL, EPD No. 147, Ranger 5 Flight Report, January 4, 1963; and, JPL Technical Bulletin No. 1, "Ranger 5," October 19, 1962, JPLHF 2-1312.)

Oct. 19 Dr. Homer E. Newell issued a directive that OSS establish a Board of Inquiry to analyze the complete Ranger Project, reliability, operations, and the reliability potential in future Ranger spacecraft, as well as the cause for the failure of Ranger 5. (Cited in U.S. Congress, House of Representatives, Subcommittee on Space Sciences and Advanced Research and Technology of the Committee on Science and Astronautics, Hearings before the Subcommittee, 1964 NASA Authorization, 88th Congress, First Session, 1606.)

Oct. 20 NASA notified JPL that a Ranger Board of Inquiry would be established and that its membership would be drawn from outside JPL. (NASA, letter from H.E. Newell to W.H. Pickering, October 20, 1962, JPLHF 2-264.)

Oct. 22 NASA Associate Administrator Dr. Robert C. Seamans was informed that a Joint OSS/OMSF Working Group had been established. The Group was charged with "recommending a detailed program of scientific exploration to OMSF, recommending to OSS a program of data acquisition to assure a timely flow of environmental information into the planning for manned projects, and establishing and maintaining close liaison with field centers, government agencies, and universities in the development of an integrated scientific program for manned space flight." Dr. Eugene Shoemaker was named Chairman of the Joint Working Group. (NASA, Memo for the Associate Administrator from H.E. Newell and D. B. Holmes, October 22, 1962, JPLHF 2-351.) (See October 11, 1962.)

In a letter to Dr. Homer E. Newell, Dr. Frank Press of Caltech requested that OSS include additional rough landing capsules in future Ranger missions as opposed to the emphasis on TV pictures. (Letter, Frank Press to Homer Newell, October 22, 1962, JPLHF 2-691.) This was the first of numerous letters from scientists

Oct. 22 cont. received at NASA Headquarters in following weeks that indicated dissatisfaction with the engineering-TV emphasis of the remaining announced Ranger flights. (See, for example, correspondence between J.R. Arnold of Bombay, India and H.E. Newell, October 30, 1962, JPLHF 2-1527.)

OSS released guidelines to JPL for Rangers 10 through 14. (NASA, N.W. Cunningham, Ranger Program Chronology, loc. cit.)

Oct. 23 NASA OMSF notified OSS that it confirmed "the relative priorities which should be attached to the development of unmanned lunar systems for acquisition of data on the lunar environment in support of the manned lunar program," as agreed upon by the two offices on October 11. Project Ranger, providing close-up TV coverage of the moon at a few selected positions was assigned highest priority. OMSF indicated that "high resolution imagery and measurement of surface characteristics should be provided no later than mid-64, assuming that success with a few TV packages has been achieved," and that "such data will be the earliest input into the Apollo system design." (NASA, Memo from J.F. Shea to O.W. Nicks, October 23, 1962, JPLHF 2-431.) (See Press at October 22, 1962.)

Oct. 24 J.D. Burke ordered termination of all heat sterilization of Ranger flight hardware at JPL. (Engineering Change Order 3703, October 25, 1962, JPLHF 2-1325.) He also announced that a special committee of non-project JPL personnel had been convened to investigate the failure of RA-5 at the direction of Dr. Pickering; a 30-day slip in the launch date for RA-6 was now official, and a two-month slip was under consideration. (JPL, Minutes of Ranger Spacecraft System Review of October 24, 1962, JPLHF 2-1313.)

Dr. Gordon J.F. MacDonald expressed concern to Oran Nicks at NASA Headquarters upon finding that the Ranger 7 vehicle at JPL included a television camera with a color wheel. Since the wheel had been eliminated by the SSSC Lunar Subcommittee meeting earlier (see September 26, 1962), this discovery "raised serious questions in my mind . . . as to whether or not serious scientists should continue to be associated with the [NASA] lunar and planetary program since this program is rapidly becoming an engineering project of limited interest." (Letter, G.J.F. MacDonald to Oran W. Nicks, October 24, 1962, JPLHF 2-355.)

Dr. Harold Urey informed Dr. Homer Newell that he was deeply concerned with the OSS emphasis on TV photography and that there were no additional lunar rough-lander capsules currently programmed in

Oct. 24 cont. NASA's unmanned lunar program. "Unless valuable scientific data are secured, the whole space program may fold up, possibly. . . ." (Letter from Harold C. Urey to Dr. Homer E. Newell, October 24, 1962, JPLHF 2-1489.)

Oct. 25 The special JPL committee, convened to investigate Ranger 5, met for the first time. Meetings were held through November 13, 1962. (Rough Draft of Ranger Final Report, op. cit., 57.)

F. Duerr, Agena Systems Manager at MSFC, requested that the Air Force investigate the G.E. Mod. III G guidance system employed in Atlas boosters and propose corrective measures. (MSFC, letter from F. Duerr to Major J. Albert, USAF, October 25, 1962, JPLHF 2-2072.)

Oct. 26 NASA Headquarters released new, broad guidelines for the sterilization of unmanned lunar and planetary spacecraft. (NASA, letter from H.E. Newell to W.H. Pickering, October 26, 1962, JPLHF 2-317.)

JPL awarded Contract 950410 to Fairchild Stratos Corporation to perform studies and estimate reliability on Block III Ranger spacecraft 6-9. (JPL, Space Programs Summary No. 37-19, Vol. VI, op. cit., 10-11.)

NASA presented its proposal for revised booster procurement and launch operations to the USAF at a joint meeting in Los Angeles. The Air Force representative, Col. Eichel, rejected the main points in their entirety. "Both parties agree that a management change is necessary and will appeal to higher authorities." (Meeting Report, Subject: Atlas-Agena Management Meeting at AFSSD, October 26, 1962, JPLHF, 2-1327a; and NASA Proposal for Revised Booster Procurement and Launch Operations, October 1962, JPLHF 2-1327b.)

Oct. 29 The NASA Board of Inquiry, chaired by Dr. Albert J. Kelley,* was formally established by H.E. Newell. The Board was charged with review of the complete project and with providing

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*Dr. Kelley previously had been Chairman of the Agena-B Coordination Board and Director of Electronics and Control in NASA Headquarters Office of Advanced Research and Technology. Other members were: Mr. Frederick J. Bailey, MSC; Mr. John Foster, Ames Research Center; Dr. John Hornbeck, Bellcomm. Inc.; Mr. James Koppenhaver, Office of Programs, NASA Headquarters; Mr. Herman Lagon, Goddard Space Flight Center; Dr. Arthur H. Rudolph, Office of Systems, OMSF, Mr. Francis B. Smith, Langley Research Center; and Dr. John M. Walker, Secretary, OART, NASA Headquarters. Mr. N.W. Cunningham and Mr. Walter Jakobowski (NASA Ranger Program Chief and Program Engineer, respectively) were appointed ex officio to assist the Board.

Oct. 29 cont.

recommendations for improvement in all areas including management, systems, components, testing, quality control, reliability assurance, and operations. Furthermore, the Board was expected to recommend whether the next Ranger launch should proceed as scheduled or be delayed.

The Board conducted its review, including on-site inspections at JPL contractor facilities, other NASA centers, and the USAF Space Systems Division, between October 30 and November 23, 1962. The written report of the Board was submitted to OSS on November 30, 1962. (NASA, memo from H.E. Newell to Distribution, October 29, 1962; and, 1964 NASA Authorization, op. cit., 1606.)

JPL initiated studies to improve the resolution and sensitivity in Ranger Follow-on[2] (Block IV, RA 10-14) TV subsystem contract. (JPL, IOM from D. Kindt/P. Buwalda to H.R. Lawrence/G. Kautz, October 29, 1962, JPLHF 2-1326a; and, Rough Draft of Statement of Work, Camera Performance Improvement Studies for the Ranger Impact TV Subsystem, October 29, 1962, JPLHF 2-1326b.)

NASA OSS and JPL plans for Project Ranger now contemplated as many as twenty flights in the unmanned lunar impact series. The announcement was made by Ranger Program Chief, N.W. Cunningham in OSS. ("Expanded Ranger Series may Total 20," Missiles and Rockets, October 29, 1962, 15, JPLHF 2-769.)

Oct. 30

In accordance with prior direction, ADF submitted its proposal for Phases I and II of the development of a Lunar Surface Photoreconnaissance Capsule (LSPC). (See October 5, 1962.) The LSPC was basically the Ranger Block II seismometer capsule with a high-resolution facsimile device replacing the seismometer experiment. It would scan and transmit to earth a complete 360-degree panoramic view of the lunar terrain surrounding the landed capsule. The system was designed to focus from four feet to infinity, and have an angular resolution of approximately one-tenth of a degree. From this device it was hoped to obtain early data on lunar slopes and protuberances, surface reflectivity, as well as confirmation of a dust layer in which the capsule would leave a landing track. ADF efforts in Phase I and II would include demonstration of the impact capability of the mechanical and electro-optical subassemblies of the LSPC in flight-type configuration, and development of a complete landing sphere assembly to the prototype development stage.*

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*The first photofacsimile camera was placed on the moon on February 3, 1966, by the Soviet Luna 9. The operating principles of the Russian device were virtually identical with those of the LSPC.

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Oct. 30 cont.	(Proposal, from Ford Motor Company, Aeronutronic Division, dated 30 October 1962, "Development of a Lunar Surface Photo-reconnaissance Capsule (LSPC) Phases I and II," Publication No. P-12412(U), JPLHF 2-633.) (Figure 52.)
During October	Ranger Block III (RA 6-9). Test operations for Ranger 6 were completed at JPL with the exception of the TV subsystems tests and final systems tests. With the 30-day slip in the Ranger Project authorized earlier, the new date for shipment of RA-6 to AMR was December 26, 1962. (JPL, Space Programs Summary No. 37-18, Vol. I, op. cit., 8.)

RCA delivered the Thermal Test Model (TTM) to JPL in early October, and Flight Model 1 (FM1) on October 18. Of the latter unit, two cameras were found not to be of flight quality. One was refocused and brought up to standard; work continued on the other. (JPL, Minutes of Ranger Spacecraft System Review, October 24, 1962, loc. cit.)

Systems test operations on RA-7, conducted in early October, uncovered difficulties with the full complement of passenger science experiments planned for this flight. "The Electron Flux experiment is non-flight, as is the TR. . . . Problems encountered with science experiments were all basic and not associated with the design of the experiments. Every interface in Science had a problem." (JPL, Minutes of Ranger Spacecraft Review, October 10, 1962, JPLHF 2-1313.) By this time the JPL Project Office had installed fuses in the power lead to each experiment over strong objections from various quarters.

On October 19, Ranger 7 was moved from the SAF to the 6-ft. space simulator where flight acceptance tests were conducted. The TV PTM, electrically connected to the spacecraft inside the vacuum chamber, was utilized because of delays encountered with the FM1 noted above. Tentative plans called for flight acceptance test of the complete RA-8 inside the 25-ft. space simulator beginning in January 1963. (JPL, Space Programs Summary No. 37-18, Vol. I, op. cit., 25; also, Space Programs Summary No. 37-19, Vol. VI, op. cit., 9.)

Assembly of RA-8 began during the month. (JPL, Minutes of Ranger Spacecraft System Review, October 10, 1962, loc. cit.) Heat sterilization of Ranger frames had resulted in warpage of Rangers 6 and 7. Misalignment had been corrected by substituting heavy duty keenserts for standard keenserts in the bus TV package mounting holes; heat sterilization of RA-8 and 9 spacecraft busses was waived. (JPL, Space Programs Summary No. 37-18, Vol. I, op. cit., 11.)

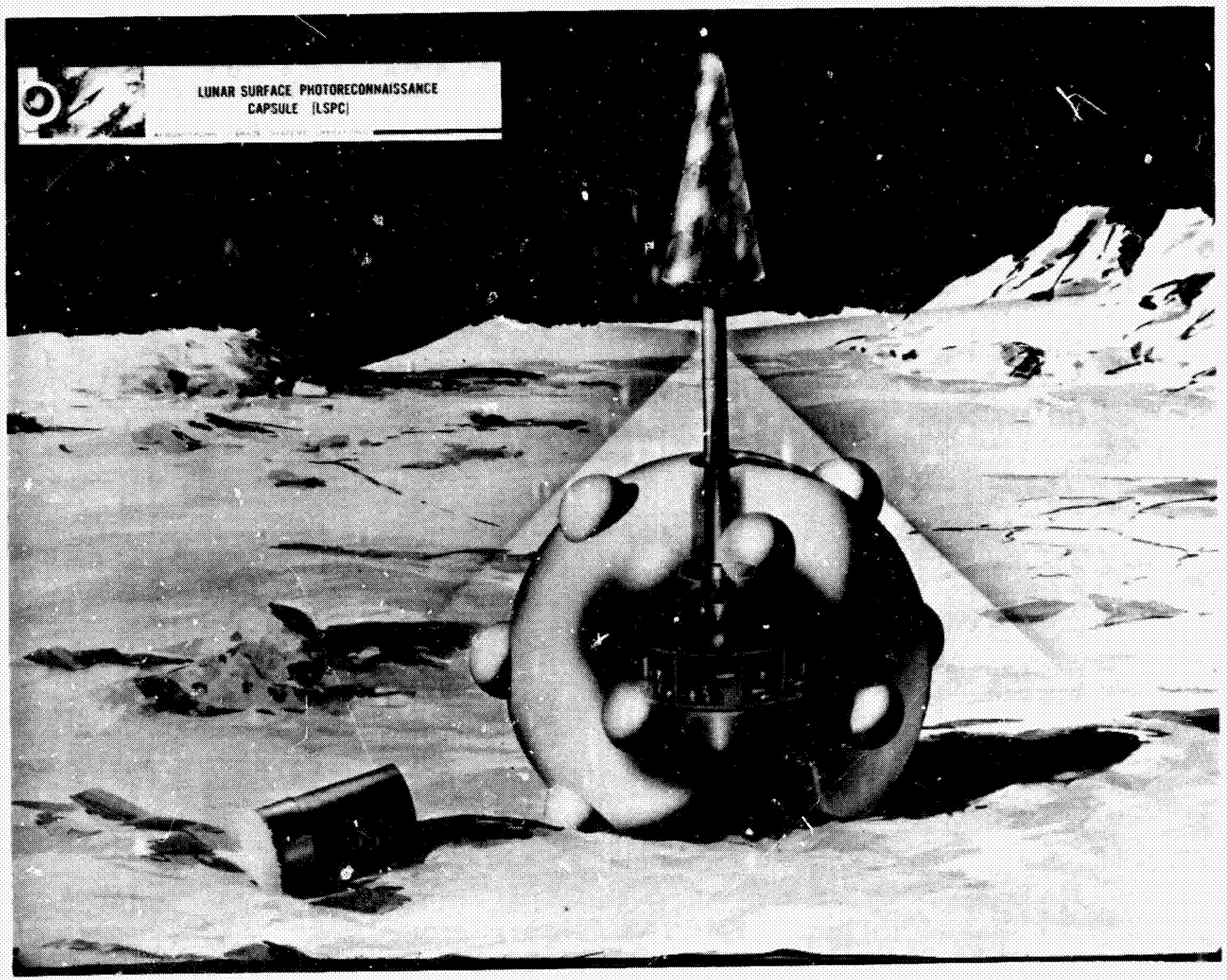

Figure 52: Proposed Lunar Surface Photo-Reconnaissance Capsule.

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During October cont. | JPL implemented a "Ranger Test and Evaluation Plan" which consisted of identifying and evaluating spacecraft problems, and performing a series of special tests on a spacecraft that was representative of Ranger. "In order to achieve this . . . a Design Evaluation Vehicle (DEV) is being assembled in the configuration of the Ranger 6 spacecraft. . . ." (Ibid., 9.) In related project areas, type approval testing of the enlarged propellant tank for the RA 6-9 midcourse propulsion system was completed successfully, and a contract was awarded to the Missile Battery Division of the Electric Storage Battery Company (ESB) of Raleigh, North Carolina for the design, development, and delivery of a new, more reliable, 12-cell battery for use in a Block III spacecraft TV flight system, beginning with RA-9. (Ibid., 20, 40.)

Ranger Block IV (RA 10-14). This project extension was formally authorized by OSS on October 3, 1962, following several months of plans and discussion. Procurements were initiated immediately by JPL for spacecraft and the television subsystem in support of the early flight dates. While the prime objective of this series of flights was acquisition of more and finer detail on the topography and physical conditions of selected points on the lunar surface. secondary passenger science experiments were planned at this time. (Rough Draft of Ranger Final Report, op. cit., 55.)

Nov. 1 | JPL presented the development plan for the ADF Facsimile Capsule to NASA. Initiation of 8 months of Phase I in this project was approved. (JPL, letter from J.D. Burke to N.W. Cunningham, November 15, 1962, JPLHF 2-265.)

Nov. 2 | In response to the letter of October 22, 1962, Dr. H.E. Newell informed Dr. Frank Press of Caltech that the OSS fully intended to schedule lunar seismometer missions "as soon as practical." He continued to observe that "attention in the Ranger Program has been focused on providing design data for Apollo at an early date," although, "insofar as possible, we are maintaining a principal objective in the lunar program, increasing our understanding of the origin and history of the moon." (NASA, letter from H.E. Newell to F. Press, November 2, 1962, JPLHF 2-693.)

JPL formally requested that NASA OSS authorize cessation of all types of sterilization for all lunar flight equipment. (JPL, letter from W.H. Pickering to H.E. Newell, November 2, 1962, JPLHF 2-656.)

Nov. 5 JPL submitted a list of recommended passenger science experiments (as well as priorities) to be flown aboard Rangers 10-14. For the primary experiment, a "Chinese copy" of the TV subsystem developed for use on RA 6-9 was now considered desirable to avoid additional costs. (JPL, letter from J.D. Burke to N.W. Cunningham November 5, 1962, JPLHF 2-1329.)

Nov. 6 NASA OSS authorization to cease further heat sterilization of flight hardware was received at JPL. Terminal surface contamination through the use of ethylene oxide gas was continued. (JPL, IOM from J.D. Burke to All Concerned, November 6, 1962, JPLHF 2-657.) (See October 24 and November 2, 1962.)

The flight dates for Rangers 6, 7, and 8 were officially slipped one month over the dates appearing at May 23, 1962. (Official NASA Flight Schedules, loc. cit.) (See also October 11, 1962.)

Nov. 7 In response to the letter of October 24, 1962, NASA OSS notified Dr. G.J.F. MacDonald that the color wheel was maintained on early TV production models so that calibration data could be obtained on the various color filters. No wheels would be flown unless approved by the experimenters and the SSSC. (NASA, letter from O.W. Nicks to G.J.F. MacDonald, November 7, 1962, JPLHF 2-356.)

Planning at JPL and at OSS now considered up to twenty-five flights in the Ranger series divided between TV on approach and rough-landing capsule experiments. (JPL Planning Document entitled "Ranger 6-25," November 7, 1962, JPLHF 2-1331.)

Nov. 8 NASA OSS formally authorized development of the ADF lunar facsimile capsule. (NASA, TWX from O.W. Nicks to R. Rodney, NASA WOO, November 8, 1962, JPLHF 2-1167.)

Nov. 9 A further proposed revision to NASA spacecraft sterilization policy was released in NASA OSS. (NASA, memo from O.W. Nicks to H.E. Newell, November 9, 1962, JPLHF 2-358; also, Memorandum for the Administrator, Deputy Administrator, Associate Administrator, from H.E. Newell, Subject: NASA Sterilization Policy, January 15, 1963. Attachment 2, JPLHF 2-658.) (See October 26, 1962.)

Nov. 13 JPL concluded its special investigation of the inflight failure of Ranger 5 under the direction of Dr. W.H. Pickering. (JPL, "Ranger RA-5 Failure Investigation," Report of the JPL Failure Investigation Board, November 13, 1962, JPLHF 2-459.)

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Nov. 14 NASA Headquarters informed JPL of the items planned for discussion at a joint meeting planned for the first week in December. First was a review of the non-visual experiments planned for Ranger 6 and subsequent, and, "because the television systems for Ranger have recently come under fire by the scientific community and some of the JPL staff, a thorough review of the TV experiments with all viewpoints represented . . ." (NASA, letter from O.W. Nicks to W.H. Pickering, November 14, 1962, JPLHF 2-1488.)

Nov. 15 Dr. H.E. Newell, Director of the NASA OSS, responded to Dr. Harold Urey's letter of October 24, and explained the objectives and rationale of NASA's unmanned lunar program, and the importance of transearth passenger science experiments. (NASA, letter from H.E. Newell to H. Urey, November 15, 1962, JPLHF 2-363.)

Nov. 21 JPL completed a design and status review of the passenger science experiments planned for flight on Rangers 7-9. Four of the eight instruments were considered to be in flyable condition. (JPL, IOM from I.E. Walenta to R.V. Meghreblian, November 21, 1962, JPLHF 2-694.)

Nov. 27 The first of several meetings took place between OSS and JPL at NASA Headquarters concerning the status and plans for the unmanned lunar and planetary program; the meetings concluded on December 17, 1962. (NASA, letter from H.E. Newell to W.H. Pickering, December 31, 1962, JPLHF 2-316.)

JPL Ranger Project Manager J.D. Burke announced that component replacements and subsystem investigations on RA-6 and 7 were approved, and that flight readiness of these spacecraft would be delayed one additional month. No new launch schedule was released. (JPL, IOM from J.D. Burke to Distribution, November 27, 1962, JPLHF 2-1695.)

Nov. 28 A meeting of the TV experimenters assigned for Ranger Flights 6-9 was held at JPL. Drs. Kuiper and Shoemaker recommended more extensive and more meaningful tests of the TV subsystem, as well as more active participation of the TV experimenters in future tests and evaluation of the system. (JPL, IOM from L.J. Goforth to R.G. Brereton, December 3, 1962, JPLHF 2-1334.)

Nov. 29 Dr. Charles P. Sonett was appointed Chief of a new Division of Space Sciences at the Ames Research Center at Moffett Field, California. (NASA News Release. Ames 62-41, "Space Sciences Division Formed at Ames Research Center," November 29, 1962.)

Nov. 30 The Final Report of the [NASA] Ranger Board of Inquiry was completed. Ranger was acknowledged as derived from early JPL designs for an interplanetary spacecraft and, as a consequence, was viewed by the Board as "conceptually not optimum for lunar missions." It was, rather, "more flexible and complicated." The Board determined that the principal factors contributing to the Ranger situation were:

- Multiple and conflicting objectives
- Schedule pressures
- Sterilization
- Spacecraft design (too much complexity, with not enough redundancy)
- Launch vehicle reliability and management
- Project management

The Board recommended that NASA and JPL reduce mission objectives; give complete responsibility for Atlas-Agena procurement and check-out and launch operations at AMR, either to the Air Force or to NASA; eliminate heat sterilization of Ranger spacecraft components; improve spacecraft design review, testing, failure reporting, quality control and engineering change control procedures; strengthen Ranger Project management; fabricate follow-on Ranger spacecraft (subsequent to RA-9) out-of-house to reduce the work-load at JPL; and delay assignment of lunar and interplanetary flight projects to JPL until improvement was shown. Formal release of the report to OSS took place on December 5, 1962, and the Board stood adjourned.

During November Ranger Block III. The flight date for Ranger 6 was slipped an additional month as an interim measure, pending further study, with the result that the project no longer had any firm schedule. Assembly was completed and initial test operations began on Ranger 8. All effort was suspended on November 19 pending evaluation of the RA-5 investigations. (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 86, November 27, 1962, JPLHF 2-1314; also, Space Programs Summary No. 37-19, Vol. VI, op. cit., 9.

Because high temperature sterilization (125°C for 24 hours) caused degradation in the solar panel thermal control surfaces and in the electrical power output, this requirement was waived beginning with the solar panels for Ranger 8. The first Mariner-type Mark IV solar panel for Ranger spacecraft was received at JPL from Electro Optical Systems on November 24. (JPL, Space Programs Summary No. 37-19, Vol. I for the period November 1, 1962 to December 31, 1962, 15 and 16.)

1962

During November cont.

Assembly of the Design Evaluation Vehicle (DEV), as nearly electrically identical to the flight vehicle as possible, was completed and the first tests were conducted to isolate potential problem areas in the RA-6. (Ibid., 6.)

The FM1 TV subsystem was subjected to further shakedown tests. After repair of a shutter failure on one camera and a transmitter failure, the system satisfactorily completed subsystem tests on RA-6 on November 15. (Ibid., 3.)

Facilities. Construction began on the Space Flight Operations Facility (SFOF) at JPL. This building, replacing the interim facility housed in Building 125, would become the nerve center for real-time direction of future NASA unmanned lunar and planetary projects. (See June 22 and July 21, 1961.) (JPL, IOM from J.D. Burke to B. Sparks, Ranger Project Status Report No. 83, November 2, 1962, JPLHF 2-1314.)

The 25-ft. space simulator, which was not accepted as complete in April 25, 1962 because of technical deficiences, was accepted by JPL. While vacuum requirements were met, the contractor-furnished solar simulation system still was not adequate for spacecraft testing. As a result JPL installed a virtually new solar source in the space simulator to improve flux intensity and uniformity. (JPL, Space Programs Summary No. 37-19, Vol. VI, op. cit., 58.)

Dec. 4

JPL issued "Guidelines for Ranger Project Reprogramming." Ranger was established as the highest priority project at the Laboratory with a single set of objectives: obtain one success out of the next two spacecraft launches. Success defined as (a) performing all spacecraft functions through terminal maneuver, and (b) obtaining at least a single picture of a quality better than earth-based pictures. In addition, a Ranger Spacecraft System Design Review Board would be created; a special Ranger Quality Assurance task force under the direction of Brooks Morris, and a formal Engineering Change Board will be established to place spacecraft system design under rigid control. Ranger manpower and organization charts were also delineated. (Guidelines for Ranger Project Reprogramming, December 4, 1962, JPLHF 2-1565.)

Dec. 6

JPL informed NASA Headquarters of its findings on the costs of attempts to sterilize lunar spacecraft. (JPL, letter from C.I. Cummings to O.W. Nicks, December 6, 1962, JPLHF 2-1697.)

Dec. 7 At JPL the Lunar Program and Planetary Program Offices were consolidated, and Mr. Robert J. Parks was appointed the Assistant Laboratory Director for Lunar and Planetary Projects. Mr. H.M. Schurmeier was appointed Ranger Project Manager, replacing J.D. Burke.

Dec. 10 NASA and the DOD signed an agreement in which the Air Force assumed responsibility to develop a standard Atlas booster for joint NASA-DOD use. This agreement was in conformance with the basic instrument of February 23, 1961. (U.S. Congress, House of Representatives, House Report No. 445, Government Operations in Space (Analysis of Civil-Military Roles and Relationships, 89th Congress, 1st Session, June 4, 1965, 129.)

Dec. 12 A meeting was held at NASA Headquarters attended by NASA OSS and JPL personnel, to review the findings of the Kelley Board. H.M. Schurmeier represented the JPL Ranger Project Office. (JPL, TWX from W.H. Pickering to the Office of the Associate Administrator, NASA Headquarters, December 10, 1962, JPLHF 2-248.)

NASA announced transfer of the Agena B vehicle program from MSFC to the Lewis Research Center in Cleveland, Ohio. The transfer also included responsibility for NASA-used Thor and Atlas first stage rockets that carried the Agena B upper stage. (Astronautical and Aeronautical Events of 1962, op. cit., 267.)

Dec. 14 Mariner II swung past the planet Venus at a distance of approximately 22,000 miles. All instruments aboard the spacecraft functioned properly, and returned data on the Venusian atmosphere and temperatures. At a subsequent press conference at NASA Headquarters, NASA Administrator James E. Webb declared that the achievement was "an outstanding first in space for this country and for the Free World. . . ." (Ibid., 268.)

Dec. 17 The last of the joint NASA-JPL Ranger review meetings was held in Washington, D.C. to discuss implementation of changes in the Ranger Project. Agreement was reached on the following: (1) the objective of the next series of Ranger flights would be to obtain TV pictures of greatest benefit to both the manned lunar program and scientists; (2) the mission would include a midcourse and terminal maneuver; (3) lunar surface pictures were of paramount importance for Apollo, in a conflict between science and manned program needs, "every consideration will be given to meeting the Office of Manned Space Flight needs;" (4) technological information resulting from Ranger Project would be considered a by-product and not an objective; and (5) a significant improvement in reliability

Dec. 17 cont. should be accomplished before attempting another launch. Coincident with the last point, sterilization requirements for lunar flights were greatly relaxed, and all sterilized hardware, with the exception of the TV subsystem, was to be replaced by non-sterilized hardware. (NASA, Memo for the Files, N.W. Cunningham, December 21, 1962, JPLHF 2-375; also, Working Draft of Ranger History prepared for Congressional Investigation, op. cit., 30; and, letter from W.H. Pickering to H.E. Newell, May 22, 1964, JPLHF 2-158.)

In concurrent JPL-NASA discussions on Project Surveyor, the lunar soft landing spacecraft, JPL representatives "stated that the Laboratory is unable to give adequate support to the Surveyor Orbiter [a lunar orbiter derived from Surveyor] and recommends deletion of this project. . . . it is recommended that no additional FY 1963 funds be expended on Surveyor Orbiter activities until a course of action has been determined." (NASA Memo from B. Milwitzky to O.W. Nicks, January 8, 1963, JPLHF 2-374.)

JPL established a Ranger Spacecraft Design Review Board composed of senior Laboratory personnel and chaired by the Ranger Spacecraft Systems Manager. The Board was charged with examining all Ranger systems, recommending changes to improve reliability, and determining the effect on schedules of individual recommendations. Membership included: A. Wolfe, Chairman, H. Curtis, G. Sweetnam, R. Forney, J. Koukol, M. Comuntzis, A. Briglio, P. Goldsmith, J. Small, T. Hamilton, R. Heacock, and B. Morris. (Document by H.M. Schurmeier/A.E. Wolfe, "Ranger Design Program," December 17, 1962, JPLHF 2-2073.)

Dec. 18 Management changes at JPL, put into effect on December 7, were made public. (JPL Announcements from W.H. Pickering to All Personnel, December 18, 1962, JPLHF 2-268 and 2-269.)

Dec. 19 NASA publicly announced that an extensive design review and test program for Project Ranger was underway as a result of the recommendations made by the Kelley Board of Inquiry. Ranger 6, it was indicated, would not be flown, but rather subjected to an exhaustive test program. (NASA News Release No. 62-268, December 19, 1962, JPLHF 2-934.)

JPL informed NASA Headquarters that, in conformance with recent discussions, all sterilization requirements were being removed for the Ranger and Surveyor unmanned lunar projects. This action was taken in anticipation of receipt of the formal revised policy

Dec. 19 cont. for lunar spacecraft sterilization; NASA concurrence was requested. (JPL, TWX from R.J. Parks to O.W. Nicks, December 19, 1962, JPLHF 2-249.) (See November 2, 1962.)

H.M. Schurmeier informed Ranger personnel that the area of emphasis in the current design review was to simplify the spacecraft and mission so as to launch with a high probability of success. In pursuing this objective, the following decisions had been taken:

1. No passenger science experiments would be flown on RA 6-9; only the TV subsystem would be used.
2. There would not be an S-band ranging experiment flown.
3. Neither heat sterilization nor ethylene oxide gas would be employed on Ranger hardware from this time on.

(JPL, Minutes of Ranger Spacecraft System Review, December 19, 1962, JPLHF 2-1313.)

Dec. 20 Launch of Ranger 6 was officially postponed from February to March, 1963. (Official NASA Flight Schedule, loc. cit.)

J.D. Burke recommended to H.M. Schurmeier that RCA be instructed to "upgrade reliability at the expense of performance" of the Ranger cameras. Burke further recommended that a reevaluation of the usefulness of the Lunar Capsule was in order due to the recent reliability drive and to the fact that the Lunar Capsule was "fundamentally a high-risk design." (JPL, IOM from J.D. Burke to H.M. Schurmeier, Subject: Ranger Jobs Outstanding as of 12/19/62, December 20, 1962, JPLHF 2-1699.)

Dec. 21 NASA concurred in the action taken by JPL to remove all sterilization requirements from Ranger and Surveyor projects for reasons of reliability. (NASA, TWX from H.E. Newell to W.H. Pickering, December 26, 1962, JPLHF 2-1336.)

Dec. 24 In a press interview Edgar M. Cortright, NASA Deputy Director of the Office of Space Sciences, indicated that relaxation of strict sterilization rules for Ranger spacecraft was one of the changes being considered for the redirection of Project Ranger. (Astronautical and Aeronautical Events of 1962, op. cit., 276.)

Dec. 26 Speaking before the American Association for the Advancement of Science, Dr. Homer E. Newell, Director of the NASA Office of Space Sciences, reaffirmed that good science was the abiding rationale in America's deep space exploration efforts, He observed, Dec. 26 cont. however, that the lunar program would evolve from unmanned to manned expeditions, stating:

> The necessary observations and measurements obviously cannot all be made just by man's standing on the moon and looking around. But a giant step will have been taken when the first scientist on the moon does look around and begins to zero in on the most likely answers, and more importantly, can determine the most promising courses to follow for obtaining the answers. Before that time some data will have been obtained by means of unmanned spacecraft, Rangers and Surveyors, but the full power of the lunar science effort will not be brought to bear until man and instrument together tackle the problems to be solved.

Dr. Newell emphasized the requirements for "top notch" scientist-astronauts who would "eventually, although very likely not on the first trip . . . conduct measurements of surface properties, radioactivity, temperature and heat flow, seismic activity, etc., bringing with him the necessary instruments to accomplish these tasks." (NASA, Comment on the National Space Program, July 1, 1963, 1st ed., B-194 and B-196, JPLHF 5-218c.)

Dec. 28 Upon request, Edgar M. Cortright, NASA Deputy Director of the Office of Space Sciences, informed the Honorable Joseph E. Karth, Chairman of the Subcommittee on NASA Oversight, Committee on Science and Astronautics, U.S. House of Representatives, of the status of the Ranger review and of the findings of the Kelley Board of Inquiry. (NASA, letter from E.M. Cortright to J.E. Karth, reprinted in 1964 NASA Authorization, op. cit., 1596-1598.)

JPL informed NASA OSS that the detailed design review and test program for Project Ranger was underway, with tentative plans to recommence launching in late 1963. Based upon prior discussions with OSS, the Ranger Project objective was considered "to be limited to that of obtaining lunar surface photographs significantly better than can be obtained from earth." A specific quantitative definition of "significantly better" remained to be established. A caveat noted that "if, as the review progresses, it should be determined that a sufficiently high confidence of success could not be obtained in launching in 1963, for example, if we become convinced that all sterilized equipment must be eliminated from flight hardware, we will recommend a plan with launchings as early in 1964 as is practical." A recommendation was also made that the planned Mariner R 1964 flight, which conflicted with Ranger, be cancelled. (JPL, letter from W.H. Pickering to E.M. Cortright, December 28, 1962, JPLHF 2-329.)

Dec. 31 NASA OSS released guidelines and directives for all JPL flight project activities which specified, inter alia, definition of Ranger Project management down to all levels, preparation of a recovery plan for Ranger, a plan to phase in an industrial contractor for follow-on Rangers, as well as an inventory of sterilized and non-sterilized Ranger components; Mariner R 1964 was cancelled, and Surveyor Orbiter was assigned a low priority pending further study by NASA Headquarters (see December 17, 1962). (NASA, letter from H.E. Newell to W.H. Pickering, December 31, 1962, JPLHF 2-316.)

The DOD formally cancelled production of the Skybolt missile at the Douglas Aircraft and Northrop Aircraft Companies. ("6,000 Face Loss of Jobs Over Skybolt," Los Angeles Times, January 3, 1963.)

During December Ranger Block III. Ranger spacecraft RA-6 and 7 were completely disassembled for microscopic inspection of all electronic components. (JPL, Minutes of Ranger Spacecraft System Review, December 19, 1962, loc. cit.) RA-6 was allocated as a test vehicle Flight acceptance tests of the RCA FM1 TV subsystem were completed in the 6-ft. space simulator, and then the subsystem was disassembled as RCA began a complete inspection and review. The objective of this study was to establish a TV subsystem configuration with a capability of obtaining pictures of the moon either during a nonstandard mission or under conditions of partial failure of the TV subsystem. (JPL, Space Programs Summary No. 37-19, Vol. VI, op. cit., 8; and, Investigation of Project Ranger, op. cit., 186.)

With elimination of sterilized components for all future Ranger spacecraft, JPL began to award contracts for new subsystems. For example, contracts were placed for six new command subsystems, four for flight and two as spares. Motorola furnished six revised L-band phase-locked Mark II spacecraft transponders. At the same time Astrodata, Inc. was authorized to redesign and build the ground portion of the command subsystem (Read, Write, and Verify). (JPL, Space Programs Summary No. 37-26, Vol. I, for the period January 1, 1964 to February 29, 1964, 30-33.)

DSIF. All permanent stations were now equipped with digital instrumentation systems that recorded performance of station equipment and afforded more direct calibration, adjustments, and checkout to expedite station readiness. Also added were L-band frequency synthesizers and atomic standards to transmitting loops, thereby providing precise doppler tracking at

During December cont.

planetary distances. The stations had been equipped with telemetry-to-teletype encoders in support of the Mariner R spacecraft. (NASA, Eighth Semiannual Report to the Congress, July 1, 1962 - December 31, 1962, 134.) Inter-station communications around the world remained a critical problem.

Sixteen racks of RCA ground equipment for Block III Rangers were installed in the control building at the Echo Station. The equipment was designed to receive the video signals from the spacecraft and convert it for ground display purposes. System checks of this equipment began. (JPL, Space Programs Summary No. 37-19, Vol. III, op. cit., 11.)

Facilities. A 100-hour test of the 25-ft. diameter space simulator was conducted during the month, with all systems functioning. "Based on [this] limited testing . . . it is concluded that the facility is acceptable for spacecraft testing. However, many more hours of testing are required before the reliability of the chamber is firmly established." (JPL, Space Programs Summary No. 37-19, Vol. VI, op. cit., 59-60.)

Sterilization. All sterilization of Ranger flight hardware was terminated with the exception of continuing procedures for cleanroom assembly and for the use of alcohol as a cleaning agent during joining operations. Sterilization studies of capacitors and connectors, begun in the spring of 1962, found that adverse effects were most pronounced with high temperature, next with liquids, and least with treatment by ethylene oxide gas. (JPL, Space Programs Summary No. 37-20, Vol. I, for the period January 1, 1963 to February 28, 1963, 14-15.)

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RANGER BLOCKS III, IV, AND V, 1963-1965

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RANGER BLOCKS III, IV, AND V, 1963-1965

1963

Jan. 1 British astronomer Sir Bernard Lovell, in an end of the year assessment of the space competition between Russia and America, declared that a successful lunar probe during 1963 was a "must" if the United States hoped to achieve a landing of man on the moon in 1967. ("63 Moon Probe Held Vital for U.S. Aims," Los Angeles Times, January 1, 1963.)

Jan. 2 In a similar assessment the aerospace newsletter Space Daily observed: "Ranger failed again and again. Our very expensive quest for a foothold on the lunar surface seems on this day as far away as it did in the beginning. It will be months before we try again. Ranger, it is said, represents again that dangerous problem of greed for over-engineering." ("1962--Year of Indecision in Space," Space Daily, January 2, 1963, p. 2.)

JPL issued further Ranger Reprogramming Guidelines which directed, inter alia, no Ranger flights before August 1963, no further spacecraft sterilization, neither heat nor terminal gas soaking; and no passenger science experiments other than the TV package. (JPL, IOM from H.M. Schurmeier to Distribution, January 2, 1963, JPLHF 2-1581.)

Jan. 3-4 The NASA OSS Senior Council meeting was held at LOC, AMR. Dr. Homer Newell, Director of OSS, announced that OSS intended to ensure support for manned lunar flight by limiting or removing science wherever it interfered with this support, and that the Lunar Program would be developed by way of manned technology with minimal unmanned scientific missions. (OSS Senior Council Meeting Minutes at LOC January 3-4, 1963, JPLHF 2-404b.) (See June 7, 1962.)

Jan. 4 The U.S.S.R. launched a lunar probe (Satellite 1963-IA) which failed to leave its earth parking orbit. (TRW Space Log, Winter 1969-70, p. 84.)

Jan. 7 JPL Ranger Project Manager H.M. Schurmeier notified Dr. E. Rechtin, Assistant Director of the JPL Deep Space Instrumentation Facility, that a firm Project decision had been made not to carry the 2300 mc transponder and ranging experiment on any Ranger vehicles flown

Jan. 7 cont. during 1963. "The question of whether the 1964 block of spacecraft will carry the 2300 mc AD equipment will remain open until design review effort is completed . . ." (JPL, IOM from H.M. Schurmeier to E. Rechtin, January 7, 1963, JPLHF 2-1356.)

Missiles and Rockets announced that JPL would lose responsibility for some of NASA's lunar and planetary spacecraft projects. A study had been authorized by NASA Headquarters to determine the capability of other NASA field centers to manage several of these missions. (Missiles and Rockets, Vol. 12, January 7, 1963, 14, JPLHF 2-771.)

Jan. 10 Ranger Project representatives met at the Lewis Research Center to review the Agena and Atlas booster system used for Project Ranger. Past performance of the launch vehicle and major areas of concern relative to vehicle reliability were discussed. (Ranger History--Working Draft, April 23, 1964, 44, JPLHF 2-458; also, Conference Report prepared by H. Margraf/G. Haddock, January 14, 1963, JPLHF 2-1357.)

NASA Associate Director Dr. Robert C. Seamans Jr. announced initiation of a field center competition for a new space probe, Pioneer, which would be designed to acquire more information on the interplanetary medium and on solar flares. The probes were scheduled to begin launching in 1964 during the International Year of the Quiet Sun. (NASA, Astronautics and Aeronautics, 1963: Chronology on Science, Technology, and Policy, Washington, D.C., 1964, 8.) (See January 7, 1963.)

Jan. 14 Aviation Week predicted that NASA would announce a decision to procure Atlas-Agena vehicles directly from the contractors, thus eliminating the USAF as a procurement agent. (Astronautics and Aeronautics, 1963, op. cit., 12.) (See November 30, 1962.)

Jan. 15 A new edition of the NASA space probe sterilization policy was circulated at NASA Headquarters. (NASA Memo for the Administrator, et. al., from H.E. Newell, January 15, 1963, JPLHF 2-658.) At about the same time the Space Science Board of the National Academy of Sciences released a draft guide for space probe sterilization for the moon and Mars. The latter guide reflected the prevailing consensus that a relaxation in sterilization procedures for lunar probes was justified in light of the extremely harsh lunar environment. (Document from Space Science Board entitled "Space Probe Sterilization," approximately January 1963, JPLHF 2-870.)

Jan. 15 cont. The Report of the Republican Advisory Committee for Space and Aeronautics was released. The Committee Report condemned the administration's space program and, among a number of points, offered the following recommendations for catching up with the Russians:

"1. The President of the United States and Congress must authorize a high-priority space program under the auspices of the U.S. Air Force immediately.

2. Our government must recognize the probability that the Soviet Union is building a military capability and must meet this challenge determined to cope with it adequately.

3. The public must be told that the need for a military space buildup must be given priority and come first ahead of any civilian effort."

(Cited in Sen. Barry Goldwater, "Ten Ways to Catch Up in the Space Race," Los Angeles Times, January 15, 1963.)

Jan. 16-17 RCA recommended an improved "split" TV subsystem for use in Ranger vehicles RA 6-8. (RCA, Ranger TV Subsystem, presentation by the Astro-Electronic Division of RCA, January 17, 1963, JPLHF 2-1741.)

Jan. 17 Announcement was made at the weekly JPL Ranger Spacecraft Systems Review that proceedings of the Design Review Board had progressed sufficiently to allow planning for launch of Block III Rangers on one-month centers during the last quarter of 1963. Hardware delivery to the SAF was scheduled to commence in May to support this plan. (JPL, Ranger Spacecraft System Review Minutes, January 17, 1963, JPLHF 2-1313.)

NASA and the DOD executed an agreement concerning management responsibilities at Cape Canaveral. While the USAF would continue as the single manager of the Atlantic Missile Range, the DOD and NASA would each be responsible for logistics and administration in their assigned areas. Specific functions, e.g., preparation, checkout, launch, and test evaluation, would be performed by each agency in its own behalf, regardless of location. (Agreement Between the Department of Defense and National Aeronautical and Space Administration Regarding Management of the Atlantic Missile Range of DOD and the Merritt Island Launch Area of NASA, January 17, 1963, cited in NASA, James Grimwood, Draft Chapter, "Planning the Experiments," History of Gemini, July 31, 1968, 31, JPLHF 2-1476.) (See November 30, 1962.)

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Jan. 21 A Ranger experimenter's meeting convened at JPL to review the status of non-visual science experiments and the revised Ranger Project. Announcement was made at this meeting that due to changes in the Ranger Program, all non-visual passenger experiments were eliminated for Ranger missions 6-9, although rescheduling was possible at a later date. A majority of the experimenters were understandably disappointed over the one-year delay before experiments could again be flown; however, there appeared to be an appreciation for the problems involved in this lunar mission. "It was emphasized that each of the experiments and experimenters will remain a part of the approved Ranger Program and that NASA intended to have them flown at some future date. Pending formal approval of this action by the Space Sciences Steering Committee and official notification from Dr. Newell, the experimenters were requested to submit their individual plans for the coming year. . . ." (NASA, Memo for the Director, Office of Space Sciences, from N.W. Cunningham, February 15, 1963, JPLHF 2-695; also, NASA OSS Review of January 17, 1963, JPLHF 2-1505.)

Mr. Clifford Rumin of NASA-WOO was appointed a NASA resident at JPL specializing in Reliability and Quality Assurance. (NASA, letter from H.E. Newell to W.H. Pickering, January 21, 1963, JPLHF 2-310; also JPL, IOM from B. Sparks to Senior Staff, et. al., June 5, 1963, JPLHF 2-270.)

Jan. 22 Speaking at the Fifth Meeting of the Panel on Science and Technology held in Washington, D.C., Dr. James Van Allen of the State University of Iowa observed that although manned lunar missions were immensely more expensive than instrumented probes, the real point in question was "how much exploration of the moon is going to be required to gain a . . . comprehensive knowledge of the nature of the moon as a geological body, [and] that I personally do not conceive of ever doing it by an unmanned machine at all. . . ." Dr. Lee DuBridge, President of the California Institute of Technology, commented that "if these fellows just get to the moon and look around and say, 'It is kind of pretty up here,' and come back with no information, I think it would not be worth 1 percent or even a tenth of a percent of our national budget. . . . The goal of our space program should be clearly thought of as a scientific objective. . . . One hundred years from now the world will look back on this space program and say that the most important thing that has happened is what we have learned, what scientific information has been obtained. . . . I think this committee and the Congress can have

Jan. 22 cont. a broader and deeper view toward the space program than only to beat the Russians, or beat them to the moon." (Proceedings before the Committee on Science and Astronautics, U.S. House of Representatives, 88th Congress, First Session, Panel on Science and Technology, Fifth Meeting, January 22 and 23, 1963, 49-51, JPLHF 2-1745.)

Jan. 23-24 A meeting was held at JPL among members of NASA Headquarters, MSFC, LeRC, SSD, and JPL, to review the status of Ranger and Mariner programs, planned launch requirements, and booster availability and improvement efforts. Increased weight of the Ranger spacecraft (no estimated at between 800-825 lbs.) caused by design changes and added redundant systems called for improvements in booster performance to allow for the added weight. (JPL document entitled, "Minutes of Meeting of NASA, MSFC, SSD, and JPL Concerning Ranger and Mariner Program Plans at JPL on 23 and 24 January 1963," JPLHF 2-1544b; and, Engineering Document No. 333, Revised, Ranger Launch Vehicle Integration Summary, 27 June 1967, 35.)

Jan. 25 At the weekly Ranger Spacecraft System Review meeting R. Mesnard indicated that improvements under consideration by the Ranger Design Review Board included: a separate antenna gear box; a new narrow angle earth sensor (to extend the launching period); an aluminum bus similar to the RA-9 design; and larger solar panels of the Mark IV design. In addition, plans called for splitting the TV subsystem into two separate systems, including the possibility of incorporating a backup clock to trigger one or both sides of the TV subsystem. (JPL, Ranger Spacecraft System Review Minutes, January 25, 1963, 1-2, JPLHF 2-1313.)

Jan. 28 All NASA Agena booster functions previously assigned to MSFC, with the exception of the Gemini Agena target vehicle program, were assumed by the Lewis Research Center in Cleveland, Ohio. Dr. S. Himmel was designated the new Agena Systems Manager at LeRC. (See December 12, 1962.) (NASA, memo from H.E. Newell, to All Directors of Centers, January 24, 1963, JPLHF 2-1359.)

A meeting of experimenters assigned to the Ranger TV payload subsystem met at JPL. Among the opinions expressed by this group were that the main value of the pictures to be obtained by Ranger would be that of confirming the landing gear design of lunar soft landing spacecraft. Two meters resolution on the lunar surface was considered of use in this regard; twenty meters or more was considered of very little value. In light of the importance of achieving a successful mission it was

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Jan. 28 cont.	suggested that the first day of a launch window, to be considered acceptable, should permit a resolution of 2-3 meters without any terminal maneuver. (JPL, Summary of Ranger Experimenters Meeting held January 28, 1963, JPLHF 2-661a; and, Minutes of Experimenter Meeting, January 28, 1963, JPLHF 2-662.)
During January	Ranger Block III. Assembly of the Design Evaluation Vehicle (DEV), a spacecraft electrically identical to the flight article, was completed at JPL. The Ranger 6 spacecraft remained in a disassembled condition pending the results of the JPL design review in progress. Decisions that had been reached to date included removal of all ancillary experiments and all requirements for heat and terminal (gas) sterilization, and providing for backup commands for Sun and Earth acquisition. (JPL, Space Programs Summary No. 37-19, Vol. VI, for the period Nov. 1, 1962 to Jan. 31, 1963, 9-11.)
	RCA had completed design review of the TV subsystem configuration and recommended an improved system that would possess greater reliability. The new "split system" was reviewed and accepted by JPL. Separate signal and power paths were established for both the P- and F-camera chains, with the result that the two camera and communications chains were capable of either independent or simultaneous operation, greatly improving the TV system capability of obtaining information either during a non-standard mission or under conditions of partial failure of the TV system. Detailed design of this system began during the month. (JPL, Space Programs Summary No. 37-20, Vol. I, for the period Jan. 1, 1963 to Feb. 28, 1963, 45-46.)
	Facilities. Work continued underway on the Space Flight Operations Facility which was now scheduled for occupancy in October 1963, and to be operational on April 1, 1964. The concept of a centralized space flight operations and data processing center for mission and network control of deep space missions had evolved during the past two years. (See During November 1962.) (JPL, Space Programs Summary No. 37-20, Vol. VI, for the period January 1, 1963 to March 31, 1963, 43-46.)
Feb. 1	NASA announced that responsibility for launching Agena and Centaur space vehicles was transferred from LOC to the Goddard Space Flight Center Field Project Branch at Cape Canaveral, with Lewis Research Center providing technical direction. (Astronautics and Aeronautics, 1963, op. cit., 38.) (See January 17, 1963.)

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Feb. 1 cont. Phase IIA Ranger 6-9 Reliability Study (JPL Contract No. 950611) was awarded to Fairchild Stratos Corporation of Bayshore, New York, and called for the contractor to further pursue analytical studies that would yield reliability estimates utilizing several sets of failure rates for the spacecraft. (JPL, IOM from Budd Love to Distribution, March 28, 1963, JPLHF 2-1587.) (At this time only RA-6 through RA-8 vehicles were approved.)

A planning purpose decision was reached at JPL that future Ranger flights beyond RA-13 would hard-land lunar surface capsule experiments based upon Ranger Block II technology. (JPL, Preliminary Draft, Technical Report No. 32, Ranger Block V Project, 1964, 43.)

Feb. 4 Dr. R.V. Meghreblian, Chief of Space Sciences Division at JPL, notified JPL Ranger Project Manager H.M. Schurmeier that active studies were now in progress on possible future Ranger mission payloads, although firm recommendations were not yet prepared. He indicated that the ADF High Resolution Facsimile Capsule probably would not be recommended for future Ranger missions. (JPL, IOM from R.V. Meghreblian to H.M. Schurmeier, February 4, 1963, JPLHF 2-1583.)

Feb. 5 The JPL Ranger Design Review Board and Senior Staff met to discuss Board recommendations for the Ranger Project. A plan was presented with launches to begin for Block III at the end of 1963. (Spacecraft changes are noted at the end of the month.) The plan was approved for presentation to NASA Headquarters on February 12 for its concurrence.* (JPL, Ranger Spacecraft System Review Minutes, February 8, 1963, 1-2, JPLHF 2-1313.)

Francis E. Lehner of Caltech and Robert L. Kovach at JPL publicly described a system to determine the character of the moon's crust by touching off small explosive charges distributed on the moon from a 50-lb. spherical capsule, and detecting the resulting sound waves with one or more geophones. (NASA, Astronautics and Aeronautics, 1963, op. cit., 44.)

Feb. 7 Objectives and experiments actively considered for Ranger Block IV vehicles by the Space Sciences Division were issued at JPL: "The primary objectives of the Ranger 64 series

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*Ranger Block terminology, referring to a series of nearly identical spacecraft, was adopted at this meeting, and later accepted by NASA.

Feb. 7 cont. [Block IV] is acquisition of information about lunar topography and surface structures in sufficient detail to provide clues to the origin and nature of lunar surface features and history of the moon, provide landing site information for Surveyor Lander, and finally, provide design criterion and landing site information for Apollo." Ten experiments were listed as candidates:

1. Television
2. Gamma-Ray Spectrometer
3. Dust Particle Detector
4. Integrating Ionization Chamber
5. Particle Flux Experiment
6. Search Coil Magnetometer
7. Ion Energy Ion Detector
8. Electron-Proton Spectrometer
9. Electron Flux Detector
10. Low Energy Solar Protons

(JPL, R.G. Brereton, "Ranger 64 Scientific Experiments," February 7. 1963, JPLHF 2-1576.) (See January 21, 1963.)

Feb. 11-12 Speaking before a NASA-Industry Conference, OSS Director Dr. Homer Newell summarized past problems in Project Ranger and planned corrective measures. He indicated that "the project was increased appreciably to provide for five additional spacecraft to bring the total future flights to nine [comprising Blocks III and IV]. This increase was made because of the urgent need for early information about the lunar surface to support Apollo manned missions to the moon." (H.E. Newell, "NASA Spacecraft are Pushing Back the Frontiers of the Universe," as cited in Comment on the National Space Program, 1st ed., July 1, 1963, B-126, JPLHF 5-218c.) (See January 3-4, 1963.)

At the same meeting, Mr. Oran Nicks, Director of Lunar and Planetary Programs at NASA, noted that NASA planning for Project Ranger now called for a total of twenty-two flights through calendar year 1965. (O.W. Nicks, "Flights Planned to the Moon and Planets in this Decade," cited at Ibid., B-151.) (The proposed increase to twenty-two flights was later rejected by NASA management.)

Feb. 12-13 The Ranger Reprogramming meeting was held in Washington, D.C. among members of the JPL Ranger Project and NASA OSS Headquarters staff. JPL presented the findings of the Ranger Design Review Board. NASA concurred in the proposed plans for Project Ranger, Feb. 12-13 cont. although answers to several questions concerning booster system launch reliability were postponed. Essentially, the project was to consist of impacting television missions separated into two blocks of several identical flights each, incorporating improvements in spacecraft and payload design. Block III was to consist of three or four vehicles with a first launch scheduled for December, 1963, carrying only the primary experiment. Block IV, the second set of impacting TV missions using improved cameras, would also carry passenger science experiments with launches to begin in mid-1964. Production of spacecraft for Block IV and subsequent series would be contracted with industry. Planning for Block V, another hard-landing capsule mission carrying scientific experiments, was approved. (JPL, IOM from H.M. Schurmeier to Distribution, February 15, 1963, JPLHF 2-1360; also, IOM from H.M. Schurmeier to W.H. Pickering, February 22, 1963, JPLHF 2-1564.)

Feb. 14 An Executive Council was established at JPL consisting of the Laboratory Director, Deputy Director, Assistant Laboratory Directors, and the Special Assistant to the Director, whose Major function was to formulate major policies and planning for the Laboratory, as well as perform as an advisory board to the Director. (JPL, IOM from W.H. Pickering to Senior Staff, February 14, 1963, JPLHF 2-962.) The Senior Staff would now serve more as a forum, sounding board, and information exchange link between higher and lower echelons of Laboratory management.

JPL's Space Sciences Division conducted a critical review of the new RCA TV system design down to the circuit and component level. Several potential failure modes were uncovered, and RCA subsequently instituted corrective design action. (JPL, IOM from R.L. Heacock to Distribution, February 25, 1963, JPLHF 2-1550.)

Feb. 15 Mr. N.W. Cunningham, Ranger Project Manager at NASA Headquarters, informed Dr. H.E. Newell, Director of OSS, of the status of passenger science experiments in Project Ranger, and of the revised objectives agreed upon with JPL for Flights 6 through 8, at the February 12-13 meeting. The objectives were:

1. The next series of Ranger flights would obtain TV pictures of the lunar surface of benefit to the scientific program as well as the manned lunar program. Pictures would be at least an order of magnitude better than available earth-based photographs.

Feb. 15 cont.

2. In the event of a conflict between requirements of the scientific program and the manned lunar program, every consideration would be given to meeting the needs of the manned program.

3. Technological data would be a by-product and not an objective of these flights.

4. There would be no secondary objectives such as cislunar fields and particles experiments.

(NASA, Memo for the Director, OSS, from N.W. Cunningham, February 15, 1963, loc. cit.) (See August 12-17, 1962.)

JPL issued Ranger Project Guidelines to all affected personnel based upon the plans agreed to on February 12-13 in Washington, D.C. Block designations were described as follows:

> "The Ranger flights will be grouped into several blocks, with changes in 'mission' objectives being made only between blocks. Block 1 consisted of Rangers 1 and 2; Block 2 of Rangers 3, 4, and 5. Block 3 will be the next group starting this year; Block 4 will consist of the group in 1964 just prior to the Mariner C Mars flights, and Block 5 will be the group in 1965."

(JPL, IOM from H.M. Schurmeier to Distribution, February 15, 1963, JPLHF 2-1360; also, NASA memo from N.W. Cunningham to John W. Rosenberry, March 12, 1963, JPLHF 2-1586.)

Dr. Pickering, Director of JPL, issued Principles Governing the Management and Operation of the Jet Propulsion Laboratory which reaffirmed a Laboratory goal ". . . to attain and maintain a pre-eminent position in selected areas of space science and technology." Among the operating principles enumerated in support of this goal were the following:

- recognize that the Laboratory is accountable jointly to NASA and Caltech for its performance.

- limit project activities to a select number of projects as may be jointly agreed upon by NASA and the management of the Laboratory.

- recognize that project activities may be undertaken either on an exclusive basis or on a mutual or subordinate participant basis with NASA Centers or with industry.

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Feb. 15 cont. Operational guidelines for Laboratory activities specified, inter alia, that a manpower ceiling of 4,000 was established for JPL, and that "activities in support of the Ranger project will have the first priority on Laboratory manpower and facilities." (JPL, Document entitled, "Principles Governing the Management and Operation of the Jet Propulsion Laboratory," February 15, 1963, JPLHF 2-964; also, Document by W.H. Pickering entitled, "Objectives of the Jet Propulsion Laboratory," February 15, 1963, JPLHF 2-965.)

Feb. 18 The SSSC convened, and Dr. U. Liddel presented a recommendation from the NASA OSS Lunar and Planetary Program Office that the eight non-visual passenger science experiments be removed from Rangers 6-9. Pending a Ranger success, the experiments would be reviewed at a later date for possible reprogramming. The SSSC approved the requested action. (NASA, Minutes of the Space Science Steering Committee meeting, February 18, 1963, JPLHF 2-1763.) (See January 21, 1963.)

Feb. 20 Dr. W.H. Pickering submitted several proposals for bringing an industrial contractor into the Ranger Project to NASA Headquarters. Phase I of the preferred plan called for contractor-assistance to the Laboratory on Block III and IV Rangers and, in Phase II, assumption of responsibility for building Block V Ranger spacecraft. Both phases were to be handled under contract to JPL rather than through contracts directly from NASA. Following competitive bids and source evaluation, a contract for Phases I would be awarded on May 1, 1963. (JPL, letter from W.H. Pickering to E.M. Cortright with JPL Procurement Plan for Phases I and II, both dated February 20, 1963, JPLHF 2-185a and 2-185b.) (See April 24, 1962.)

Feb. 21 The JPL Ranger Planning Office voiced skepticism of the advisability of current project plans to launch Block III Rangers on one month centers beginning in December, 1963. (JPL, IOM from Ranger Planning Office to Section 312 Engineers, February 21, 1963, JPLHF 2-1585.)

Feb. 22 The JPL Spacecraft Power Section recommended against a Project proposal to split the power system configuration for Block III Rangers. (JPL, IOM from G.E. Sweetnam to M.R. Mesnard, February 22, 1963, JPLHF 2-1548.)

Feb. 23 K.C. Coon was appointed Ranger Block V Spacecraft System Manager. (JPL, Ranger Block V Project, op. cit., 37, JPLHF 2-1969.)

Feb. 26 The JPL Space Sciences Division completed expansion of organization support for Project Ranger. Mr. Charles Campen was named Division Representative, Dr. Harold Washburn Project Scientist, and Mr. Ray Heacock Project Engineer. In addition, Dr. T. Vrebalovich was appointed Assistant Project Scientist for Ranger. (JPL, IOM from R.L. Heacock to Distribution, February 26, 1963, 2, JPLHF 2-1550.)

JPL consolidated the Quality Assurance Group and Parts Quality Assurance Group within an Office of Quality Assurance and Reliability, headed by Mr. Brooks Morris. (JPL, IOM from W.H. Pickering to Distribution, February 26, 1963, JPLHF 2-440.) (See July 7, 1961.)

Feb. 27 The decision to contract with industry for the manufacture of follow-on Ranger spacecraft appeared in the press: "Several companies have discussed the possibility of providing manufacturing services for building Ranger spacecraft with NASA. Selection of one of these without competitive bidding would be a joint decision of NASA and JPL. Two contractors seen favored. . . if a sole-source award is made are Northrop's Nortronics Division and General Electric's Missile and Space Division. . . ." (The Independent [Pasadena], February 27, 1963.)

Feb. 28 The JPL Ranger Project Guidelines were revised to account for a fourth spacecraft approved by NASA Headquarters for Block III, making the full complement RA-6 through RA-9. The number of spares remained at two. (JPL, IOM from H.M. Schurmeier to Technical Division Chiefs, February 28, 1963, JPLHF 2-1361.)

JPL was notified by NASA Headquarters that the OSS Space Sciences Steering Committee had approved removal of all scientific experiments, with the exception of the television payload, from Ranger Block III spacecraft. (NASA, letter from H.E. Newell to W.H. Pickering, February 28, 1963, JPLHF 2-184a.) (See January 21, 1963.)

The Official NASA Flight Schedule was issued including the launch dates for all approved Ranger flights in the revised program:

Block	Vehicle	Launch
III	RA-6	December, 1963
	RA-7	January, 1964
	RA-8	March, 1964
	RA-9	April, 1964

Feb. 28 cont.

Block	Vehicles	Launch
	RA-10	July, 1964
	RA-11	August, 1964
IV	RA-12	September, 1964
	RA-13	January, 1965
	RA-14	March, 1965

(Official NASA Flight Schedule, February 28, 1963, JPLHF 2-968.)

During February

Ranger Block III. As a result of the intensive Ranger Design Review which concluded early in the month, the Ranger spacecraft design selected was that of the former RA-8 (less passenger science) with the addition of a separate antenna gear box. Other modifications--to increase spacecraft reliability and take advantage of the additional weight provided by removal of some experiments and improved Agena performance--included the following:

- The spacecraft bus structure was changed from magnesium alloy to aluminum alloy.
- Larger, rectangular, Mark IV solar panels replaced the trapezoidal panels used previously. Mylar insulation was replaced by a thicker layer of epoxy glass on the Mark IV panels, and each panel was wired such that three segments in each panel could independently produce rated voltage.
- A second 1,200 w/h battery was added, doubling the power capacity in the spacecraft.
- A second 1/4-w transponder was provided in the RF chain so that each antenna was supported by a separate unit.
- Brand new (unsterilized) central computer and sequencer (CC&S) units would be fabricated for Block III together with a hydraulic timer to back up certain vital CC&S commands.
- A 400-cps backup clock would be provided for telemetry and commutation in the event normal "sync" in the CC&S was lost.
- A completely redundant attitude control gas system, originally planned for RA-10, was incorporated in the new design.
- The squib firing assembly was modified so that existing redundant firing channels would be driven separately by onboard batteries.
- A larger midcourse motor, first planned for use on RA-10, was included.
- The TV subsystem was "split" into two redundant chains (as mentioned previously).

(JPL, Space Programs Summary No. 37-20, Vol. I, op. cit., 2-5, 7.)

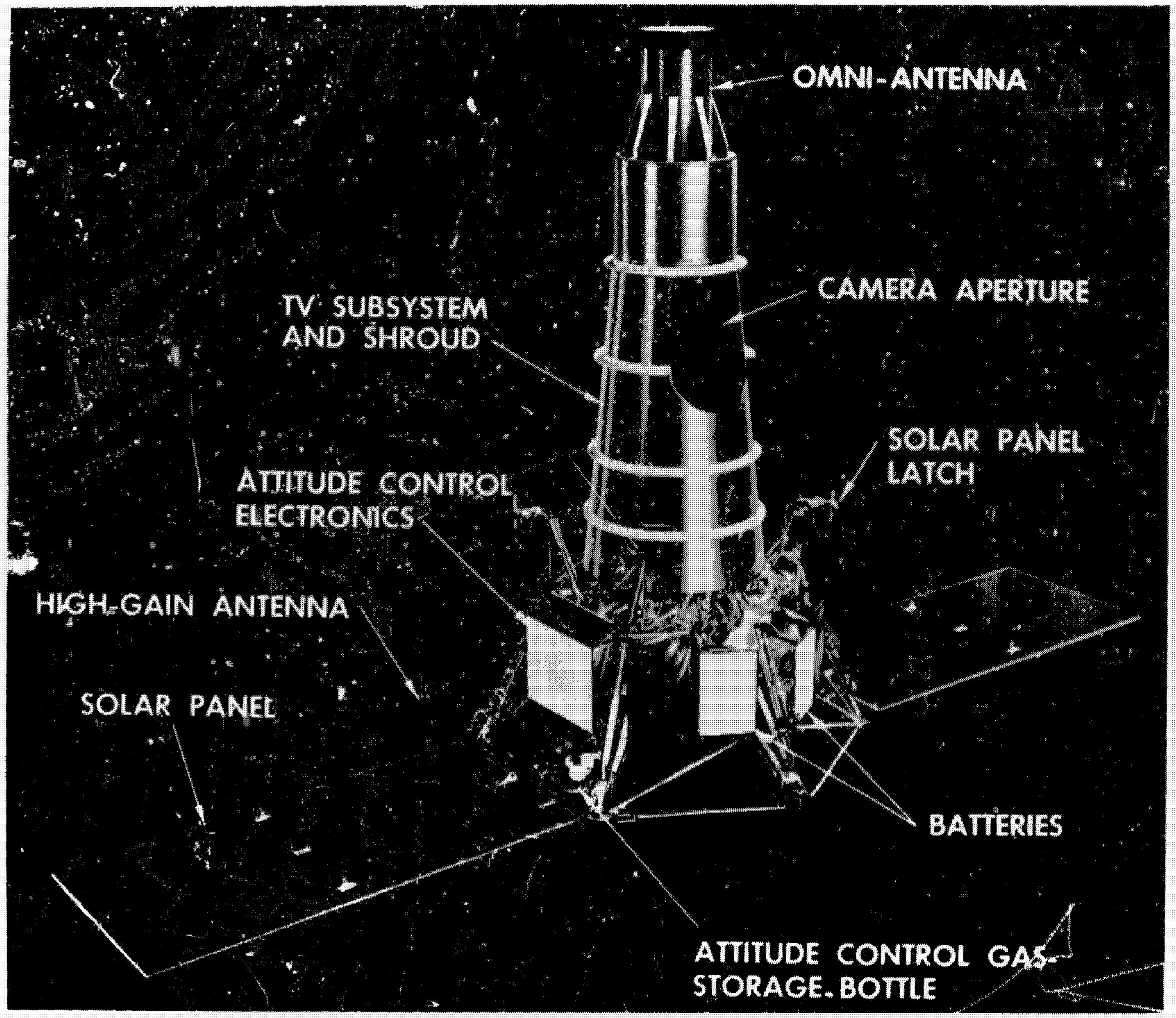

Figure 53: Modified Ranger Block III spacecraft configuration, February 1963.

During February cont.

Other means were adopted to further improve spacecraft reliability including:

1. No heat-sterilized electronic components would be flown on the bus.
2. Electronic subsystems would employ Hi-Rel components or components from the Preferred Parts List to the greatest extent possible.
3. A standard "burn-in" method was adopted for all electronic components.
4. Type-approval tests were required on all like items in all electronic units.
5. Built-up circuit boards containing solid-state components would not be ultrasonically cleaned.
6. Quality assurance and environmental testing procedures were tightened.

(Ibid., 5.)

Assembly of a Block III Life Test Vehicle (LTV) from old RA-6 components began on February 12 and was completed on February 20. Max Goble was appointed Test Director for the Life Test Vehicle Program. The program involved a series of real-time mission tests in a simulated space environment. Thirteen tests were conducted from February through April, and the vehicle had logged 1,263 hours of operation upon conclusion of the tests. (JPL, Ranger Spacecraft System Review Minutes, February 15, 1963, 1, JPLHF 2-1313; and, Testimony of Oran Nicks in Investigation of Project Ranger: Hearings before the Subcommittee on NASA Oversight of the Committee on Science and Astronautics, U.S. House of Representatives, 88th Congress, Second Session, GPO, Washington, D.C. 1964, 83-84.)

The most serious problem in the RCA TV subsystem remained vidicon availability and performance. Original erasure requirements had been relaxed in order to obtain enough tubes for the program. The three principal changes in the Block III TV subsystem were incorporation of F/1 lenses, the splitting of the F and P camera chains to eliminate interdependence, and provision of a redundant timer for TV system turn-on as a backup to the JPL command system. Flight unit 2 (non-split system) was received at JPL on February 19. (JPL, D.H. Kindt, Ranger Spacecraft System Review Minutes, February 21, 1963, 1, JPLHF 2-1313; and, IOM from R.L. Heacock to Distribution, February 26, 1963, loc. cit.)

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During February cont. All TV ground recording and display units were in operation at Goldstone and other respective field locations. RCA was preparing to modify this equipment as necessary to achieve compatibility with the revised Ranger TV subsystem. (JPL, Space Programs Summary No. 37-20, Vol. I, op. cit., 56.)

Ranger Block IV. Block IV schedule of activities had been established at the Ranger Quarterly Review on February 19:

3/4	Mission objectives defined
3/25	Design characteristics and restraints issued
4/15	Preliminary design completed
4/15	Project Policy and Requirements document issued
4/15	Functional specifications released
7/1	Drawings completed
7/1	Procurement initiated.

(JPL, A.E. Wolfe, Ranger Quarterly Review Minutes, February 19, 1963, JPLHF 2-1546.)

Ranger Block V. Late in the month JPL distributed a Request for Proposal (RFP) to a number of firms soliciting bids for the assumption of support and fabrication of Ranger Block V vehicles.

Work continued at ADF on the Lunar Facsimile Capsule configuration layout and prototype capsule construction. Preparations were underway to functionally test the basic azimuth drive and extension mechanism for the camera periscope device. (JPL, Space Programs Summary No. 37-20, Vol. I, op. cit., 33.)

Mar. 1 Revised Ranger flight schedules were released at JPL for planning purposes. Block III flights remained the same as those released on February 28; however, Block IV was reduced to three vehicles, RA10-12, to be launched in July, August, and September, 1964, and Block V was expanded to six--vehicles RA13-18, to be launched in January, March, May, July, October and December, 1965. (JPL, IOM from W.H. Pickering to Distribution, March 1, 1963, JPLHF 2-430.)

NASA OMSF issued a new edition of "Requirements for Data from Unmanned Spacecraft in Support of Project Apollo." The document called upon OSS to state its plans for obtaining data critically needed for Apollo in the areas of solar radiation, micrometeoroid flux, and details on the characteristics of the lunar surface. (NASA, Office of Manned Space Flight, "Requirements for Data from Unmanned Spacecraft in Support of Project Apollo," March 1, 1963, JPLHF 2-1362.)

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Mar. 4-6 The Planetology Subcommittee of the NASA SSSC convened in Washington, D.C. A Colloquium on "The Nature of the Lunar Surf ce," chaired by Dr. Homer E. Newell, was conducted during the first two days, with the final session given over to a consideration of penetrometer experiment for Ranger, and a recommendation that Ranger 7 be employed to measure lunar surface slopes through high resolution photos. (JPL, IOM from H.W. Washburn to R.V. Meghreblian, March 22, 1963, JPLHF 2-1368b; and, M.R.G., "Lunar Sciences Subcommittee," NASA, Lunar Science Chronology, draft, January 15, 1965, JPLHF 2-652; also, Minutes of the Planetology Subcommittee of the Space Sciences Steering Committee, March 4-6, 1963, 2, JPLHF 2-1771.)

The Planetology Subcommittee summarized the current understanding of the nature of the lunar surface (various hypotheses), and concluded that one of the most important investigations for Apollo support was that of measuring the slopes by high resolution photographs in order to obtain information as to the minimum strengths of surface material. (Ibid., 9-11.)

Mar. 5 A meeting was held at NASA Headquarters between JPL representatives and OSS. NASA representatives informed JPL that a contract for a Ranger spacecraft system contractor would be awarded, on a sole-source basis, to the Northrop Corporation, Northrop Space Laboratories. (NASA, letter from H.E. Newell to W.H. Pickering, March 8, 1963, JPLHF 2-183; and, Testimony of E.M. Cortright, U.S. Congress, Senate, NASA Authorization for Fiscal Year 1964, 88th Congress, First Session, Part 1, Scientific and Technical Programs, 1600.) The two-phase contract would move from Ranger support on Block III and IV to Northrop fabrication of spacecraft and ground support equipment for Block V. (JPL was not favorably disposed to the sole-source award.)

Mar. 7 NASA obligated $13,388,000 for Ranger Block IV. (NASA, TWX from E.M. Cortright to R. Rodney of NASA-WOO, March 7, 1963, JPLHF 2-1589.)

Similarity in mission objectives of Ranger Block IV compared to Ranger Block III caused serious questions as to the value of this flight series to be raised at JPL. D. Alcorn asserted that "if there are one or two successful Block III shots, the value of Block IV is extremely questionable. If there are no successful Block III shots, does it make sense to fire more of the same machine? . . ." (JPL, IOM from D. Alcorn to A. Wolfe, March 7, 1963, JPLHF 2-1578; also, NASA, memo from N.W. Cunningham to J.W. Rosenberry, "Definition of Ranger Block Concept," March 12, 1963, JPLHF 2-1586.)

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Mar. 8 NASA announced selection of the Northrop Corporation for industrial support on Ranger Blocks III and IV, and as contractor for Ranger Block V spacecraft. (JPL Public Information Release, "NASA Selects Ranger Industrial Support Firm," March 8, 1963, JPLHF 2-1365; and, "Northrop Ranger Award," Aviation Week, March 18, 1963, JPLHF 2-740.)

In response to the RA-5 Failure Review Board findings, JPL issued Rev. 1 of EPD-65, Ranger Project Policy and Requirements, which provided the basic framework within which spacecraft system and subsystem engineering, and JPL Quality Assurance and Reliability Office participation in project activities would take place. (JPL, EPD-65, Rev. 1, March 8, 1963, JPLHF 2-1547a.) (Original Engineering Planning Document was released on January 18, 1962.) This document and the corresponding one issued for the Mariner 1964 Mars Project were made as similar as possible in order to maintain equivalent high standards on both projects.

Mar. 11 JPL Contract No. 950591 was awarded to Northrop Corporation for Phase I industrial support on Project Ranger. The contract scope of work included personnel support activities to JPL for Ranger Block III and IV, in addition to spacecraft system contractor for Ranger Block V. (JPL, Space Programs Summary No. 37-25, Vol. I, for the period November 1, 1963 to December 31, 1963, 2.)

In a letter to Dr. S. Himmel, LeRC Agena Systems Manager, JPL Ranger Project Manager H.M. Schurmeier outlined a number of recommendations developed by JPL for improving reliability of the Atlas-Agena B booster system. (JPL, Ranger History--Working Draft, op. cit., 45; also, Ranger Launch Vehicle Integration Summary, op. cit., 39.)

Mar. 13 The first six Northrop engineers were assigned positions at JPL in support of Ranger Block III. (NASA, N.W. Cunningham, OSS Review of March 21, 1963, 36, JPLHF 2-1505.)

Mar. 14 N.W. Cunningham, NASA Ranger Program Chief, issued proposed mission objectives for Ranger Block III and Block IV: to obtain high resolution pictures of the lunar surface. Secondary experiments would be carried on Block IV spacecraft. (NASA, letter from N.W. Cunningham to H.M. Schurmeier, March 18, 1963, JPLHF 2-182.) (See March 7, 1963.)

Problems with the Ranger operational support equipment (for reconstructing the video signal) were uncovered at the Goldstone

Mar. 14 cont. tracking station. (JPL, IOM from R. Heyser to R.L. Heacock, March 14, 1963, JPLHF 2-1555.)

Mar. 15 Mr. N.W. Cunningham requested NASA OSS approval for use of an improved television subsystem as the primary payload for Ranger Block IV vehicles. Dr. G.F. Kuiper of the University of Arizona and Dr. E.M. Shoemaker of the NASA Office of Space Sciences were recommended as co-experimenters. (NASA, Memo for the Director, Office of Space Sciences, from N.W. Cunningham, March 15, 1963, JPLHF 2-696.)

Mar. 18 NASA OSS submitted the Ranger Block IV payload recommendation to the SSSC. For lack of time and a quorum, the Chairman directed that a special meeting be convened to consider the Block IV payload. (NASA, Minutes of Space Science Steering Committee, March 18, 1963, 3, JPLHF 2-1765.)

The NASA charter for the Ranger, Mariner and Fire Tracking, Telemetry and Communications Panel was executed by the respective project managers. The purpose of this panel was to evaluate and coordinate tracking, telemetry, and communications requirements for these projects, and to recommend solutions for problems to project managers. (The charter was further revised on November 1, 1963.) (JPL, "Charter of the Ranger, Mariner and Fire Tracking, Telemetry and Communications Panel," March 18, 1963, JPLHF 2-2074.)

Mar. 21 The SSSC met to consider the Ranger Block IV experiments. The Committee recommended approval of the Block IV TV sub-System, with the understanding that every effort would be made to include as many non-visual passenger experiments as possible. Drs. Kuiper and Shoemaker were designated co-experimenters for the Block IV TV subsystem. A decision on non-visual experiments was postponed pending receipt of information on payload weight capability. (NASA, Minutes of the Space Sciences Steering Committee, March 21, 1963, 2, JPLHF 2-1766.)

Missions that were being considered at JPL for the Ranger Block V rough landing capsule included: seismometer (as in Block II), visual (LSPC), and hardness (SURMEC, or a Langley penetrometer capsule). (Minutes of Ranger "Tuesday - Thursday Meeting," March 21, 1963, JPLHF 2-1584; also, OSS Review of March 21, 1963, op. cit., 35.)

1963

Mar. 22 LeRC decided to continue using the Atlas D boosters in the Ranger Project through Block IV, rather than risk first launches on a "Standard Atlas" under development by GDA for the Air Force. (JPL, IOM from A.W. Vogan to Distribution, March 22, 1963, JPLHF 2-1618.)

Mar. 25 JPL issued a document, Method for Design and Engineering Documentation Change Control, which improved on the existing ECR system, and established specific change control procedure in conformance with EPD-65. (JPL, IOM from R.J. Parks to Division Chiefs, et. al., April 5, 1963, JPLHF 2-1372.)

Mar. 26 Dr. Homer E. Newell, Director of OSS, informed NASA Director James Webb of his concern with the disinterest in space science in evidence at OMSF in Houston. He recommended that Mr. Webb emphasize the complementary role that engineering and science play for each other in space exploration. (NASA memo from H.E. Newell to J. Webb, March 26, 1963, JPLHF 2-376.)

Robert Parks, Assistant Laboratory Director for Lunar and Planetary Programs, directed a letter to Dr. S. Himmel, LeRC Agena Systems Manager, emphasizing the very great importance the Laboratory attached to implementation of the recommended improvements in the Atlas/Agena outlined in the letter of March 11, 1963. (Cited in Ranger Launch Vehicle Integration Summary, loc. cit.)

Mar. 27 Discussion of possible reinstitution of terminal sterilization (ethylene oxide-ETO) for Ranger spacecraft at JPL resulted in several surveys to determine the schedule, cost, and performance impact. The conclusion was that ETO probably could be accommodated if the requirement was firmed up within two weeks while further impact evaluations were undertaken (e.g., effect of ETO requirement on existing contracts). (JPL, IOM from A.P. Bowman to H.M. Schurmeier, March 27, 1963, JPLHF 2-1556.)

Mar. 28 NASA issued the charter for the Atlas/Agena Lunar and Interplanetary Missions Panel for Performance Control, Trajectories, Guidance and Control, and Flight Dynamics. (JPL, IOM from V. Clarke to Distribution, April 1, 1963, enclosing above Charter.)

Mar. 29 NASA OSS distributed invitations to potential experimenters soliciting proposals of instruments for use on Ranger Block IV TV missions scheduled for flight in late 1964, and on Ranger

Mar. 29 cont. Block V rough landing capsule flights scheduled for launch in 1965. (NASA, letter from H.E. Newell to experimenters formerly associated with Project Ranger, dated March 29, 1963, JPLHF 2-1746; and, letter, same date to other scientists, JPLHF 2-1747.)

During March Ranger Block III. The only remaining major design decision for Block III vehicles involved the backup clock for the TV subsystem, and several approaches were under evaluation.

As in the case of Block II spacecraft, weight had once again become a critical problem; however, the problem was now caused by the addition of new equipment and redundant systems in the spacecraft rather than by faulty booster performance estimates. Maximum allowable weight was 810 lbs., and RA-6 was estimated at just a few pounds short of this figure. (JPL, Ranger Spacecraft System Review Minutes, March 20, 1963, 1, JPLHF 2-1313.)

Formal JPL approval of the split system design for the Block III TV system was given RCA AED during the month, and RCA began a series of tests on this system to determine its ability to obtain pictures under conditions of partial failure. (Testimony of Kreuzer, Investigation of Project Ranger, op. cit., 88.)

Ranger Block IV. Proposed changes to be introduced into Block IV spacecraft were becoming firm, and the vehicle was taking shape as a slightly modified Block III design incorporating some passenger science experiments to meet the requirements of OMSF. (See March 1, 1963.) The number of non-visual experiments was not yet fixed with certainty, but there would be much less than the ambitious list first considered (see February 7, 1963). The number of flight vehicles was reduced from five to three due to potential funding constraints and mission similarity with Block III. (See March 1, 1963.) (Rough Draft of Ranger Final Report, 39-40, JPLHF 2-122; and, Ranger Spacecraft System Review Minutes of March 6, 1963, 2, JPLHF 2-1313.)

Ranger Block V. Development of major subassemblies of lunar facsimile capsule (LFC), designed to take detailed pictures of the lunar surface after hard landing, continued in progress at ADF. (JPL, Space Programs Summary No. 37-20, Vol. VI, op. cit., 13.) Another study and preliminary design contract was initiated with ADF for the seismometer capsule for the purpose of evaluating Block V capsule requirements and to define any changes in the Block II design necessary to meet the requirements. With these exceptions, no other Block V work was budgeted at this time. (Ranger History--Working Draft, op. cit., 36; and, JPL, IOM from J.D. Burke to H.M. Schurmeier, March 28, 1963, JPLHF 2-1369.)

During March cont.

The number of planned Block V vehicles was established at twelve, RA13-24 by OSS, as the higher science content in this group was most favorably received by the scientific community. "In addition to the prime capsule payload, it is anticipated that Block V flights will be capable of carrying a sizable quantity of non-visual experiments similar to those being considered for the Block IV flights." (NASA, OSS Review of March 21, 1963, 2, JPLHF 2-1505.)

Apr. 1

In a meeting of all JPL Technical Division Chiefs, a Laboratory decision was announced that, in the interests of quasi-projectizing flight projects, hereafter all individuals assigned from functional JPL divisions to flight projects could not be ordered by the division chief to another assignment without the concurrence of the Flight Project Manager and the JPL Deputy Director. (JPL, IOM from B. Sparks to Technical Division Chiefs, April 4, 1963, JPLHF 2-1591; also, testimony of W.H. Pickering, Investigation of Project Ranger, op. cit., 165-166.)

JPL Functional Specification R3-2-110, Ranger Block III Spacecraft Mission and Design Criteria was issued. The purpose of Project Ranger was established as developing unmanned spacecraft and lunar space flight technology, and obtaining information about the moon. The mission objective for Block III flights was "to obtain television pictures of the lunar surface which would be of benefit to both the scientific program and the United States Manned Lunar Program. These pictures should be at least an order of magnitude better in resolution than any available earth-based photography." (JPL Specification R3-2-110, April 1, 1963, 1, 2; see November 8, 1961.)

JPL Ranger Project Manager H.M. Schurmeier notified N.W. Cunningham, Chief of the Ranger Program Office at NASA Headquarters, of his preference for wording mission objectives for Ranger Block IV:

> "The primary mission of the Block 4 Ranger flights is to obtain television pictures of the lunar surface which will be of benefit to both the scientific program and the United States Manned Lunar Program. The pictures should be of higher quality and, if appropriate, of different locations than those of Block 3. The secondary mission is to obtain by means of non-visual techniques significant new and useful data concerning the lunar topograph, environment and composition."

(JPL, TWX from H.M. Schurmeier to N.W. Cunningham, April 1, 1963, JPLHF 2-1579.)

1963

Apr. 2 NASA informed JPL that further consideration was being given to "a simplified sterilization procedure for lunar spacecraft. The major elements of this procedure are expected to involve clean-room assembly and terminal sterilization by exposure to ethylene oxide gas in the hangar at AMR. It is requested that JPL provide this office with information regarding the specific effects of such a sterilization plan as they relate to Ranger and Surveyor spacecraft development, operations, facilities, reliability, and costs." (NASA, TWX from O.W. Nicks to R.J. Parks, April 2, 1963, JPLHF 2-1557.)

Dr. Homer E. Newell informed Dr. A.R. Hibbs, Chief of the Arms Control Study Group at JPL, that NASA Headquarters was reviewing the roles of science experimenters in NASA flight projects with the intent to expand experimenter participation. "In line with this policy, we are expecting to increase the participation and responsibilities of the TV experimenters in the forthcoming Ranger series, and will be asking experimenters personally to sign off on the equipment and preparations for the flight." (NASA, letter from H.E. Newell to A.R. Hibbs, April 2, 1963, JPLHF 2-1590.)

The Soviet Union announced launch of a 1-1/2 ton unmanned space ship towards the moon, and implied that it might land a robot station in preparation for manned flights. ("Station on Moon? Russia Blasts off New Space Shot," Los Angeles Times, April 3, 1963.) Soviet astronomer Nikolai Kuprevich declared that Luna IV "'would send back detailed reports on the most topical issue--what the moon's surface is like.'" (Newsweek Magazine, April 15, 1963.)

Apr. 3 Due to degradation of a Ranger Earth sensor employing a narrow 120° look angle, a decision was reached to return to the original sensor with a 180° angle even though weight and center of gravity problems were involved. (JPL, Ranger Spacecraft System Review Minutes, April 3, 1963, 1, JPLHF 2-1313.) (See January 25, 1963.)

Apr. 4 Arcing problems with the RCA TV subsystem for Block III Rangers were reported at JPL. (Minutes of Ranger "Tuesday - Thursday Meeting," April 4, 1963, JPLHF 2-1584.)

Russia's moon-bound spacecraft was described by Radio Moscow as two years ahead of United States lunar vehicles and apparently comparable to the Surveyor robot scheduled for launching in 1965. (Marvin Miles, "Moon Spacecraft Two Years Ahead of U.S. Vehicles, Russians Boast," Los Angeles Times, April 4, 1963.)

1963

Apr. 5 In response to a NASA request (April 2, 1963) the JPL Ranger Project Office prepared a sun aiy of Ranger sterilization experience for JPL management. (JPL, IOM from Ranger Project Office to Dr. F.E. Goddard, April 5, 1963, JPLHF 2-1559b.)

Tass News Agency reported that Luna IV would pass close to the moon but would not land. "Experiments and observations which are being carried aboard the Luna IV station are necessary for the realization of further flights under the program worked out for the exploration of the moon," the official news agency said. ("Lunik IV Will Miss Moon, Russia Says," Los Angeles Times, April 5, 1963.) "Radio Moscow cancelled a special program entitled 'Hitting the Moon' and broadcast music instead. Though that old devil moon appeared to be plaguing Russia as it had the United States Ranger program, the Russians were secretive as ever." (Newsweek, April 15, 1963.)

JPL established an Advanced Technical Studies Office to direct, coordinate, and originate advanced mission studies in the areas of unmanned lunar and planetary exploration. (Testimony of W.H. Pickering, Investigation of Project Ranger, op. cit., 166.)

Apr. 8 NASA issued the formal wording for Ranger Block IV objectives:

> " The primary objective of the Ranger Block IV flights is to obtain television pictures of the lunar surface which will be of scientific significance, and which will contribute to the United States manned lunar landing program. These pictures should be of higher quality than those of Block III and should provide coverage of as many sites as possible within the Ranger spacecraft capability.
>
> The secondary objective is to obtain by means of non-visual techniques significant new and useful data concerning the lunar topography, environment, and composition."

(NASA, letter from N.W. Cunningham to H.M. Schurmeier, April 8, 1963, JPLHF 2-697.) (See April 1, 1963.)

Apr. 8-9 A series of meetings were held at JPL with NASA, JPL, and experimenter participants, concerning selection of non-visual passenger science for Ranger Block IV. Most of the experiments considered were those planned previously for Ranger Block III. Weight problems again militated against a large selection, and Mr. N.W. Cunningham subsequently recommended in favor of the JPL Project choice; namely, the gamma-ray spectrometer and pulse radar. (NASA, memo from N.W. Cunningham to O.W. Nicks, April 12, 1963, JPLHF 2-698.)

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Apr. 9 President John F. Kennedy, in a memo to Vice-President Lyndon B. Johnson, requested information from the National Space Council on the benefits of and suggested future course for the United States space program and, in particular, asked to what extent the program could be reduced beginning in FY 1964 that would not affect Project Apollo. Responding to this request a few days later, NASA OSS indicated that a reduction in funds for Pioneer, Mariner B and Mariner C would not directly affect the Apollo program, although it would result in serious setbacks for deep space exploration and the scientific community. (Memo, President Kennedy to Vice-President Johnson, requesting information from the National Space Council on the benefits of, and future course for, the United States space program, April 9, 1963, JPLHF 2-333; and NASA, Memo from the Director, Lunar and Planetary Programs, to the Director, Program Review and Resources Management, Subject: Response to Questions for Letter to the President, April 17, 1963, JPLHF 2-333a.)

JPL issued the charter for the combined Quality Assurance and Reliability Office. (See March 8, 1963.) This action also formalized transfer of the Component Parts Evaluation Group of the Guidance and Control Analysis and Integration Section to the Quality Assurance and Reliability Office. (JPL, IOM from W.H. Pickering to Distribution, April 9, 1963, JPLHF 2-441.)

Apr. 10 Ranger Project internal operations priority was issued at JPL:

1. Block III primary objective
2. Block IV " "
3. Block V " "
4. Block IV non-visual experiments
5. Block V " " "

(JPL, Minutes of the Ranger Bi-weekly Project Meeting, April 10, 1963, JPLHF 2-1573.)

Apr. 11 RCA had undertaken tests in an attempt to resolve the arcing problem in the TV subsystem. A JPL representative was to be assigned to monitor these tests; RCA recommended a shake test of the complete TV subsystem. (JPL, Ranger "Tuesday - Thursday" Project Meeting Minutes, April 11, 1963, JPLHF 2-1584.)

A JPL study of the cost and schedule implications of instituting terminal sterilization with ethylene oxide gas in Project Ranger--including sterilization prior to type approval tests to determine effects on spacecraft reliability--resulted

Apr. 11 cont. in a cost estimate by the Ranger Project Manager of $.5-to-1 million dollars and a schedule slip from one to two months. (JPL, IOM from A. Bowman/J. Schlue to H. Schurmeier, April 11, 1963, JPLHF 2-1560.) (See April 2, 1963.)

Apr. 13 An editorial "Race to the Moon," appearing in The New Republic, observed that growing opposition to Project Apollo was especially apparent in the scientific community which doubted that there was any substantial value in sending a man to the moon. It concluded that "so long as Project Apollo continues to dominate the NASA budget, pure science must wait." (See March 26, 1963.)

Apr. 15 The NASA Space Sciences Steering Committee approved the OSS recommendation to use a Gamma Ray Spectrometer and Pulse Radar as the two passenger science experiments on Ranger Block IV vehicles. Other non-visual experiments recommended by the JPL Space Sciences Division (a Fluxgate Magentometer and Search Coil Magnetometer, Dr. E.J. Smith) were rejected. (NASA, Minutes of Space Sciences Steering Committee meeting, April 15, 1963, 1-3, JPLHF 2-1768; and, as reported in NASA memo from N.W. Cunningham to H.E. Newell, April 19, 1963, JPLHF 2-699; also, letter from H.E. Newell to W.H. Pickering, June 13, 1963, JPLHF 2-291; and, Ranger Spacecraft System Review Minutes, April 17, 1963, JPLHF 3-1313.) (See March 21 and April 8-9, 1963.)

Missiles and Rockets magazine reported that the NASA intra-agency report on mission roles for field centers favored expansion of GSFC tasks to include portions of the Mariner and Voyager deep space flight projects presently assigned to JPL. ("Goddard Management May Expand," Missiles and Rockets, April 15, 1963.)

Apr. 19 The Abelson editorial "Manned Lunar Landing" appeared in Science, and stirred a controversy. Of all the justifications for Project Apollo, only scientific inquiry was determined adequate, and "the scientific exploration of the moon has been accorded a secondary priority in the lunar program. . . ." Abelson urged more emphasis on unmanned scientific lunar exploration, and a reevaluation of program priorities. (P.H. Abelson, "Manned Lunar Landing," Vol. 140, Science, 259, April 19, 1963, JPLHF 2-1793.)

Apr. 20 Speaking before the American Society of Newspaper Editors, Dr. Homer E. Newell, Director of the NASA Office of Space Sciences, emphasized that "space science is simply science done in space. . . . Discussion frequently centers on whether the motivation should be simply to advance knowledge, or primarily to sow the seeds for

Apr. 20 cont. future applications, or primarily to support the manned flight program, or primarily to support the military effort. Such discussions tend to indicate that the science program would be different if the motivation was different. However, it is our conviction that the kind of research that best supports any of these objectives is a good sound scientific program." (As reprinted in Comment on the National Space Program, op. cit., B-2 through B-4, and B-121.) (See March 26, 1963.)

Apr. 22 Mr. N.W. Cunningham, Ranger Program Chief in NASA OSS, began submitting weekly status reports on the progress of Project Ranger to NASA Associate Administrator Dr. Roberts Seamans, Jr.

JPL requested a comprehensive JPL-LeRC design review of the Atlas-Agena launch vehicle system for Project Ranger as soon as it was practical. (TWX message to Dr. S.C. Himmel cited in Ranger History--Working Draft, op. cit., 46.)

Apr. 23 Phase I of JPL Contract No. 950591 with the Northrop Corporation for support on Project Ranger was definitized by the execution of Modification 1. (NASA, memo from N.W. Cunningham to R.C. Seamans, Weekly Status Report No. 2 - Ranger Program, May 1, 1963, 2, JPLHF 2-708.)

Apr. 24 JPL notified NASA Headquarters that studies of reinstituting terminal ethylene oxide sterilization of Ranger vehicles had been concluded: "The findings are that in order not to compromise reliability, a hardware qualification program must be carried out in both a TA and FA sense. This involves a thorough gassing, which in turn, will involve a one to two month delay. The cost of these efforts might run one-half to one million dollars and, inasmuch as the objectives of and justification for sterilization are very nebulous, it is not felt that delay is justified and it is strongly recommended not to reinstitute terminal sterilization." (JPL, letter from R.J. Parks to O.W. Nicks, April 24, 1963, JPLHF 2-307.) (See April 2, 1963.)

Dr. Colin S. Pittendrigh, Professor of Biology at Princeton University, "told the National Academy of Sciences today that, in view of the 'prestige races' this country was relaxing provisions for sterilization of vehicles sent to the moon." However, Dr. Pittendrigh did not oppose relaxing these requirements on Project Ranger. (New York Times, April 24, 1963; and, Walter Sullivan, "Moon 'Race' Held to Ignore Germs," New York Times, April 25, 1963.)

1963

Apr. 25 In a TWX to NASA Headquarters, JPL Ranger Project Manager H.M. Schurmeier reaffirmed JPL's position concerning the importance of establishing mission objectives and priorities at the earliest possible time:

"1. The mission objectives are the guiding statement for all elements of the project. They should be clear, concise, and unambiguous. If they are unclear or fail to resolve known issues, then various people or organizations will necessarily interpret them differently and as a result, confusion, inefficiency, misunderstanding, and often hard feelings will reign.

2. If there are multiple objectives they should either be stated in the proper priority order or if they are equal it should be so stated. If they are made equal it must be on the basis of having established to a reasonable accurate degree that the total set of objectives are indeed compatible with all of the project constraints.

3. The project manager's main job is to properly control and trade-off the four project parameters--mission objectives (in the sense of technical accomplishments) schedule, cost, and reliability. There is a danger and tendency to tie down the schedule and cost with great precision, but let the mission objectives wander. The result is that the project manager has a very difficult time obtaining accurate advice pertinent to necessary decisions, making or arranging for these decisions, and implementing the decisions.

4. As problems arise throughout the course of a project during design, fabrication, test, and operations, the mission objectives should be referred to as an aid--in fact, a controlling criteria--for the proper trade-off in specific decisions. A case in point, I believe, exists now on the Block 4 Rangers. If, for example, the gamma ray data were the primary mission objective, and the TV was secondary, then possibly the weight presently allocated to the mid-course capability improvement, should be allocated to a boom for the gamma ray experiment."

(JPL, TWX from H.M. Schurmeier to W. Jakobowski and N.W. Cunningham, April 25, 1963, JPLHF 2-1593.)

In a review of FY 1964 reprogramming, NASA OSS Deputy Director Edgar Cortright observed that the Ranger hard-lander (Block V) had become essentially a back-up for the Surveyor in 1965, and that additional data points obtained by the impacter technique (Block IV) might not be worth the additional cost, especially if the Soviet Union furnished data via a soft landing. On the other hand, he observed, "one successful [lunar] orbiter i

Apr. 25 cont. worth dozens of successful Ranger TV impacters." In light of these considerations, Mr. Cortright recommended cancelling Ranger Block IV, continuing Block V at a low level, and initiating a lunar orbiter project to commence in FY 1964. (NASA, IOM from E.M. Cortright to H.E. Newell, Subject: Recommended Reprogramming Within the Office of Space Sciences, April 25, 1963, JPLHF 2-1774.)

During the OSS monthly review, N.W. Cunningham indicated that all Rangers, including Blocks III and IV, utilized L-Band communications equipment. "NASA's agreement with the IRAC (Interdepartmental Radio Advisory Committee) specifies that conversion to S-Band will be accomplished by January 1, 1965. The Ranger spacecraft can be quite readily converted; however, some question exists if an S-Band transmitter small enough and rugged enough to be compatible with the hard-landing capsule is feasible. We are working with JPL and OTDA on this problem." (NASA, OSS Review of April 25, 1963, JPLHF 2-1505.)

Mr. Robert J. Parks, JPL Director of Lunar and Planetary Programs, announced publicly that sterilizing lunar probes "may be abandoned," but that planetary probes definitely would be sterilized to prevent contamination. (Marvin Miles, "Sterilization of Lunar Probes May be Halted," Los Angeles Times, April 26, 1963.)

Apr. 26 NASA Headquarters, OSS, informed JPL of tentative approval for the SSSC approved non-visual passenger science experiments for Ranger Block IV missions, RA-10, 11, and 12. They were the gamma-ray spectrometer, Dr. James Arnold, UCSD, Principal Investigator; and pulse radar, Dr. Walter E. Brown, Jr., JPL. In granting tentative approval, however, Dr. Newell of OSS reiterated his position concerning the importance of the science content in unmanned space flight projects:

> "In its review of these experiments, the Space Sciences Steering Committee had certain reservations about the payload in general and the radar experiment in particular. The general reservation concerned the subordinate role in which the non-visual experiments have been placed as a result of the established objectives for these flights. While I concur in the importance of the television system, it should be recognized that we have not de-emphasized the importance of obtaining scientific measurements which can be provided by non-visual experiments. In the light of these reservations, we will want to discuss possible modifications to the existing objectives with your Ranger Project management."

(NASA, letter from H.E. Newell to W.H. Pickering, April 26, 1963, JPLHF 2-180.)

Apr. 26 cont. In response to questions of Senator Margaret Chase Smith, during testimony before the Senate Committee on Aeronautical and Space Sciences, NASA Associate Administrator Dr. R.C. Seamans Jr. submitted answers for the record showing that no formal sterilization procedures were in effect for unmanned lunar spacecraft since there was now a consensus among scientists--nationally and internationally--that the lunar environment was too hostile for any viable microorganisms to survive. Nevertheless, NASA would minimize contamination through the use of assembly techniques in clean rooms and under environmental conditions similar to surgical operating facilities. Likewise, for the Apollo lunar flight program, NASA had no plans for sterilizing manned vehicles to the moon. (Testimony of R.C. Seamans Jr., NASA Authorization for Fiscal Year 1964, op. cit., 598.)

Apr. 29 Dr. Joseph F. Shea, Deputy Director for Systems at the NASA Office of Manned Space Flight, declared that sterilization of the Ranger payload had been a contributing factor in the problems of that program, and that the Apollo payload would not be sterilized because "sterilization is antagonistic to reliability." ("Ranger Sterilization," Aviation Week & Space Technology, April 29, 1963, p. 26.)

During April Ranger Block III. Northrop had now assigned 37 technical personnel at JPL under Phase I support, with an additional 30 people assigned to Ranger at Northrop. Definitization of the Phase II effort was scheduled for July 1, 1963. (NASA, OSS Review of April 25, 1963, loc. cit.)

During the month the new Mark IV solar panels underwent environmental type approval (TA) tests in vibration, temperature, vacuum and humidity. (JPL, Space Programs Summary No. 37-22, Vol. VI, for the period May 1, 1963 to July 31, 1963, 8-9.) The DEV program, begun in mid-1962, was brought to a satisfactory conclusion indicating that there were no unknown or uncompatible problem areas in the new Block III spacecraft design. (Ranger History--Working Draft, op. cit., 42.) All Ranger spacecraft electrical conversion equipment was either reprocured or completely reworked for Block III. (JPL, Space Programs Summary No. 37-21, Vol. I, for the period March 1, 1963 to April 30, 1963, 23.) The STM and TCM programs continued in process during the initial period of the Block III development.

During April cont.

RCA reported development of a new technique of erase and preparation for exposure utilizing a rapid-scanning beam for the Block III full-scan cameras. "This development is a significant improvement in camera performance as it reduces the residual image after erase to less than 5%. . . ." (Ibid., 57-58.)

The first interface tests were run at the Goldstone tracking station between the DSIF and the Ranger RCA TV ground reconstruction electronic equipment. However, the Goldstone parametric amplifier failed and forced termination of the tests. (JPL, Minutes of April 15 meeting of Ranger Bi-weekly Project Meeting, JPLHF 2-1573; and, IOM from R. Heyser to R. Heacock, April 29, 1963, JPLHF 2-1595.) (See March 14, 1963.)

Ranger Block IV. RCA was given a go-ahead on procurement of long lead items and certain study contracts for the Block IV TV system. (JPL, Ranger "Tuesday - Thursday" Project Meeting Minutes of April 11, 1963, JPLHF 2-1584.) Plans called for using an improved booster system employing an Atlas D and a standard Agena D second stage.

The Ranger spacecraft was in the development stage prior to design freeze; design reviews were continued. Essentially, the vehicle was the same as Block III with the addition of the two non-visual experiments. The first of these, the radar ranging altimeter experiment, was designed to (1) provide an electronic profile of certain lunar surface characteristics, and (2) verify the design of an altimeter to generate a fuzing signal for the ejectable capsule planned for Block V spacecraft. The gamma ray spectrometer would sense gamma radiation in cislunar space as well as in the near vicinity of the moon, especially for the purpose of determining the spectrum of radiation emanating from the lunar surface. (JPL, Space Programs Summary No. 37-21, Vol. I, op. cit., 13-14, 19.)

Ranger Block V. Work continued on capsule component development and studies at ADF. JPL had determined that Phase II of the Northrop contract should include all spacecraft design, fabrication, test and checkout operations by Northrop as it assumed responsibility for Block V development. (JPL, FY 1964 Project Guidelines, R.J. Parks, April 1, 1963, JPLHF 2-429.)

NASA Residency at JPL. Mr. Paul Ross replaced Mr. Robert Rodney as NASA resident at JPL. (See During February, 1962.)

1963

May 1 Concerning Project Ranger, NASA Associate Administrator Robert Seamans, Jr., was notified that "a problem has arisen in the RCA television system which has been referred to as 'multi-pacting.' This phenomenon is produced only when the system is operating under vacuum and results in electrical arcing within the connectors. No ready solution has been suggested for this problem. However, if a connector redesign is recommended, it will create a possible two-month delay in the delivery of the RF hardware." (NASA, memo from N.W. Cunningham to R.C. Seamans, "Weekly Status Report No. 2, Ranger Program," May 1, 1963, JPLHF 2-708; also, Space Programs Summary No. 37-21, Vol. VI, for the period March 1, 1963 to May 31, 1963, 4.) (See April 4 and 11, 1963.)

RCA informed JPL that it had developed a method for reducing power to ease the arcing problems in the TV subsystem for Block III Rangers. (JPL, Minutes of the Ranger Spacecraft System Review, May 1, 1963, JPLHF 2-1313.)

NASA LeRC began dealing directly with Lockheed for Agena second stage booster vehicles and was no longer required to work through the USAF. (JPL, Minutes of the Ranger Bi-weekly Project Meeting, April 2, 1963, JPLHF 2-1573.)

May 2 The Ranger TV Subsystem Quarterly Review was held at RCA facilities in Princeton, New Jersey. Among various actions taken, RCA announced that it would expedite procurement of high power RF test equipment and devote maximum attention to a solution of the arcing problems. Mr. T. Breedon indicated that the procurement and test cycle would consume 45 days, and did not provide much time to establish full confidence in the TV system prior to delivery of flight unit #1. (JPL, IOM from J.J. Nielsen to H.M. Schurmeier, Minutes of Ranger TV Sub-System Quarterly Review, Princeton, New Jersey, May 2, 1963, 1,4, JPLHF 2-1607.)

May 6 JPL issued policies and organizational responsibilities for spacecraft viedo ground data processing at the Laboratory. (JPL, IOM from R.J. Parks to Distribution, May 6, 1963, JPLHF 2-1597.)

JPL issued EPD-154, Project Description, Spacecraft System Contract, Ranger Block V, which described the project, tasks, and requirements placed upon the spacecraft system contractor by JPL.

May 6 cont. JPL requested a proposal from Northrop on Phase II activity for a complete Block V spacecraft system development program defined by EPD-154. (JPL, Ranger Block V Project, op. cit., 40.)

May 13 H.M. Schurmeier established a Design Review Board to examine the DSIF and SFO systems for Project Ranger; the review was planned for May 27. (JPL, IOM from H.M. Schurmeier to M.S. Johnson/N.A. Renzetti, May 13, 1963, JPLHF 2-1599.)

A decision was reached to exclude the Block V survival sphere (impact limiter, capsule and experiment) from the scope of work of the spacecraft system contractor; hardware to be procured by JPL directly from the capsule contractor. (Ranger Block V Project, op. cit., 45.)

May 14 JPL issued EPD-156 (superseding EPD-40), TV Subsystem Requirements for Ranger Block III. Mission objectives specified obtaining "television pictures of the lunar surface which will be of benefit to both the scientific program and the United States Manned Lunar Program. These pictures should be at least an order of magnitude better in resolution than any available Earth-based photography."

May 14-15 A design review of the Ranger TV payload communications subsystem was held at RCA-AED in Hightstown, New Jersey, and considered the changes and improvements involved with the new split system, as well as the RF arcing problems. (JPL, TWX from D. Kindt/C.J. Bennett to RCA, May 9, 1963, JPLHF 2-1551.)

May 15 Quality Assurance notified the JPL Ranger Project Office of serious shortcomings in the Nortronics development of the Ranger CC&S for Block IV vehicles. (JPL, IOM from J.W. Bott to W. Scott, May 16, 1963, JPLHF 2-1600.)

NASA Administrator Mr. James E. Webb took issue publicly with prominent individuals who had recently criticized the space program in general and the manned lunar program in particular. He suggested that some scientists saw single motives for exploring space, in isolation from other considerations, and compounded the error by "adopting a narrow and superficial view of these motives, the misgivings become magnified out of all proportion to reality. . . ." Webb was especially critical

May 15 cont. of the resultant confusion stemming from these conflicting viewpoints. He took issue with recent comments by Warren Weaver, Vice President of the Alfred P. Sloan Foundation, and Dr. Lee DuBridge, President of the California Institute of Technology, among others. Weaver had suggested that scientific considerations did not justify the size, cost, and pace of the space program, while DuBridge believed that important science considerations were downgraded in favor of space spectaculars. The NASA Administrator pointed out that the space program was undertaken to achieve a number of purposes, and that no single justification predominated. (Text, NASA News Release dated May 15, 1963, address by James E. Webb at the 2nd National Flight Forum Symposium, Hartford, Conn., JPLHF 2-2077.)

NASA Headquarters notified JPL that a decision had been reached not to employ ethylene oxide terminal sterilization for unmanned lunar vehicles (Ranger and Surveyor). Emphasis would remain attached to improving assembly techniques in clean rooms under "conditions similar to surgical operating facilities." (NASA, letter from O.W. Nicks to R.J. Parks, May 17, 1963, JPLHF 2-179a.) (See April 24, 1963.)

May 20 Responding to the article on "Ranger Sterilization" that appeared in the April 29 issue of Aviation Week, Mr. A.M. Nowitzky, a specialist in spacecraft sterilization at a large aerospace firm, declared that "Since all known tests indicate that gaseous surface sterilization does not affect reliability, Ranger problems were definitely not due to sterilization but, instead, were ordinary design problems unrelated to the inclusion of this requirement. It is, therefore, grossly unrealistic to blame sterilization for the Ranger failures." (Letters to the Editor, Aviation Week and Space Technology, May 20, 1963.)

An editorial in the Los Angeles Times noted the sorry state of the U.S. lunar programs:

> There is growing criticism of the U.S. manned moon rocket program by those who question its value weighed against cost. Space Administrator James E. Webb lashed back at the critics, claiming that the project is vital to U.S. prestige and security. To venture less would destroy our image as a "can-do nation" he said. . . . The program is a year behind schedule. The Ranger III, IV and V shots were unsuccessful and now the rest of the series has been postponed indefinitely. . . .

(Editorial in Los Angeles Times, May 20, 1963.)

1963

May 21 The NASA-JPL Ranger Quarterly Review was held at JPL. The meeting considered the spacecraft design changes and test program, as well as the planned design reviews of the Launch Vehicle system and DSIF/SFO Complex. Mr. O.W. Nicks, Director of Lunar and Planetary Programs, suggested that either experimenters assigned to the TV payload begin actively participating in the program or be asked to resign. Mr. Schurmeier indicated that experimenters would be invited in for the field tests of the TV ground equipment at Goldstone in October. (JPL, Minutes of the Ranger Quarterly Review, May 21, 1963, JPLHF 2-1603b.)

May 22 NASA Headquarters reduced the Block V Rangers from twelve to six flights to make available $27.9 million required for the new Lunar Orbiter Program in FY 1964. Plans now called for a first Block V flight in the second quarter of 1965, with subsequent flights at three-month intervals. (NASA, OSS Review of May 29, 1963, 42, JPLHF 2-1505.) (See April 25, 1963.)

May 24 Dr. E. Rechtin, JPL Assistant Director for DSIF, informed the JPL Lunar and Planetary Program Director, R.J. Parks, that any pronounced change in Ranger schedules would have a marked effect upon DSIF operations and installation schedules:

"1. It is preferred that no Block 3 Ranger spacecraft be launched after April 30, 1964 as it is highly desirable, and possibly required, that ten uninterrupted weeks be available in the period May, June and July of 1964 during which equipments required to support Mariner C and Surveyor launches will be installed and tested.

2. No Rangers can be supported by the DSIF during the last quarter of 1964."

(JPL, IOM from Dr. E. Rechtin to R.J. Parks, May 24, 1963. JPLHF 2-1608.)

May 27 Responding to a critical report by the Senate Republican Policy Committee on the U.S. space program in a speech before the U.S. Senate, Senator Clinton P. Anderson refuted the contention that the nation's space program should be turned over to the military by citing statements of General Thomas S. Power, Commander-in-Chief of SAC, who emphasized the importance of NASA's role in space exploration. Turning his attention to the criticisms voiced recently on the science content in the lunar program, he continued, "The notion that manned lunar landing programs are being conducted at the expense of unmanned scientific projects

May 27 cont. is simply not correct. A large number of unmanned scientific projects are included in our manned lunar landing programs. Examples are Ranger and Surveyor. These programs involve more than $3 billion in payloads and directly related launch vehicle developments and operations." (Cited in Comment on the National Space Program, op. cit., B-162, 163.) (See January 15, 1963.)

The initial meeting of the Ranger DSIF-SFO Design Review Board was held at JPL. In a series of meetings the Board examined the overall data system, communications system, computer programming, spacecraft video analysis and operation, configuration of the DSIF stations, Goldstone operations, overall operational planning, and the planned activities of the Flight Path Analysis Group and the Spacecraft Data Analysis Team, the procedures developed for standard and non-standard missions, and DSIF and SFO documentation. (Ranger History--Working Draft, op. cit., 48-49.) (See May 13, 1963.)

May 28 A preliminary draft of the Ranger Block V Program Development Plan was issued at JPL. (JPL, IOM from H.M. Schurmeier to Distribution, May 28, 1963, JPLHF 2-1606a.)

May 29 Responding to Dr. Newell's letter of March 29, ADF submitted a planning purpose proposal to NASA of experiments for Block V Ranger flights. Experiments consisted of SURMEC, LSPC, and seismometer capsules. (ADF, letter from John B. Lawson to NASA, May 29, 1963, JPLHF 2-710.)

May 31 Responding to Dr. Newell's letter of March 29, JPL submitted four scientific experiment proposals to NASA for the Ranger Block V program. (JPL, letter from V.C. Larsen, Jr. to NASA, May 31, 1963, JPLHF 2-711.)

The devisiveness generated in the lunar program controversy was recapitulated in the New York Herald Tribune: "Indeed, the National Aeronautics and Space Administration, leader of the American engineering community's assault on the moon, has kept the scientists--the men who want to understand nature--at arm's length. . . to the latter, an insult. Thus for the first time since World War II, the scientists find themselves on the outside of a major technological development looking in. The competition to land a man on the moon before 1970 belongs now to engineers and managers. . . . [This] split over the moon race goes deep, extending even to the President's Science Advisory Committee, where prominent members, remaining anonymous to avoid embarrassing the President, deride the entire

May 31 cont. project as nonsense." (Earl Ubell and Stuart Loory, "Moon Race: Does Versus Knowers," fourth of five articles, New York Herald Tribune, May 31, 1963.)

Northrop subcontracted with ADP for a Phase I study of the Ranger Block V capsule delivery system. (JPL, Ranger Block V Project, op. cit., 44-45.)

During May Ranger Block III. Assembly of the PTM spacecraft, which began in April, was completed and initial power turn-on took place on May 29 at the SAF. (The purpose of the PTM was to verify the spacecraft design through exposure to environmental and test levels more severe than those to which the flight spacecraft would be subjected, and to check out any necessary design changes prior to their incorporation in the flight spacecraft. In addition, the vehicle was used to verify compatibility of the spacecraft design with ground support and test equipment.) (JPL, Space Programs Summary No. 37-22, Vol. VI, op. cit., 9.)

The overall functional and detailed design for Ranger 6 was complete. Assembly of RA-6 was scheduled to commence on June 10. Outstanding problems involved late deliveries of the Nortronics CC&S, power subsystem, and the RF arcing problems in the TV payload. (JPL, Space Programs Summary No. 37-21, Vol. VI, op. cit., 1; and, Minutes of Ranger Quarterly Review, loc. cit.)

A reliability study was concluded which considered the performance of Ranger Block III spacecraft operating altogether on batteries as opposed to solar panels and a single battery. It was determined that a power source consisting of all batteries would be "slightly more reliable . . . but would weigh 57 pounds more." As weight was critical, the approach could not be pursued. (IOM from J.F. Lucca[Northrop]/C.D. Fredrickson, to G.E. Sweetnam, JPL, May 17, 1963, JPLHF 2-1602.)

The RCA TV subsystem PTM was completed and successfully subjected to vibration tests on May 20. (JPL, Space Programs Summary No. 37-22, Vol. I, for the period May 1, 1963 to June 30, 1963, 57.)

Phase A of the Ranger LTV Test Program was concluded following ten "real time" mission tests run on the spacecraft. Phase B, to consist of three "real time" mission tests in the horizontal vacuum chamber, was to conclude on June 10, 1963. (JPL, Minutes of the Ranger Spacecraft System Review, May 15, 1963, JPLHF 2-1313.)

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During May cont.	Ranger Block IV. Design changes for Block IV spacecraft were established. Major bus improvements consisted of increased midcourse capability and a new CC&S. Additional non-visual passenger experiments were the radar and gamma ray instruments. (JPL, Minutes of the Ranger Quarterly Review, loc. cit.) Sixty-three Northrop personnel were presently at JPL in support of the Block III and Block IV effort. (JPL, Minutes of the Ranger Spacecraft System Review, May 21, 1963, 3-4, JPLHF, 2-1313.)
	Ranger Block V. Northrop was established as the spacecraft system contractor for Block V vehicles, with JPL issuance of the RFP on May 6. Schedules called for capsule missions launched during 1965. Retention of L-Band communications for the payload capsule was considered desirable and not an insurmountable problem for the DSIF. NASA agreements called for discontinuing use of L-Band equipment on January 16, 1965; however, NASA Program Chief N.W. Cunningham indicated that this decision was not irrevocable. (JPL, Minutes of Ranger Quarterly Review, op. cit., 4.)
	DSIF. New decommutators and teletype units were scheduled for installation at all overseas stations. All three stations would possess a command capabulity for Ranger Block III flights. The old SFO facility would be used for Block III, and the new SFOF, available for occupancy on October 1, 1963, would be used for Block IV. (Ibid.)
June 1	ADF submitted a proposal, "Summary of Ranger Payloads," (Publication No. P-1301399U), to NASA OSS summarizing studies and development of Ranger payloads. Included was an advanced Ranger spacecraft Lunar Orbiter.
June 5	NASA OSS announced creation of a Manned Space Science Group as a new division within OSS, headed by Dr. Eugene Shoemaker. Institutionally the Group would report to Dr. Newell; functionally it would report both to Dr. Newell of OSS and to D. Brainard Holmes of OMSF. The new Group was responsible "for planning scientific training and the selection of astronauts, and recommendations for experiments for manned science exploration." (NASA, Summary of the OSS Senior Council Meeting, June 5, 1963, JPLHF 2-1051.)
June 6	NASA Headquarters queried Paul Ross, NASA resident at JPL, about the impact of the Skybolt termination at Northrop and its possible effects on Northrops's projected overhead rates and manpower loading. (NASA, TWX from Thomas, Office of Procurement, to Paul Ross, June 6, 1963, JPLHF 2-1181.)

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June 7 John Small, Deputy Chief of the Systems Division, informed H.M. Schurmeier, JPL Ranger Project Manager, of objections to the preliminary PDP for Ranger Block V on the grounds that too many objectives were proposed and that too many scientific experiments were to be attempted. (JPL, IOM from J. Small to H.M. Schurmeier, June 7, 1963, JPLHF 2-1609.) (See May 28, 1963.)

June 10 The JPL Ranger Project was informed of unsatisfactory conditions existing in the TV subsystem assembly area at RCA-AED. (JPL, IOM from E.H. Piercy, JPL Quality Assurance, to K. Tate, June 10, 1963, JPLHF 2-1623c; also, IOM from J. Curtis to K. Tate, June 8, 1963, JPLHF 2-1623d.)

A Northrop proposal for Ranger Block V Phase II activity was submitted to JPL. (JPL, Ranger Block V Project, op. cit., 41.)

Dr. Colin S. Pittendrigh, Professor of Biology at Princeton University, testified at a Congressional hearing concerning the relaxation of sterilization standards for the lunar program. "When all things were considered," he observed, "the fact remains that the major forces leading to the decision were nonscientific ones (of lost momentum, prestige, and money) concerning the consequences of adhering to more rigorous standards. The scientific consideration was that the decision was unfortunate but acceptable. . . ." (U.S. Congress, Senate, Committee on Aeronautical and Space Sciences, 88th Congress, First Session, Scientists' Testimony on Space Goals, June 10 and 11, 1963, 83.)

JPL issued EDA-161, Ranger Block IV Launch Vehicle/Spacecraft Integration.

June 12 A JPL evaluation of the available Ranger budget for FY 1964, Laboratory manpower limitations, and exceedingly tight schedule for Ranger Block III, led to a decision to recommend a slip in the Block IV schedule. "The amount of time is presently unknown." (JPL, Ranger Spacecraft System Review Minutes of June 12, 1963, JPLHF 2-1313; see also, Project tradeoffs proposed in Ranger Contingency Plans, June 12, 1963, JPLHF 2-1612.)

June 13 JPL notified RCA AED that corrective action was necessary to improve practices in the TV subsystem assembly area before assembly of flight unit #1 was begun. (JPL, letter from J. Curtis, Quality Assurance, to C.S. Peterson of RCA, Subject: Ranger Integration Assembly Area, June 13, 1963, JPLHF 2-1623a; and, letter from J. Curtis to C.S. Peterson, Subject: Unacceptable Practices on JPL Ranger TV Subsystem Equipment, June 13, 1963, JPLHF 2-1623b.)

June 13 D.W. Curkendall recommended advancing the TV subsystem turn-on time to 45 minutes before impact rather than 15 minutes now planned in order to provide additional time for troubleshooting in the event of non-standard performance, and to ensure receipt of at least some pictures in the event a guidance failure directed the spacecraft across the terminator onto the darkened side of the moon. (JPL, IOM from D.W. Curkendall to Distribution, June 13, 1963, JPLHF 2-1611.)

The Wall Street Journal pointed out difficulties attending LEM design at Grumman in the absence of firm data on the lunar surface. The article indicated that delay in information returned on the unmanned program had generated "an intensive earth-based research effort on moon surface material. The probing ranges from intensive radar and telescopic studies of the moon to experiments with simulated moon dust in vacuum chambers. . . ." (Jerry E. Bishop, "Moon Mystery: Riddle of Lunar Surface Unsolved as Developers Rush Space Ship Work," The Wall Street Journal, June 13, 1963.)

June 14 NASA Headquarters informed JPL that its fiscal 1964 manpower ceiling would remain at 4,000 throughout the contract year. (NASA, letter from R.C. Seamans Jr. to W H. Pickering, June 14, 1963, JPLHF 2-467.)

In a further comment on the preliminary Ranger Block V PDP, L. Piasecki informed H.M. Schurmeier that an accelerometer payload was of questionable value since it would provide information on the bearing strength of lunar soil at high rates of loading encountered in a hard landing, and might result in misleading information on the loadings of soft landing. Launching science capsules to obtain information on lunar seismic activity or magnetic fields was also questioned since these science experiments did not directly support the Surveyor and Apollo programs. (JPL, IOM from L. Piasecki to H.M. Schurmeier, June 14, 1963, JPLHF 2-1613.)

The USAF contracts for procurement and modifications of Agena B and Atlas D boosters for Ranger Block III were transferred to NASA. (Testimony of O.W. Nicks, Investigation of Project Ranger, op. cit., 106.) (See November 30, 1962.)

June 17 A detailed budget review was held between the NASA and JPL Ranger Project offices to consider the effects of increased project cost incurred in design changes and implementing more

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June 17 cont. stringent controls for quality assurance, and reprogramming of Ranger funds to the Lunar Orbiter Project. The problem of an exceedingly tight schedule for Project Ranger between Blocks III and IV was evaluated. Consideration was given to slipping the Block IV schedule to allow concentration of manpower and attention on Ranger Block III, as well as alleviate the FY 1964 budget problems. Further meetings on this subject were scheduled for the first week in July. (NASA, memo from N.W. Cunningham to R.C. Seamans, Ranger Status Report No. 10, June 26, 1963, JPLHF 2-715.) (See May 22 and June 12, 1963.)

June 18 In releasing a detailed RA-6 schedule, Ranger Project Manager H.M. Schurmeier noted the extremely short time to planned launch in December. He declared that the schedule was not, however, to be maintained at the expense of flight reliability. (JPL, IOM from Ranger Spacecraft Systems Manager to Ranger Personnel, June 18, 1963, JPLHF 2-1615.)

JPL issued detailed flight qualification test requirements to be placed on Ranger spacecraft before they could be considered ready for flight. (JPL, IOM from A.E. Wolfe to M. Mesnard, et. al., June 18, 1963, JPLHF 2-1616.)

June 21 JPL issued Functional Specification FR3-2-110, <u>Ranger Block III Mission Objectives and Design Criteria</u>. (Superseding R3-2-110, April 1, 1963.)

The JPL Space Sciences Division recommended that camera angle settings for Ranger Block IV be identical to Block III allowing overlapping and redundancy in the pictures, as opposed to pointing one or more cameras at the lunar horizon. (JPL, IOM from C.F. Campen to D. Kindt, June 21, 1963, JPLHF 2-1373.)

June 24 H.M. Schurmeier notified Project personnel that in order to alleviate manpower shortages at JPL and RCA, and

> "As an outcome of the current budgeting and reprogramming activities being conducted in conjunction with Headquarters, it has been mutually agreed that RA-10 schedule will be slipped six months.
>
> The timing of flights subsequent to RA-10 has not been established. However, it is expected that this will be resolved within a few weeks and all interested parties will be promptly notified.
>
> A moratorium should be placed on Block IV work. All possible effective effort should be applied to Block III."

(JPL, IOM from H.M. Schurmeier to Distribution, June 24, 1963, JPLHF 2-1374.) (See June 17, 1963.)

June 24-25 The SSSC Planetology Subcommittee met at NASA-WOO offices in Santa Monica, California. Twenty-five firm experiment proposals submitted to NASA for Ranger Block V flights were evaluated (see March 29, 1963). Members of the Subcommittee agreed with Dr. Gordon MacDonald that payloads flown on earlier unsuccessful spacecraft were still extremely desirable from a scientific standpoint. Experiments recommended by order of priority for the hard landing capsule were:

Experiment	Principal Investigator
1. Seismometer	F. Press, CIT
2. TV (LFC)	E.M. Shoemaker, USGS
3. Penetrometer	Not named

For the spacecraft bus they were:

1. Gamma-ray spectrometer	J.R. Arnold, UCSD
2. Approach TV	Not named
3. Radar	W.E. Brown, JPL

(NASA, memo from O.W. Nicks to Chairman of Planetology Subcommittee, August 22, 1963; and, Minutes of the Planetology Subcommittee of the Space Sciences Steering Committee. June 24-25, 1963, JPLHF 2-1772.)

June 27 Due to manpower, schedule, and financial problems, JPL requested formal authorization from NASA for a six-month slip in Ranger Block IV flights, and requested a complete review of Project Ranger following Block III. (JPL, letter from W.H. Pickering to H.E. Newell, June 27, 1963, JPLHF 2-188.) (See June 24, 1963.)

R.L. Heacock, Chief of Space Instruments Development Section, recommended that "Block IV should be cancelled to accelerate and enhance Block V. . . . It is proposed that Block IV mission objectives be achieved by the Block V system, a modified Block V system without a capsule, . . . or by picking up an equivalent Block IV mission after the first Block V shots." (JPL, IOM from R.L. Heacock to C.F. Capen, June 27, 1963, JPLHF 2-1383.)

Northrop Corporation was authorized, by Modification 3 to Contract No. 950591, to begin restricted Block V Phase II activity. (JPL, Ranger Block V Project, op. cit., 37.)

The House Committee on Science and Astronautics reduced the Ranger Program budget from $90 million to $65 million. Congressman Joseph Karth, Acting Chairman of the Subcommittee on NASA Oversight, declared: ". . . of the five Ranger spacecraft already launched, June 27 cont.

none has been a . . . success. The so-called Kelley report on the Ranger Project casts grave doubts upon the adequacy of the management of this project, both by NASA Headquarters and the Jet Propulsion Laboratory. As a result of the Kelley report, the next four spacecraft will be modified prior to launch and this will result in a delay in the project. The Subcommittee feels that in view of the poor record of Ranger to date, Congress should be given reasonable assurance of success before going forward full speed with spacecraft to 13 and 14." (Cited in Bill Sumner, "Ranger May be Unhorsed; House Unit Puts Squeeze on JPL Expansion Plans," Independent, [Pasadena], June 27, 1963.) Congressional scrutiny of NASA had increased, and 1963 proved to be a pivotal year in NASA's relationship with Congress. For the first time Congress cut NASA's Bureau of the Budget approved request from $5.7 billion to $5.1 billion. (Thomas P. Jahnige, "The Congressional Committee System and the Oversight Process: Congress and NASA," Western Political Quarterly, June 1968, 235, JPLHF 2-752.)

During June

Ranger Block III. Testing of the LTV was concluded on June 8. (The purpose of this test program was to determine spacecraft performance in a simulated space environment for extended periods.) The LTV consisted of the former Ranger 6 spacecraft with minor exceptions, and the TV subsystem used was the former flight model FM2. At the conclusion of these tests 1263 hours of operation had been logged on the LTV; approximately 800 hours were tests in vacuum. With the exception of one catastrophic (power converter) failure during one test, all thirteen real-time (66-hour lunar flight) mission tests were successful. (JPL, Space Programs Summary No. 37-22, Vol. VI, loc. cit; and Space Programs Summary No. 37-22, Vol. I, op. cit., 19-20.)

Work began at RCA in fabricating the first Block III Flight Model TV subsystem. Performance of the split system electrical system "has been tested and proven during this reporting period." (Ibid., 60, 67.)

On June 15 the first set of Ranger Mark IV solar panels was received from Electro Optical Systems, Inc. Panel electrical output and calibration had been accomplished previously in tests at Table Mountain, and by flying standard cells to 77,000-ft. altitude in a balloon. (JPL, Space Programs Summary No. 37-23, Vol. VI, for the period July 1, 1963 to September 30, 1963, 2; and, Space Programs Summary No. 37-25, Vol. VI, for the period November 1, 1963 to December 31, 1963, 7)

During June cont.

Increase in prices for Ranger components was attributed to JPL's imposition of EPD-65 requirements on all vendors. A tentative decision was made that vendors would not be forced to adopt the JPL failure reporting system where it could be demonstrated that they already had a good system in effect. (JPL, Ranger "Tuesday-Thursday" Project Meeting Minutes of June 11, 1963, JPLHF 2-1584.)

Ranger Block IV. Difficulties associated with funding, schedules, and manpower caused a JPL decision to be made in favor of slipping Block IV by six months, with further project evaluation in process. (See June 17 and June 27, 1963.)

Ranger Block V. Northrop Space Laboratories submitted their program plan and proposal for Ranger Block V Phase II effort to JPL during the month. Due to a number of undecided factors (e.g., L-Band or S-Band for the capsule, instrumentation to be used in SFOF) the proposal was not definitive. Estimated total costs, including fabrication of six spacecraft, was $72,486,900 including a 6.8 per cent fixed fee. JPL go-ahead on procurement of long lead time items and other Phase II activity was conditionally approved on June 27. (See Vol. 1 and Vol. 2 of Proposal, Ranger Spacecraft System, Phase II, NSL 63-89, Northrop Corp., June 1963.)

DSIF. An antenna model range was installed at the Goldstone station to conduct advanced antenna calibration pattern tests, thereby making possible finer resolution in tracking data received from space probes. (NASA, Ninth Semiannual Report to Congress, January 1, 1963 to June 30, 1963, 126.)

The 50 W "uplink" transmitter system at the Woomera deep space station in Australia was replaced by a standard 200 W transmitter system. The DSIF now possessed the capability for generating two-way doppler and the transmission of commands to the spacecraft, both on a 24 hour/day basis.

July 1

JPL approved initial Northrop Phase II effort on a limited basis for Ranger Block V (less funding than the first forty days called for in the Phase II effort proposal). "This action was taken in view of a lack of final resolution in Block III-IV-V discussions that were in process at the time between JPL and NASA (OSS)." (JPL, IOM from G. Nichols to Block V Division Project Engineers, Summary of Block V Engineering Meeting, July 3, 1963, 2, JPLHF 2-1628.)

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July 2 JPL announced that test results indicated that deterioration of a fiber washer could have caused the short circuit and overheating in Ranger 5, which suffered from a power failure shortly after launch on October 18, 1962. (JPL, IOM from R.G. Piereson to C.C. Kirsten, July 11, 1963, JPLHF 2-1625.)

The official NASA flight schedule was released. All Ranger Block III flights (RA-6 through RA-9) remained firm (see February 28, 1963); however, flight dates for Block IV Rangers (RA-10 through RA-14) were cancelled and launch was placed in an indeterminate status: "under study." (Official NASA Flight Schedules, July 2, 1963, JPLHF 2-968.)

July 2-3 A Ranger Program Review was conducted at NASA Headquarters. (See June 17, 1963.) JPL recommended, in view of increased costs, budget cuts, scheduling difficulties, and similarity in missions, that Block IV be cancelled, and that Block V be retained on the present planned schedule with launches during 1965-1966. (NASA, Memo for File, from N.W. Cunningham, July 12, 1963, JPLHF 2-718.)

July 8 Mr. Earl D. Hilburn, formerly Vice President and General Manager of Curtiss-Wright's Electronics Division, assumed the position of NASA Deputy Associate Administrator for Industry Affairs. He would represent Dr. Seamans in all "relationships involving the general-management affairs of the NASA field installations. . ." (NASA News Release 63-141, June 27, 1963.)

July 9 A meeting was convened by NASA Associate Administrator Robert Seamans and members of the OSS to consider the NASA Lunar Program. Results of the meeting of July 2-3 were reviewed, as well as the impact of the Lunar Orbiter Program. "Dr. Seamans stated that it was most desirable to have both a Ranger Block V and an Orbiter Program, . . ." and that a decision by Associate Administrator would be forthcoming. (NASA, Memo for File from N.W. Cunningham, July 12, 1963, loc. cit.)

July 10 JPL began evaluation of the camera performance in the first assembled RCA flight unit split system TV payload. Environmental, thermal, and vibration tests of the subsystem were scheduled to be completed by the end of the month. (JPL, Ranger Spacecraft System Review Minutes, July 10, 1963, JPLHF 2-1313.)

July 11 Mr. H.M. Schurmeier, JPL Ranger Project Manager, notified Dr. W.H. Pickering, Laboratory Director, of the confused situation existing concerning the role of "experimenters" and the "principal investigator" on Ranger TV missions, and their

July 11 cont. working relationship with the JPL Project Office and RCA. A formal statement of role was recommended. (JPL, IOM from H.M. Schurmeier to W.H. Pickering, July 11, 1963, JPLHF 2-418a.)

NASA informed JPL that the Ranger TV mission experimenter team would consist of only one JPL technical representative, with the remainder of the team to come from the outside scientific community. Mr. Ray Heacock was appointed the JPL representative. (NASA, letter from H.E. Newell to A.R. Hibbs, July 11, 1963, JPLHF 2-189.)

July 12 Responding to the JPL letter of June 27, NASA Headquarters directed JPL to terminate all efforts on impacting TV missions beyond Block III. The decision was "based primarily on the potential of the Surveyor and Orbiter Programs [in 1965-1966] and on the extremely tight fiscal situation. . . ." Block III TV missions were to receive maximum attention for success by early 1964. The Ranger Block V impacting capsule project was to continue so as to support launches during 1965; however, the Laboratory also was asked to study the implications of terminating the Ranger Project after Block III. (NASA, letter from H.E. Newell to W.H. Pickering, July 12, 1963, JPLHF 2-190; also, rationale contained in NASA, Memo for the Record, E.M. Cortright, Subject: Some Comments on the NASA Reorientation of the Ranger Programs, July 15, 1963, JPLHF 2-719.) Mr. Edgar Cortright, Deputy Director of OSS, subsequently indicated that the move was considered a stretchout and realignment. He observed that "A single lunar orbiter can obtain 500,000 times the coverage of the moon's surface as a Ranger up to the resolution of one meter. . . ." (Robert Kolcum, "Three Ranger Hard-Landing Flights Eliminated; Four Others Delayed," Aviation Week, July 29, 1963.) (See April 25, 1963.)

Commenting on the Congressional cut of $25 million in Project Ranger, Science Magazine observed that

> The House committee's rough handling of Ranger certainly reflects a new militancy in judging NASA's plans and performance. The decision to recommend the Ranger cutbacks cannot have been taken lightly, since the project is regarded by NASA as providing the first direct steps toward a manned landing on the moon and is generally viewed as having important scientific value in its own right. The five straight failures not only embarrassed the space agency and frustrated the scientists who had worked hard on the Ranger experiments, but also disappointed the scientific community at large.

(John Walsh, comments on Ranger in Science Magazine, Vol. 141, p. 140, July 12, 1963.)

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July 15 The Ranger Program Office at NASA Headquarters recommended changing the Block numbers to account for the cancellation of the follow-on TV missions. The remaining Block V capsule flights were to be redesignated Block IV. (This recommendation was not placed in effect and Block V continued by that designation.) (NASA, memo from N.W. Cunningham to E.M. Cortright, July 15, 1963, JPLHF 2-1636.)

Space Daily noted that Phase II of the Soviet lunar program, to soft land an automatic station on the surface of the moon, "has been plagued with troubles comparable with our own Ranger Program. The last three attempts to initiate this new exploration plan have failed, the last of which the soviets dubbed Lunik IV missing the target and injecting itself into . . . orbit of the sun." ("The Soviet Lunar Program," Space Daily, July 15, 1963.)

July 17 JPL directed all Divisions to terminate work on Ranger Block IV. (JPL, IOM from V.C. Larsen, Jr. to Senior Staff, et. al., July 17, 1963, JPLHF 2-271.)

July 18 The JPL Ranger Project Office requested adequate support from the DSIF for Ranger Block III in consonance with the highest Laboratory priority previously assigned these missions. (JPL, IOM from H.M. Schurmeier to E. Rechtin, July 18, 1963, JPLHF 2-1629.)

July 19 Following review of the scientists' role in lunar flight projects, NASA Headquarters issued a tentative list of the Principal Investigator and Co-Experimenters for the Ranger Block III TV experiment:

Dr. G.P. Kuiper, Principal Investigator
Dr. E.M. Shoemaker, Co-Experimenter
Dr. H.C. Urey, Co-Experimenter
Mr. R.L. Heacock, Co-Experimenter
Mr. E.A. Whitaker, Co-Experimenter

(NASA, memo from N.W. Cunningham to H.E. Newell, July 19, 1963, JPLHF 2-721.)

The JPL Ranger Project Office notified all Divisions that, with the cancellation of Ranger Block IV, Ranger Block V vehicles were now listed as RA 10-15 inclusive, involving hard landed capsules limited to the seismometer and photographic types. (JPL, IOM from H.M. Schurmeier to Ranger Distribution, July 19, 1963, JPLHF 2-1631.)

July 24 JPL was informed that the RCA flight TV payload for Ranger 6 had experienced a failure during subsystem tests. The failure

July 24 cont. — was attributed to shorting of an IPA tube in the transmitter. Delivery of Flight Unit #1 was rescheduled to August 15, while corrective measures were undertaken. (JPL, Minutes of the Ranger Spacecraft System Review, July 24, 1963, JPLHF 2-1313.)

RCA notified JPL that the launch environment might tune on one or both channels of the TV system early in the flight. (RCA, letter from B.P. Miller to D. Kindt, Subject: Mission Operations--Ranger TV Subsystem, cited in IOM dated October 11, 1963 from R. Moyer, L.M. Bronstein to P. Rygh, Subject: Mission Analysis-3, Ranger Block III TV System Control, JPLHF 2-1663.)

Management policy for the Ranger Block V effort was eatablished by the JPL Director for Lunar and Planetary Projects. (JPL, IOM from R.J. Parks to W.H. Pickering, July 24, 1963, JPLHF 2-1775.)

JPL issued JPL-Northrop responsibilities for Ranger Block V. (JPL, IOM from H.M. Schurmeier/K. Coon to Distribution, July 24, 1963, JPLHF 2-1376.)

July 31 — JPL requested that NASA Headquarters ease the established manpower restriction at JPL (see June 14, 1963) to allow for the hiring of additional personnel. (JPL, letter from W.H. Pickering to E.D. Hilburn, July 31, 1963, as cited in letter from E.D. Hilburn to W.H. Pickering, August 2, 1963, JPLHF 3-199.)

During July — Ranger Block III. The first systems test and tests of redundant design features of Ranger Block III were conducted on the PTM during July 2 and 3. A cable problem caused some difficulty with transponder gain control during systems test, but no major design deficiencies were uncovered. (JPL, Space Programs Summary No. 37-23, Vol. I, for the period July 1, 1963 to August 31, 1963, 2, 13.)

Assembly of the Ranger 6 spacecraft began on July 1 at the SAF, and continued throughout the month. Assembly of Ranger 7 began on July 17. Weight of the Block III spacecraft was 819 pounds. (Ibid., 14, and Space Programs Summary No. 37-24, Vol. I, for the period September 1, 1963 to October 31, 1963, 12.)

Ranger Block V. With the cancellation of Block IV, Block V vehicles were renumbered RA-10 through RA-15. Northrop Space Laboratories submitted a final report and Block V familiarization manual on three initial tasks completed under Phase I of Contract No. 950591. (NSL Peport 63-134, July 1964, Final Report, NSL Ranger Phase 1 Program, Tasks C(1), C(2), and C(3), JPLHF 2-1624.)

During July cont.	Some problems were encountered with nomenclature as LeRC was now referring to Block V as Block IV. (JPL, Minutes of the Ranger Bi-Weekly Project Meeting of July 31, 1963, JPLHF 2-1573.)
	The first prototype of the LFC, containing a top tube and azimuth drive and extension mechanism, a structural model transmitter, and dummies of the supporting subsystems, was installed in a balsa impact limiter at ADP.* "Above-design-level vibration and impact tests were conducted, followed by functional testing for two mission lifetimes under hard vacuum. No damage or degradation of any kind was evident." (JPL, <u>Space Programs Summary No. 37-23, Vol. VI</u>, <u>op. cit</u>., 7.)
Aug. 1	The seventh meeting of the Ranger DSIF-SFO Design Review Board was held. (See May 27, 1963.) As a result of its first six meetings the Board issued a report citing major deficiencies in Ranger flight operations documentation. Subsequent meetings evaluated progress in correcting these deficiencies. (Ranger History--Working Draft, <u>op. cit</u>., 48.)
Aug. 2	NASA Headquarters informed JPL that the manpower ceiling established for JPL could be modified if the Laboratory would supply supportive data on manpower loading contrasted with requirements for NASA task assignments. (NASA, letter from E.D. Hilburn to W.H. Pickering, August 2, 1963, <u>loc. cit</u>.) (See July 31, 1963.)
Aug. 5	JPL Space Sciences Division recommended to the Ranger Project Office that the primary Block V mission consist of depositing a capsule on the moon carrying a passive single axis seismometer. (Rough draft of IOM from R.V. Meghreblian to H.M. Schurmeier, August 5, 1963, JPLHF 2-1638a.) This recommendation was adopted, and NASA Headquarters was notified that the primary mission objective of Ranger Block V should be the successful landing and operation of a seismometer capsule on the moon. A photographic capsule as a possible successor was recommended only with strong reservations. (JPL, letters from H.M. Schurmeier to N.W. Cunningham, August 9, 1963, JPLHF 2-1640 and 1641.)

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*On July 1, 1963, with the purchase of the Philco Corporation, Aeronutronics became a Division of the Philco Corp. which was, in turn, a subsidiary of the Ford Motor Company.

Aug. 5 cont. The NAS-SSB completed an evaluation of the problems and policies involved in the decontamination of interplanetary spacecraft, begun the year previously at the Iowa Summer Study, and released a report Space Probe Sterilization, A Policy Statement to the National Aeronautics and Space Administration. The document essentially concurred in recent NASA decisions on spacecraft sterilization procedures. (Contained in Appendix J of C.M. Atkins, NASA and the Space Science Board of the National Academy of Sciences, JPLHF 2-797.) (See January 15, 1963.)

NASA Agena B vehicle 6008 completed the manufacturing cycle at LMSC in Sunnyvale, California.

Aug. 7 JPL recommended that NASA OTDA continue to support DSIF use of L-band on Ranger through 1965, and that such support should end January 1966, at which time conversion to S-band would be accomplished. (JPL, letter from E. Rechtin to G.M. Truszynski, NASA, August 8, 1963, JPLHF 2-289.) (See April 25, 1963.)

Aug. 9 Because of the size, urgency, and differences in implementation (in-house versus contractor) between Ranger Block III and Ranger Block V, JPL divided these efforts into two separate flight projects. Geoffrey Robillard was named Project Manager for Ranger Block V, while Harris M. Schurmeier remained Project Manager for Block III. (JPL, IOM from R.J. Parks to Section Chiefs, et. al., August 9, 1963, JPLHF 2-191a; and, IOM from W.H. Pickering to Senior Staff, et. al., August 9, 1963, JPLHF 2-272.)

Responsibility for checkout and launch operations for NASA Atlas-Agena vehicles was assigned to NASA upon signature of a revised NASA/USAF agreement on Agena vehicles. Internally, LeRC assigned this task to the Goddard Launch Operations Branch. (See February 1, 1963.) NASA LeRC also began direct procurement of Agena B vehicles for Project Ranger from LMSC, replacing AFSSD for this function. (Testimony of Oran Nicks, Investigation of Project Ranger, loc. cit.)

Aug. 12 Responding to cirtics who urged increased emphasis on military space programs, Dr. Homer E. Newell, in a speech at Blacksburg, Virginia, asserted:

> those who argue that we should dispense with the frills of science and space exploration and concentrate on the necessities of military development, forget that we can't really say what the military necessities in space will be

Aug. 12 cont. and it would be foolhardy to pretend we can." He continued to point out that it would be of little value "to develop a maginot line in space, only to have it flanked by forces of greater flexibility. We need to develop in a broad way our space capability so that we will have the ability to move in any direction required. . . ."
("U.S. Scientist Decries Space Weapon Plea," The Evening Star, Washington, D.C., August 12, 1963.)

The Northrop Corporation contract for Ranger Block V Phase II activity was redefined by Modification No. 4. Effort was to be based upon a first flight in the second quarter of 1965; Northrop was directed to submit a recommended Block V Spacecraft System, supported by Design Evaluation Recommendations, by November 1, 1963. (JPL, Ranger Block V Project, op. cit., 41.)

Aug. 16 Spurious r.f. signals in the 960 mc. region were detected in the RA-6 flight unit payload at RCA similar to the anomalies that occurred in the TV PTM. (JPL, IOM from W.G. Leflang to D.H. Kindt, August 16, 1963, JPLHF 2-1645.)

Aug. 20 D.H. Kindt, Project Engineer for the Ranger TV Subsystem, requested a JPL Ranger Block III Project Office waiver of a final TV Subsystem Design Review at RCA. (JPL, IOM from D.H. Kindt to A.E. Wolfe, August 20, 1963, JPLHF 2-1553.)

Aug. 21 JPL informed NASA Headquarters of the continuing problem with vidicon tube yield on the Ranger Block III payload and of JPL and RCA plans to improve the situation. (JPL, letter from H.M. Schurmeier to N.W. Cunningham, August 21, 1963, JPLHF 2-644.)

Aug. 23 The JPL Ranger Block III Project Office granted the request for a waiver on an overall TV Subsystem Design Review. (JPL, IOM from A.E. Wolfe to W. Downhower/D.H. Kindt, August 23, 1963, JPLHF 2-1554.)

Aug. 26 NASA Headquarters submitted its recommendations to the SSSC for the scientific payload to be carried on initial Ranger Block V flights. OSS concurred in the choice of a seismometer as the primary experiment. (See August 5, 1963.) (NASA, memo from H.E. Newell to R.C. Seamans, Ranger Status Report No. 17, August 29, 1963, JPLHF 2-724.)

Aug. 26 cont. A tentative Ranger Block V launch schedule was issued at JPL.

Spacecraft	Launch Month
10	April '65
11	August '65
12	November '65
13	February '66
14	May '66
15	August '66

(Ranger Block V Launch Schedule, August 26, 1963, JPLHF 2-1649.)

Aug. 28 JPL was informed that RCA did not agree with JPL opinion that the transmitter spurious output problem represented a serious potential hazard. Action was requested to require RCA to verify that each payload meets the requirements of EPD-156. (JPL, IOM from W.G. Leflang to D.H. Kindt, August 28, 1963, JPLHF 2-1552.) (See August 16, 1963.)

JPL issued EPD-176 Requirements for a Ranger Block V Lunar Rough Landing Capsule. The primary mission assigned Block V flights was "to land a surviving payload containing a single-axis, passive seismometer on the lunar surface. . . ." (p. 2-1)

Aug. 30 NASA Headquarters approved commencement of the Lunar Orbiter Project under the direction of the Langley Research Center. (U.S. Congress, Senate, Committee on Aeronautical and Space Sciences, Hearings Before the Committee, NASA Authorization for Fiscal Year 1965, Part 1, Scientific and Technical Programs, 88th Congress, Second Session, March 4, 1964, 129.)

During August Ranger Block III. The Block III PTM Was subjected to vibration tests between August 19 and 23, and uncovered problems when the CC&S failed to properly store certain commands. Thermal control tests followed in the JPL 25-ft. space simulator and were satisfactorily completed on August 28. (JPL, Space Programs Summary No. 37-23, Vol. I, op. cit., 13-14; and, Space Programs Summary No. 37-24, Vol. I, op. cit., 9.)

Power turn-on in Ranger 6 occurred on August 7, and by August 22 RA-6 had completed all subsystem tests and calibrations, a power survey, and the first systems test. The first flight unit RCA TV subsystem was delivered to JPL on August 23, and turned over to the SAF on August 24. The spacecraft (with TV subsystem installed) completed the second systems test on August 28, and

During August cont.

preliminary test data indicated correct operation of all equipment. Assembly of Ranger 7, began July 29, continued in process. (JPL, Space Programs Summary No. 37-23, Vol. I, loc. cit.; and, Space Programs Summary No. 37-23, Vol. VI, op. cit., 1-2.) (Figure 54.)

At the Ranger Quarterly Review held at JPL on August 13, the pacing items in the program were considered to be TV power supply anomalies, late delivery of the command subsystem fabricated by Texas Instruments, and a capacitor problem. (Ranger JPL/NASA Quarterly Review Minutes, August 21, 1963, JPLHF 2-1647; and, Space Programs Summary No. 37-23, Vol. VI, op. cit., 1-2.)

Ranger Block V. Primary effort at Northrop continued to be in the design evaluation area, with briefing sessions held at JPL for Northrop personnel. About 100 NSL personnel were in residence at JPL.

Under JPL contract ADP continued to develop major subassemblies of the landing sphere assembly for the lunar facsimile capsule (LFC) although opinion at JPL and NASA now favored a seismometer for various reasons. (See August 26 and August 28, 1963.) (JPL, Space Programs Summary No. 37-23, Vol. I, op. cit., 27; and, Ranger JPL/NASA Quarterly Review Minutes, August 21, 1963, loc. cit.)

Sept. 3

Recommendations for the scientific payload for Block V Ranger missions were discussed further (see August 26 and 28, 1963) by the SSSC, and that body concurred in the OSS selection of payloads for Rangers 10 and 11, with Rangers 12 and 13 to be prepared as backup missions:

1. Single Axis Passive Seismometer Capsule; Principal Investigator, Dr. Frank Press, Caltech Seismological Laboratory.
2. Gamma-Ray Spectrometer; Principal Investigator, Dr. James Arnold, UCSD.
3. Surface Scanning Radar; Principal Investigator, Mr. Walter E. Brown, JPL.
4. Approach Television; Principal Investigator, Dr. Gerard Kuiper, University of Arizona.

Notification of investigators was withheld pending a NASA review of the FY 1964 program. (NASA, Summary Minutes of the Space Sciences Steering Committee of September 3, 1963, 3-7, JPLHF 2-1769; also, memo from H.E. Newell to R.C. Seamans, Ranger Status Report No. 18, September 18, 1963, JPLHF 2-725; and memo from

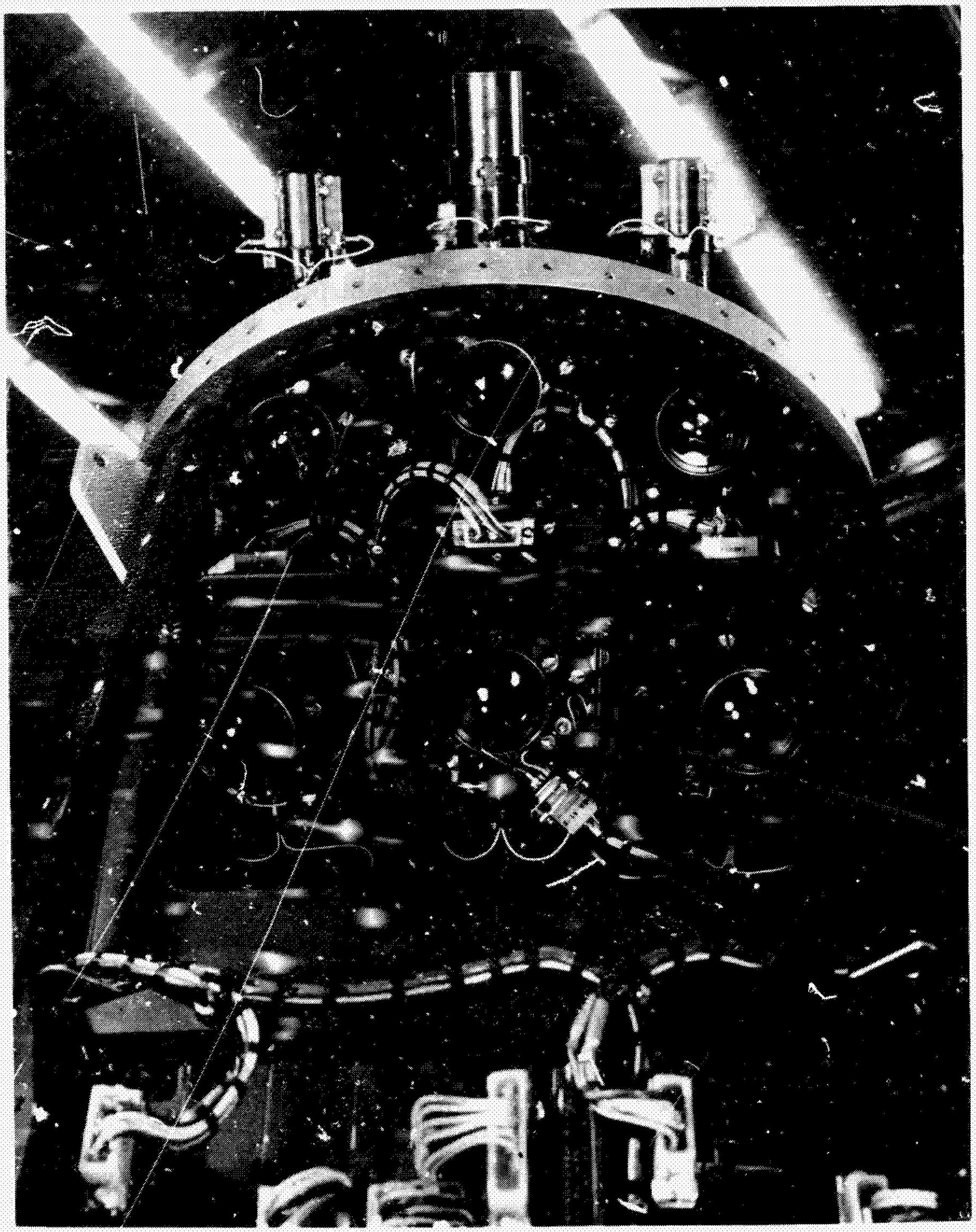

Figure 54: Ranger Block III TV cameras. Wide angle cameras located at center in both banks.

1963

Sept. 3 cont. H.E. Newell to O.W. Nicks, September 18, 1963, JPLHF 2-726.) Except for incorporating new technology, Ranger Block V was essentially a copy of Ranger Block II.

Sept. 5 NASA OTDA and OSS reached agreement calling for cessation of DSIF L-band support to flight projects at the end of 1965, thus permitting Block V seismic capsules to employ L-band equipment. The maintaining of the Block V flight schedule was critical to this agreement. (JPL, IOM from E. Rechtin to H.M. Schurmeier and G. Robillard, September 5, 1963, JPLHF 2-1654; and, IOM from E. Rechtin to R.J. Parks, September 5, 1963, JPLHF 2-1653.) (See August 7, 1963.)

Sept. 6 JPL Ranger Block III Project Office and NASA Headquarters signed an agreement with the Ranger Block III Principal Investigator clarifying the functions and authorities of all parties, in conformance with NASA Management Instructions 4-1-1 and 37-1-1. (Memorandum of Agreement by H.M. Schurmeier, September 6, 1963, JPLHF 2-1386.) (See July 11, and 19, 1963.)

The Ranger Design Review Board for DSIF and SFO systems issued a final report on Board findings and recommendations. (See August 1, 1963.) (Ranger History--Working Draft, op. cit., 48-49.)

JPL requested a Ranger Block V Capsule Study proposal from ADP. (JPL, Ranger Block V Project, op. cit., 45.)

Sept. 9 NASA Headquarters was informed that poor yield of Ranger TV vidicon tubes remained a significant problem. Because of this problem "the very best tubes have been selected for RA-6 with the remainder scheduled for RA-7. . . . Consequently, we have recommended that the flight schedule for RA-7, 8 and 9 be slipped in order that these missions will have at least as good a TV system as RA-6." (NASA, memo from N.W. Cunningham to O.W. Nicks, September 9, 1963, JPLHF 2-645.) (See August 21, 1963.)

NASA issued new instructions for sterilization and decontamination of unmanned deep space vehicles. (General Management Instruction 4-4-1, NASA Unmanned Spacecraft Decontamination Policy, September 9, 1963, JPLHF 2-435.) (See May 17, 1963.)

Sept. 10 NASA flight schedule was issued. No vehicles other than Block III were listed, and the Block III schedule was adjusted as follows:

RA-6 No change (See February 23, 1963.)
RA-7 Slipped from January 1964 to February 1964

Sept. 10 cont.

RA-8 Slipped from March 1964 to May 1964
RA-9 Slipped from April 1964 to July 1964

(Official NASA Flight Schecules, September 10, 1963, JPLHF 2-968.)

Dr. Robert C. Seamans, Jr., NASA Associate Administrator, conducted a review of OSS programs in light of Congressional funding cuts in the FY 1964 program. Budget problems were intensified by initiation of the Lunar Orbiter Project (see August 30, 1963). Various options were proposed including either cutting down or slipping the schedule of Ranger Block V. (See September 5, 1963.) (Ranger "Tuesday - Thursday" Project Meeting Minutes of September 10, 1963, JPLHF 2-1584.)

Sept. 14

During a JPL-LeRC review of the Atlas GE guidance improvement program held in Cleveland, Ohio, JPL personnel were informed of two test failures in GE guidance components resulting from short circuits caused by loose gold flakes in certain 1N459 diodes. Since hundreds of the same diodes were in use on Ranger Block III spacecraft, the Ranger Project Office was notified and special examinations were recommended. (Document, no date, entitled "Ranger 6 Diode Failure Report," JPLHF 2-1528.)

In an article in the Saturday Evening Post, Stuart H. Loory detailed some of the problems affecting the American space program, pointing out that the unmanned lunar program in particular was a source of national embarrassment:

> As far back as 1958 the United States tried to land something on the moon in a keep-up-with-the-Soviets drive. The Army, Air Force and industry ran up a string of eight failures in eight attempts to hit or come close to the moon. Then NASA entered Ranger in the competition in 1961 and 1962 and racked up five failures in five attempts--though only three were real efforts to hit the moon and get information home.

(Stuart H. Loory, "Are we Wasting Billions in Space?" Saturday Evening Post, September 14, 1963.)

ADP issued Proposal for a Design Study of a Lunar Rough Landing Capsule, (P130219) in response to the JPL request of September 6, 1963.

Sept. 17

A Ranger Block V Mission Analysis Panel was established at JPL with participation of NSL personnel. (JPL, letter from G. Robillard, to Dr. V.W. Howard, NSL, September 17, 1963, JPLHF 2-197.)

1963

Sept. 18	NASA Headquarters informed JPL of SSSC approval of JPL-recommended experiments and principal investigators for Block V Rangers 10 and 11, with Rangers 12 and 13 as backup. (NASA, letter from H.E. Newell to W.H. Pickering, September 18, 1963, JPLHF 2-192.) (See September 3, 1963 for details.)
	NASA Headquarters authorized the JPL Ranger Block III Project Office to continue using the milestone/bar chart reporting procedures adopted during Ranger reprogramming activities in January 1963, rather than the PERT reporting system used previously. (NASA, letter from N.W. Cunningham to H.M. Schurmeier, September 18, 1963, JPLHF 2-1655.)
Sept. 20	Ranger Agena B vehicle 6009 completed manufacture at LMSC in Sunnyvale, California.
Sept. 23	NASA Headquarters informed JPL that the Office of Space Sciences was preparing to conduct a thorough review of all flight projects, and that Project Ranger was scheduled for the day of November 7, 1963. (NASA, memo from E.M. Cortright to Directors of Ames, JPL, Goddard and Langley, September 23, 1963, JPLHF 2-1656.)
	Ralph Serlin assumed procurement responsibility for JPL Contract No. 950137, the RCA-AED TV subsystem at JPL. (JPL, IOM from C.J. Bennett to H.M. Schurmeier, September 25, 1963, JPLHF 2-1809.)
Sept. 26	Ranger Block V status reports began to be submitted separately to NASA Headquarters. (JPL, letter from G. Robillard to N.W. Cunningham, September 26, 1963, JPLHF 2-1657a.)
Sept. 27	General Motors Corporation recommended continuation of a JPL study contract to determine the feasibility of visually observing a Ranger impact on the lunar surface. (JPL, IOM from R.G. Brereton to Distribution, September 27, 1963, JPLHF 2-1387.)
During September	Ranger Block III. During early September the PTM underwent Mission Test #1 in the 25-ft. space simulator. (JPL, Minutes of the Ranger Spacecraft System Review, September 18, 1963, JPLHF 2-1313.) Final verification tests were performed on the Mark IV solar panels including humidity, vibration, vacuum temperature and thermal shock, and electrical performance. (JPL, Space Programs Summary No. 37-25, Vol. VI, op. cit., 6.)
	Two consecutive RA-6 mission tests (complete 66-hour lunar flight tests) in the 25-ft. space simulator began on September 26 and

During September cont.

continued into early October prior to RA-6 tear-down and re-inspection. (JPL, Minutes of Ranger Bi-Weekly Project Meeting of September 25, 1963, JPLHF 2-1573.) (Figure 55.)

Initial power turn-on of RA-7 was accomplished on September 16 with the TV subsystem and CC&S not yet installed. The RCA TV subsystem was shipped to JPL on September 27, and was mated with the spacecraft at the end of the month. (JPL, Space Programs Summary No. 37-24, Vol. I, loc. cit.; and, Space Programs Summary No. 37-25, Vol. I, op. cit., 39.)

Ranger TV ground support was reported operational at the Goldstone field locations, and system integration tests were performed with the DSIF. "It appears that no basic system problems exist and that the various pieces of JPL/RCA equipment are compatible." (JPL, Space Programs Summary No. 37-23, Vol. VI, op. cit., 11.)

Ranger Block V. ADP completed Phase I development effort on the LFC on September 13. This work, contracted at $1.3 million in November 1962, covered development to the prototype stage of the critical capsule subassemblies. The contract was completed on schedule and within budget. (Aeronutronic, Division of Philco Corp., Publication No. U-2350, Bimonthly Technical Progress Report No. 6, Lunar Facsimile Capsule Program, JPL Contract No. 950462.) (See Final Technical Report, Lunar Facsimile Capsule, Phase I Development, ADP No. U-2224, JPL Contract No. 950462, September 13, 1963.)

An ADP proposal for a 90-day design study of the Lunar Rough Landing Seismometer Capsule was reviewed at JPL, and agreement was reached on the level of effort to be applied to the various tasks. A definitive contract was expected to be executed by October 10. JPL also approved an NSL letter contract for ADP to initiate the preliminary design activity on the capsule landing system. (Ranger Block V Biweekly Status Report, September 30, 1963, 2, JPLHF 2-1676.)

NSL issued Ranger Payload Delivery Subsystem Study, NSL 63-161.

Oct. 2

In a move to centralize control and authority for spacecraft data acquisition and processing, Dr. Eberhardt Rechtin was appointed Assistant Laboratory Director for Tracking and Data Acquisition. In his new position, Dr. Rechtin was responsible for the complete DSIF including interstation communications. The SFOF remained a separate operation. (JPL, IOM from W.H. Pickering to Senior Staff, et. al., October 2, 1963, JPLHF 2-273.)

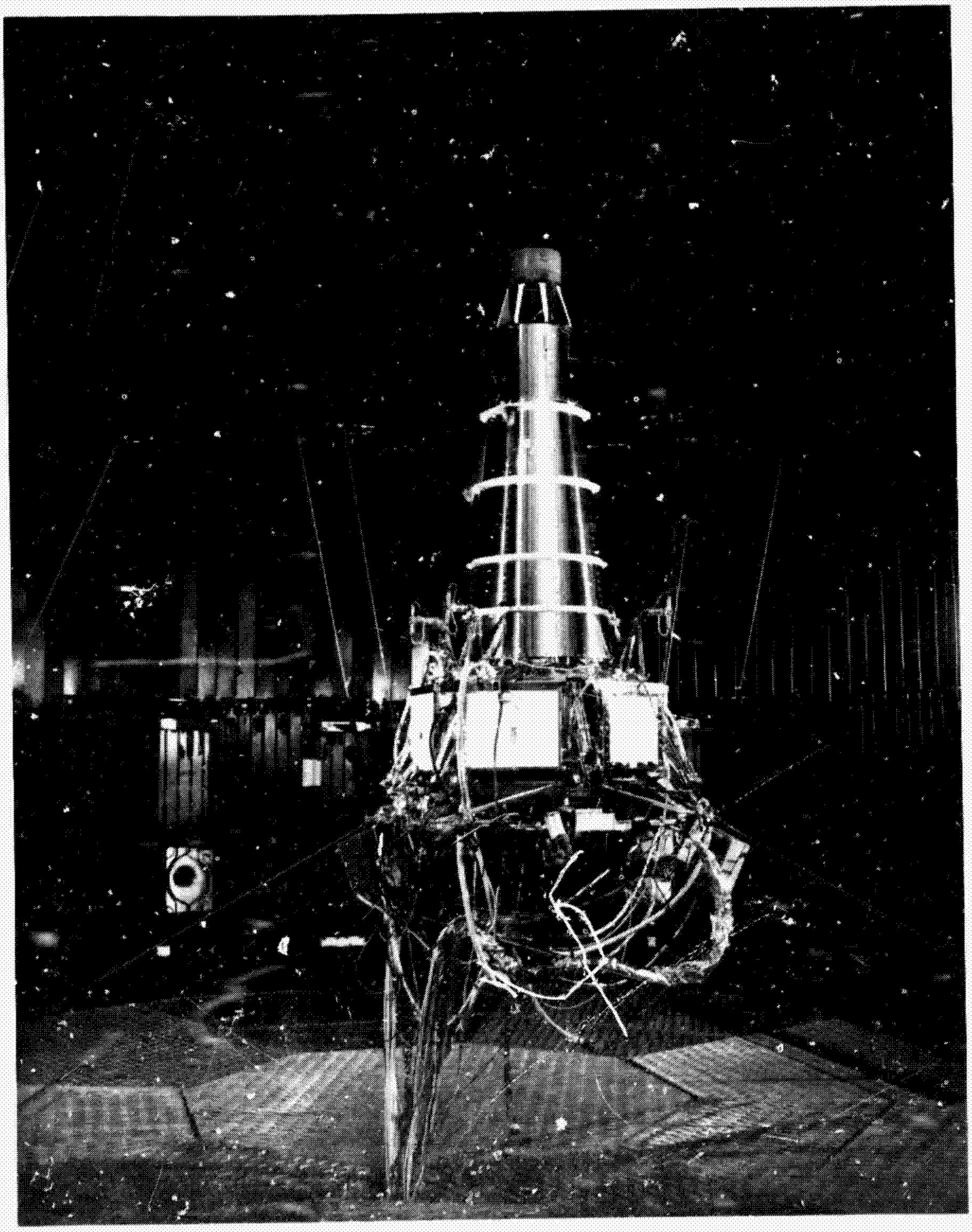

Figure 55: Ranger 6 in JPL space simulator.

Oct. 2 cont. JPL began a sampling, inspection, and test program of 1N459 diodes (see September 14, 1963) used in the Ranger spacecraft. Results obtained during the succeeding two weeks showed that after vibration the incidence of gold-flake contamination was so high (about 30% of all diodes examined) that most equipment containing these diodes was unfit for flight. (Document, undated, entitled, "Ranger 6 Diode Failure Report," loc. cit.)

JPL issued EPD-182, Ranger Block V Launch Vehicle Requirements.

Oct. 4 Time Magazine observed that:

> Caltech's Jet Propulsion Laboratory is admittedly far behind in its campaign to explore the moon's surface by means of unmanned Ranger spacecraft. Of the five Rangers launched so far, none has worked well enough to send back useful information. JPL blames a good part of the failure on the heat treatment given the Rangers to prevent them from contaminating the moon with earthly microorganisms; but whatever the cause, the delay is already on the books.

("The Grandstands are Emptying for the Race to the Moon," Time, October 4, 1963.)

Oct. 8 NASA Deputy Associate Administrator Earl D. Hilburn notified Dr. Lee DuBridge, President of Caltech, that the pending reorganization of NASA would place responsibility for JPL operations and whatever new contract agreement was entered into for Caltech sponsorship of JPL, in Dr. Homer E. Newell. (NASA, letter from E.D. Hilburn to Dr. DuBridge, October 8, 1963, JPLHF 3-401.)

Oct. 9 NASA announced a major reorganization effective November 1, 1963. Three major NASA offices were established, reporting to Associate Administrator Robert C. Seamans, Jr. The new offices were now responsible for both technical and management activities at all NASA field centers including JPL. This reorganization removed the task of general operation for the centers from the Associate Administrator where it had resided for two years, reduced the number of personnel who reported to his office, and returned the NASA organization to a structure more nearly like the Glennan arrangement that was in effect prior to November 1, 1961. The three new offices were Manned Space Flight (OMSF), Advanced Research and Technology (OART), and Space Science and Applications (OSSA). Dr. Homer E. Newell was appointed Associate Administrator for the latter office.

NASA Administrator James E. Webb announced that the changes were implemented "to improve even further a performance record that saw the success ratio of NASA's space flights climb from

Oct. 9 cont. 36 percent to 83 percent in its first five years." (NASA Release No. 63-225, October 9, 1963, JPLHF 2-1774.) Already, on September 30, 1963, Aviation Week had called Dr. Homer E. Newell "the big winner in the latest NASA reorganization," in which five technical offices were consolidated and reduced to three.

Oct. 11 In response to RCA notification of the potential for TV system turn on caused by a severe launch environment, R. Moyer and L.M. Bronstein prepared a report on potential inadvertent TV actuation conditions and suggested operational procedures to minimize this kind of event from occurring. (See July 24, 1963.) (JPL, IOM from R. Moyer/L.M. Bronstein, to P. Rygh, October 11, 1963, *loc. cit.*)

Oct. 15 JPL Ranger Block III Project Manager H.M. Schurmeier informed the Laboratory Director that the RCA TV subsystem short duration power dropout problem had been isolated "to a 4-port hybrid, but the exact mechanism of this breakdown is still not pinned down. It is thought to be either an arc, possibly due to local outgassing, or a multipacting type of breakdown." (JPL, IOM from H.M. Schurmeier to W.H. Pickering, October 15, 1963, JPLHF 2-1665.)

Oct. 17 The final design review of Agena B vehicles for Block III Rangers was held at LMSC in Sunnyvale, California (Lockheed document LMSC/A377602, "Block III Ranger Final Design Review.")

JPL issued Specification 75001, *Ranger Block V Project Policy and Requirements*.

Oct. 18 Upon completion of the program to investigate contaminated 1N459 diodes (see October 2, 1963), JPL recommended to NASA Headquarters that the flight of Ranger 6 be postponed until (1) the subject diodes in all critical spacecraft components were replaced with improved devices, and (2) new GE guidance components incorporating the same changes be provided for the Atlas booster programmed for Ranger 6. (JPL, letter from W.H. Pickering to H.E. Newell of NASA, October 29, 1963, JPLHF 2-287.)

NASA released the launch schedule for Block V Rangers:

Vehicle	Launch
RA-10	2nd Quarter, 1965
RA-11	3rd Quarter, 1965
RA-12	4th Quarter, 1965
RA-13	1966 (year only)
RA-14	1966 (year only)

(Official NASA Flight Schedules, October 18, 1963, JPLHF 2-968.) (See August 26 and September 10, 1963.)

Oct. 18 cont. RCA notified JPL that "it is our conclusion that the [TV] dropout phenomena is of an intermittent, non-sustaining nature. . . . it is the position of RCA that a successful mission can be obtained with the existing equipment configuration." However, several tests using the PTM were recommended to JPL for seeking an engineering solution to this problem in the event JPL was determined to pursue a solution. (RCA, TWX from B.P. Miller to Schurmeier/Kindt/Yarnes, October 18, 1963, JPLHF 2-1666.)

Oct. 21 NASA Headquarters accepted JPL's recommendations of October 18 and ordered a two-month slip of RA-6, a one-month slip of RA-7, with RA-8 and 9 launch dates remaining unchanged. (See September 10, 1963.) The additional time was to be used to resolve current problems such as diodes, obtain adequate spares, and to clarify all outstanding failure reports. No design improvements would be introduced. There was to be no public announcement of the schedule change. (JPL, Minutes of the Ranger Bi-Weekly Project Meeting, October 21, 1963, JPLHF 2-1573; also, letter from W.H. Pickering to H.E. Newell of NASA, October 29, 1963, loc. cit.)

Oct. 22 NASA Headquarters formally notified JPL and LeRC of the schedule changes in Project Ranger. (NASA, TWX from H.E. Newell to W.H. Pickering, October 22, 1963, JPLHF 2-193; and, TWX from H.E. Newell to Lewis Research Center, October 22, 1963, JPLHF 2-1668.)

Oct. 23 JPL awarded ADP Contract No. 950755 for a design study and development plan for lunar hard landing capsule for Block V Rangers. (JPL, Ranger Block V Project, op. cit., 46.)

Oct. 24 The Ranger Seventh Quarterly TV Subsystem Review was held at RCA among NASA, RCA, Northrop and JPL personnel. The session was somewhat strained with disagreement over the importance of TV subsystem development problems; however, a decision was reached that Block III TV effort would include investigation of the 4-port hybrid assembly in an effort to understand and eliminate the RF dropout problem, as well as investigate and resolve several other technical problems still plaguing the payload. (See September 9, 1963.) (JPL, Space Programs Summary No. 37-25, Vol. I, op. cit., 40.)

At the NASA OSS staff meeting the future of Project Ranger was discussed in light of Headquarters manpower figures and the budget proposed for FY 65. It was pointed out that dropping Ranger Block V would free funds for some urgent needs--for example, $30 million for the FLOX effort to ease the Surveyor payload limitation. A decision would be necessary within the next few weeks. (NASA, OSS Staff Meeting Minutes, October 24, 1963, JPLHF 2-1759.)

Oct. 24 cont. The 100th anniversary of the founding of the National Academy of Sciences took place with relative equanimity as members avoided altercation over the value of manned lunar exploration. (Howard Simons, "Scientists Call Truce in Moon Plan Dispute," Los Angeles Times, October 24, 1963.)

Oct. 25 JPL directed RCA to investigate replacement of 1N459 diodes (subject to a high incidence of gold flaking) in the Ranger TV subsystem and to determine the effects of both temporary and permanent shorting conditions if diodes were retained. (JPL, letter from R. Serlin/D. Kindt to J. Davison and B.P. Miller of RCA, October 25, 1963, JPLHF 2-2076.)

Oct. 29 JPL requested that RCA take "every practical advantage" of the two months launch delay occasioned by the contaminated diodes "toward the thorough and careful resolution of all known questions or problems." (JPL, letter from R.J. Parks, to Barton Kreuzer, RCA, October 29, 1963, JPLHF 2-246.)

Astronomers at Lowell Observatory in Arizona observed a twenty-minute disturbance on the lunar surface near the Crater Aristarchus. ("Air Force Spots Second Disturbance on Moon," Los Angeles Times, December 5, 1963.)

The NASA Director of Lunar and Planetary Programs, OSS, recommended to the Director of OSS that JPL should be covered under implementation of an experimental NASA procedure involving periodic contractor performance evaluation. (NASA, memo from O.W. Nicks to the Director, Office of Space Sciences, October 29, 1963, JPLHF 2-1669.)

Oct. 30 At JPL D. Alcorn was appointed Project Engineer for Ranger Block III; R. Mesnard assumed the new position of Block V Staff Engineer. (JPL, Ranger Spacecraft System Review, October 30, 1963, 1, JPLHF 2-1313.) Mr. Ken Coon remained in charge of the Block V Spacecraft System at JPL.

Oct. 30-31 JPL personnel were notified of the delay in the Ranger Block III Project and of its causes. (JPL, IOM from W.H. Pickering to All Personnel, October 30, 1963, JPLHF 2-275; and, IOM from R.J. Parks to Ranger, Mariner and Surveyor Personnel, October 31, 1963, JPLHF 2-1389.) (See October 21, 1963.)

Oct. 31 The revised Ranger Block III Project Development Plan was issued. (For initial release, see September 23, 1961.) The document stated the project objectives as:

> The mission of the Block 3 Ranger flights is to obtain television pictures of the lunar surface which will be

Oct. 31 cont.

of benefit to both the scientific program and the U.S. manned lunar program. These pictures should be at least an order of magnitude better in resolution than any available earth based photograph.

Should the requirements of the manned lunar program conflict with the scientific requirements, every consideration will be given to meeting the manned lunar program needs.

The attainment of technological data will be the by-product and not an objective of these flights.

Total estimated cost of Project Ranger (Blocks I, II, and III) was set at $223,000,000, of which approximately $105,000,000 was for Blocks I and II, and $118,000,000 for Block III. (Project Document No. 8, Ranger, Block III, Project Development Plan, October 31, 1963, JPLHF 2-13.)

During October

Ranger Block III. The Block III PTM, having completed all of its systems and environmental tests, was shipped to the Goldstone Tracking Station on October 21. Between October 22 and November 9, a series of tests were performed with the DSIF including command, data threshold limits, and evaluation of the TV equipment under simulated lunar levels of RF signal strength. No incompatibilities were encountered between DSIF equipment and the spacecraft, and spacecraft systems operated properly at threshold distances. (JPL, Space Programs Summary No. 37-25, Vol. I, op. cit., 7.)

Ranger 6 completed two complete mission tests which began in late September. Acceptance criteria for a successful test called for completion of two successive 66-hour flights in the 25-ft. space simulator without a catastrophic failure. Temperatures varied between 110° - 60° C. Two partial failures, both associated with the TV subsystem, were recorded during the first mission run. Pictures were lost from Camera B, and an RF power drop recurred for a duration of 0.2 seconds. (NASA, OSSA Review October 2, 1963, JPLHF 2-1505.)

In mid-October RA-6 was returned to the SAF for disassembly and inspection prior to final tests and shipment to AMR. During inspection, which involved microscopic and black light inspection of parts, torque verification and conformal coating touch-up, the Hybrid Coupler on the TV subsystem was found to have evidence of arcing in the connectors and a bubble in the silver plating. The unit was removed and replaced with a spare. (JPL, Ranger Spacecraft System Review, October 16, 1963, 2, JPLHF 2-1313.)

1963

During October cont.

On October 21 RA-6 was ordered placed in controlled storage where it remained through November 17 while equipment containing contaminated diodes were rebuilt and requalified for flight. (JPL, Space Programs Summary No. 37-24, Vol. I, op. cit., 10.)

Ranger 7 completed System Test 2 on October 4. The flight TV subsystem and flight communication subsystem were received at JPL on October 7. All other remaining flight equipment was received and calibrated by October 11, when System Test 3 was conducted. No significant problems were encountered. Agena match-mate tests and a dummy run precountdown were completed by October 21, when RA-7 was placed in controlled storage with RA-6 pending replacement of equipment containing faulty diodes. (Ibid., 12.)

RCA-AED reorganized the Ranger TV Project Office, under the direction of B.P. Miller, to provide for more efficient operation. Payload development remained on schedule; however, rework of flight payloads was undertaken late in the month when it was ascertained that 120 suspect diodes were used in the camera electronics and in high current regulators.

Intensive study of the TV subsystem was ordered at the October 24 Quarterly Review. Included were the RF drop-out problem, camera shutter operation, and vidicon shelf life. New production of internal mask vidicons by the Lancaster Division of RCA provided increased vidicon yield and encouraged a belief that the problem of external mask vignetting could be solved. (See September 9, 1963.) (Minutes of Seventh Ranger Quarterly Review at Hightstown, N.J., October 24, 1963, 4, 7, JPLHF 2-1672; and, JPL, Space Programs Summary No. 37-25, Vol. I, op. cit., 40.)

Ranger Block V. Preparation of the Block V Project Development Plan was initiated at JPL, (JPL, IOM from G. Robillard to Distribution, Minutes, Ranger Spacecraft Block V Review Meeting held October 29, 1963, JPLHF 2-1388.)

Northrop completed all design evaluation recommendations for Block V spacecraft, as well as performance specifications for the subsystems. (Northrop Space Laboratories Report No. NSL 63-267, Ranger Program, Management and Financial Report, Ranger Spacecraft Systems for October 1963, 3.) JPL issued a request for a new proposal from NSL covering complete Block V spacecraft system development based on EPD-154, Revision 1, a first flight in the second quarter of 1965, and the use of L-band communications on flights through 1965, with S-band on flights in 1966. (JPL, Ranger Block V Project, op. cit., 42.)

During October cont. The Ranger Block V schedule established on October 18 slipped the planned first launch by two months, to April 1965. In light of this stretchout, taken to ease funding problems, Northrop resubmitted a decreased budget request to JPL on October 28. (NSL Report 63-267, loc. cit.)

Facilities. The SFOF became available for occupancy. Installation of Block 1 IBM 7094 computers and a subcommunications center was completed. Block 2 installation and checkout of remaining computer equipment, communications system, and command, control and display consoles, was scheduled for completion in April, 1964. (JPL, Space Programs Summary No. 37-23, Vol. VI, op. cit., 35.)

Nov. 1 RCA submitted a camera optimization plan for the Ranger TV subsystem to JPL. The plan included two principal efforts: vidicon testing to ensure an adequate supply of acceptable vidicons; and sufficient camera testing to arrive at a complement of twelve cameras of uniform flight acceptability. (RCA, AED R-2172, Ranger TV Subsystem Camera-Optimization Plan, November 1, 1963, JPLHF 2-1674.)

A revised charter for the Ranger, Mariner, Surveyor and Fire Tracking, Telemetry and Communications Panel was issued by JPL and LeRC. (JPL, IOM from M.S. Johnson to W.E. Giberson, et. al., dated November 26, 1963, enclosing revised charter, November 1, 1963, JPLHF 2-1680.)

Nov. 5 NASA OSSA listed outstanding problems with and decisions required for Project Ranger as:

1. Block V decision (the PAD was not yet signed)
2. Additional costs incurred by delay in RA-6 and 7 caused by retrofitting diodes
3. Capsule development for Block V (what to do and how to pay)

(NASA, memo from O.W. Nicks to H.E. Newell and E.M. Cortright, November 5, 1963, JPLHF 2-1675.)

Nov. 6 RCA informed JPL that every effort would be made to see that the RCA subsystem difficulties were resolved during the retrofit period. (See October 29, 1963.) (RCA, letter from B. Kreuzer to R.C. Parks, November 6, 1963, JPLHF 2-1673.)

1963

Nov. 7 A NASA Headquarters review of Project Ranger was conducted with JPL in Washington, D.C. This review took the place of the normal Block III Quarterly Review. No minutes of this meeting have been located; however, a decision on Ranger Block V apparently was postponed for a separate review. Fiscal problems caused by the program delay were discussed. (JPL, TWX from H.M. Schurmeier to N.W. Cunningham at NASA Headquarters and to S.C. Himmel, of LeRC, October 28, 1963, JPLHF 2-1670a; and Minutes of the Ranger Bi-Weekly Project Meeting of November 20, 1963, JPLHF 2-1573.)

Nov. 11 The importance attached to unmanned, automated lunar spacecraft in light of Apollo program development was reviewed in the Wall Street Journal: "On the basis of observations with optical and radar telescopes, the astronomers have come up with a variety of contradictory theories [of the lunar surface]. Some of the theories if found true could herald disaster for a manned lunar landing." The report continued that as design of the Apollo lander progressed, "the Ranger and Surveyor are intended to answer the most crucial questions now facing the man-to-the-moon program. This is the mystery of the nature of the lunar surface." (Jerry Bishop, "Man Flight Effort Enters Crucial Phase of Exploring Surface with Instruments," Wall Street Journal, November 11, 1963.)

Nov. 20 In order to reduce some of the difficulties involved in Center relationships with science experimenters on space flight projects, NASA Headquarters directed JPL Project Managers to:

1. Define organizational lines of project responsibility enabling Principal Investigators to report more directly to the Project Manager's office. . . .
2. Invite Principal Investigators to participate directly in project meetings, at frequent intervals, with other spacecraft personnel involved in day to day project activities. . . .

(NASA, letter from O.W. Nicks to R.J. Parks, November 20, 1963, JPLHF 2-286.)

Nov. 25 The launch date for RA-6 was officially changed from early December 1963 to late January 1964. (Official NASA Flight Schedules, November 25, 1963, JPLHF 2-968.) (This represented a two-month slip in lunar launch dates.)

1963

Nov. 27 JPL notified NASA Headquarters of its understanding of the proposed revision of Management Instruction 37-1-1, establishing relationships between scientist experimenters and Project Offices, as given in the draft document. (See also November 20, 1963.) (JPL, letter from W.H. Pickering to H.E. Newell, November 27, 1963, JPLHF 2-194.)

Air Force astronomers at Lowell Observatory, Arizona, sighted and filmed a second lunar disturbance of an hour and a half. The first sighting occurred on October 29. Both disturbances were near the Crater Aristarchus, both were ruby-red in color, and both were noticed when the moon was in the same phase. ("Air Force Spots Second Disturbance on Moon," loc. cit.)

The target date for a definitized contract with NSL for provision of Block V Rangers was slipped from January 1 to February 1, 1964. (NASA, letter from N.W. Cunningham to G. Robillard, November 27, 1963, JPLHF 2-1955.)

During November Ranger Block III. The PTM was returned to the SAF from Goldstone on November 9 where the vehicle was prepared for further tests. Torsional vibration tests and systems tests were conducted from November 15 through the 19th. No spacecraft problems were encountered. During the remainder of the month the PTM underwent temperature control and light tests in the 25-ft. space simulator to determine the effects of light and heat reflection from the spacecraft sun shade and other spacecraft surfaces on the earth sensor. No problems were indicated. (JPL, Space Programs Summary No. 37-25, Vol. I, op. cit., 7,8.)

RA-6 was removed from controlled storage, reassembled, and various tests were performed on subsystems between November 18 and the end of the month. The rebuilt CC&S was delivered on December 4, and a satisfactory systems test with all flight equipment installed was run on December 5. (Ibid., 8.)

RA-7 remained in controlled storage throughout the month. (Ibid., 9.)

Ranger Block V. A request for proposal (RFP) was transmitted to NSL on November 1 to establish a definitized Block V contract. (JPL, Ranger Block V Bi-Weekly Status Report, November 14, 1963, 4, JPLHF 2-1678.) Following the NASA Headquarters meeting of November 7, Addendum 1 to the RFP was issued on November 14, reflecting a revised format and schedule, which altered the NSL submission date to December 4, 1963. Negotiations on execution of a definitized contract were likewise postponed. (JPL, Ranger Block V Bi-Weekly Status Report, November 22, 1963, 3, JPLHF 2-1679.)

1963

During November cont. — DSIF. To accommodate Ranger 6 video bandwidth requirements, unity gain 30-Mc isolation amplifiers were installed at the Goldstone Echo and Pioneer stations. Similar modified equipment was sent to overseas stations to feed the video recorders. (JPL, Space Programs Summary No. 37-25, Vol. VI, op. cit., 20.)

Dec. 2 — The Wall Street Journal reported that NASA's ardor for new space assignments was fading, and that top officials were concentrating instead on tightening agency management: "These include ways to push suppliers toward higher standards of manufacturing reliability; defining the goals of its educational and research program more precisely; remedying administration inadequacies which have hamstrung such key projects as the Ranger moon probe. . . ." (Jonathan Spival, "Johnson and Space," The Wall Street Journal, December 2, 1963.)

Dec. 4 — NSL submitted to JPL a recommended Block V spacecraft system configuration together with supporting Design and Evaluation Recommendations. (JPL, Ranger Block V Project, loc. cit.) (Figure 56.)

Dec. 6 — JPL Director Dr. W.H. Pickering recommended to Dr. Homer Newell, Director of NASA OSSA, that NASA Headquarters appoint a small group composed of members of the Kelley Investigation Board to thoroughly examine the entire Ranger 6 system prior to its scheduled launch in January 1964. (JPL, letter from W.H. Pickering to H.E. Newell, December 6, 1963, JPLHF 2-195.)

AT JPL L.M. Bronstein recommended that overseas deep space stations be authorized to transmit a TV turn-off command to Ranger 6 in the event the TV subsystem was prematurely turned on before reaching the moon. (See October 11, 1963.) (JPL, IOM from L.M. Bronstein to P. Rygh, December 6, 1963, JPLHF 2-1683.)

Dec. 8 — A former Air Force test pilot, Roy Wolford, recommended launching a small rocket from Ranger 6 during descent onto the surface of the moon and within the field of view of the TV cameras in order to obtain a visual record of the surface burst and to gain a better understanding of the makeup of the lunar surface. (Marvin Miles, "Rocket Hit on Moon Suggested," Los Angeles Times, December 8. 1963.)

Dec. 9 — NSL submitted a proposal covering complete development program for the Block V spacecraft system to JPL. (JPL, Ranger Block V Project, op. cit., 43.)

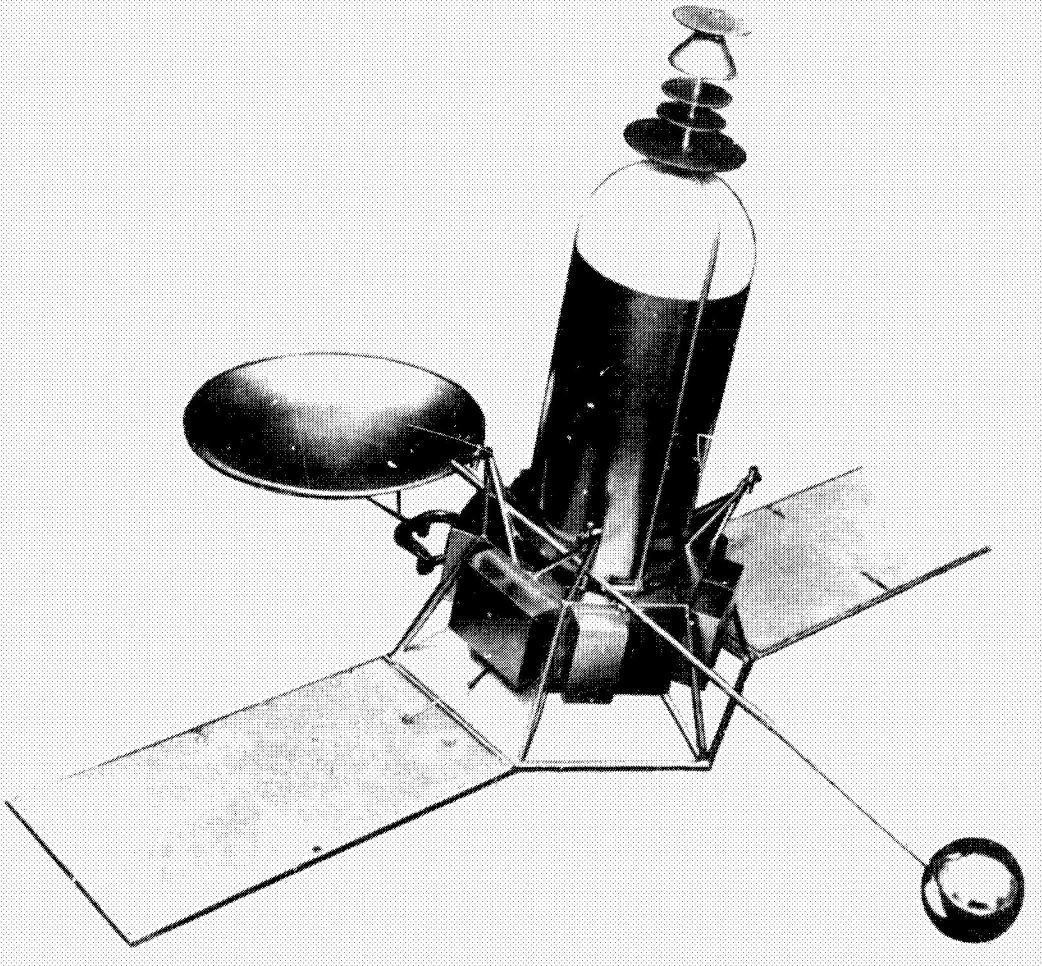

Figure 56: Northrop-proposed Ranger Block V spacecraft configuration.

1963

Dec. 11 Addendum 1 to the Bronstein/Moyer memorandum of October 11 was issued at JPL. The addendum outlined further potential TV turn-on conditions and means for turn off. (See December 6, 1963.) (JPL, Addendum to IOM from R. Moyer/L.M. Bronstein to P. Rygh, December 11, 1963, JPLHF 2-1664.)

Dec. 13 NASA Headquarters directed that JPL terminate all activities associated with the Ranger Block V program. The decision was reached to cancel Block V in light of the final FY 1964 NASA appropriation and the anticipated level of support likely in FY 1965. Secondarily, this move was seen as a way to ease JPL's manpower shortage problems under the 4000-man ceiling established for the year. (See August 2, 1963.) (NASA, letter from H.E. Newell to W.H. Pickering, December 13, 1963, JPLHF 2-196; also TWX from H.E. Newell to W.H. Pickering/P. Ross, December 13, 1963, JPLHF 2-1685; and IOM from K.C. Coon to G. Robillard, December 13, 1963, JPLHF 2-1684.) JPL, in turn, terminated Contract No. 950591 with Northrop, and Contract No. 950755 with Aeronutronics.

Publicly Dr. Newell observed that "we are placing greater reliance on the remaining four Rangers, the Surveyor landers and the Lunar Orbiters for unmanned lunar exploration prior to manned landings on the Moon. At the same time, this move will contribute to necessary economies in the overall NASA program." (NASA, Astronautics and Aeronautics, 1963, op. cit., 477.)

The Wall Street Journal, among other publications, noted that "many experts in and out of the agency [NASA] have had increasing doubts about the value of Ranger, unsuccessful so far in five tries, and have considered it preferable to place greater emphasis on more advanced projects for gleaning information about the moon." ("Space Agency Announces Cut in Ranger Moon Probe Plans, Cites Reduced Budget," The Wall Street Journal, December 16, 1963.)

Dec. 17 A flight readiness acceptance review of RA-6 was held at JPL. In this review--attended by N.W. Cunningham, Ranger Program Manager at NASA Headquarters, the ad hoc JPL Spacecraft System Design Review Board formed a year earlier (December 17, 1962)--the status of the RA-6 spacecraft and ths supporting qualification testing and analysis were evaluated to determine if the vehicle should be shipped to AMR. The review team approved shipment for the flight. (JPL, letter from H.M. Schurmeier to N.W. Cunningham, December 19, 1963, JPLHF 2-1687; and, IOM from M. Goble to

Dec. 17 cont. to Crabtree/McGee, December 18, 1963, JPLHF 2-1686; also, IOM from A.E. Wolfe to H.M. Schurmeier, December 30, 1963.)

Mr. N.W. Cunningham, NASA Ranger Program Manager, subsequently informed NASA Associate Administrator Robert Seamans that the RCA TV RF drop-out problem appeared to be solved. A redesigned TV hybrid ring (where the signals from the two TV channels were combined and sent on the antenna) had undergone an intensive test program on the PTM and no multipacting-type power dropouts were encountered. The new hybrid ring design was authorized for standard use on all Block III flights. (NASA, memo from N.W. Cunningham to R.C. Seamans, Status Report No. 25, December 23, 1963 JPLHF 2-1688b.)

Dec. 19 RA-6 was shipped to AMR by motor van from JPL.

Dec. 20 NASA announced selection of the Boeing Company of Seattle, Washington, to make the lunar orbiting spacecraft in the Lunar Orbiter Project, managed by the Langely Research Center in Hampton, Virginia. (The Wall Street Journal, December 23, 1963.) (See August 30, 1963.)

Dec. 24 JPL established the Deep Space Network (DSN) as an organizational entity. This move consolidated control of the DSIF, Interstation Communications, and all mission independent portions of the SFOF in one office: the Assistant Laboratory Director for Tracking and Data Acquisition (see October 2, 1963). JPL would encourage OSSA and OTDA to begin negotiations on a single source of funding for the entire system. "This change is made in order to accommodate efficiently the increasing number of outside flight projects for which the Jet Propulsion Laboratory has been tasked to supply tracking and data acquisition support. This change should also assist in closer integration of the previously separate facilities." (JPL, IOM from W.H. Pickering to Senior Staff, et. al., December 24, 1963, JPLHF 2-277.)

Bellcomm Inc. completed a study of Ranger to determine the expected data return and its implications on the Surveyor follow-on missions. "It is concluded that Ranger [Block III] has about a 0.75 chance of increasing our knowledge of the small scale roughness and the photometric function." (Bellcomm, Inc. Technical Memorandum 63-1112-5, "Block III Ranger and Block I Surveyor Programs and Apollo Site Certification," December 20, 1963, JPLHF 2-1953b.)

Dec. 30 In an interview, Nobel Prize winner Dr. Harold C. Urey sharply criticized NASA cancellation of the Block V Ranger Project for

Dec. 30 cont. hard-lander scientific instruments on the moon: "' . . . There is no possibility now of finding out anything about the composition of the moon's surface until 1966 or 1968, and I feel very disappointed.'" He continued, "'space science is suffering because of cutbacks in the budget. The first thing sacrificed is always science.'" Dr. Urey observed that astronauts in the Apollo program had no background in science and little to contribute to the space science program: "'so far as the main popular purpose is concerned, namely putting someone on the moon, any man or woman with an attractive personality would do.'" (William Hines, "Urey Says Economies Hurt Space Science," The Evening Star, Washington, D.C., December 31, 1963.)

During December Ranger Block III. All final testing of RA-6 was completed in mid-December, and approval to ship to AMR was received on December 17. RA-6 and associated OSE arrived at AMR on December 22, and by the end of the month, the spacecraft was checked out and ready for initial systems testing. (JPL, Space Programs Summary No. 37-26, Vol. I, for the period January 1, 1964 to February 29, 1964, 10.) (Figure 57.)

RA-7 was removed from controlled storage on December 9, and retrofitted with rebuilt parts that did not contain contaminated diodes. Subsystem tests, separation tests, and vibration tests were completed by the end of the month. Between planes of vibration and cruise mode, telemetry of the TV subsystem turned on inadvertently. This condition, traced to a short circuit in the hydraulic timer, was fixed. During high frequency vibration another problem was tracked to the mixer in the Transmitter-A chassis, and that unit was replaced. (Ibid., 13; also, Space Programs Summary No. 37-25, Vol. I, op. cit., 9; and Space Programs No. 37-25, Vol. VI, op. cit., 2.)

Mechanical assembly of RA-8 began on December ., and proceeded toward completion in early January 1964. There were problems in late delivery of equipment. (JPL, Space Programs Summary No. 37-25, Vol. I, loc. cit.; and, Space Programs Summary No. 37-25, Vol. VI,. loc. cit.)

Ranger Block V. Ranger Block V was cancelled on December 13, shortly after vehicle designs and development plans were completed. Northrop and Aeronutronics began closeout efforts as defined under termination clauses of their contracts. Northrop continued to provide engineering support to JPL on the Block III Project through 1964. (See testimony of R.H. Horner in Investigation of Project Ranger, op. cit., 207.)

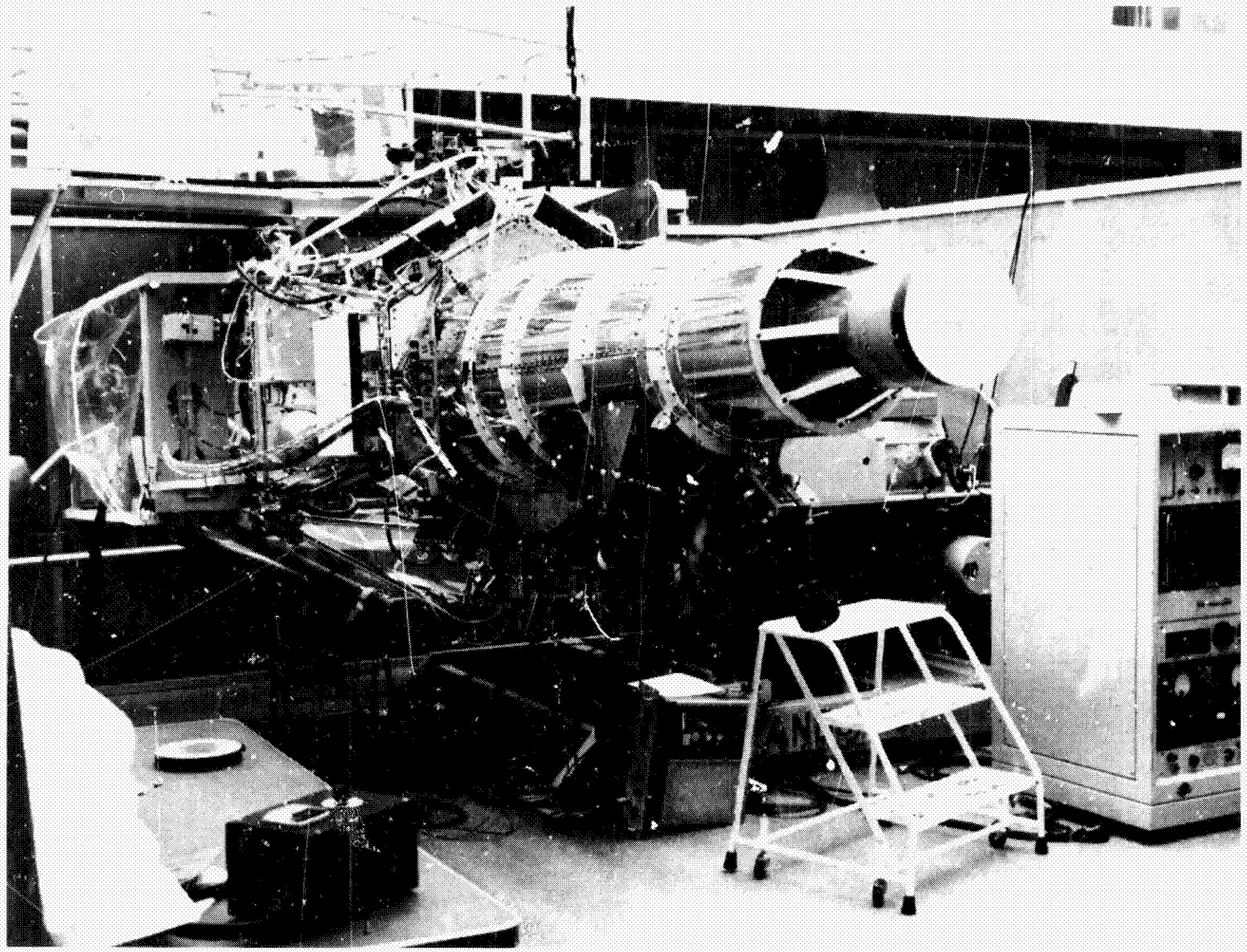

Figure 57: Ranger 6 in JPL systems test complex.

During December cont.

New Programs. JPL initiated an Engineering Change Requirements (ECR) control program in which a computer accounted for all ECR's completed and in-process on the Mariner C and on Ranger Block III. Another computer program reported the effects of all spacecraft weight and power changes brought about by design changes, and maintained an up-to-date detailed log of the weight and power breakdown by subsystem and subassembly. (JPL, Space Programs Summary No. 37-25, Vol. I, op. cit., 9-10.)

DSN. By the end of the month communications circuits between JPL and Woomera, Australia, were converted from high frequency radio to submarine cable. This change resulted in a significant improvement in reliability. Special ground processing equipment for Ranger Block III data was in place at all operational stations and Ranger compatibility and command procedure tests were conducted between December 16-19. (NASA, Tenth Semiannual Report to the Congress, July 1 - December 31, 1963, 150-151.)

1964

Jan. 1 Designations for all remaining Ranger spacecraft were altered by NASA: "Conforming to a recent NASA order redesignating mission names for all of its projects, this spacecraft [RA-6] will be called Ranger A prior to launch. Similarly, what had been Rangers 7 through 9 in the Block III series, will be called Rangers B through D. If this Ranger is successfully launched, it will be named Ranger VI." (NASA document entitled "Information Plan, Ranger A," January 1964, JPLHF 2-1800.)*

Jan. 2 In an organizational change effective January 6, JPL established the position of Assistant Laboratory Director for Technical Divisions. This office was to be responsible for supervising all Laboratory technical divisions to ensure that the divisions were responsive to the needs of project offices, and that established priorities were consistently observed. Mr. Fred Felberg was appointed to fill the new position. (IOM, from Dr. W.H. Pickering to Senior Staff, January 2, 1964, JPLHF 2-439.)

Jan. 6 Initial power turn-on of RA-6 occurred at AMR. Subsystem tests were normal except for attitude control, where the roll gyro did not perform properly. The gyros and associated electronics were replaced with a spare unit. (JPL, Minutes of Ranger Spacecraft System Review, January 8, 1964, JPLHF 2-1313.)

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*This alphabetized nomenclature was not adopted by the press. (It is also not used in the remainder of the Chronology in order to avoid confusion.) Commenting on the move several months later, Life Magazine observed: "Despite all the new precautions, NASA was still so leery of Ranger's chances that it seriously considered a labeling gimmick to minimize embarrassment over any more failures. Instead of numbering all the Rangers consecutively, thus keeping accurate count of the failures, they designated the next one Ranger A instead of Ranger VI. If it failed the next try would be Ranger B. Only when the launch came off successfully would it be called Ranger VI. By this trick they hoped to soak people's memories in alphabet soup to convey the impression that there had been only five failures before the final success. But reporters had been calling Ranger VI Ranger VI all along, and they stubbornly insisted on calling it that. When the launch was a success, NASA called it Ranger VI too." (Jim Hicks, "Many a Slip 'Twixt Earth and Moon--and Measles Too," Life, August 14, 1964, 36a, JPLHF 2-706.) For example, just prior to launch, Popular Science ran an article, "Ranger 6, Can it Beat the Jinx?" (JPLHF 2-1799.)

1964

Jan. 6 cont. An editorial in the Christian Science Monitor, citing Dr. Harold Urey, noted that NASA projects being trimmed in cutbacks were those aimed at gathering scientific information, rather than the manned spaceflight projects: "Dr. Urey acknowledges that, if men are to go to the moon at all, the engineering development needed to ensure their safety must have top priority. Nevertheless, it is obvious that the interests of scientific research are not served by an overriding goal that causes scientific aspects of the program to be cut back when a budget squeeze is on." ("Lunar Economy," Christian Science Monitor, January 6, 1964.)

Jan. 7 As part of its phase-out work on Project Ranger, Northrop was awarded Contract NAS7-269 to evaluate the possible use of Ranger-developed technology and subsystems for the Lunar Orbiter Project, and for a Mariner-type Mars project. (NASA, TWX from O.W. Nicks to E. Sample, January 7, 1964, JPLHF 2-1802.)

DSIF and the SFOF began integration tests which covered all Ranger countdown procedures during launch through the midcourse and terminal maneuvers. Operational readiness tests, including AMR, were conducted between January 21 and 24. (Investigation of Project Ranger, op. cit., 110.)

Jan. 8 A Ranger Experimenters' Meeting convened at JPL. A firm policy was established that the release of any Ranger video data to anyone other than the experimenters themselves must be approved by the Ranger Project Manager. Until NASA released the pictures, all requests for data would be forwarded to the Project Manager. (Minutes of Ranger Experimenters' Meeting, January 24, 1964, JPLHF 2-732.)

NASA Headquarters informed JPL that the revised GMI 37-1-1 (Scientist-Project Relations) called for the establishment of a Principal Investigator Team that would report to a designated Project Scientist or Project Manager. (NASA, letter from H.E. Newell to W.H. Pickering, January 8, 1964, JPLHF 2-754.) (See July 11 and September 6, 1963.)

Jan. 9 Ranger 6 was moved to launch complex 12 at AMR preparatory to final tests. (JPL, Space Programs Summary No. 37-26, Vol. I, op. cit., 11.)

Jan. 13 The joint flight acceptance composite test (J-FACT) was performed on Ranger 6. The only problem encountered was slow response in roll gyro performance. After troubleshooting, the gyros performed satisfactorily during a rerun. The spacecraft was returned to Hangar AM where preparation for the final system test was initiated. (Ibid.)

1964

Jan. 15	JPL issued priorities for the remaining Ranger launches and for two Mariner C flights scheduled in 1965. Highest priority was assigned design qualification activities for RA-6 (e.g., type approval tests, failure report closeouts, etc.). (JPL, IOM from W.H. Pickering to Senior Staff, et. al., January 15, 1964, JPLHF 2-278.)
Jan. 16	JPL issued Revision 3 of EPD 78, Space Flight Operations Plan, Ranger 6. (The SFOP defined plans for space flight operations in normal and anticipated departures from normal conditions.)
Jan. 18-19	Final systems test of Ranger 6 was performed at AMR. Minor difficulty encountered with operational support equipment (OSE) was corrected. The TV subsystem was also exercised satisfactorily in the cruise mode. On January 19 a special test was conducted to verify proper backup operation of the TV-clock pulse timing. (JPL, Space Programs Summary No. 37-26, Vol. I, op. cit., 12.)
Jan. 19-20	The Ranger 6 midcourse propulsion system was fueled and pressurized and installed in the spacecraft in the Explosive Safe Area (ESA) at AMR. (Ibid., 39.)
Jan. 20	JPL notified RCA-AED Project Management of continuing JPL concern over Ranger TV subsystem reliability. RCA was requested to provide JPL with an "evaluation of the RA-6 TV subsystem and confidence in its proper functioning in flight. . . ." (JPL, letter from H.M. Schurmeier to Ray Hogan of RCA, January 20, 1964, JPLHF 2-1804.)
Jan. 21	JPL requested assurance from LeRC concerning the reliability of the Atlas-Agena launch vehicle programmed for the RA-6 flight. (JPL, letter from W.H. Pickering to A. Silverstein, January 21, 1964, JPLHF 2-1805.)
Jan. 23	In response to the letter of January 20, JPL was notified that "it is the opinion of RCA that the III-1 [RA-6] TV subsystem is ready for flight and that all problems encountered during testing to date which could conceivably affect the success of the Ranger mission have been solved." (RCA, TWX from R. Hogan to H.M. Schurmeier, January 23, 1964, JPLHF 2-1806.)
	NASA OSSA maintaining close contact with the Office of Manned Space Flight concerning the progress of Project Ranger, was informed that Mr. W. Taylor had been designated by Dr. Mueller to represent him at JPL for initial viewing of pictures returned from the moon by

Jan. 23 cont. Ranger 6. Plans were established for the activation of a Headquarters mission status room during the flight of Ranger 6, for experimenter participation in flight events, and for arrangements on press briefings and release of lunar surface photographs to the news media. (NASA, OSSA Review of January 23, 1964, 41-42, JPLHF 2-1505.)

JPL announced the appointment of Mr. William H. Bayley as Deep Space Network General Manager, in conjunction with the creation of the DSN under an Assistant Laboratory Director for Tracking and Data Acquisition. (JPL, IOM from B. Sparks to Distribution, January 23, 1964, JPLHF 7-22.) (See December 24, 1963.)

Jan. 24 In response to the letter of January 21, LeRC notified JPL that the Atlas-Agena booster system had received concerted attention, and could be expected to perform satisfactorily. (NASA, letter from A. Silverstein to W.H. Pickering, January 24, 1964, JPLHF 2-1807.)

Jan. 27 Reflecting confidence in the Block III Rangers, Laboratory personnel were informed that the status of mission activities during Ranger 6 flight would be disseminated Laboratory-wide by means of status bulletins, spot announcements on the PA system, and, in the terminal phase, by real-time coverage through an announcer in von Karman auditorium. (JPL, IOM from Schurmeier/Parks to All Laboratory Personnel, January 27, 1964, JPLHF 2-1808.)

President Johnson submitted his annual space report to Congress. The 148-page report advised of an impressive success and reliability record achieved by the National Aeronautics and Space Administration: 14 out of 15 launch attempts were successful, including a 10-for-10 score on earth satellite tries. (United States Aeronautics and Space Activities, 1963: Report to Congress from the President of the United States, January 27, 1964.)

Jan. 28 A simulated launch was performed on Ranger 6. Spacecraft operations were normal, and the test was considered a success. (JPL, Space Programs Summary No. 37-26, Vol. I, op. cit., 12.)

Jan. 29 A special test was conducted on Ranger 6 gyro operations; no problems were noted during the test operations. (Ibid.)

Jan. 30 to Feb. 2 Ranger 6 (Atlas 199D, Agena B 6008) was launched at 10:49 a.m. EST at the conclusion of the first countdown. The mission objective was to obtain television pictures of the lunar surface of benefit to the science program and to the Apollo lunar landing program. The television subsystem was designed to return pictures at least an order of magnitude better than available earth-based photographs. Additional non-visual passenger science experiments were not carried on this flight.

The Atlas-Agena boosters functioned as programmed and, with second-burn of the Agena a half hour after launch, Ranger 6 was delivered from an earth parking orbit at 110 miles altitude into the proper lunar intercept trajectory. The spacecraft successfully separated from the Agena, extended its solar panels, and acquired the sun and earth as orientation references when the attitude stabilization system was activated. (Figure 58.)

Early telemetry returns indicated that Channel 8 telemetry monitoring the television subsystem inexplicably came on two minutes after launch for about one minute, and then just as inexplicably turned off again. A few minutes later data returns showed Channel 8 telemetry turned on this time as scheduled, and that normal cruise mode operations were in effect. The anomaly was discussed, amongst other matters at hand, at the JPL space flight control center. Since the only means for accomplishing a thorough checkout at this stage consisted in turning on the complete television subsystem (which operated on a limited battery power supply that would exhaust before lunar encounter if the unit refused to turn off), and since telemetry returns now indicated that everything was normal, a decision was reached to proceed without changes to the flight plan and not to exercise the TV system in an in-flight checkout sequence.

After analysis of trajectory data on the following day, January 31, commands were sent from the JPL space flight control center through the Goldstone deep space tracking station instructing the spacecraft to adjust its course toward its aiming point in the lunar Sea of Tranquility. Another radio signal then activated the proper roll and pitch sequence, followed by ignition of the onboard rocket engine. The midcourse maneuver was properly performed, onboard sensors reacquired the sun and earth, the spacecraft restabilized and resumed its translunar cruise mode operations.

Ranger 6 approached the moon on course in a "nominal" flight as February 2 began in the Western Hemisphere. Analysis of the spacecraft sttitude indicated that alignment of the television camera axis relative to the velocity vector was within acceptable picture-taking tolerances. This made performance of a terminal positioning maneuver unnecessary, and a decision was made to turn on the "F" Channel (two full-scan television cameras and their associated transmitter) with the TV Backup Clock Timer, and to turn on "P" Channel

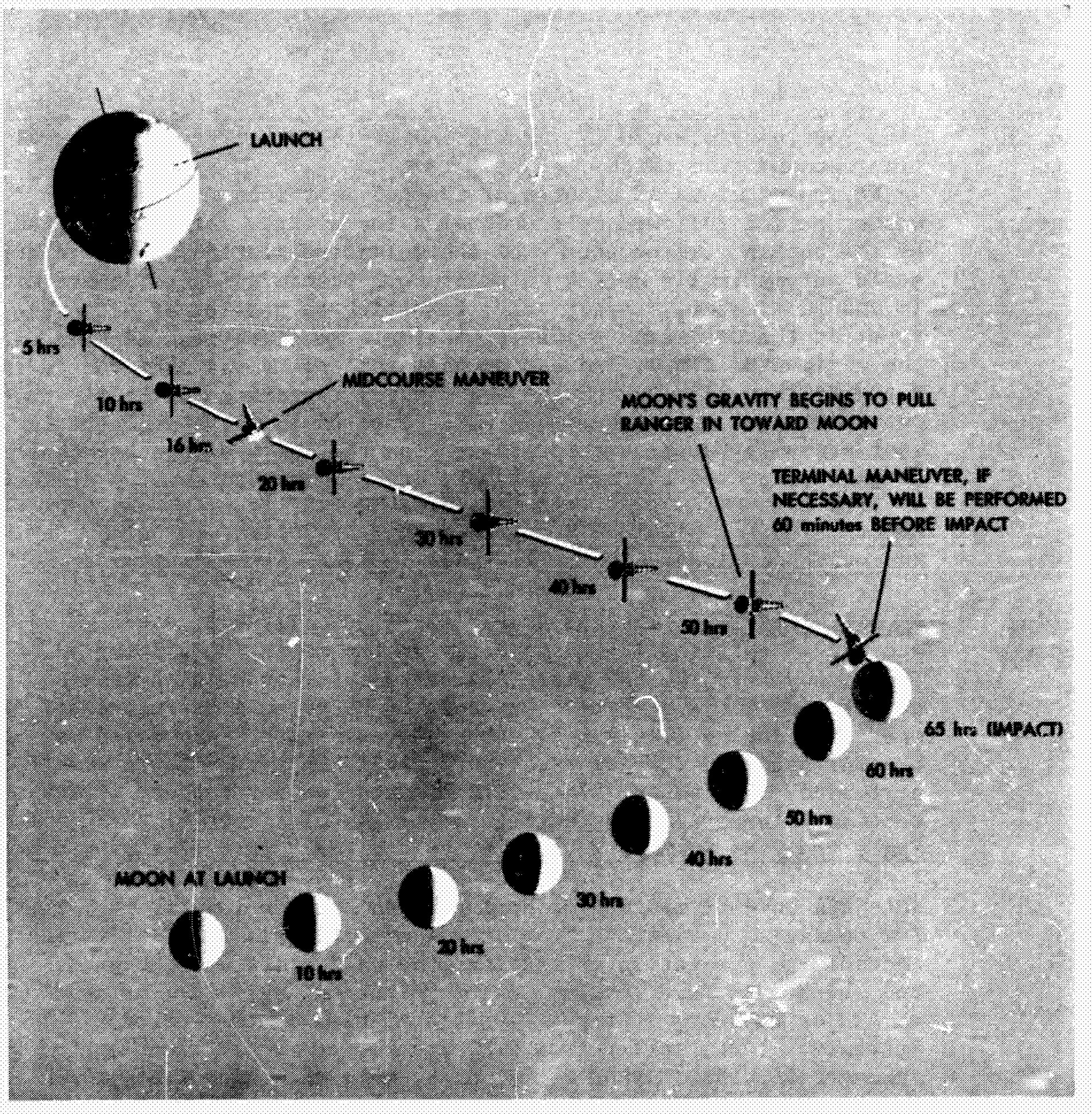

Figure 58: Ranger launch to impact trajectory.

Jan. 30 to Feb. 2 cont.

(the four partial-scan TV cameras and their transmitter) by a real time command from earth.

At impact minus 18 minutes, F Channel went into a five minute warmup period followed by P Channel a few minutes later, triggered by the backup command sent from the Goldstone station. These channels would automatically switch to full power transmission at impact minus 13 and 10 minutes, respectively, resulting in receipt of video pictures at the Goldstone tracking station. No signal was received at the designated times, indicating that full power was achieved in the F and P Channels. During the few minutes remaining in the flight, two additional backup commands were directed to the spacecraft in what proved a futile attempt to turn on the television subsystem. Ranger 6 impacted the moon without returning any television pictures at 1:24 a.m. PST. (JPL Technical Memo 33-275, Tracking and Data Acquisition for Missions VI-IX, September 15, 1966, 10; also, Ranger 6 Log, January 30 to February 2, 1964, JPLHF 2-924.)

During Janaury

Ranger Block III. The Ranger PTM satisfactorily completed acoustical verification tests early in the month in Building 82. It was moved to the SAF where midcourse-motor propulsion valves were fired with live pyrotechnics in order to monitor spacecraft operation during this shock. Subsequently the PTM was moved to the SAF Ranger 8 complex area where final PTM system tests were performed. On January 27 the PTM was readied for support of any necessary investigations during the flight of Ranger 6. (JPL, Space Programs Summary No. 37-26, Vol. I, op. cit., 12-13.)

JPL-NASA buy-off meeting of Ranger 7 was held on January 24. The few remaining deviations from acceptance criteria were determined amenable to completion at AMR, and the spacecraft was accepted and shipped to Cape Kennedy on the following day. RA-7 arrived at AMR on February 1, for a launch scheduled at the end of February. (JPL, letter from H.M. Schurmeier to N.W. Cunningham, February 18, 1964, JPLHF 2-152; also, Memo to Ranger Files, from N.W. Cunningham, "Ranger B Chronology Since the Launch of RA-VI," July 17, 1964, 1, JPLHF 2-654.)

Initial power turn-on for subsystem power tests on Ranger 8 began on January 6, and continued while another roll gyro problem was resolved in succeeding weeks. Ranger 8 TV subsystem checkout proceeded separately during this period. (JPL, Space Programs Summary No. 37-26, Vol. I, op. cit., 15.)

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Feb. 2 Collectively, the news media was sympathetic in first reports of this sixth failure in the Ranger series, although the timing could not have been worse, since it blemished an impressive recent success record (see January 27) and opened a week in which NASA was going to Congress to try and justify the need for additional appropriations for FY 1964, and $5.3 billion in authorizations for the next fiscal year. (Cf., "Cameras on Ranger Fail as it Hits Moon Precisely: Both Sets Unable to Transmit Pictures of Lunar Surface--Officials Fear Congress Reaction to 6th Setback," New York Times, February 3, 1964; and, "Board Will Study Failure of Ranger 6, Series' Sixth Flop May Hurt Plan for Manned Landing," Los Angeles Times, February 4, 1964.)

JPL established an RA-6 Failure Review Board chaired by Don Kindt, Project Engineer for the Ranger TV subsystem, to determine the cause of the TV subsystem failure. (JPL, Ranger History--Working Draft, op. cit., 58.)

Feb. 3 NASA announced formation of an independent review board to determine the program effect of the Ranger 6 failure and ascertain its cause. The board would be chaired by Earl D. Hilburn, Deputy Associate Administrator for Industry Affairs.* Dr. Robert C. Seamans, NASA Associate Administrator, indicated that the scope of inquiry would be restricted--in contrast with the Kelley Board of Inquiry convened in October 1962. He stated that NASA was seeking answers to a single question: "What must be done to launch Ranger 7?" Then, continuing, "We're not investigating JPL, we're only investigating the failure of Ranger 6." (NASA Announcement No. 64-27, Subject: Establishment of the Ranger VI Review Board, February 3, 1964, JPLHF 2-1811; and, Stuart H. Loory, "Our Race to the Moon--The Failure and the Future," New York Herald Tribune, February 4, 1964; also, "Legislators Back NASA on Ranger," Aviation Week, February 10, 1964.)

Upon conclusion of negotiations, Caltech executed a three-year contract extension with NASA for operation of the Jet Propulsion Laboratory. Among the changes was separation of facilities construction to a separate contract, and elimination of the "mutuality clause" in NASA tasking of JPL. This contract extension was not signed by NASA until much later in the year.

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*Members of the board were: Earl D. Hilburn, Herman LaGow, Francis Smith, Walter Jacobowski, and Eugene Dangle.

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Feb. 4 JPL established a second Ranger 6 review group made up of senior Laboratory personnel to provide an independent flight review and evaluation of the approach being taken by JPL project personnel, to confirm completeness of the project investigation, to suggest additional modes in which failure might have occurred, and to review conclusions and recommendations advanced by project personnel. This group was chaired by W.J. Downhower and consisted of T. Hamilton, R. Heacock, R. Harker, J. Scull, M. Comuntzis, P. Goldsmith, and J. Paulson. (JPL, IOM from W.J. Downhower to D.H. Kindt, February 12, 1964, JPLHF 2-2078.)

JPL released a Launch Vehicle/Spacecraft Failure Report which indicated that analysis of telemetry tapes showed that TV subsystem Channel 8 telemetry had inadvertently turned on for 69 seconds shortly after launch while the vehicle was in a critical atmospheric pressure region. "This could be associated with another failure in the TV subsystem which did not manifest itself until the final minutes of the mission. After spacecraft separation the Channel 8 telemetry turned on in a normal manner and remained normal. The cause of failure is still undetermined, and exact location of failure within the TV subsystem is still unknown." (NASA Form 1036f, Launch Vehicle/Spacecraft Failure Report No. 5-0001-06-64-01, February 4, 1964, JPLHF 2-1751.)

In a speech in Milwaukee, Wisconsin, Dr. Joseph F. Shea, manager of the Apollo Spacecraft Office at MSC, discussed the Apollo program and the roles and goals of the Ranger, Surveyor, and Lunar Orbiter probes scheduled to provide information about the lunar surface prior to a manned lunar landing. If the unmanned lunar craft should fail, he observed, NASA would provide for Apollo recommaissance flights to orbit the moon prior to a landing flight: "It might set our landing back six months to a year, but if the other programs don't work, we aren't dead." (NASA, Astronautics and Aeronautics, 1964: Chronology on Science, Technology, and Policy, SP-4005, Washington, D.C., 1965, 47.)

Feb. 5 The Honorable George P. Miller, Chairman of the Committee on Science and Astronautics, U.S. House of Representatives, sent similar letters to Drs. Homer Newell, Associate Administrator for Space Sciences and Applications, and William H. Pickering, Director of JPL, noting that the accurate flight of Ranger 6 was a significant accomplishment "despite the disappointing failure to obtain photographs of the lunar surface." (Letter from George P. Miller to W.H. Pickering, February 5, 1964, JPLHF 2-1813; and, letter from George P. Miller to H.E. Newell, February 5, 1964, JPLHF 2-1821.)

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Feb. 5 cont. Mr. E.M. Cortright, Deputy Associate Administrator for NASA's Office of Space Science and Applications, directed a letter to JPL calling for continued perserverance and total objectivity in achieving the ultimate success of Ranger. NASA Headquarters, in turn, would try and provide an umbrella for the Laboratory so that work could continue. (NASA, letter from E.M. Cortright, to W.H. Pickering, et. al., February 5, 1964, JPLHF 2-149.)

Feb. 6 NASA Headquarters notified JPL that news stories noting officials at MSC would request Apollo lunar reconnaissance flights due to repeated failures of unmanned moon probes were incorrect, and that MSC would issue a denial. (NASA, TWX from Julian Sheer to W.H. Pickering and F. Colella, February 6, 1964, JPLHF 2-150.)

The NASA Ranger Board of Inquiry convened at Headquarters. (Investigation of Project Ranger, op. cit., 13.)

Speaking before a space medical conference at Brooks Air Force Base, Texas, John M. Eggleston, a space environmental specialist observed that the Apollo Project had requested an extra Apollo flight for a lunar reconnaissance mission. "'There is a certain amount of sentiment within NASA that a reconnaissance mission should be flown,' he said. 'There is a group of us in the rank and file who feel especially strong that Apollo should be a self-sufficient program, and not rely on the Ranger and Surveyor unmanned [lunar] programs.'" ("Extra Apollo Moonshot Proposed," Los Angeles Times, February 6, 1964.)

Feb. 7-12 The NASA Review Board visited JPL. At the Ranger 6 Postflight Analysis, held on February 7, it was pointed out that a principal suspect point in flight occurred approximately one second after start of the Atlas booster staging. "At this time the cruise telemetry of the TV subsystem inadvertently came on and stayed on for 69 seconds, then just as suddenly went off. Normally, the TV cruise mode starts 17 minutes after separation [from the Agena]." (Minutes of Ranger VI Postflight Analysis Presentation Meeting at JPL, February 7, 1964, JPLHF 2-1814.)

Feb. 10 In a scathing editorial in Missiles and Rockets, William Coughlin charged that "Ranger VI was a 100% failure. . . . The record on Ranger of JPL, a non-profit organization operating under the over-lordship of Cal Tech, is a disgrace. . . ." He continued, observing that Caltech had recently received a fee estimated at $1.2 million for operating the Laboratory and providing it direct association

Feb. 10 cont. with an eminent academic institution during fiscal 1964: "that may be exactly the heart of the problem. An academic environment is neither comparable nor conducive to the kind of hard-driving industrial atmosphere required to make complex space hardware function in a highly reliable manner. A price of $1.2 million for a leisurely university atmosphere and little else is exorbitant. . . . We think Congress should reopen the whole question of the JPL-Cal Tech relationship." (William J. Coughlin, "A $150-million Failure," Missiles and Rockets, February 10, 1964.)

JPL issued Ranger VI Preliminary Spacecraft Operations Letter, which contained data presented on February 7 at the Post Flight Meeting.

Feb. 11 JPL informed NASA Headquarters that the exact cause of the Ranger 6 failure was not yet determined, and requested that the launch dates for Rangers 7-9 be rescheduled to afford the time necessary for preventative action to be taken. (JPL, TWX from W.H. Pickering to H.E. Newell, February 11, 1964, JPLHF 2-151.)

At a news conference in Washington, D.C., NASA Administrator James Webb discussed the current Ranger Review Board investigations, the suspected TV cruise telemetry turn-on early in the flight, and probable delay in the program. In response to a question from a reporter concerning the earlier Kelley Review Board, Mr. Webb observed that "While there has been criticism of JPL, there also has been very great success for this nation out of JPL." In regard to the Caltech contract to operate JPL, Webb indicated that changes were under consideration in renegotiating a three-year-extension in June. He observed that "one of the things that is most important to NASA is to provide a strong, hardheaded industrial type of management of programs were large sums of money and many subcontractors are involved." (NASA News Release, February 11, 1964, JPLHF 2-1816.)

Feb. 12 NASA Administrator James Webb telephoned Dr. Lee DuBridge, President of Caltech, to clear up any misunderstandings that might have occurred as a result of the news conference on the day preceding. DuBridge informed Aviation Week and Space Technology that "our conversation was very friendly, and he [Webb] was apologetic." ("DuBridge Defends JPL; Denies Top-Level Management Shakeup," Aviation Week, February 24, 1964.)

In an evening news conference, Dr. Lee DuBridge, President of Caltech, denied that any shakeup in top management at JPL was contemplated. He asserted "It is not true that any radical change in top management of JPL has been requested by NASA or is being considered by Caltech." ("Shakeup of JPL Staff Denied: DuBridge Sees no Changes." Independent (Pasadena), February 13, 1964.)

Feb. 12 cont. JPL Ranger Project personnel were notified that, since investigations had not resulted in a firm definitive cause for the RA-6 TV failure, the RA-7 launch was cancelled for the time being. (JPL, IOM from H.M. Schurmeier to Senior Staff, February 12, 1964, JPLHF 2-1817.)

Feb. 13 NASA Administrator James Webb notified Dr. William Pickering, JPL Director, that "I want to let you and all at JPL know we have complete confidence in the ultimate success of Ranger and other NASA projects assigned to JPL. . . . Success for the missions assigned to JPL requires a great deal of determination and fortitude and we know you and your outstanding and dedicated staff will carry on. JPL can count on our full support and best efforts from this Headquarters to solve whatever problems lie ahead." (NASA, TWX from J.E. Webb to W.H. Pickering, February 13, 1964, JPLHF 2-899b.)

MSC assured JPL that recent news reports of Apollo lunar reconnaissance missions were misconstrued by the news media, and that MSC counted on receiving necessary lunar data from JPL's programs. (NASA, letter from Robert R. Gilruth, Director of Manned Spacecraft Center, to Dr. W.H. Pickering, February 13, 1964, JPLHF 2-1820.) (See February 4 and 6, 1964.)

Feb. 14 Mr. Earl D. Hilburn, Deputy Associate Administrator of NASA, and Chairman of the NASA Ranger Review Board, presented the preliminary findings of the Board to Dr. Hugh Dryden, NASA Deputy Administrator, and Dr. Homer E. Newell, Associate Administrator for Space Science and Applications. Initial findings and recommendations portrayed a very dark picture. The Board recommended extensive redesign of the TV subsystem and a corresponding lengthy delay in the program. While there was agreement on specific points, these general observations were not shared by NASA personnel associated with Project Ranger. (NASA, memo from W. Jakobowski, to H.E. Newell and E.M. Cortright, February 14, 1964, JPLHF 2-1823.)

Dr. H.E. Newell informed Dr. W.H. Pickering that: "At this time of difficulty in the Ranger Project, it is understandable that people may feel under severe stress and morale may be at low ebb. I thought, therefore, that you and the JPL people might be interested to know that we have received considerable encouragement and understanding from our Congressional committees. . . . Please be assured that we in NASA Headquarters will work vigorously alongside of JPL to help the Laboratory in any way we can. Please also

Feb. 14 cont. be assured that we have the utmost confidence that Ranger Program will achieve the success it so richly deserves." (NASA. letter from H.E. Newell to W.H. Pickering, February 14, 1964, JPLHF 2-1822.)

Feb. 16 The Ranger 7 TV subsystem was returned from AMR to RCA-AED in New Jersey. (NASA, Memo to Ranger Files, by N.W. Cunningham, July 17, 1964, 1, JPLHF 2-654.)

Feb. 17 In accordance with a telephone conversation on February 14, NASA informed JPL that its February 11 request to cancel the presently scheduled launch period for Ranger 7 had been approved. (NASA, TWX from N.W. Cunningham to H.M. Schurmeier, February 17, 1964, JPLHF 2-1826.)

RCA established a Ranger TV subsystem design review committee chaired by Abe Pressman. (NASA, Memo to Ranger Files by N.W. Cunningham, July 17, 1964, op. cit., 2.)

In a NASA OSSA management realignment to provide improved coverage for the scientific aspects of flight programs, responsibility for flight program science was placed with scientific program chiefs. Program scientists, who formerly reported to program managers, were reassigned to the science branch of SL. Dr. R. Allenby was named Science Program Chief for Ranger, Surveyor, and Lunar Orbiter, reporting to the respective program managers. (NASA, memo from O.W. Nicks to SL Staff, February 17, 1964, JPLHF 2-1490.)

Feb. 19 JPL issued Mod. 40 to RCA Contract No. 950137 for design revision and hardware modification of the Block III TV subsystems (PTM and flight units). (JPL, Document entitled "Contract Summary, Contract No. 950137," JPLHF 2-1701.)

Feb. 19-20 Members of the JPL and NASA Ranger Project Offices and the Hilburn Review Board met to review project status and to formulate plans for rescheduling Ranger 7. It was agreed that the RCA TV subsystem would be modified and retested at AED while the Ranger spacecraft remained at AMR. Changes to the Ranger spacecraft would be limited to wiring necessary to accommodate the requalified TV subsystem. The Ranger PTM would be used in requalification tests. The earliest launch opportunity was considered to be in May, 1964. (NASA, OSSA Review, February 24, 1964, JPLHF 2-1505.) (See February 14, 1964.)

Feb. 24 NASA formally approved a three-month launch delay (until May) for Ranger 7, as discussed on February 19-20, and instructed JPL "to

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Feb. 24 cont. objectively consider the recommendations of the Hilburn Board* in arriving at a detailed plan. Until the detailed plans are approved, the official flight schedule will remain under study." (NASA, TWX from H.E. Newell to W.H. Pickering, February 24, 1964, JPLHF 2-1828.)

Mr. Earl D. Hilburn, Chairman of the NASA Ranger Review Board, presented the findings and recommendations of the Ranger 6 Board of Inquiry to NASA Associate Administrator Dr. Robert C. Seamans and to Admiral Boone. (NASA, Memo to Ranger Files, by N.W. Cunningham, July 17, 1964, loc. cit.)

Feb. 25 Testifying before the Committee on Science and Astronautics, U.S. House of Representatives, Dr. Homer E. Newell, Associate Administrator for Space Science and Applications, described satellite applications and the technology utilization program. He observed that: "Returns from basic research such as that in which space science programs are involved are more evolutionary in character. That means, naturally, that schedules cannot be pinpointed as closely as those involving applied research. Practical benefits from space science will most certainly accumulate not only in the immediate future but increasingly over coming decades." As to the United States space program in its entirety: "The most important immediate returns will be in the building of a space capability for all defense and peaceful needs which the position and growth of the United States demands." (Text at H.E. Newell, before Committee on Science and Astronautics, House of Representatives, Practical Results from the NASA Space Science and Applications Program, 2-3, February 25, 1964, JPLHF 2-1752.)

Feb. 27 The JPL Ranger Office established a special task team to implement the detailed effort necessary to launch Ranger 7. The team's efforts were divided between two assignments involving (1) a detailed review and monitoring of the RCA design, implementation, and testing "of the several preventative measures adopted to preclude what are believed to be the most probable causes of the RA-6 failure," and (2) a "detailed review of the other areas of the TV subsystem to assure ourselves that there are no other areas of major concern." (JPL, IOM from H.M. Schurmeier to Distribution, February 27, 1964, JPLHF 2-1830.)

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*Oral recommendations made at the February 19-20 meeting only. The Hilburn report was not yet issued.

Feb. 27 cont. NASA Headquarters informed Caltech that some management realignment at JPL would be expected prior to NASA approval of the new contract to operate the Laboratory. (NASA, letter from Earl D. Hilburn, Deputy Associate Administrator for Industry Affairs, to Mr. Gilmore, Vice-President for Business Affairs, Caltech, February 27, 1964, JPLHF 2-1829.)

During February Ranger Block III. Ranger 7, which was shipped from JPL on January 25, arrived at AMR on February 1. Preliminary tests indicated all spacecraft functions were normal. Following the flight of Ranger 6, the TV subsystem was removed from the RA-7 spacecraft and returned to RCA-AED on February 16 for further examination. A new launch date in May was eatablished later in the month. (JPL, Space Programs Summary No. 37-26, Vol. VI, for the period January 1, 1964 to February 29, 1964, 11.)

Mar. 2 NASA-OSSA and JPL agreed upon final TV design modifications to be incorporated in Ranger 7. (NASA, Memo to Ranger Files, N.W. Cunningham, July 17, 1964, loc. cit.)

Marshall Johnson, Chief of Space Flight Operations Section, informed JPL Ranger Project Manager H.M. Schurmeier that if Ranger space flight operations were to be moved from Bldg. 125 to the newly constructed Space Flight Operations Facility (SFOF) before the launch of Ranger 7, a decision to move would be required by March 18. (JPL, IOM from M.S. Johnson to H.M. Schurmeier, March 2, 1964, JPLHF 2-1831.)

Mar. 4 In a meeting at NASA Headquarters, JPL presented more recent findings and recommendations (since February 19-20) on the flight of Ranger 6 and on project plans. The month of June was recommended as the earliest practical launch opportunity for Ranger 7 in light of the modifications scheduled for the TV subsystem.

Mar. 5 Testifying before the Senate Committee on Aeronautical and Space Sciences, NASA Associate Administrator Dr. Robert C. Seamans, Jr. affirmed that an extension of the present contract with Caltech for operation of JPL, scheduled to expire at the end of the calendar year, was under negotiation. The instrument contained improved operational terms based upon a comprehensive NASA review of the NASA/Caltech/JPL relationship. Changes included:

"First, the earlier contracts were based on a principle of mutually requiring CIT/JPL concurrence before NASA

Mar. 5 cont.

directions would be carried out. This often resulted in lengthy 'negotiations' of assigned tasks. The new contract restricts the principle of mutuality to the broad terms of the operating relationship, but clearly gives NASA the unilateral right to issue task orders, require reports, and take other administrative actions as desired.

"Second, a separate facilities contract is also being negotiated which will provide the government a more direct control over the planning, construction, and utilization of the facilities at JPL.

"Third, a new principle is provided for determining CIT's fee for the operation of the Laboratory. The new contract contains a schedule which sets the upper and lower limits of the fee on the basis of the dollar volume of work which NASA places with CIT/JPL. The exact fee within these limits, will be determined by how well CIT/JPL performs in the management of the Laboratory."

(NASA, Astronautics and Aeronautics, 1964, op. cit., 97-98.) (See February 3, 1964.)

Robert C. Toth, Los Angeles Times correspondent in Washington, D.C., commenting on this testimony observed that NASA Headquarters desired "more of an industry environment, with better management controls . . . in JPL to complement the academic and research orientation that is now dominant. It is up to Caltech to decide how to satisfy NASA on this score. One possibility is hiring a general manager with industrial experience to run the laboratory directly under its chief, Dr. William Pickering." (R.C. Toth, "NASA Takes Tighter Control of Jet Lab.," Los Angeles Times, March 6, 1964.)

Mar. 6

In a press interview, Dr. Lee A. DuBridge, President of Caltech, indicated that the new NASA contract was not fundamentally different than its predecessor:

"When they [NASA] ask a university to manage JPL, a different set of rules is employed which may cause some confusion in government circles. NASA has always had the final say, through budgetary controls, of JPL projects and activities and the level at which they are to be carried out. The new contract recognizes this situation more explicitly--and hardly represents any 'sweeping change.'"

("DuBridge Says Contract Involves No Big Change," Los Angeles Times, March 7, 1964.)

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Mar. 6 cont. NASA Headquarters provided a briefing to the PSAC on the flight of Ranger 6. (NASA, Memo to Ranger Files, N.W. Cunningham, July 17, 1964, loc. cit.)

The current public review of JPL drew comment in Science magazine, which noted that the controversy appeared to be adversely affecting relationships between the Laboratory and the parent institute:

> Sensitivity to criticism within JPL arises in good measure from a sincere feeling that the difficulties and risks of the unmanned program are not sufficiently understood. Among faculty at Caltech there is some concern that criticism of JPL will reflect unflatteringly on Caltech, and this seems to have increased tension between JPL and Caltech a little.
>
> University scientists concerned with the unmanned program seem generally to feel that JPL scientists are competent, but it is not difficult to find those who say that many NASA-JPL decisions are questionable. One Caltech faculty member pointed out that it would have been possible to get pictures of the moon with spacecraft much less complicated than Ranger.

(J. Walsh, "JPL: Ranger VI Failure Increases Speculation on Jet Lab's Future Links with Space Agency, Caltech," Science, March 6, 1964.)

Mar. 7 The New York Times reported that "Observatories here and abroad are continuing to observe unusual activity on the moon, raising the eagerness of scientists for close-up information on earth's natural satellite." (Walter Sullivan, "Lunar Environment Shows Signs of Activity," New York Times, March 7, 1964.)

Mar. 8 JPL issued Ranger Block III Project Policy and Requirements, Addendum 1, EPD-65, Revision 1.)

Mar. 10 Northrop Space Laboratories proposed to NASA Headquarters that it build four Block III Ranger spacecraft on a fixed price contract not to exceed $29 million, to be flown in the period between Ranger 9 and the beginning of the Surveyor flights. (Letter, from Richard E. Horner, Northrop Space Laboratories, to H. E. Newell, NASA, March 10, 1964, JPLHF 2-153.)

Mar. 11 A new Ranger 7 launch date was approved by NASA for late June. (JPL, TWX from H.M. Schurmeier to Dr. S.C. Himmel, LeRC, March 11, 1964, 2, JPLHF 2-1833.)

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Mar. 12 JPL Ranger Project personnel were notified of the new Ranger launch date. Launch dates for Rangers 8 and 9 were postponed indefinitely: "A firm schedule for these shots has not been approved at this time, but they will both be launched after Mariner C* and for planning purposes the first quarter of CY '65 should be used." (JPL, IOM from H.M. Schurmeier to Ranger Block III Distribution, March 12, 1964, JPLHF 2-1834.)

A NASA Resident Office-JPL, was established. (U.S. Congress, House of Representatives, Committee on Science and Astronautics, Subcommitte on Space Science and Applications, Hearings Before the Subcommittee, 1966 NASA Authorization, Part 3, 89th Congress, GPO, 1965, 305.)

Mar. 13 JPL issued an official Laboratory flight schedule:

RA-7	June 27, 1964
Mariner-Mars	October 2, 1964
Mariner-Mars	December 3, 1964
RA-8	January 8, 1965
RA-9	March 9, 1965

(JPL, IOM from B. Sparks to Distribution, March 13, 1964, JPLHF 2-426.)

NASA MSC requested that RA-7 be flown to the very same impact site as Ranger 6 since "observation of this fresh crater [made by RA-6] would be of considerable scientific and engineering interest. . . ." (Letter, from M.A. Faget of Manned Spacecraft Center to W.B. Foster, NASA, March 13, 1964, JPLHF 2-393.)

Mar. 17 NASA issued internally the Final Report of the Ranger 6 Review Board (Hilburn Report). Since Ranger 6 telemetry had not pinpointed a failure mode exactly, the Board had "broadened its investigation to include an evaluation of any general weaknesses in Ranger designs, testing philosophy and procedures which might have contributed to or enhanced the possibilities of in-flight failure." Of the principal options: to undertake a major vehicle redesign or adopt minor modifications, a decision was made in favor of the latter course. The Board recommended that

*Launch of NASA-JPL Mariner-Mars interplanetary spacecraft claimed priority at AMR since a favorable launch window appeared every other year, unlike the moon where such a period becomes available each month.

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Mar. 17 cont.	NASA: (1) closely monitor all testing of RA-7; (2) launch Ranger 7 in June if the modification and tests proceed satisfactorily; and (3) hold Ranger 7 at JPL until NASA agrees that it is flightworthy. (See February 3 and 14, 1964.)
Mar. 19	Two additional NASA SL engineers were detailed to JPL to assess test plans for and operations on Ranger 7. (NASA, memo from O.W. Nicks to N.W. Cunningham, March 19, 1964, JPLHF `-392.)
Mar. 20	Dave Williams was appointed as deputy to D.H. Kindt, JPL Project Engineer for the Ranger TV subsystem, on the Ranger TV subsystem effort. AT RCA-AED B.P. Miller, Ranger TV Project Manager, also appointed a deputy to handle more of the day-to-day operating problems. (JPL, IOM from D.H. Kindt to Distribution, March 20, 1964, JPLHF 2-1835.)
Mar. 23	The JPL Ranger Project Office designated Section 311, Launch Vehicle Systems, responsibility for coordinating detailed task team investigations of Ranger 6 television subsystem turn-on during booster ascent. Mr. M.A. Piroumian was placed in charge of these efforts. The primary focus of attention continued to be one group of male umbilical pins located on the spacecraft shroud which included a sensitive TV command circuit. (Draft of ED-333, <u>Ranger Launch Vehicle Integration Summary</u>, December 27, 1965, p. 111, JPLHF 2-2080.)
	A detailed test schedule for RA-7 was established at JPL. (NASA, Memo to Ranger Files, N.W. Cunningham, July 17, 1964, <u>loc. cit</u>.)
Mar. 25	Following changes to the spacecraft command control circuitry to accommodate the modified TV subsystem, the entire vehicle (including the TV subsystem) would be subjected to three-axis vibration and to two complete mission tests in the space simulator. (JPL, Minutes of Ranger Bi-Weekly Project Meeting, March 25, 1964, JPLHF 2-1573.)
	JPL and RCA-AED established an interlocking operation for handling failure reports on the TV subsystem. (NASA, Memo to Ranger Files, N.W. Cunningham, July 17, 1964, <u>loc. cit</u>.; also, IOM from H.M. Schurmeier to Distribution, March 25, 1964, JPLHF 2-1836; and, IOM from D. Kindt to Distribution, May 24, 1964, JPLHF 2-1862.)
Mar. 26	NASA Headquarters directed a copy of the <u>Final Report of the Ranger 6 Review Board</u> to JPL Director Dr. W.H. Pickering, for his personal review. (NASA, letter from R.C. Seamans to W.H. Pickering, March 26, 1964, JPLHF 2-1837.) (See March 17, 1964.)

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Mar. 27 JPL issued EPD 205, Ranger VI Failure Analysis and Supporting Investigation which included findings and recommendations of the two JPL review boards. "The investigation was unable to determine a single simple failure that would account for all of the events. However, the most plausible failure mechanism was the destruction of the transmitter high voltage supplies during an inadvertent turn-on while the spacecraft was in a critical pressure environment. This conclusion was prompted by the unscheduled appearance of telemetry signals on Channel 8 for 67 seconds following booster engine cutoff." (iii) Suspected causes were discussed, together with recommended actions to prevent recurrence.

During a normal quality control survey, a small polyethylene bag containing 14 screws and one lock washer was discovered in the camera electronics Unit 038 of the Ranger 7 TV subsystem at RCA-AED. (RCA, letter from R.E. Hogan to H.M. Schurmeier, April 23, 1964, 1, JPLHF 2-1851.)

Mar. 31 NASA Director James E. Webb sent a letter to George P. Miller, Chairman of the House Committee on Science and Astronautics, and to Clinton P. Anderson, Chairman of the Senate Committee on Aeronautics and Space Sciences in which he described NASA action on Project Ranger taken as a result of the flight of Ranger 6. Webb pointed out that "Our review was extended to include an evaluation of certain aspects of the Ranger 6 design, testing philosophy, and procedures." Five deficiencies in design, in construction, and in testing the spacecraft were cited. (These deficiencies cited were primarily the Hilburn Board findings in which JPL did not concur.) Information copies were furnished to Arnold O. Beckman, Caltech Board of Trustees, and JPL. (NASA, TWX from R.C. Seamans to A. Beckman, Caltech, and W.H. Pickering, JPL, March 31, 1964, JPLHF 2-154.)

During March Ranger Block III. On March 25 the RA-7 spacecraft bus was loaded on a van at AMR and returned to JPL where minor changes, primarily in the wiring harness area to accommodate the modified TV subsystem, were made. The TV payload was scheduled for return to JPL from RCA-AED on April 30. (NASA, OSSA Review, March 26, 1964, 53, JPLHF 2-1505.)

Primary changes to the TV subsystem involved incorporating TV turn-on circuitry lockout during booster phases, providing for more extensive telemetry coverage of the TV subsystem, and enhancing reliability by eliminating as many circuits and components as possible. In addition, emphasis on quality assurance during fabrication at the contractor's plant was markedly increased. (Ibid.; and, EPD-205, op. cit., 2-6.)

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The Ranger 8 TV subsystem and all TV "spares" were returned to RCA for rework on March 2. All operations on the Ranger 8 bus were suspended. (JPL, Space Programs Summary No. 37-27, Vol. VI, for the period March 1, 1964 to April 30, 1964, 3.)

NASA Technology Utilization Office awarded Contract NAS 7-277 "Technology Utilization Review and Analysis," to Northrop Space Laboratories. Task 1 of this contract involved evaluation of Project Ranger technology. (Northrop Space Laboratories, Technology Utilization Review and Analysis, Final Report, Vol. II, NSL 64-192, September 1964, 2-6.)

DSN. Ranger Block III space flight operations (SFO) were moved from JPL Buildings 125, 190 and 202 to the new Space Flight Operations Facility (SFOF), Building 230. Ranger Block III test and SFO plans were revised to reflect the changes in operations control. A first test to prove compatibility of the new SFOF computer system and Ranger Block III data was satisfactorily performed on April 2, and the computer programs were approved by P.J. Rygh, Ranger SFO Director. (JPL, Space Programs Summary No. 37-27, Vol. I, for the period March 1, 1964 to April 30, 1964, 3.)

In an article regarding the escalating NASA-JPL embroglio, Los Angeles Times Aerospace Editor Marvin Miles observed that while NASA had been critical of certain business procedures at the Laboratory, "there are some who feel NASA is maneuvering to oust Caltech from its administrator position and take over the lab completely on a Civil Service basis." (Miles, "Reasons for NASA Attack on Lab Studied," Los Angeles Times, April 4, 1964.)

Ranger VII Test and Operations Plan, TOP 3R001, was issued by JPL.

Speaking before a Tuesday Evening Forum, Dr. Lee A. DuBridge, President of Caltech, said that JPL now shared the task of unmanned deep space exploration with other NASA centers, but retained the primary function for research and development in this field. In response to a question he observed: "Sure there were criticisms as a result of the failure of the television cameras aboard the Ranger 6 that successfully landed on the moon. . . . But if there's complete success next time, there'll be applause. . ." (John Copeland, "DuBridge Sees Sharing of JPL Space Assignment," Independent Star-News, April 8, 1964.)

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Apr. 8 RCA and JPL management directed that investigation of the "bag of hardware" incident be expanded. (RCA, letter from R.E. Hogan to H.M. Schurmeier, April 24, 1964, op. cit., 2.) (See March 27, 1964.)

Apr. 9 Congressman George P. Miller, Chairman of the Committee on Science and Astronautics, U.S. House of Representatives, announced that the Subcommittee on NASA Oversight, under acting chairman Joseph E. Karth, would investigate recent charges that failures in the Ranger Project were due to faulty design and inadequate testing by the Jet Propulsion Laboratory. According to the Los Angles Times Washington correspondent covering the story: "The study seems to have been triggered less by the failure of Ranger vehicles to photograph the moon than by a recent letter from NASA Chief James E. Webb to Congress." (Robert C. Toth, "House Unit to Probe NASA, Jet Lab Dispute," Los Angeles Times, April 10, 1964; and, Bill Sumner, "House Will Probe JPL Controversy," Pasadena Star News, April 9, 1964.)

In a press interview in Pasadena, Dr. Lee DuBridge, President of Caltech, stated that the Institute "welcomes the opportunity of presenting its case" before the House subcommittee. "There have been many confusing reports about the Ranger flights and other JPL matters and we shall be glad to give the committee our full story." ("Caltech Welcomes Chance to Tell Story," Los Angeles Times, April 10, 1964.)

Apr. 14 Launch dates for Ranger 8 and 9 were altered from 12/64 and 1/65, respectively, and placed "Under Study." (Official NASA Flight Schedule, April 14, 1964, JPLHF 2-968.)

Apr. 15 At a news conference NASA Administrator James Webb announced that the new contract with Caltech for operation of the Jet Propulsion Laboratory would specify changes to improve JPL organization and management. He said "NASA is not going to impose rigid methods of organization and management on the Jet Propulsion Laboratory. . . . But neither are we going to abdicate our own responsibility for this expenditure of public funds and for the success of the missions." Webb indicated that "if this process produces the kind of organizational changes and the kind of ability to fix organizational responsibility that . . . [is desired], then we will go forward. If they don't, both we and JPL will be looking for some other arrangement." Webb intimated that a business manager at the Laboratory, reporting to Dr. Pickering, was suggested as one approach favored by NASA. (NASA News Conference by James E. Webb-Transcript, April 15, 1964, 10, JPLHF 2-1972; Robert Toth, "NASA Pact Alters Setup at Jet Lab," Los Angeles Times, April 16, 1964; and, "Management Problems Delay New Contract Between NASA and JPL," Aviation Week, April 20, 1964.)

1964

Apr. 20 NASA and the DOD signed an agreement for a Lunar Mapping and Survey Program. The Air Force would provide technical assistance to NASA in developing manned lunar mapping and survey equipment. (U.S. Congress, House of Representatives, Committee on Government Operations, Government Operations in Space (Analysis of Civil-Military Roles and Relationships), 89th Congress, 1st Session, June 4, 1965, GPO, Washington, D.C., 131.)

Apr. 22 NASA Administrator James E. Webb directed a letter to Congressman Joseph E. Karth (see April 9, 1964) in which he pointed out that the Hilburn report on Ranger 6 would not be made available in its entirety to Congress or to the public: It is not a definitive agency position. Neither all the program managers, nor the full staff at JPL, nor the RCA Company has had an opportunity to examine the report, and its character, which makes it effective for our internal use, may preclude this." (Contents cited in NASA, Investigation of Project Ranger, op. cit., 2.)

JPL issued Functional Specification FR3-4-110-B, Ranger Block III Flight Equipment, Television System.

NASA Headquarters responded to the NSL proposal of March 10, 1964, indicating that at present an extension of the Ranger Project was not contemplated. (NASA, letter from H.E. Newell to R.E. Horner of Northrop Space Labs, April 22, 1964, JPLHF 2-1847.)

Apr. 23 Investigation of the "bag of hardware" incident was concluded at RCA. A consensus held that the original oversight "was caused accidentally and that the situation existed because of the extreme time scheduling required on the Ranger Program . . ." (RCA, letter from R.E. Hogan to H.M. Schurmeier, April 24, 1964, loc. cit.) (See April 8, 1964.)

Apr. 24 At JPL, R.R. Rennilson and C.F. Campen released findings of astronomical observations carried out during the flight of Ranger 6 in an attempt to photograph the impact on the moon. (Astronomical Observations During Flight of Ranger VI, April 24, 1964, JPLHF 2-1852.)

Apr. 27 The Congressional investigation of Project Ranger began in Washington, D.C., and concluded seven days later, on May 4. Congressman Karth observed that "the actions which precipitated these hearings are letters which Mr. Webb addressed to the Chairman of the two space committees." (March 31, 1964.) The review was directed primarily to problems of project management and the NASA-JPL relationship, rather than to technical aspects of the project as first specified (see April 9, 1964). Testimony was taken from:

Apr. 27 cont.

Dr. Homer E. Newell, Associate Administrator, Office of Space Science and Applications, NASA.
Edgar M. Cortright, Deputy Associate Administrator, Office of Space Science and Applications, NASA.
Oran W. Nicks, Director, Lunar and Planetary Programs, Office of Space Science and Applications, NASA.
H.M. Schurmeier, Ranger project manager, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.
Dr. William H. Pickering, Director, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.
Robert J. Parks, Assistant Laboratory Director for Lunar and Planetary Projects, Jet Propulsion Laboratory.
Barton Kreuzer, division vice president and general manager, Astro-Electronics Division, RCA, Princeton, N.J.
Richard E. Horner, senior vice president (technical), Northrop Corp., Hawthorne, California.
Mr. James E. Webb, Administrator of NASA.
Dr. Robert C. Seamans, Jr., Associate Administrator, NASA.

The Subcommittee on NASA Oversight concluded that (1) deficiencies existed in Ranger fabrication and testing, although a NASA consensus on this point was not present; (2) NASA supervision of JPL was inadequate because of a tendency to regard JPL as a field center rather than a contractor; and (3) JPL had not demonstrated the proper responsiveness to NASA direction. Four recommendations were made: (1) NASA should provide adequate supervision for JPL either as a contractor or field center; (2) a general manager should be installed at JPL as Deputy to the Director to manage in-house projects; (3) NASA should reform its present relationship with the Laboratory; and (4) that NASA consider executing a one-year contract with Caltech rather than a longer term agreement. (Investigation of Project Ranger, loc. cit.; and Project Ranger, Report of the Subcommittee on NASA Oversight of the Committee on Science and Astronautics, 88th Congress, Second Session, GPO, Washington, D.C. 1964.)

During April

Ranger Block III. The PTM TV subsystem acceptance tests were performed at RCA on April 4-5. The subsystem was assembled with the PTM spacecraft at JPL on April 10. Following an initial systems test, the PTM was subjected to vibration tests in x, y, and z axis on April 16 through the 24th. No problems were encountered. A systems test was conducted on April 25 in the Spacecraft Development Building. All systems, except the jet vanes, operated normally. The x-axis jet vane was found to be inoperative and was replaced. (JPL, Space Programs Summary No. 37-27, Vol. I, op. cit., 3-4; NASA, Weekly Status Report

During April cont.

No. 31, Ranger Program, April 6, 1964; and, Space Programs Summary No. 37-28, Vol. I, for the period May 1, 1964 to June 30, 1964, 11.)

The RA-7 TV subsystem (FM III-2) was reassembled from reworked units on April 4, and initial power application and checkout took place between April 6 and 9. Thereafter, camera performance was measured, adjusted, and evaluated. Thermal vacuum tests and a subsystem test were completed by April 18, when a formal review was conducted at JPL on all tests performed since reassembly. A final subsystem test was performed on April 29, followed by another formal review at JPL. No significant difficulties were encountered with the modified TV subsystem. (JPL, Space Programs Summary No. 37-28, Vol. I, op. cit., 19-20.)

DSN. A microwave link (installed by Western Union) was completed between the Goldstone Tracking Station and the JPL SFOF. The system, scheduled for use during the next Ranger launch, was placed in test operation. (NASA, Astronautics and Aeronautics, 1964, op. cit., 143.)

May 1

The RA-7 TV subsystem buy-off was concluded at RCA in Hightstown, New Jersey. The redesign, rework, and checkout of the subsystem were considered satisfactory by JPL and NASA participants, and the subsystem was shipped to JPL that evening. (NASA, Status Report No. 34 - Ranger Program, May 1964, JPLHF 2-708; memo, N.W. Cunningham to O.W. Nicks and E.M. Cortright, May 6, 1964, 4, JPLHF 2-396; and, memo from N.W. Cunningham to Deputy Associate Administrator for Space Science and Applications, May 6, 1964, JPLHF 2-1856.)

May 6

NASA Headquarters established a high-level Ranger 7 "buy-off" committee to accept the spacecraft for shipment to AMR and to authorize launch. It consisted of:

Homer E. Newell, Chairman
Frank Smith
Oran W. Nicks
Herman LaGow
Edgar M. Cortright
Robert F. Garbarini
Robert C. Seamans, Jr., ex officio

(NASA, memo from E.M. Cortright to O.W. Nicks, May 6, 1964, JPLHF 2-1855.)

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May 11 JPL recommended to NASA Headquarters that, in view of the extremely tight test schedule set for Ranger 7, the date of the launch should be postponed one month, from June to July. (JPL, TWX from W.H. Pickering to H.E. Newell, May 11, 1964, JPLHF 2-1858a.)

May 12 NASA Headquarters notified JPL that the request for a one month delay in the launch of Ranger 7 was approved. (NASA, TWX from H.E. Newell to W.H. Pickering, May 12, 1964, JPLHF 2-1858b.)

May 14 JPL dedicated the new Space Flight Operations Facility in ceremonies at the Laboratory. Opening of the facility was triggered by a radar signal bounced off the planet Venus. Participating in the ceremonies were Senator Clinton P. Anderson, Representative George P. Miller, Dr. Robert C. Seamans, Jr., Dr. Homer E. Newell, Dr. Lee A. DuBridge, and Dr. William H. Pickering. In an address Dr. Newell again pointed out that there was no real difference in science for the manned or the unmanned space programs: "Man and his thinking are the prime ingredients of science." (See February 25, 1964.) (NASA, Astronautics and Aeronautics, 1964, op. cit., 177; and, "Signal to Venus Opens JPL Space Facility," Independent (Pasadena) May 15, 1964.)

A meeting was held at JPL attended by Seamans, Newell, Cortright, Garbarini, Nicks, and Cunningham of NASA Headquarters, and JPL personnel. It was agreed that (1) the SCR-based command/control circuit for the TV subsystem would be retained, (2) a full-power test of the TV subsystem would be conducted at the ESA, and (3) a "minimum cables" test of the PTM in the thermal vacuum chamber would be run prior to the launch of Ranger 7. (JPL, TWX from H.M. Schurmeier to N.W. Cunningham, May 20, 1964, JPLHF 2-1859.)

May 15 Mr. Earl D. Hilburn assumed the post of NASA Deputy Associate Administrator, reporting to Dr. Seamans, replacing Walter L. Lingle, Jr.

Commenting on the results of the Congressional probe of Project Ranger, Science observed:

> Inferences of a showdown over renewal of a contract between NASA and JPL, which is managed by the California Institute of Technology, had been read into a Webb press conference in February by many observers. But the strong support given JPL by Webb during the hearings led some people on Capitol Hill to conclude that Webb, like the grand old Duke of York in the nursery rhyme, had marched his soldiers up the hill then marched them down again.

("Ranger: Oversight Subcommittee Asks Why NASA Doesn't Prevail on JPL to 'Rigidize' Projectwise," Science, May 15, 1964.)

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May 15 cont. The launch date for Ranger 7 was officially slipped from June to July, 1964 (Official NASA Flight Schedule, loc. cit.)

May 18-19 NASA and JPL personnel met at the Laboratory to review decisions of the preceding week. Plans for a full-power test of the TV subsystem at the ESA would be subject to re-examination should the risk of squib degradation be found unacceptable. (JPL, TWX from H.M. Schurmeier to N.W. Cunningham, May 20, 1964, JPLHF 2-1860.)

May 19-21 With the Congressional investigation of Project Ranger concluded and the failure mechanism of the Ranger 6 TV subsystem still not established with certainty, cartoonist Chester Gould had detective Dick Tracy and Diet Smith fly to the moon's Sea of Tranquility in Smith's "space coupe" to see for themselves. Alighting beside the tangled debris in the crater formed by Ranger 6, Tracy exclaimed, "Its easy to see why the cameras failed. They were never turned on--look." Commenting on the cartoon several months later, Life Magazine declared "inaccurate though this [account] was, millions of Americans didn't find it unbelievable at all." (Jim Hicks, "Many a Slip 'Twixt Earth and Moon--and Measles Too," Life, August 14, 1964, 36a, JPLHF 2-706.)

May 20 Testifying before a Congressional committee, Dr. Lee A. DuBridge, President of Caltech, informed committee members that if the government requested the Institute to establish the Jet Propulsion Laboratory today, "we would of course say no. . . . [however] There is no way of turning it off now, and we would not want to. The Laboratory is an asset to Caltech's science activities, but an administrative headache and a mixed public relations blessing. . . ." ("Caltech Would Balk at Setting Up New JPL," Los Angeles Times, May 21, 1964.)

May 21 NASA directed JPL to proceed with testing as established in meetings of May 14 and May 18-19. (TWX cited in JPL TWX from W.H. Pickering to H.E. Newell, May 26, 1964, JPLHF 2-2079.)

May 22 In response to a request, JPL submitted a comprehensive reply to NASA Headquarters on the Final Report of the Ranger 6 Review Board. (JPL, letter from W.H. Pickering to H.E. Newell, May 22, 1964, JPLHF 2-158.)

May 24 NASA Headquarters formalized the "buy-off" committee for Ranger 7. (See May 6, 1964.) (NASA, memo to Distribution from H.E. Newell, May 25, 1964, JPLHF 2-1727.)

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May 26 Dr. Alex Bratenahl advanced a new hypothesis to explain the cause of inadvertent turn-on of the Ranger 6 TV subsystem. He suggested that booster venting of LOX into the atmosphere which occurred at the time of TV activation would be accompanied by a shock wave, and that ionization effects could have produced a high conductivity region sufficient to permit shorting around the pins which activate the command switch. (JPL, IOM from A. Bratenahl to H.M. Schurmeier, May 26, 1964, JPLHF 2-923.)

May 28 JPL issued EPD 78, Space Flight Operations Plan for Ranger 7.

During May Ranger Block III. The reworked RA-7 TV subsystem was returned from RCA to JPL on May 1, and installed on the RA-7 bus. (JPL, Space Programs Summary No. 37-28, Vol. I, op. cit., 1.) Systems and vibration tests were performed during the next few weeks. The final systems test conducted on May 5 was the scheduled "no cables" test in which spacecraft performance was determined with the only data link being the RF system. This test was run to demonstrate that the spacecraft operated properly without direct access cables and related OSE. Ranger 7 performed properly in this test and no problems or failures were encountered. (NASA, Status Report No. 34, May, 1964, op. cit., 2.)

Preparation for mission tests began on May 18, and the spacecraft commenced mission tests in a small vacuum chamber on May 23. Two successful mission tests were concluded on May 31, when the spacecraft was disassembled for inspection. (NASA, Memo to Ranger Files, N.W. Cunningham, July 17, 1964, op. cit., 3; and, JPL, Space Programs Summary No. 37-28, Vol. I, op. cit., 1, 9-10.)

The PTM underwent three mission verification tests. During the second test momentary power dropout was observed on the P-Channel. (Ibid., 12.)

June 1 In response to telephone discussions of possible further JPL inspection of the RA-7 TV subsystem as a result of the bag of hardware incident, RCA notified JPL that investigations indicated that this was a single accident: "It is the considered opinion of RCA that no further inspection of the RA-7 assemblies is required to confirm this position." (Cited in TWX from R.E. Hogan, RCA, Manager, System Program Management, to H.M. Schurmeier, June 8, 1964, JPLHF 2-1863.) (See April 24, 1964.)

1964

June 4-5 Astronomers carried out special telescopic observations of the moon in an attempt to determine the nature of mysterious red spots first observed by Sir William Herschel in 1738. The spots had been seen in the crater Aristarchus. (NASA, Astronautics and Aeronautics, 1964, op. cit., 203.) (See November 27, 1963.)

June 11 JPL notified NASA Headquarters that a consensus, following investigation of the bag of hardware episode, agreed "this was an isolated incident that was caused accidentally, not intentionally." A prime cause was attributed to the 24-hour, 7-day week operation that was in effect at RCA. (JPL, TWX from H.M. Schurmeier to N.W. Cunningham, June 11, 1964, JPLHF 2-155.)

June 15-16 The OSSA Buy-off Board met at JPL to consider the shipping status of Ranger 7. JPL and the Board agreed that: (1) RA-7 had an excellent test history and met established acceptance criteria; (2) the TV subsystem was improved to a point where further improvement would require major expenditure of time and money; (3) although all testing of the PTM was not complete, no modification of the flight spacecraft was thus far indicated. JPL recommended shipping Ranger 7 to AMR rather than hold the vehicle at JPL while PTM tests were concluded. (JPL, letter from H.M. Schurmeier to N.W. Cunningham, June 22, 1964, JPLHF 2-156; and, NASA document entitled, "Report of OSSA Buy-off Committee on Ranger B Spacecraft Preshipment Meeting of June 15-16, 1964," JPLHF 2-1971b.)

June 17 NASA OSSA unanimously recommended that Headquarters approve shipment of RA-7 to the Cape, and JPL was notified to proceed with shipment. (NASA, memo from E.D. Hilburn, Deputy Associate Administrator, to the Associate Administrator, June 17, 1964, JPLHF 2-1864; and, letter from H.E. Newell to W.H. Pickering, June 17, 1964, JPLHF 2-157.)

June 22 Aviation Week announced that action was underway at NASA and at JPL to meet the recommendations made by the Subcommittee on NASA Oversight that followed the Ranger investigation (See April 27, 1964), including appointment of a general manager at JPL. "Webb's staff plans 'to go fully into the recommendations' of the committee report with JPL and its parent institution, the California Institute of Technology. A NASA spokesman said he felt that the House subcommittee would be completely satisfied." ("Ranger Management Compromise Sought, Aviation Week, p. 25.)

June 23 The Army Map Service announced completion of the most thorough lunar map ever compiled. The topographic study was prepared under NASA contract. (NASA, Astronautics and Aeronautics, 1964, op. cit., 220.)

1964

June 29 JPL Director Dr. W.H. Pickering announced appointment of Major General Alvin R. Luedecke (USAF Ret.), General Manager of the Atomic Energy Commission, as Deputy Director of the Jet Propulsion Laboratory replacing Brian Sparks, effective August 1. "JPL said officially that Luedecke would be in charge of administrative matters at the Laboratory. The General told Missiles and Rockets, however, that while he will be responsible for most administrative matters, 'I also expect to be deeply involved in the management of Ranger, Surveyor, and Mariner programs.'" ("JPL Deputy Named," Missiles and Rockets, July 6, 1964, p. 6.)

The JPL Ranger Project Office completed investigations of the turn-on of the Ranger 6 TV subsystem. Tests to confirm a possible conductance agent in electrostatic discharge between the booster and umbilical pins proved inconclusive. (Vehicle design changes had already eliminated the umbilical pins as a source for accidental turn-on.) Dr. Bratenahl's hypothesis of a shock wave at booster staging (see May 26, 1964) had been disproved in calculations made by Dr. James Kendall, Jr., in the Fluid Physics Section. The turn-on sequence had not been exactly duplicated in laboratory tests; accordingly, no single known cause could account for the event. (JPL, IOM from M.A. Piroumian to H.M. Schurmeier, "Presentations on Ranger Investigations Concerning Launch to Invection Environment," June 25, 1964, JPLHF 2-1865; also, IOM from M.A. Piroumian to H.M. Schurmeier, "Analysis of High Voltage and RCA Test Results," June 17, 1964, JPLHF 2-2082; and, IOM from M.A. Piroumian to H.M. Schurmeier, "Status of Ranger Investigations Concerning Launch to Injection Environment," June 5, 1964, JPLHF 2-2083.)

During June Ranger Block III. On June 8 the TV subsystem and Ranger 7 spacecraft began operational verification tests in the space simulator. After Ranger 7 buy-off the assembled vehicle was shipped to AMR on June 17, arriving on June 21. (JPL, Space Programs Summary No. 37-28, Vol. I, op. cit., 11.) An initial systems test was conducted on June 27 with satisfactory results. (JPL, Ranger 7 Status Bulletin No. 1, July 24, 1964, JPLHF 2-907.)

By agreement with NASA, a second "no cables" RF test of RA-7 utilizing spacecraft batteries was performed on June 29. Spacecraft performance was normal. (JPL, Space Programs Summary No. 37-29, Vol. I, for the period July 1, 1964 to August 31, 1964, 2.)

The PTM continued a rigorous test program at JPL. On June 4 and 5 a "no cables" test verified that serious hazards to

During June cont.	installed pyrotechnic devices could be overcome. Later in the month this vehicle was subjected to a combined environment of axial vibration and launch pressure-change simulation in the 25-ft. space simulator. This marked the first test at JPL where a large system was vibration-tested under changing pressure, approaching conditions experienced during launch. (JPL, Space Programs Summary No. 37-28, Vol. VI, for the period May 1, 1964 to June 30, 1964, 4; also, Space Programs Summary No. 37-28, Vol. I, op. cit., 15.)
	Rework of the RCA-AED TV subsystem was completed, implementing recommendations contained in the RCA (Ranger 6) Flight Model III-1 Flight Evaluation Report and Design Study Report. Four of six functional portions of the TV subsystem were modified: cameras, telecommunications, control, and power. Rework was concentrated in three areas of effort: (1) All exposed terminals and uninsulated conductors were conformal coated in a manner equivalent to that employed on the spacecraft bus; (2) All Ranger 7 TV (FM III-2) assemblies were examined and reevaluated with emphasis on spot bonding, venting, and mechanical reliability (no additional venting was found necessary), and various design improvements were made in the transmitter and power supply; (3) improvements were incorporated in the FM III-2 wire harness. Environmental test results of the rework system indicated that reliability of the TV subsystem was significantly improved. (Ibid., 21.)
	DSN. Reliability in communications to Johannesburg, South Africa station was improved with installation of a backup circuit from South Africa to Australia, to Hawaii, to the United States. (NASA, Twelfth Semiannual Report to Congress, July 1 - December 31, 1964, Washington, D.C.)
July 2	Experimenters involved in Ranger Block III flights convened at JPL to participate in a final series of TV tests on the PTM.
July 9	The NASA OSSA Ranger 7 "Buy-off" committee met with JPL and RCA representatives at AMR to consider vehicle status and launch authorization. As no major difficulties or open items remained with the spacecraft, JPL recommended that launch operations proceed toward a planned launch date of July 27. A positive yes or no launch determination by the Buy-off Board was not forthcoming. In the absence of a decision to the contrary, launch operations

July 9 cont.	continued as planned. (A NASA-OSSA TWX authorizing launch apparently was sent to JPL around July 15. This document has not been located.) (JPL, Ranger Status Report for July 13, 1964, JPLHF 2-1315.) (Figure 59.)
July 10	Ranger 7 satisfactorily completed J-FACT. (Ibid.)
July 13	Mr. B.T. Morris, Chief of Quality Assurance and Reliability at JPL, informed JPL Director Dr. W.H. Pickering that Atlas booster reliability was much improved with reduction of the G.E. Mod. III guidance problem, and with the spread of NASA Project Mercury experience and techniques. Agena reliability was considered acceptable. (JPL, Weekly Report of QA and Reliability Office to Dr. Pickering/B. Sparks, from B. Morris, July 13, 1964, JPLHF 3-317.)
July 14	The second phase integration tests were conducted for the DSIF/SFOF. (Ranger 7 was to be the first launch handled through the new SFOF.) (JPL, Ranger Status Report for July 20, 1964, JPLHF 2-1315.)
July 15	The preflight systems test of RA-7 indicated that the spacecraft was ready for launch. (JPL, Space Programs Summary No. 37-29, Vol. I, op. cit., 3.)
July 16	NASA Headquarters issued launch dates for the two remaining Ranger spacecraft. Launch dates were on two month centers: Ranger 8 in January and Ranger 9 in March, 1965. (Official NASA Flight Schedules, July 16, 1964, JPLHF 2-968.)
	JPL informed NASA Headquarters that it estimated the probability of mission success for Ranger 7 at 50% with an approximate 90% probability of meeting mission objectives with the three shots. Goals and objectives agreed upon for Ranger Block III were reiterated. (JPL, letter from W.H. Pickering to H.E. Newell, July 16, 1964, JPLHF 2-161.)
July 17	Tests were conducted on the Ranger PTM to determine if the spacecraft was susceptible to arc breakdown from the booster vehicle. It was determined that high voltage arcing from the spacecraft shroud to the Agena surface caused no discernible degradation of spacecraft performance. (JPL, IOM from W. Johnson/E. Beran to Distribution, July 23, 1964, JPLHF 2-1873.)

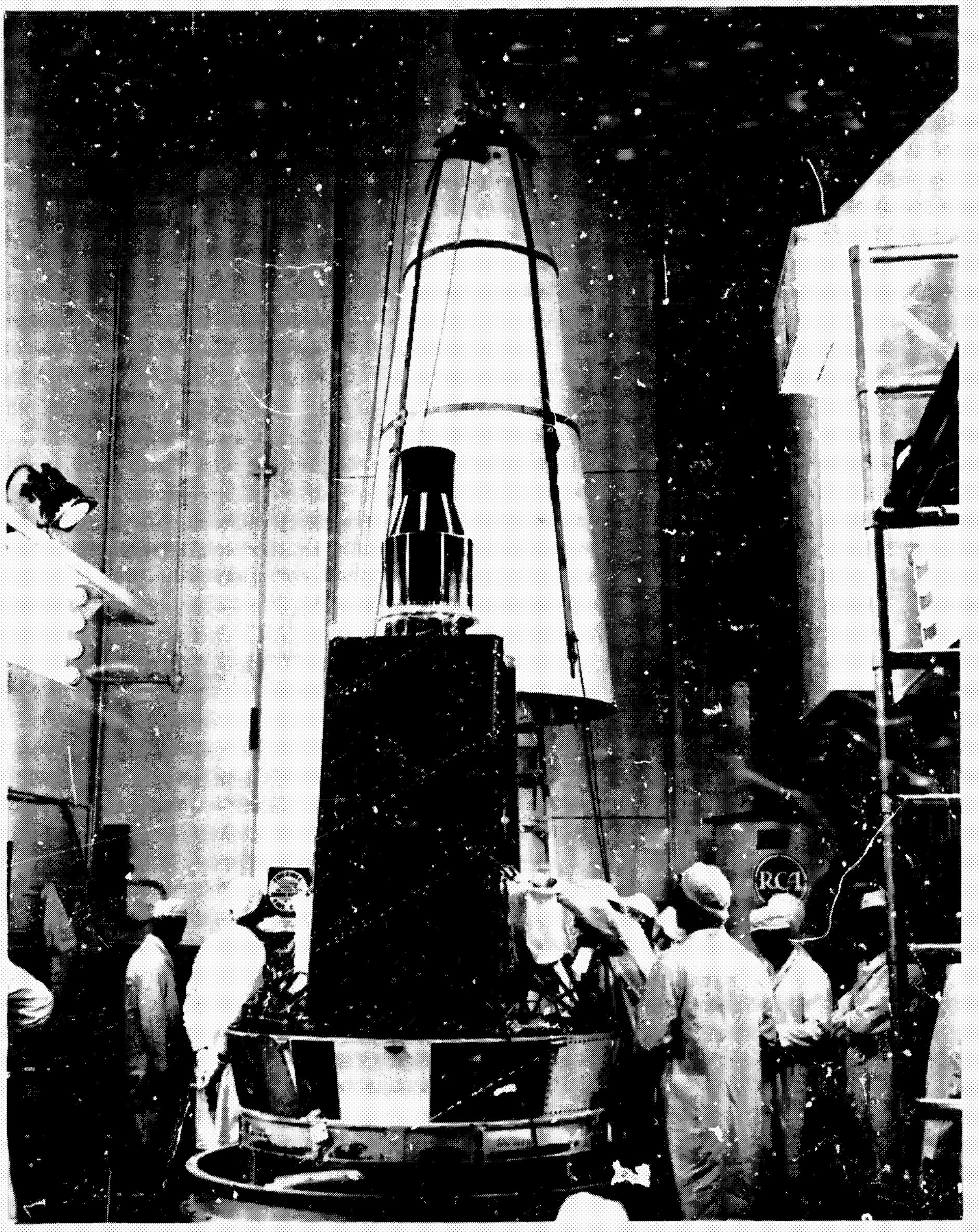

Figure 59: Ranger 7 at AMR, ESA, preparatory to J-FACT.

July 17 cont. JPL issued the RA-B [RA-7] launch operations portion of the Ranger Block III Mission Operations Plan, PD-20, together with PD-18, Addendum 1, Ranger Block III Launch Constraints Planning Document.

July 18 Ranger 7 was transported to the Explosive Safe Area (ESA) for installation of the midcourse motor and pyrotechnics. (Ranger B Status Bulletin No. 1, July 24, 1964, loc. cit.)

July 20 RA-7 TV subsystem was exercised at full power in the ESA. (NASA, Memo to Ranger Files, N.W. Cunningham, July 17, 1964, op. cit., 4.)

B.T. Morris notified JPL management that the recent move of space flight operations from Building 125 to the new SFOF could impose risks to the Ranger 7 flight, and urged that measures be taken to isolate and resolve any potential DSN problem areas. (JPL, IOM from B.T. Morris to F. Felberg, R.J. Parks and E. Rechtin, July 20, 1964, JPLHF 2-1870.) (See DSN, During March, 1964.)

JPL issued EPD 143, Rev. 3, Capabilities and Procedures, Flight Operations Facilities, Ranger Block III.

July 21 A review of NASA OSSA flight projects, including Ranger and Mariner, was conducted between members of the Karth Committee (Subcommittee on NASA Oversight) and OSSA at NASA Headquarters. Upon the request of Chairman Karth, it was agreed similar briefings would be provided the Congressional committee at three month intervals. (JPL, Ranger Status Report for July 27, 1964, JPLHF 2-1315; NASA, memo from J.A. Crocker to H.E. Newell, June 19, 1964, JPLHF 2-1963; and, NASA, memo from W.L. Sturdevant to Mr. Callaghan, July 21, 1964, JPLHF 2-1964.)

July 23 RA-7 was transported to Launch Complex 12 and mated with the booster rockets for prelaunch testing. (JPL, Space Programs Summary No. 37-29, Vol. I, loc. cit.)

July 25 NASA OSSA made a final presentation to NASA Associate Administrator Dr. R.C. Seamans concerning the findings of the Hilburn report. Actions taken by OSSA, JPL, and RCA to improve the flightworthiness of Ranger 7 were considered responsive to the review board findings. (JPL, Ranger Status Report for July 27, 1964, loc. cit.)

July 27 Countdown for Ranger 7 began at Launch Complex 12, AMR, at 3:17 a.m. EDT. The countdown proceeded normally until 11:31 a.m. when a hold was called for about one hour to replace a faulty telemetry battery

July 27 cont. in the Atlas booster. The countdown was resumed and continued until T-22 minutes at 1:14 p.m., when it was terminated again, this time because of a high noise level in a ground-based guidance transmitter at the Cape. The difficulty was not resolved in time to permit launch before the close of the launch window for the day (between 12:32 and 3:42 p.m. EDT). Launch was rescheduled for the following day. (JPL, Ranger B Status Bulletin No. 3, July 27, 1964, JPLHF 2-907.)

July 28 NASA Headquarters acknowledged JPL's response to the Hilburn report of May 22. It was also noted that the OSSA Ranger 7 Buy-off Committee was agreed that the TV subsystem was appropriately modified to improve reliability and to prevent inadvertent turn-on. The Committee agreed with JPL's recommendations to ship RA-7 to AMR as scheduled. (NASA, letter from H.E. Newell to W.H. Pickering, July 28, 1964, JPLHF 2-163.)

NASA Headquarters notified JPL of planned actions to improve JPL-NASA working relationships and operations. (NASA, letter from H.E. Newell to W.H. Pickering, July 18, 1964, JPLHF 2-164.)

July 28-31 Ranger 7 was launched at 12:50 p.m., EDT upon conclusion of the second countdown at AMR. Mission objectives and content were the same as programmed for Ranger 6 (see January 30-February 2, 1964). The Atlas and Agena boosters again performed "nominally," and following second-burn of the Agena engine half-an-hour later, Ranger 7 was rocketed out of its 119 mile altitude parking orbit and injected into the proper lunar intercept trajectory. Ranger 7 separated from the Agena and extended its solar panels. Sensors acquired the sun and earth, activating the attitude control system; spacecraft transmissions switched from the omniantenna to the high-gain antenna. The following day, July 29, the midcourse maneuver was initiated. The proper roll and pitch movements were executed, the rocket engine ignited and burned for the desired period, and the vehicle restabilized. As in the case of its predecessor a few months earlier, Ranger 7 was on a course that would place it within a few miles of the intended point of aim. Aside from a brief loss of two-way lock on the spacecraft immediately following launch by the DSIF tracking station at Cape Kennedy, there were no significant anomalies in the flight. Ranger 7 proceeded in text-book fashion toward impact with the moon, this time in the "Sea of Clouds" region. (Figure 60.)

On the morning of July 31, in the final hours of its flight, the spacecraft accelerated toward the moon under the influence of lunar gravity. Analysis of attitude and trajectory data revealed that

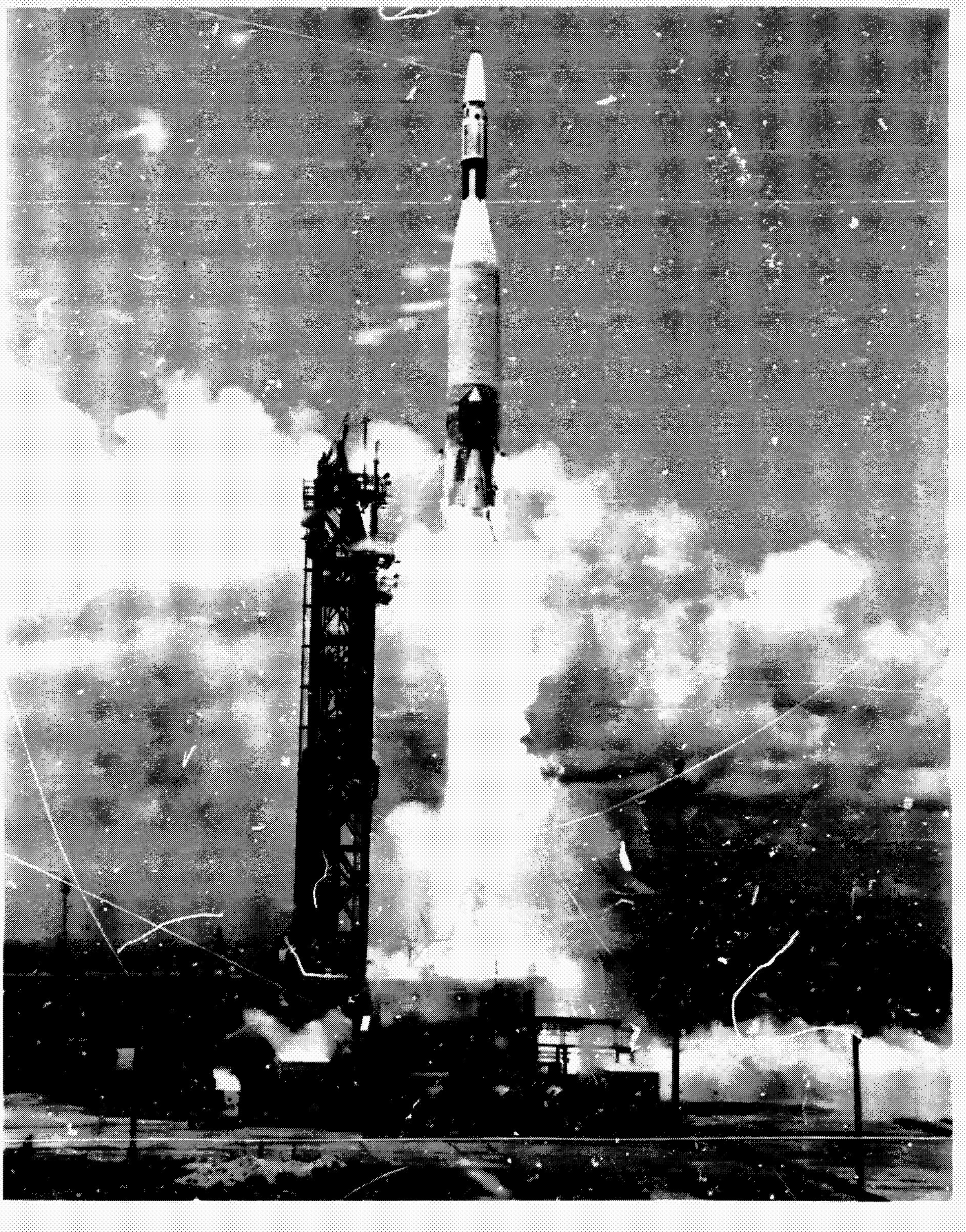

Figure 60: Launch of Ranger 7.

July 28-31 cont. the flight path of Ranger 7, like Ranger 6, was suitably directed in relation to spacecraft orientation for useful TV pictures to be obtained without a terminal maneuver. Accordingly, in order to avoid any chance for a last minute failure in the attitude control system, a decision was reached to forego a final maneuver and to activate the cameras by backup command. Each channel of the TV system had been modified to reach full power from warmup in a little over one minute, rather than a period of five minutes as in the case of Ranger 6.

At impact minus 18 minutes, F Channel went into a one-minute warmup period necessary before a switchover to high power. Sixty seconds later Channel F cameras reached full power, and recorders at Goldstone tracking station went into operation. (P Channel repeated the sequence a few minutes later with similar results.) Ranger impacted the moon at 6:25 a.m. PDT. For the first time the United States and the world had closeup pictures of the lunar surface, many of them from distances measured in feet rather than in miles. ("Space--Changing Man's View," Time, August 7, 1964, pp. 39-42; Jim Hicks, "Many a Slip 'Twixt Earth and Moon--and Measles Too," loc. cit.; JPL, Tracking and Data Acquisition for Missions VI-IX, op. cit.; Ranger 7 Log, undated, JPLHF 2-925; Dave Swain, "Pickering Jubilant Over Moon Photos," Pasadena Star-News, July 31, 1964; "Taking the Measure of the Moon," Newsweek, August 10, 1964; and, "Impact!" New York Times, August 7, 1964; and, JPL, TR No. 32-700, Ranger VII Part 1. Mission Description and Performance.) (Figures 61 and 62.)

July 31 President Johnson telephoned Dr. Homer E. Newell, NASA Associate Administrator for OSSA, and Dr. William H. Pickering, JPL Director, and expressed his congratulations and thanks for the successful moon shot: "On behalf of the whole country, I want to congratulate you and those associated with you in NASA and the Jet Propulsion Laboratory and in the industrial laboratories. All of you have contributed the skills to make this Ranger 7 flight the great success that it is. We are proud of the tremendous technical achievement which this successful flight represents.

This is a basic step forward in our orderly program to assemble the scientific knowledge necessary for man's trip to the moon." (White House text as reprinted in "Johnson Thanks Jet Lab," Christian Science Monitor, August 1, 1964.)

Following picture processing, a Ranger 7 post-impact press conference was held at von Karman auditorium at JPL beginning at 9 p.m., PDT, before a nationwide television audience. Participating were NASA OSSA Associate Administrator Dr. Homer Newell, JPL Director Dr. William Pickering, JPL Ranger Project Manager Harris M. Schurmeier, and project scientists. An assortment of

Figure 61: Ranger 7 lunar surface closeup with impact area identified.

Figure 62: Members of the Ranger experimenters team examining pictures returned by Ranger 7. Foreground, left to right: E. A. Whitaker, R. L. Heacock, G. P. Kuiper.

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July 31 cont. slides from among the 4,316 Ranger 7 television pictures were first shown and publicly discussed. Virtually all pictures were of excellent quality enhanced by the 1150 television scan lines per frame, as opposed to 500 lines on a frame in a home television set. Dr. Gerard P. Kuiper, principal experimenter, opened the conference with an observation that:

"This is a great day for science, and this is a great day for the United States. What has been achieved today is truly remarkable. We have made progress in resolution of lunar detail, not by a factor of 10 as the Ranger pamphlet hoped would be possible with this flight, nor by a factor of 100, which would have been already very remarkable, but by a factor of 1000. This means that the Moon, which to the unaided eye of course is seen at a distance of about 240,000 miles, and which in a good telescope can be brought to a distance of 500 miles equivalent, has been brought in this experiment, in this Ranger VII experiment, to a distance of half a mile. This of course covers only a small region of the lunar surface, but the sample shown is . . . very representative . . ."

(Ranger VII Post-Impact Press Conference, July 31, 1964, 1a, JPLHF 2-745.)

With a known sun-angle at 23° above the horizon, it was concluded that the data would prove most useful to Project Apollo in determining average slopes. As to scientific questions concerning the moon, no determination was ventured on such short notice, although Dr. Kuiper suggested that theories concerning the origin of the moon and lunar surface would not be "immediately affected by these observations. . . ." (Ibid., 22.)

Following the press conference one astute reporter did some speculating of his own:

"One of the things that did surprise the scientists who saw only the first few photographs from Ranger 7 . . . was that the sides of many of the secondary impact craters were quite steep but their lips were softly rounded. This raised a question about the nature of a material that would produce this shape on impact. The features of the craters indicated that the consistency of the lunar surface is neither solid rock, dusty nor muddy, but more like a wet, firm sand."

(John A. Osmundsen, "Ranger Photos Answer Question: Lunar Surface is Not Deep Dust," New York Times, August 2, 1964.)

During July Ranger Block III. Ranger Block III PTM completed its test program at JPL and was made ready for investigation of any problems which might come up during the flight of Ranger 7. (JPL, Ranger Spacecraft System Review, Minutes of July 22, 1964, JPLHF 2-1313.)

Aug. 1 The press, nationally and internationally, hailed the success of Ranger 7. (For world reaction see U.S. Information Agency, Research Report R-107-64, Foreign Media Reaction to Ranger 7, August 6, 1964, JPLHF 2-895; also, domestic response in NASA Public Information Office, Current News, August 6, 1964.) The Washington, D.C. Sunday Star proclaimed that, "as a space spectacular . . . Ranger 7's flight occupies a place in the front rank, alongside Sputnik I, the Vostok I flight of Yuri Gagarin, and the Venus fly-by exploit of Mariner II." In a similar vein, the New York Times observed "psychologically, the Ranger 7 flight was a welcome end to a string of 13 failures in 13 United States attempts . . . to put useful payloads on, or in orbit around, the moon. Internationally, the Ranger 7 flight was a propagandistic bonanza for the United States. In the space olympics it probably represented almost as impressive a 'first' as the orbiting of the first Sputnik and the first manned orbital flight by Yri A. Gargarin. . . ." ("Journey to the Moon," The Sunday Star, Washington, D.C., August 2, 1964; and Richard Witkin, "Ranger Spurs Space Program," New York Times, August 2, 1964.)

NASA Associate Administrator for Space Science and Applications Dr. Homer E. Newell, and JPL Director Dr. William H. Pickering briefed President Johnson on the Ranger 7 mission. Dr. Newell explained that the principal investigators had tentatively concluded that the presence of small, sharply defined craters on the lunar surface indicated that, contrary to some hypotheses, a deep layer of dust did not exist, at least not at this site. Turning for a moment to the flight of Ranger 7 in an international context, the President inquired: "This is a battle for real existence in the world, isn't it--for survival?" Dr. Newell agreed that it was and said he was now "hopeful" that the United States could maintain its schedule for a lunar landing in Project Apollo. "You don't expect a Congressional investigation, then?" Mr. Johnson asked, smiling. The briefing closed with a statement by the President: "We know this morning," he said, "that the United States achieved fully the leadership we sought for free men." (NASA News Release "NASA Briefing for the President of the United States," August 1, 1964, JPLHF 2-172; and Tom Wicker, "Moon Landing Areas are Usable, Scientists Tell Johnson: President Says Success Justifies Space Program," New York Times, August 2, 1964.)

In a telegram to President Johnson, Chancellor Ludwig Erhard of West Germany stated that: "We are happy with the American people over this tremendous technical and scientific achievement."

Aug. 1 cont. President of Mexico Adolfo Lopez Mateos released a similar statement calling Ranger 7 "without doubt, up to the present moment, the most brilliant page registered in the scientific history of modern times." (NASA, Astronautics and Aeronautics, 1964, op. cit., 273.)

General A.R. Luedecke assumed the position of JPL Deputy Director. ("JPL Deputy," Aviation Week, June 29, 1964, 16, JPLHF 2-784.) (See June 29, 1964.)

Aug. 2 Pope Paul VI, offering his Sunday blessing to the public, alluded to Ranger 7 when he observed that: "We also would unite ourselves in admiration for a happening that concerns the life of all humanity, and that shows how far the man of science and technology has progressed. . . ." (NASA, Astronautics and Aeronautics, 1964, loc. cit.)

Aug. 3 Dr. Alex Bratenahl completed his investigations of the RA-6 TV turn-on during booster ascent. (See June 29, 1964.) His conclusions, supported by strong circumstantial evidence, pinpointed the cause as a highly conducting detonation wave (not a LOX pressure wave as initially supposed) at Atlas booster staging, acting on the umbilical pins in the spacecraft shroud.

1. Upon Atlas staging several hundred pounds of LOX and kerosene fuel are dumped into the atmosphere, vaporize and mix together, envelope the complete missile, and ignite in brilliant flashes.
2. The umbilical door was mechanically rather than hermetically latched.
3. Critical pins, including the sensitive TV command circuit, were connected to an internal voltage source. A high impedence amplifier located behind the pins could pick up a transient signal with the pins acting as antenna, and activate the TV relay.
4. Three volts were necessary to trigger TV operation, and 20 volts were available on the battery pin located one-quarter inch away.
5. Plasma from the detonation wave could cross the pins and supply the necessary power for a command signal, and electrical arcing in the TV subsystem would occur at that altitude and critical pressure region.

Aug. 3 cont.

6. Time of TV turn-on coincided to 100th of a second with the forward movement of the unique Atlas detonation wave over the nose shroud of the missile.

(JPL, IOM from A. Bratenahl to C. Campen, Subject: "Current Thinking on Effects of Booster Separation as Cause of Accidental Turn-on of RA-6 TV," August 3, 1964, JPLHF 2-2084.) With the success of Ranger 7, and as design changes had eliminated the umbilical pins as a source of accidental TV turn-on, further investigations to conclusively prove this hypothesis were not pursued. It remains the most plausible explanation for the loss of Ranger 6. (JPL, IOM from R.J. Mackin to R.V. Meghreblian, Subject: "Electrostatic Charging of Launch Vehicles During Ascent," February 8, 1965, JPLHF 2-2085.)

Dr. E. Rechtin, Assistant Laboratory Director for Tracking and Data Acquisition, recommended that JPL consider slipping the launch dates of Rangers 8 and 9 (to permit more complete mission analysis), as well as all Surveyor flights. It was, he observed, now firmly established that "the important date is the date of first success, not first flight." (JPL, IOM from E. Rechtin, to Executive Council, August 3, 1964, JPLHF 2-403.)

Dr. Joseph F. Shea and Dr. Robert R. Gilruth of the MSC Project Apollo Office visited JPL for a first-hand briefing on the Ranger 7 pictures. (Richard Witkin, "Apollo Officials to Study Pictures," New York Times, August 2, 1964.) Subsequently, Dr. Joseph F. Shea, Manager of the Apollo Program Office at MSC, observed that expected problems involved in selecting a landing site and in actually landing the Lunar Module had been eased by Ranger pictures. The surface was, he concluded, "more benign" than originally anticipated. ("Ranger Photos Boost Confidence In Apollo," Aviation Week, August 10, 1964, 19, 21, JPLHF 2-786.)

Aug. 4

NASA and JPL representatives gave a special Ranger 7 briefing for members of Congress. Principal investigator Dr. Gerard P. Kuiper, Director of the Lunar and Planetary Laboratory, University of Arizona, explained that Ranger (1) confirmed Apollo landing design constraints, (2) indicated a smoother surface than originally was expected, and (3) tended to disprove the "deep dust" theory of the lunar surface. Dr. Kuiper asserted that "we have entered a new era in the study of the moon." Ranger 7 photos did not disclose whether the origin of the lunar craters was volcanic or meteoric. (NASA, Ranger VII, A Special Report, August 5, 1964, 3, JPLHF 2-887; NASA, Astronautics and Aeronautics, 1964, op. cit., 275-276; and, "Science and Space," Newsweek, August 17, 1964.)

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Aug. 5 NASA issued Ranger VII, A Special Report.

NASA and JPL personnel gave another Ranger 7 briefing to members of the President's Cabinet, the DOD and other high government officials. (JPL, Ranger Status Report for August 10, 1964, JPLHF 2-1315.)

Aug. 7 NASA Headquarters notified JPL that, in the future, planetary flight projects would also be contracted outside JPL as determined necessary. While there was general agreement with JPL on the desirability of maintaining at least one in-house flight project at the Laboratory, hereafter this would not be guaranteed. Accordingly, JPL was instructed to plan for a 1969 Mariner Project to be initiated as an out-of-house project. (NASA, letter from H.E. Newell to W.H. Pickering, August 7, 1964, JPLHF 2-397.)

Aug. 8 Business Week reported that ". . . perhaps the most important thing about Ranger 7's flight, NASA officials say privately, is the boost it has given the entire civilian space program. Except for the first orbital flight of Astronaut John Glenn, NASA has never had a success to match it." ("It's Not Green Cheese," Business Week, August 8, 1964, 82.)

Aug. 10 Caltech President Dr. Lee A. DuBridge notified JPL Director Dr. W.H. Pickering that ". . . I want to place on the record, on behalf of myself personally and on behalf of the entire Caltech community, our great pride in what JPL has done. . . . We at Caltech see especially clearly how your achievement has brought glory to the United States, has brought glory to JPL and to all of Caltech." (Letter reprinted in Lab-Oratory, August 1964, 3, JPLHF 2-1744.)

Aviation Week declared that the "Success of Ranger 7 has given a psychological boost to lagging morale in the National Aeronautics and Space Administration, and has provided an invaluable first that aided the passage of the long-delayed Fiscal 1965 space appropriation by the Senate. Impact of the first fully successful United States lunar photographic mission carried beyond the confines of the space agency to the Senate floor, where Ranger 7 pictures helped defeat attempts at reducing Fiscal 1965 funds." ("Successful Ranger Lunar Flight Aids NASA Budget Through Senate," Aviation Week, August 10, 1964, JPLHF 2-787.)

Aug. 13 NASA Administrator James Webb informed JPL Director Dr. W.H. Pickering that ". . . I was in Europe with my family when the

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Aug. 13 cont. Ranger VII flight achieved its great success. The impact in Italy was terrific and of great value to all the space and other U.S. programs we are working toward. . . . On my first day back, I want to send my thanks and congratulations to you and all at JPL." (Letter reprinted in Lab-Oratory, August, 1964, loc. cit.)

The Ranger 7 postflight analysis meeting was held at JPL. (Minutes of Ranger 7 Postflight Analysis Meeting, August 13, 1964, JPLHF 2-1876.)

Aug. 14 NASA directed one complete set of RA-7 mission photographic negatives to the USAF Aeronautical Chart and Information Center (ACIC) in St. Louis, Missouri. Detailed relief maps were to be produced in 90 days. (Letter from Robert W. Carder, Aeronautical Chart and Information Center, USAF, to Dr. Gerard P. Kuiper, University of Arizona, August 19, 1964, JPLHF 2-168.)

Aug. 16 In a statement announcing the dispatch of complete sets of lunar photographs taken by Ranger 7 to the leaders of 110 nations, President Johnson observed that "the success of the Ranger 7 exploration has been greeted with enthusiasm and interest around the world. Men of all nations recognize this is one of the greatest extensions of human knowledge about the lunar surface to occur in many centuries." He called upon all nations to join through the United Nations in placing "the peaceful realm of space off limits to the designs of aggressors upon the earth." (NASA, Astronautics and Aeronautics, 1964, op. cit., 287-288.)

JPL verbally proposed a one-month slip in the launch of Ranger 8 to NASA Headquarters. (JPL, Ranger Status Report from H.M. Schurmeier to Executive Council, August 17, 1964, JPLHF 2-1315.)

Aug. 17 U.S. News and World Report noted "now that everybody's seen those photographic close-ups, the argument is on again--whether it's worth the price to put a man on the moon. . . ." ("Why 20 Billions to see More of the Moon?" U.S. News and World Report, August 17, 1964.

Aug. 18 JPL formally requested a one-month slip of Ranger 8 to avoid tracking interference that would arise with the concurrent flight of Mariner 64. (JPL, TWX from H.M. Schurmeier to N.W. Cunningham, August 18, 1964, JPLHF 2-1877.)

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Aug. 20 A second complete set of photographs of the lunar surface obtained by Ranger 7 was directed to the Apollo office at MSC. (JPL, Ranger Status Report from H.M. Schurmeier to Executive Council, August 24, 1964, JPLHF 2-1315.)

NASA Headquarters called for a meeting of Ranger experimenters in Washington, D.C. on August 28 to release more lunar photographs obtained in the Ranger 7 mission; and to discuss preliminary scientific findings. The first major discussion of scientific results was scheduled for August 31, at the International Astronomical Union in Hamburg, Germany. (TWX cited in letter from Gerard P. Kuiper to Oran Nicks of NASA, August 22, 1964, JPLHF 2-167.)

Aug. 21 JPL submitted a proposal to NASA Headquarters to assemble (from spares) and fly an additional Ranger 10 spacecraft. (JPL, Ranger Status Report, August 24, 1964, loc. cit.)

Aug. 22 Dr. Gerard P. Kuiper proposed to Dr. A. Dollfus, President of Commission 16 of the International Astronomical Union, that the name "Mare Cognitum" be assigned to the Ranger 7 impact area. An alternative term "Lacus Cognitus" was also proposed. (Letter from G.P. Kuiper to O. Nicks, August 22, 1964, loc. cit.)

Aug. 26 The Aeronutronic Division of the Philco Corporation submitted a proposal to NASA Headquarters for fabrication, test, and flight of a Lunar Surface Hardness and Facsimile Capsule (LSHFC) on existing Ranger spacecraft. The capsule would acquire and store impact acceleration data during a landing on the moon and, after coming to rest on the lunar surface, transmit this information to earth together with a photograph of the lunar surroundings. A forty-eight week development schedule was proposed. (Aeronutronic Division, Philco Corp., "A Lunar Surface Hardness and Facsimile Capsule," August 26, 1964, JPLHF 2-630.)

Aug. 28 The Ranger 7 Preliminary Scientific Results Press Conference was convened in Washington, D.C. It was revealed that Ranger 7, which impacted six miles from its planned target in one of the rays from the Crater Tycho, had returned photographs that resolved objects down to 10-15 inches, and that overall resolution was 1000 to 2000 times better than the very best earth-based observation.

Dr. Eugene M. Shoemaker and Dr. Gerard P. Kuiper expressed the opinion that the observed lunar maria were lava flows. Dr. Kuiper believed that the impact area was perhaps not typical of the lunar surface because of the presence of ejecta material from Tycho. No firm conclusions were drawn concerning the lunar surface, and the

Aug. 28 cont. amount of dust present was disputed. Dr. Kuiper stated that it was "purely a guess" that there was "fairly solid stuff there," and estimated erosion on the surface to be about five feet in depth. He added that it was not possible, however, to deduce surface bearing strength from the photographs. Dr. Shoemaker suggested that the moon might lose more material than it gained, and that the depth of erosion could be on the order of fifty feet. He said the moon's surface was "smoother than I dared hope." and that slopes averaged around 10 degrees. This finding confirmed Apollo LM spacecraft design which was premised on landing in areas with slopes not exceeding 15 degrees. Dr. Harold Urey was not convinced that the lunar maria were lava, and tended to favor a surface consisting of finely divided material. (NASA News Release, Interim Scientific Results Conference, Ranger VII, August 28, 1964, JPLHF 2-173.)

Aug. 29 Soviet Premier Nikita Khrushchev directed congratulations to President Johnson on the success of Ranger 7. (NASA, Astronautics and Aeronautics, 1964, op. cit., 300.)

Aug. 30 In La Jolla, California Dr. Harold Urey disagreed with some of the preliminary Ranger findings released two days before, that the photographs proved the moon's surface strong enough to support manned spacecraft. "I don't see that the pictures show the depth of the dust on the moon's surface," he said. "As of now its thickness is a matter of guess." ("Harold Urey Disputes Moon Surface Theories," Independent (Pasadena), August 31, 1964.)

Aug. 31 Scientific experimenters and other members of the Ranger Project presented initial scientific and engineering results of the Ranger 7 mission to the International Astronomical Union at a special session of their Twelfth International Federation meeting in Hamburg, Germany.

Dr. Thomas Gold, a proponent of the "fairy castle" theory of lunar surface structure, stated that nothing appearing in the Ranger 7 photographs provided any reason for a revision of this hypothesis; he disputed Dr. Kuiper's interpretations which indicated the presence of lava flows on the moon.

Dr. Fritz Zwicky of Caltech "commented with some acidity that he had long ago proposed that a projectile be fired into the moon to see what effect it would have on the surface. Had such a device been fired from Ranger 7 as it approached, the argument of how soft and dusty its surface may be might have been settled, he said."

By a formal act of the Union, the unnamed small lunar sea in which Ranger 7 impacted was named "Mare Cognitum," the sea which

Aug. 31 cont. has become known. (NASA, memo from O.W. Nicks to H.E. Newell, September 8, 1964, JPLHF 2-399; NASA EP-38, The View from Ranger, 45, JPLHF 2-574; NASA, Astronautics and Aeronautics, 1964, op. cit., 301; and, "What the Moon Ranger Couldn't See," Saturday Review, September 5, 1964, 40, JPLHF 2-599; also, "Ranger Photos Stir Debate on Surface of Moon," New York Times, September 1, 1964.)

During August — Ranger Block III. Authorization to assemble the TV subsystems for Rangers 8 and 9 was received during the month. Delivery dates were slipped to October and November, 1964, respectively. (RCA, Ranger TV Subsystem, Block III, Final Report, Vol. I: Summary, July 22, 1965, 2, JPLHF 2-960.)

Sept. 1 — General William F. McKee was appointed NASA Assistant Administrator for Management Development, reporting directly to the Administrator. (NASA Announcement No. 64-190, September 1, 1964, JPLHF 2-170.)

Sept. 4 — In response to a JPL request of August 18, NASA Headquarters approved a one-month slip in the launch of Ranger 8 from January to February, 1964. No slip in the launch of Ranger 9 was authorized, however, although a reassessment was possible at a later date, since the launches were now back-to-back one month apart. (NASA, TWX from O.W. Nicks to H.M. Schurmeier, September 4, 1964, JPLHF 2-398.)

Dr. Thomas Gold, in an article in Science, asserted that the absence of surface rock outcroppings in Ranger 7 close-up lunar photographs supported his contention that much of the moon was covered with a layer of dust. The dust, however, even if of great depth, should not be a cause of concern to a manned lunar landing since it would tend to compact and not be necessarily loose or powdery below the surface. (Dr. T. Gold, "Ranger Moon Pictures, Implications," Science, September 4, 1964, 1046-1048.)

In a letter to the editor, in the same issue of Science, Andrew T. Young, associated with Harvard College Observatory, observed that aside from the aesthetic value of the Ranger 7 photographs,

> "one cannot say that these pictures provide great scientific knowledge. They may be adequate for certain statistical studies of small craters. They *may* indicate that the 'dust' layer is thin, or that it is solid enough to support crater formation; in any event, we expect to learn the actual thickness of the insulating layer from groundbased infrared and

Sept. 4 cont. microwave studies in the next few years. On the whole, the pictures show nothing very surprising."
(Andrew T. Young, "Space Program and Earth-Based Astronomy," Letters to the Editor, Science, September 4, 1964, JPLHF 2-1879.)

Sept. 5 The varied interpretations being given Ranger 7 lunar photographs, especially as they related to a manned lunar landing, were discussed in Saturday Review by Science editor John Lear:

"The net sum of the evidence here recited is that the Congress and the people have been misled about the true significance of the RANGER VII mission. The pictures sent back home by the ingeniously constructed robot dragonfly contain no more assurance of the safety of a manned landing on the moon than existed before Ranger VII took off. On the contrary, one sure danger has been discovered that had not been suspected before. The apparent disappearance of the supposed danger of impenetrable dust is accompanied by the equal danger of a landing surface that may be as fragile as a tea biscuit. Ranger VII couldn't possibly have seen what matters most of all when human expeditions of the moon are being weighed: the bearing strength of the lunar face. Given man's present limited knowledge of soil physics, no photograph could tell whether the moon's surface will hold a special space boat or even a lone man. . . ." (p. 40)

Sept. 7-12 The Fifteenth Congress of the International Astronautical Federation (IAF) was held in Warsaw, Poland. Dr. W.H. Pickering, JPL Director, and H.M. Schurmeier, Ranger Project Manager at JPL, presented a first report to the Congress on the Ranger 7 mission. Dr. Pickering was unanimously elected new President of the IAF at its opening session. The Ranger photographs were the "number one topic" at the meeting, but little interest was expressed in their potential science content. (NASA, Astronautics and Aeronautics, 1964, op. cit., 309; and, Report of the OSSA Staff Meeting, September 17, 1964, JPLHF 2-1754.) On his return trip Dr. Pickering stopped in Rome, Italy to accept the Columbus Gold Medal for 1964.

Sept. 9 JPL issued schedules for work completion on Rangers 8 and 9. Launch of Ranger 9 as currently scheduled was emphasized. (JPL, IOM from H.M. Schurmeier to Ranger Distribution, September 9, 1964, JPLHF 2-1880.)

Sept. 11-12 The Space Science Board of the NAS met in Washington, D.C. to discuss and outline proposed national goals in space exploration. (Prior discussions between members of the Space Science Board and NASA Headquarters resulted in a consensus that it was time for the Board to undertake a study of certain desirable areas for future space research.) Accordingly, plans were drawn up by the SSB to

Sept. 11-12 cont. invite specialists from several scientific disciplines to convene for a Summer Study at Woods Hole, Massachusetts, during June and July of 1965. (Space Science Board, Space Research, Directions for the Future, Part I, 1965, iii, JPLHF 2-756; and, letter from Frederick Seitz, President, National Academy of Sciences, to James E. Webb, October 30, 1964, JPLHF 5-302a.)

Sept. 15 NASA issued SP-61, Ranger VII Photographs of the Moon: Part I, Camera A Series.

Sept. 16 The launch date for Ranger 8 was officially slipped from January to February, 1965. Launch of Ranger 9 remained scheduled for March. (Official NASA Flight Schedules, September 16, 1964, JPLHF 2-968.) (See September 4, 1964.)

Sept. 17 The Wall Street Journal noted the growing conflict in interpreting Ranger 7 data. (Jerry E. Bishop, "New Look at Ranger VII: After Early Jubilation, Scientists Debate what it Revealed," Wall Street Journal, September 17, 1964.)

Sept. 18 NASA OSSA recommended against a proposal to name a lunar landing site after President Kennedy since the International Astronomical Union, responsible for naming lunar features, did not include political leaders among candidate categories of names. (NASA, memo from H.E. Newell to J.E. Webb, September 18, 1964, JPLHF 2-400.)

Sept. 21 JPL received informal notice from NASA Headquarters that chances for an additional Ranger flight (RA-10) had only a 50-50 chance of being implemented. More than one additional flight had almost no chance whatever. (JPL, Ranger Status Report from H.M. Schurmeier to Executive Council, September 21, 1964, JPLHF 2-1315.) (See August 21, 1964.)

Sept. 23 Agena B 6006 completed the assembly cycle at LMSC in Sunnyvale, California.

Sept. 25 Dr. Gerard P. Kuiper, principal investigator on Ranger Block III, notified co-experimenters that a one-day meeting would be held at the Lunar and Planetary Laboratory in Tucson, Arizona, to coordinate efforts being made toward a final scientific report to NASA Headquarters on the results of Ranger 7. (Memo from G.P. Kuiper to Co-Experimenters, Ranger Project, September 25, 1964, JPLHF 2-1881.)

JPL issued STOR R7001, Ranger VII System Test and Operations Report.

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Sept. 29	Oran W. Nicks, OSSA Director of Lunar and Planetary Programs, extended congratulations to JPL on the success of Ranger 7, and noted the importance for success of the forthcoming flights of Rangers 8 and 9. (NASA, letter from O.W. Nicks to W.H. Pickering, September 29, 1964, JPLHF 2-171.)
Sept. 30	At an international conference on earth sciences held at MIT, Dr. Gerard P. Kuiper flatly asserted that much of the lunar surface was naked lava, indicating that the lunar seas were of volcanic origin. The moon, he continued, is constantly "sandblasted" by high-speed particles from space. These impacts knock more material off the moon than is deposited by the bombardment. "Dr. Kuiper said other recent photographs of the lunar seas in various wavelengths, including infrared, showed sharp relief features in the lunar seas that were lava flows. 'There cannot even be one millimeter' of cosmic dust on the surface, he stated." (NASA, Astronautics and Aeronautics, 1964, op. cit., 331; also, Walter Sullivan, "Surface of Moon is Said to be Lava," New York Times, October 1, 1964.)
During September	Ranger Block III. The PTM was placed in a standby condition, standard operation mission support mode, available for support testing as required. The RA-8 TV subsystem completed system, vibration, and thermal vacuum tests during the month. (JPL, Ranger Spacecraft System Review, Minutes of September 16, 1964, JPLHF 2-1313.)
	Northrop Space Laboratories issued a Ranger Technology Utilization Review and Analysis, Final Report, NSL 64-192. (See January 7, 1964.)
Oct. 1	To enhance development of space exploration technology and engineering services for space flight projects, JPL established a new division, Project Engineering, under an Assistant Laboratory Director for Lunar and Planetary Projects. The new division, Division 29, was composed of: Section 291, Launch Vehicle Integration; Section 292, System Design and Integration; Section 293, System Test and Launch Operations; and Section 294, Environmental Requirements. (These sections were drawn from the Systems Division, Division 31; its assignments now focused primarily upon data requirements and computer related technology.) Mr. John Small was appointed Chief of Division 29. (JPL, IOM from A.R. Luedecke to Distribution, October 1, 1964, JPLHF 2-442.)

1964

Oct. 5 The Lunar and Planetary Office in NASA OSSA informed JPL that it would make a presentation for follow-on Ranger flights in a package covering two proposals (Ranger 10 and Rangers 11/12) after the OSSA budget stabilized. (JPL, Ranger Status Report No. 182, from H.M. Schurmeier to Executive Council, October 5, 1964, JPLHF 2-1315.)

Oct. 7 Recommendations for subsystem design improvements for incorporation in any follow-on Ranger spacecraft were prepared at JPL. (JPL, IOM from J.H. Newman to D. Alcorn, October 7, 1964, JPLHF 2-1883.)

Oct. 10 Dr. Gerard P. Kuiper, Director of the University of Arizona's Lunar and Planetary Laboratory, charged that Science Editor John Lear's article on Ranger 7 in the September 5 issue of Saturday Review "implies nonexisting dark forces, . . . and misleads the U.S. public. . . . One implication of Mr. Lear's article seems to be that I have given him information to the effect that scientists are under pressure to make statements that are favorable to the continuance of large government projects. This is complete fantasy. . . ." (Gerard P. Kuiper, in Letters to the Editor entitled "The Ranger VII Report," in Saturday Review, October 10, 1964, 32, JPLHF 2-1975.)

Oct. 12 JPL issued EPD 242, Space Flight Operations Memorandum, Ranger VII, which summarized performance of the spacecraft, space flight operations, trajectory data, and television picture analysis, among other considerations.

Oct. 13 The NASA-JPL "buy-off" meeting for the Ranger 8 TV subsystem was held at RCA-AED facilities in Hightstown, New Jersey. The subsystem was accepted for shipment to JPL with some reservations, since there were assembly and test problems with the equipment still outstanding. (JPL, IOM from Brooks T. Morris to JPL Director/Deputy Director, October 19, 1964, JPLHF 3-317.)

Oct. 14 JPL submitted manpower and cost estimates for additional RA-11 and RA-12 missions to NASA Headquarters. (JPL letter from H.M. Schurmeier to N.W. Cunningham, October 16, 1964, JPLHF 2-1886a; and attachment entitled "RA-11 and RA-12 Estimates," October 14, 1964, JPLHF 2-1886b.) (See August 21, 1964, RA-10 proposal submitted.)

Oct. 16 Major General S.C. Phillips of the NASA OMSF requested that OSSA select a lunar aim point for Ranger 8 (a) within the permissible Surveyor and Apollo landing zones, and (b) in a ray-free maria region characterized by the lowest albedo and least observable

Oct. 16 cont. surface relief consistent with spacecraft and trajectory constraints. (NASA, memo from Maj. Gen. S.C. Phillips to O.W. Nicks, October 16, 1964, JPLHF 2-2062.)

Agena B Vehicle 6007 completed assembly at LMSC in Sunnyvale, California.

Oct. 18 NASA Headquarters requested that JPL assess a three-month slip instead of a JPL-proposed one-month slip for Ranger 9. A JPL first review indicated that the effects of a three-month slip on dollars, manpower, and the DSN were so profound that it would be preferable to stay with the present back-to-back launch schedule on a one-month center. (JPL, Ranger Status Report for October 19, 1964, JPLHF 2-1315.)

Oct. 19 JPL reported that analysis of the last lunar photograph transmitted by Ranger 7 found that median slope of the lunar surface was 1.6° over a 30-ft. distance. No problems for the Apollo LM design were indicated. (NASA, Astronautics and Aeronautics, 1964, op. cit., 357.)

Oct. 22 NASA Headquarters advised JPL that Project Ranger would be terminated with the flight of Ranger 9. Present plans called for leaving Ranger 9 at the one-month launch interval. (JPL, Ranger Status Report for October 26, 1964, JPLHF 2-1315.)

Oct. 23 Dr. John A. O'Keefe of the Goddard Space Flight Center reported in Science that Ranger 7 photos provided evidence for recent volcanism on the moon; that that body was therefore not a dead cinder ball as many astronomers believed.* ("Interpretation of Ranger Photographs," Science, October 23, 1964, JPLHF 2-1887.)

Oct. 23-24 Ranger experimenters met at the Lunar and Planetary Laboratory of the University of Arizona. Major differences of opinion were again reflected in the scientific papers that were presented. Another problem involved a lack of funding at JPL to fully

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*This unauthorized release caused consternation among Ranger experimenters who expected sole NASA rights to the use of photo data for ninety days, as established in agreement on September 11, 1963. While MSC carefully observed this restricted, the Goddard Space Flight Center had not been notified, and Dr. O'Keefe was not aware of this restriction. (NASA, Memo to Ranger Files, from N.W. Cunningham, October 13, 1964, JPLHF 2-1728.)

Oct. 23-24 cont. process photographs. (Minutes, Experimenters Meeting, Ranger VII, Lunar and Planetary Laboratory, University of Arizona, October 23-24, 1964, JPLHF 2-660; and, Ranger Status Report for October 26, 1964, loc. cit.)

Oct. 28 NASA Headquarters concluded a review of the NSL reports prepared under Contract NAS 7-277, to identify any possible technological advances and innovations developed in the course of Ranger Block III efforts which might have direct application to commercial industry. A conclusion was reached that in Ranger Block III "very little use was made of 'off the shelf' equipment, and few technological innovations were required. . . . it follows that most of the work that was done in the development of Ranger Block III consisted largely of minor support re-design together with extensive re-packaging--all of which was well within the state of the art." (NASA memo from Earl D. Hilburn, Deputy Associate Administrator, to George Friedl Jr., Deputy Associate Administrator for Industry Affairs, October 28, 1964, JPLHF 2-1888.)

NASA Headquarters notified JPL that "the review of the Ranger 9 scheduling situation and the question regarding the possibility of adding another flight to the program has been completed within the Office of Space Science and Applications. Based primarily on the fiscal situation, and the JPL input relative to manpower and DSN support, a tentative decision has been made not to change the Ranger 9 schedule and to discontinue further consideration of additional Rangers. . . ." (NASA, TWX from N.W. Cunningham to H.M. Schurmeier, October 28, 1964, JPLHF 2-1889; and, Memo to Files, from W. Jakobowski, November 3, 1964, JPLHF 2-1729.) (See October 22, 1964.)

The Space Science Board of the NAS publicly issued its statement on national goals in space, 1971-1985, via a speech by Dr. Homer E. Newell, in Philadelphia. The Board recommended unmanned exploration of the nearer planets as the most rewarding goal on which to focus national attention for the ten to fifteen years following manned lunar landing. Mars, in particular, was singled out as the planet deserving primary attention. The lunar program should be subordinate to a program for the exploration of Mars. (Document entitled, "Statement of the Space Science Board of the National Academy of Sciences on National Goals in Space, 1971-1985," October 28, 1964, JPLHF 2-302b; also, Karl Abraham, "Scientists Ask U.S. Give Priority to Unmanned Solar-System Probes," Evening Bulletin, Philadelphia, October 28, 1964.)

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Oct. 30	The SSB of the NAS transmitted its space goals report (discussed October 28) to NASA Administrator James E. Webb. (Letter from Frederick Seitz, to James E. Webb, October 30, 1964, loc. cit.)
	NASA OSSA was requested to institute uniform sterilization and decontamination policies and requirements for all deep space flight projects. (NASA, memo from R.C. Seamans to H.E. Newell, October 30, 1964, JPLHF 2-450.)
During October	Ranger Block III. Ranger 8 was released from storage and mechanical assembly was completed. Subsystem checkout and calibration indicated no problem more serious than a defective attitude-control module. The Ranger 8 TV subsystem arrived at JPL October 18 and was assembled with the spacecraft bus for systems tests, which continued throughout the remainder of the month. (JPL, Space Programs Summary No. 37-31, Vol. I, for the period November 1, 1964 to December 31, 1964, 6; Space Programs Summary No. 37-30, Vol. I, for the period September 1, 1964 to October 31, 1964, 7; and, Space Programs Summary No. 37-31, Vol. VI, for the period November 1, 1964 to December 31, 1964, 2.)
	Ranger 9 was removed from storage, and the wiring ring harness was modified to be compatible with the reworked TV subsystem. Initial alignment, calibrating, and testing of the assembled RA-9 TV subsystem began at RCA facilities in New Jersey. (JPL, Space Programs Summary No. 37-30, Vol. I, loc. cit.; and, Space Programs Summary No. 37-31, Vol. I, loc. cit.)
Nov. 3	The Ranger Project Manager H.M. Schurmeier notified Dr. Gerard Kuiper, Ranger Block III Principal Investigator, that the meeting in which formal results of Ranger 7 would be presented to NASA was scheduled for December 15 in Washington, D.C. "The press will be invited to attend, but the meeting is not to be set up as a press conference." (JPL, letter from H.M. Schurmeier to G.P. Kuiper, November 3, 1964, JPLHF 2-1890.)
Nov. 5	A review of the RA-8 and RA-9 test and operations plan was held for Dr. Seamans and his staff by NASA OSSA project personnel. The JPL-planned microscopic inspection of RA-8 prior to shipment to AMR was approved, and the one-month back-to-back launch of RA-9 was confirmed. (NASA, letter from N.W. Cunningham to H.M. Schurmeier, November 9, 1964, JPLHF 2-174; and, Ranger Status Report, November 9, 1964, JPLHF 2-1315.)

1964

Nov. 5 cont. Mariner III was launched toward the planet Mars from AMR Pad 12. The Atlas-Agena D performed as planned; however, the nose fairing failed to separate from over the spacecraft and the mission was lost. (NASA, Astronautics and Aeronautics, 1964, op. cit., 378.)

Nov. 9 NASA Associate Administrator Dr. Robert Seamans notified Dr. Homer Newell, NASA Associate Administrator for OSSA, that upon reflection he held reservations about disassembly and microscopic inspection of RA-8 after environmental tests because of the possibility of interjecting foreign objects into the various subassemblies. If disassembled, absolutely no changes, part substitutions, or repairs should be made without special approval. (NASA, memo from Robert C. Seamans Jr. to Homer E. Newell, November 9, 1964, JPLHF 2-1891.)

NASA turned over release of Ranger 7 lunar surface film clips and glossy photos for the public to several private contractors. 70,000 requests for photos since August had swamped NASA and JPL Public Information Offices. (NASA, memo from N.W. Cunningham to H.E. Newell, November 9, 1964, JPLHF 2-401.)

Nov. 10 NASA OSSA advised the JPL Ranger Project Office that JPL would "educate other programs within OSSA on [spacecraft] testing procedures." (JPL, Ranger Status Report, November 16, 1964, JPLHF 2-1315.)

Nov. 13 JPL Ranger Project personnel were notified that NASA Headquarters had considered the possibility of a one- or three-month slip for RA-9, and had "decided that there is to be no rescheduling . . . accordingly, RA-8 and RA-9 remain on the one-month center." (JPL, IOM from H.M. Schurmeier to Distribution, November 13, 1964, JPLHF 2-1892.) (See October 18, 1964.)

Nov. 16 The NASA OMSF notified JPL that

> The excellent results of your RANGER VII mission have had a striking effect on our attitude toward the lunar surface. Where we previously had tended toward a pessimistic view, we are now perhaps a trifle overconfident that we will be able to find a suitable landing site. The emphasis in our discussions has shifted from the optical to the mechanical characteristics of the surface, although we are aware that this confidence cannot be wholly justified on the basis of a single sample. Accordingly, our first suggestion for targets for RANGERS VIII and IX would be to return to the impact site of RANGER VII. . . . Assuming the above mission is not feasible, our next suggestion would be an attempt to provide increased confidence in our ability to select smooth landing sites from earth-based observations. Having successfully predicted one smooth site, we believe the greatest

Nov. 16 cont.

gain in confidence would be achieved by predicting and finding a poor site. Accordingly, we suggest that RANGER VIII be aimed at an area which we currently might expect to be a poor landing area. . . .

(Letter from Joseph F. Shea, Manager, Apollo Spacecraft Program Office, to H.M. Schurmeier, November 16, 1964, JPLHF 2-2086.)

Nov. 17

NASA Chief of Lunar and Planetary Projects Mr. Oran W. Nicks, recommended to Dr. Homer Newell, Associate Administrator for OSSA, that one of the remaining Ranger flights be directed to obtain high resolution photographs of the backside of the moon. "I should . . . like to recommend such a mission because it could be done relatively soon, and would obviously be of exciting significance to the scientific community and would have prestige value. . . ." (NASA, memo from O.W. Nicks to H.E. Newell, November 17, 1964, JPLHF 2-402.)

Nov. 18

Robert C. Cowen of the Christian Science Monitor reported on JPL studies undertaken to reproduce small lunar craters with softly rounded edges that appeared in Ranger 7 photographs. Among the tools used were sand tables in which an impact was made, and then fine sand and dust were sifted over the surface:

"According to an informal [JPL] report, the sand experiments suggest the pictures may show an area deeply buried in dust. But this will convince no one. Those who feel the moon is covered in dust kilometers thick feel the photographs support their view. Those who think the lunar dust layer is very thin also feel vindicated. The successful performance of the Ranger spacecraft was a magnificant engineering achievement. But the plain fact is, three months after impact the photos themselves have added very little to our knowledge."

(Robert C. Cowen, "Was the Ranger Worth the Cost?" Christian Science Monitor, November 18, 1964.)

Nov. 19

The success of Ranger 7, which increased interest in selection of target areas for Rangers 8 and 9, resulted in a meeting at JPL attended by Ranger experimenters and project personnel, and representatives from MSC in Houston, OMSF in Headquarters, Bellcomm., the Surveyor Project, and the Lunar Orbiter Project. Requirements and recommendations from each group were presented and discussed. Drs. Urey, Shoemaker, and Whitaker reviewed their conclusions that the moon's surface material might be of a sufficiently unstable nature that slumping could take place. Dr. Kuiper maintained his

Nov. 19 cont. thesis that the surface consisted primarily of bare lava.

One fundamental area of agreement was secured: that the prime objective of Ranger 8 should be used to improve the lunar model as a whole. A tentative decision was reached that during the first two days of the RA-8 launch window, Mare Tranquillitatis was favored. In the event of a slip to the third and fourth day, a highland or crater aim point (to be named) was preferred; if delayed until the fifth and sixth days, impact should be directed to an area of Surveyor interest. (JPL, Minutes of Ranger 8 and 9 Target Selection Meeting, November 19, 1964, JPLHF 2-1894; NASA, letter from H.E. Newell to G.E. Mueller, Director of OMSF, January 19, 1965, JPLHF 2-1511; NASA, OSSA Review of December 9, 1964, 2-3, JPLHF 2-1505; and, JPL, Ranger Status Report, November 23, 1964, JPLHF 2-1315.)

Nov. 20 NASA Headquarters made initial determination for the functions, authority, and assignments of the NASA JPL Residency Office, and the establishing at JPL of technical representatives from the NASA Office of Lunar and Planetary Programs. (NASA, memo from O.W. Nicks to P.E. Ross, November 20, 1964, JPLHF 2-1895.) (See March 12, 1964.)

Nov. 27 Responding to the request of October 30, 1964, NASA Associate Administrator for OSSA explained NASA's decontamination policy for unmanned deep space missions to Dr. Seamans, NASA Associate Administrator, and indicated that Mr. Lawrence B. Hall was developing policy guidance in this area for Project Apollo. (NASA, memo from H.E. Newell to R.C. Seamans, Jr., November 27, 1964, JPLHF 2-453.)

Nov. 28 Mariner IV Mars probe was successfully launched into an interplanetary trajectory from the Atlantic Missile Range. The spacecraft attained its objective, conducted experiments, and photographed portions of the surface of Mars during encounter the following July. (NASA, Astronautics and Aeronautics, 1964, op. cit., 397.)

Nov. 30 The Douglas Aircraft Corporation proposed to OMSF at NASA Headquarters the launch of several Rangers to the moon carrying new payloads in support of Apollo. The proposal, Project ELF, was predicated upon JPL performing the entire job except for the payload. (JPL, Ranger Status Report, November 30, 1964, JPLHF 2-1315.)

1964

During November

Ranger Block III. Ranger 8 spacecraft completed systems tests on October 26, and underwent environmental testing during November. Vibration testing was completed on November 20, and the post vibration system test was completed on November 23. No problems were encountered. At the end of the month the spacecraft was installed in the 25-ft. space simulator preparatory to mission testing. (JPL, Space Programs Summary No. 37-31, Vol. I, op. cit., 2; and, NASA, OSSA Review of December 9, 1964, loc. cit.)

Ranger 9 completed mechanical assembly on November 13 at the SAF. Ground wiring, electrical integrity checks and initial power application were successfully performed. All subsystem tests and calibrations were completed by November 30. (JPL, Space Programs Summary No. 37-31, Vol. I, op. cit., 2-3.)

Dec. 1

Dr. Gerard P. Kuiper, Principal Investigator for Ranger Block III, notified co-experimenters that the article which appeared in the Christian Science Monitor on November 18 "points to the necessity for the scientific team to come up with a strong and coherent Final Report which will enable NASA to counter . . . articles of this type. . . . Clearly, the responsibility of the scientists has increased when projects of the magnitude of Ranger are reviewed." (Letter from G.P. Kuiper to Co-Experimenters, Ranger Program, December 1, 1964, JPLHF 2-1897.)

In recognition of the close functional relationship between the deep space network and the SFOF during operations, management responsibility for the SFOF was transferred from OSSA to the NASA Office of Tracking and Data Acquisition (OTDA). All FY 1965 operating funds for "mission-independent activities" (i.e., activities not associated directly with any single space flight project) also were transferred to OTDA. (NASA, TWX from H.E. Newell to W.H. Pickering, December 1, 1964, JPLHF 2-175; also, U.S. Congress, 1966 NASA Authorization, Part 4, House of Representatives, Subcommittee on Advanced Research and Technology, Hearings before the Subcommittee, 89th Congress, Washington, D.C., March, 1965, 37.)

Dr. J.E. Geake of Manchester College of Science and Technology proposed that lunar subsurface luminescent material raised by impact or volcanic activity could account for the patches of red light periodically observed on the moon. The rocks, he suggested, would emit light when struck by charged particles. (NASA, Astronautics and Aeronautics, 1964, op. cit., 403-404.)

1964

Dec. 2 Mr. N.W. Cunningham, NASA Ranger Project Manager, notified JPL that the experimenters' request to postpone the Ranger 7 Final Report to NASA by one month could not be accommodated. The report, "particularly the portion dealing with the scientific conclusions of the experimenter team," would have to meet the presentation date now scheduled for December 22. In the event JPL could not prepare the published report in time, a final typewritten draft would be acceptable with the published report following as soon as possible. (NASA, TWX from N.W. Cunningham to H.M. Schurmeier, December 2, 1964, JPLHF 2-1899.)

Dec. 14 First among the ten top scientific, technological and medical advances in 1964 as selected by Dr. Watson Davis, Director of Science Service, were:

1. Ranger 7 closeup photographs of the moon.
2. Orbiting of the earth by three cosmonauts in the *Voskhod I* spacecraft.
3. Discovery of quasars, the brightest and most violent sources of light and radio waves.

(NASA, *Astronautics and Aeronautics, 1964*, *op. cit*., 419.)

Dec. 15 Jane's *All the World's Aircraft, 1964-1965*, published in London, declared that the United States probably led the Soviet Union in scientific and military intelligence data acquired from space. Ranger 7 photographs of the moon's surface, termed as "one of the great astronautical achievements of 1964," was cited in support of this contention. (*Ibid*., 421.) (See January 1, 2, 1963.)

JPL issued TR 32-700, *Ranger VII, Part I, Mission Description and Performance*.

Dec. 16 JPL released a report on the results of astronomical observations conducted during the flight of Ranger 7. No citings of lunar impact were observed. "It must be concluded that the probability of detecting impact phenomenon is even lower than expected. It is recommended, therefore, that this program be discontinued except under unusual [viewing] circumstances. . . ." (JPL, J.J. Rennilson, "Astronomical Observations During Flight of Ranger VII," December 16, 1964, 3, JPLHF 2-1900.)

1964

Dec. 16 cont. NASA Headquarters executed a two-year extension of the Caltech contract for operation of the Jet Propulsion Laboratory (NAS7-100, Mod. 10). (See February 3, 1964.) Significant changes are summarized below:

1. The principal change between the old contract and Modification No. 10 was that NASA could now issue unilateral direction to CIT to perform work within six broad areas of activity as follows: (1) exploring the moon and its environment, the planets, and interplanetary space; (2) conducting programs of supporting research and advanced technical development; (2) developing and operating the deep space instrumentation facility and space flight operations facilities; (4) carrying out investigations in the field of aeronautics; (5) assisting NASA in the formulation and execution of its programs by providing technical advice, studies, and reports; and (6) providing technical direction or project management in connection with contracts for work falling within the broad areas listed above. Under the previous contract CIT had the right to request negotiations and discussions before it would accept any specific new task. (This provision was known as the mutuality clause.)

2. The new contract also provided for an "authorized manpower" clause. This clause permitted the contracting officer to establish a manpower ceiling on the total number of persons which the contractor could employ at JPL and provided for disallowing costs of persons employed in excess of the ceiling.

3. All property of a facilities nature, including real estate was placed under a separate facilities contract.

4. The new contract provided Caltech a variable fee range based upon: (1) the NASA approved financial operating plan; (2) extent of subcontracting; (3) complexity of work; and (4) past performance evaluations conducted under a new clause of the contract entitled "Evaluation of Contractor's Performance."

(NASA Authorization for Fiscal Year 1966, op. cit., 713-714; and Robert C. Toth, "Caltech Signs [sic] New Pact with Space Agency to Operate JPL," Los Angeles Times, December 18, 1964.)

Dec. 18 JPL issued TR 32-663, Ranger Block III Attitude Control System.

JPL issued TR 32-694, Ranger 7 Flight Path and Its Determination from Tracking Data.

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Dec. 21 JPL issued EPD 78, Revision 5, Space Flight Operations Plan, Rangers 8 and 9.

Dec. 22 The Ranger experimenters team presented the findings of Ranger 7 mission to NASA Headquarters in Washington, D.C. Data presented included spacecraft performance, publication of photographic atlasas, a summary of ACIC work, and individual experimenters' reports. As before, experimenters differed vigorously in their interpretation of photographic results. (NASA, "Presentation of Ranger VII Mission Results," Agenda, December 22, 1964, JPLHF 2-1901; and, Ranger Status Report of December 28, 1964, JPLHF 2-1315.)

Dec. 23 JPL created a new position of Deputy Assistant Laboratory Director for Lunar and Planetary Projects. Mr. Jack N. James was appointed to the position; Mr. Dan Schneiderman was appointed Manager of the Mariner C Project. (JPL, IOM from A.R. Luedecke, to Senior Staff, et. al., December 23, 1964, JPLHF 2-282.)

Dec. 28 The Christian Science Monitor reviewed NASA-issued flight record for 1964. There were 28 successful missions out of a total of 33 launches. "That gives NASA a yearly average of 85 percent. The highlight of the year, of course, was the photographing of the moon's surface by Ranger 7, a thousand times clearer than had ever been done by telescopes on earth." (Neal Stanford, "NASA Adds Up Successes," Christian Science Monitor, December 28, 1964.) (See January 27, 1964.)

Agena B vehicle 6006 completed systems test at LMSC, Sunnyvale, California, and was accepted by NASA.

Dec. 30 The American Geophysical Union Western Division meeting was held in Seattle, Washington. Dr. Harold Urey told scientists in attendance that the structure of some of the ridges on the lunar surface photographed by Ranger 7 indicated that water might have been present on the moon at some time. (NASA Authorization for Fiscal Year 1966, op. cit., 438.) (See November 4, 1961 and April 7, 1962.)

Scientific American printed an article by Dr. Eugene Shoemaker, "The Geology of the Moon," which attempted to determine a time scale for lunar events in the Mare Imbrium region employing Ranger photographs. (Scientific American, Vol. 211, No. 6, December, 1964, JPLHF 2-1908.)

During December

Ranger Block III. Updating operations and all scheduled tests were completed on the Ranger PTM. The vehicle was maintained in the final Block III configuration for use in evaluating any problems that might develop during the missions of Rangers 8 and 9. (JPL, Space Programs Summary No. 37-31, Vol. VI, op. cit., 1.)

Ranger 8 with the TV subsystem installed underwent two complete 66-hour mission tests in the 25-ft. space simulator on December 12. Minor timer clock and camera resolution problems were encountered. Subsequently, the vehicle underwent RF link tests (minimum cables) in the chamber. Final electrical tests were completed on December 30. (Ibid., 2; NASA, OSSA Review of December 9, 1964, loc. cit.; and, JPL, Space Programs Summary No. 37-32, Vol. I, for the period January 1, 1965 to February 28, 1965, 2.)

The Ranger 9 RCA TV subsystem was accepted by JPL on December 2, and the unit was shipped to JPL, arriving at the SAF on December 4. Camera quality was considered best in the Block III series. All precountdown and countdown dummy runs for the assembled RA-9 spacecraft were completed by December 30. (JPL, Space Programs Summary No. 37-32, Vol. VI, for the period January 1, 1965 to February 28, 1965, 2-3; and, NASA, OSSA Review of December 9, 1964, loc. cit.)

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Jan. 4 The Ranger 8 spacecraft pre-shipment buy-off meeting was held at JPL. Except for two open items the test record was "quite clean." JPL recommended shipment; NASA Headquarters representatives, with concurrence of O.W. Nicks, affirmed this decision and the spacecraft was shipped to AMR that evening. (NASA, OSSA Review of January 12, 1965, JPLHF 2-1505, and, JPL, Ranger Status Report from H.M. Schurmeier, to Executive Council, January 5, 1965, JPLHF 2-1315.)

Dr. G.P. Kuiper, Principal Investigator on Ranger Block III, submitted a revised manuscript of Ranger 7 scientific findings to the JPL Ranger Project Manager. (Letter from G.P. Kuiper to H.M. Schurmeier, January 4, 1965, JPLHF 2-2017.)

The Christian Science Monitor ran a second installment of "Was Ranger Worth the Cost?" The article contained a response to the initial article from Dr. Kuiper, who pointed out that no known ground based telescopic effort could provide 1u0th of the magnification (resolution) obtained by Ranger 7: "I definitely know of no better and cheaper way to get high-resolution lunar photographs--if I did, I would propose it," Dr. Kuiper asserted. Turning to the contention surrounding Ranger's photographic return, he observed that "scientists normally do not talk about points of agreement, but debate their differences, the very process by which alternatives are sorted out . . . . [and that] lunar problems are geophysical in nature and it is well known that major geophysical problems such as mountain and continent formation are still being debated hotly though the earth is right at hand."

In response, Robert Cowen cited Andrew T. Young, a Research Fellow at Harvard College Observatory, to the effect that "'Rocket-borne research involves many costly failures, but a duplicate 200-inch telescope could easily be built and staffed for the $28 million that Ranger 7 alone cost. . . .'" Cowen continued:

> "The question can still be asked, was it worth $270 million to get two or three series of high resolution photos of tiny areas of the Moon? Nothing that has been announced to date encourages the belief that such photos will be of great scientific value in studying the origins of the earth and the moon. It is hard for some of us to escape the conclusion that Ranger has been pushed (by the administration, not by dedicated scientists such as Dr. Kuiper) more for its publicity value than for its scientific value. Indeed,

1965

Jan. 4 cont.

> Ranger, in this respect, typifies the moon program in general, with its emphasis on a manned landing in this decade."

(Robert C. Cowan, "Was Ranger Worth the Cost?--II," Christian Science Monitor, January 4, 1965.)

Jan. 6 Dr. Harold Urey, a co-experimenter on Ranger Block III, informed Dr. Kuiper that he did "not see any way by which agreement can be secured between myself and the experimenters" in the findings being prepared for the Ranger 7 Experimenters' Report. (Letter from H.C. Urey to G.P. Kuiper, January 6, 1965, JPLHF 2-2018.)

Jan. 15 A Ranger Experimenters' Meeting convened at JPL. Attendees agreed upon the contents and structure of the Ranger 7 experimenter report. It was to be a collection of independent articles presenting individual interpretations of the investigators. (JPL, Experimenter Meeting Minutes, January 15, 1965, JPLHF 2-2019.)

Jan. 19 Dr. H.E. Newell, NASA Associate Administrator for Space Science and Applications, informed Dr. George E. Mueller, Associate Administrator for Manned Space Flight, of results of the meeting at JPL on November 19, 1964 to select the aim points for Rangers 8 and 9:

> ". . . . The OMSF and MSC representatives in particular felt that both Rangers 8 and 9 should be used to increase our total understanding of the moon and should not be narrowly considered as instruments for determining or verifying specific Apollo landing sites. I am in complete agreement with them in this significant conclusion."

(NASA, memo from H.E. Newell to G.E. Mueller, January 19, 1965, JPLHF 2-2060.)

Jan. 22 The Planetology Subcommittee of the SSSC met at UCLA in Los Angeles. After deliberation, the subcommittee recommended that Rangers 8 and 9 photographic data be released as quickly as possible rather than wait for expiration of the 90-day period reserved for project experimenters, as called for in the Ranger Project Development Plan. (NASA, Memo to Files from N.W. Cunningham, March 1, 1965, JPLHF 2-1516.)

Jan. 26 Ranger Agena B vehicle 6007 completed systems testing and was accepted by NASA, in Sunnyvale, California.

Jan. 26 cont. Dr. George Mueller, NASA Associate Administrator for Manned Space Flight, requested Dr. Homer Newell, Associate Administrator, OSSA, that the subject of lunar aim points for Rangers 8 and 9 be reconsidered in light of Apollo lunar landing requirements. (NASA, memo from G.E. Mueller to H.E. Newell, January 26, 1965, JPLHF 2-2061.) (See January 19, 1965.)

Jan. 29 Co-experimenter Ewen A. Whitaker of the University of Arizona submitted his contribution to the Ranger 7 experimenters report to the JPL Project Manager. (Letter from E.A. Whitaker to H.M. Schurmeier, January 29, 1965, JPLHF 2-2020a.)

Jan. 31 A JPL film "Ranger Seven Photographs the Moon" was shown at the Third International Scientific Film Festival in Brussels, Belgium. This film so impressed the large audience that upon request it was shown again at the end of the evening. (U.S. Information Service Field Message No. 35, from USIS Brussels to USIA Washington, D.C., April 21, 1965, JPLHF 2-2043b.)

During January <u>Ranger Block III</u>. Ranger 8 arrived at AMR on January 8. Between January 8 and January 24 initial test and assembly operations were conducted in Building AO. Between January 25 and January 31 the vehicle was moved to the ESA where the midcourse motor was installed and the TV subsystem was tested at full-power. (JPL, <u>Space Programs Summary No. 37-32, Vol. VI</u>, for the period January 1, 1965 to February 28, 1965, 2; and, <u>Space Programs Summary No. 37-32, Vol. I</u>, for the period January 1, 1965 to February 28, 1965, 2.)

During the first week of January, Ranger 9 completed pyrotechnics verification tests and weight and center of gravity tests. Between January 8 and January 13 vibration tests were performed at the Environmental Test Laboratory. After preparation, Ranger 9 was subjected to two complete mission tests in the JPL 25-ft space simulator, which concluded on January 25. RF-link tests occupied the remainder of the month. (JPL, <u>Space Programs Summary No. 37-32, Vol. VI</u>, <u>op. cit</u>., 2-3.)

<u>DSN</u>. The Ranger Space Flight Operations (SFO) system began intensive testing in preparation for the Ranger 8 mission in February. (<u>Ibid</u>., 4.)

<u>General</u>. JPL Director William H. Pickering said in an article in the AIAA journal <u>Astronautics and Aeronautics</u>:

". . . With Ranger 7, the prime factor was the expectation that the Apollo mission would choose a landing area on one

During January cont.

> of the smooth 'maria.' So it was of great value to this program to find out as much as possible about the mare topography. In particular, it was necessary to know if these areas were really lava flows and, if so, how much was exposed lava and how ensely the small craters were scattered over the surface. Ranger gave some of the answers. . . . However, the absence of any significant number of features showing edges with a small radius of curvature, and the presence of small craters which have been filled with debris, point to erosion as a significant modifier of the primeval lunar surface. This erosion could arise from meteoric bombardment and the effects of solar radiations. Estimates of the depth of surface which has been eroded away [continue to] range from 5 to 50 feet. . . ."

(W.H. Pickering, "Ranger--On an Upward Trail," Astronautics and Aeronautics, January 1965, 20.)

Feb. 1 NASA Headquarters notified JPL that a meeting would be held in Washington, D.C. on February 6 to reconsider the lunar aim point selected for Ranger 8 in light of Apollo program requirements. (NASA, TWX from H.E. Newell to W.H. Pickering, et. al., February 1, 1965, JPLHF 2-145.) (See January 26, 1965.)

JPL submitted a cost proposal for "Long-Range Ranger Data Analysis" to NASA Headquarters in response to an earlier request. (JPL, letter from H.M. Schurmeier to N.W. Cunningham, February 1, 1965, JPLHF 2-2021a.)

Feb. 2 The Ranger 8 Pre-launch Acceptance (buy-off) Meeting was held at AMR. A major area of concern remaining was sporadic radio interference at 890 mc produced by the television "P" channel transmitter after attaining full power. After discussion among NASA, JPL, and RCA attendees which determined that the anomaly was not sufficiently serious to degrade spacecraft performance, a decision was reached to proceed through remaining operations to launch. (NASA, memo from N.W. Cunningham to E.M. Cortright, February 9, 1965, JPLHF 2-1513.)

Feb. 6 The Ranger 8 lunar target selection meeting was held in Washington, D.C. among representatives of OSSA, JPL, OMSF, and project scientists, to consider additional recommendations for Ranger target sites by the Office of Manned Space Flight. A conclusion was reached by Ranger Project representatives that the primary targets on all but one flight

Feb. 6 cont. day (between February 17 and February 24) were not only of value for a better knowledge of the moon, but also provided opportunity for observing sites in the proposed Apollo landing zone. In the second day of the launch period (February 18) the best landing site was outside the Apollo zone, but offered good opportunity for increased understanding of the moon. The primary target area selected was the lunar Sea of Tranquility, a dark flat area relatively free of crater rays on the lunar equator, near the shadow line on the three-quarter moon. Dr. Mueller and General Phillips of OMSF were briefed on the meeting results and concurred in the target points selected. (NASA, memo from O.W. Nicks to H.E. Newell, February 9, 1965, JPLHF 2-1514b.)

Several of the scientists who attended the meeting favored targeting to highland as opposed to flatland lunar regions, and requested OSSA to adopt this position for Ranger 9. (Letter from D.U. Wise of Franklin and Marshall College to Dr. Urner Liddel, NASA, February 4, 1965, JPLHF 2-2028.)

Feb. 9 The Ranger 9 Spacecraft Acceptance (buy-off) Meeting was held at JPL. Authorization to ship to the Cape was received on February 16. (NASA, memo from N.W. Cunningham to E.M. Cortright, February 24, 1965, JPLHF 2-1515.)

Feb. 10 A Ranger Experimenters' Meeting was held at JPL. Decisions reached included: dissemination of Ranger 8 photographic data to selected members of the scientific community should transpire as quickly as possible after impact; a meeting would be held at JPL on February 27 to discuss results of Ranger 8 and to determine objectives for Ranger 9; because of the short interval between the flights of Ranger 8 and 9, scientific results for both flights would be incorporated in one report. Completion of drafts for this report was set for July 31. (Minutes of Ranger Experimenters Meeting, February 10, 1965, JPLHF 2-2022.) (See January 22, 1965.)

JPL issued TR 32-700 Part II, Ranger VII Experimenters' Analyses and Interpretations.

Feb. 15 NASA announced distribution of Ranger 7 photographs to scientists around the world, including the Soviet Union. (NASA News Release No. 65-35, "NASA Distributes Ranger VII Photos to World Scientists," February 15, 1965, JPLHF 2-2024.)

JPL confirmed understanding with NASA for immediate release (within 48 hours) of Ranger 8 photographs to selected scientists in the

Feb. 15 cont. United States and abroad, including the U.S.S.R. (JPL, TWX from H.M. Schurmeier to N.W. Cunningham, February 15, 1965, JPLHF 2-2025.)

JPL issued Description and Flight Analysis of Ranger 7 TV Sub-System, TR 32-680.

NASA issued SP-62, Ranger VII Photographs of the Moon, Part II, Camera B. Series.

Feb. 17-20 Ranger 8, Atlas 196D, Agena B 6006, was launched at 9:05 a.m. PST from Cape Kennedy at conclusion of the first countdown. Mission objectives and content were the same as programmed for Ranger 6 (see January 30-February 2, 1964). The Atlas and Agena boosters again performed satisfactorily, and the Ranger 8 was injected into a lunar trajectory that would carry the vehicle around the trailing edge (right side) of the moon at an altitude of about 1,000 miles, well within the midcourse correction capability. By 1:30 p.m. PST, Ranger 8 had completed deployment of its solar panels and established normal cruise mode operations (i.e., Sunlock, Earthlock, and transition to high gain antenna). No spacecraft anomalies were detected. (Figure 63.)

The selected target point for Ranger 8 was near the lunar equator in the Sea of Tranquility, not far from the Ranger 6 impact site. Therefore, as planned (and carried out on previous missions), a spacecraft course correction maneuver was scheduled for about 16 hours after launch, when the Goldstone tracking site would be viewing Ranger 8. The commands specifying the roll turn, pitch turn, and amount of impulse to be delivered by the on-board rocket engine were composed, sent to the spacecraft, and accepted, and the maneuver was initiated. During this maneuver, and after all ground based commands were accepted by the spacecraft and switchover from the high gain to the omnidirectional antenna had been accomplished--about three seconds after the end of the roll turn--the Ranger 8 spacecraft transmitter power dropped to a degree that caused the Deep Space Net to lose lock on all telemetry channels. This condition continued intermittently for 25 minutes through the pitch turn, until suddenly, coincident with the firing of the midcourse motor, the power level returned to normal. (Figure 64.) The spacecraft properly completed the midcourse maneuver--which ultimately brought Ranger 8 to within 15 miles of its intended target on the lunar surface--and resumed normal cruise mode operations.

The telemetry dropout, while cause for concern, posed no serious threat to the TV camera system, which operated from independent batteries and transmitters. As in the case of Ranger 7, project experimenters decided not to perform a terminal maneuver

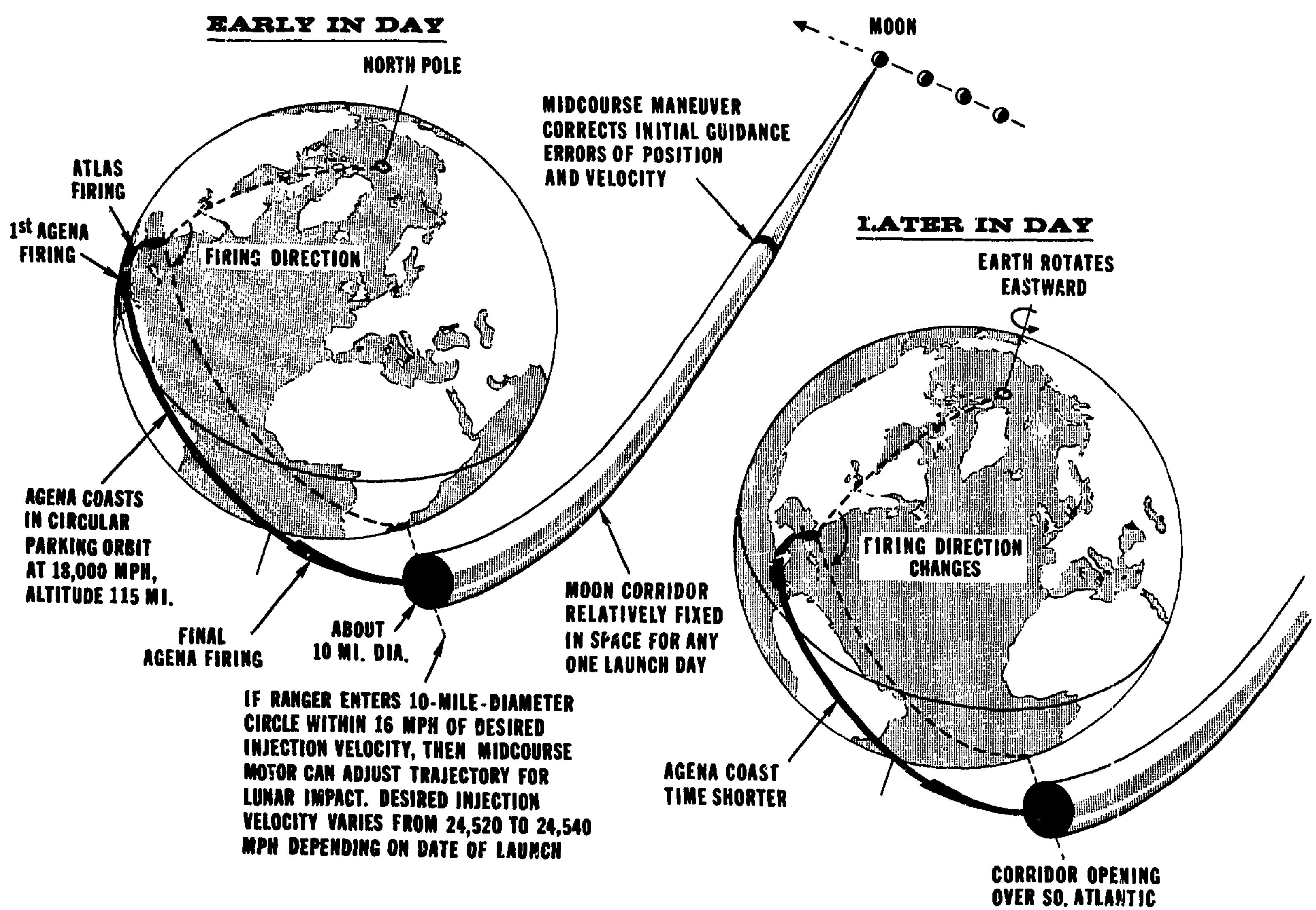

Figure 63: Ranger injection constraints, typical launch to the Moon.

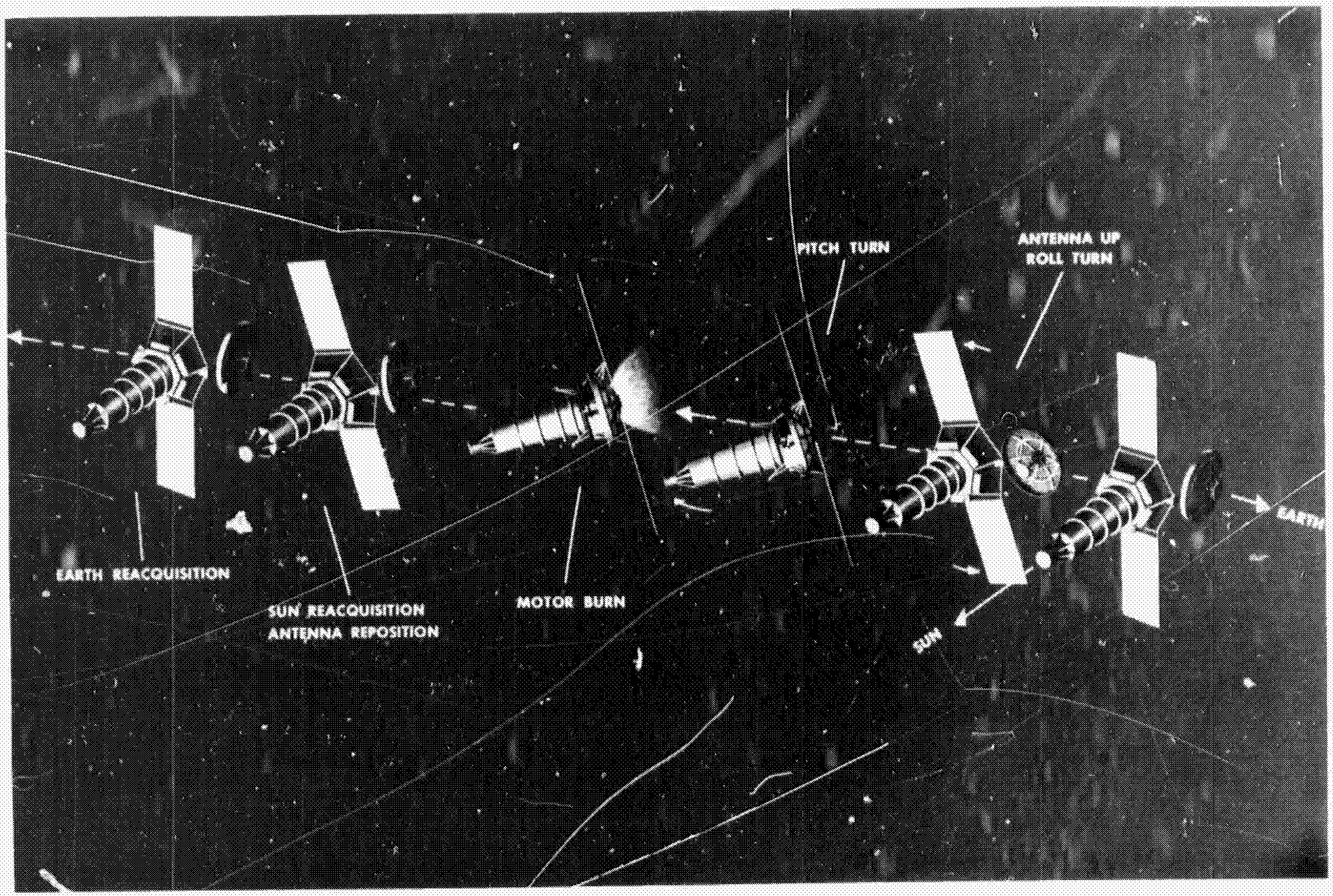

Figure 64: Ranger midcourse maneuver.

Feb. 17-20 cont. which would roll the spacecraft and align the cameras more directly along the velocity vector, thus providing more pictures of the impact zone. (In cruise mode attitude, with the "top hat" omni-antenna pointed toward the sun, the TV cameras "looked" laterally to the line of flight, and would sweep across larger areas of the moon during approach.) Active discussion preceded this decision as some project engineers favored proceeding with the terminal maneuver in order to gain experience in exercising the spacecraft to its full design capability. Dr. Kuiper and other project scientists, however, who were interested in photographic coverage, preferred not to pursue this option, and plans for a terminal maneuver were dropped. In the absence of a terminal maneuver, however, Ranger 8's rather shallow approach to the surface (42 degrees above local horizontal at impact) would cause the terrain to move relatively quickly before the cameras, so that some detail would be distorted in the final frames. Nevertheless, this sacrifice of terminal detail was accepted to gain area coverage of the moon's surface. This approach was also expected to permit stereo groupings and relief mapping. The truncated maneuver employed by Ranger 7, which involved a backup command to turn the TV cameras on, also was employed on Ranger 8; area coverage was increased further by starting TV operations ten minutes early.

Twenty minutes prior to impact, on the morning of February 20 as Ranger 8 descended toward the moon at an angle 48 degrees off the vertical and at an altitude of about 1,550 miles, the spacecraft TV cameras switched to full power and began transmission of pictures. During the next few minutes the field of view of the cameras swept across the face of the moon from the center of the lunar disc, near the large crater Ptolemaeus, to the impact point near the terminator, in the Sea of Tranquility. At 1:57 a.m. PST the whine of telemetry from Ranger 8 ceased upon impact. 7,137 video pictures had been recorded on magnetic tape and on 35 mm film at the Goldstone tracking station. (Ranger C Status Bulletins 1 through 5, February 17 through February 24, 1965, JPLHF 2-1992; JPL Technical Report No. 32-800, Ranger VIII and IX, Part I, Mission Description and Performance; Marvin Miles, "Probe Hits Moon," Los Angeles Times, February 20, 1965; and, Dave Swaim, "6,000-Photo Finish Marks Ranger Trip," Pasadena Star-News, February 20, 1965.)

Feb. 20 Sir Bernard Lovell, Director of the Jodrell Bank Astronomical Observatory in Great Britain, called Ranger 8 "another brilliant achievement." It was hoped, he said, that Ranger 8 would clarify some of the questions raised by Ranger 7 concerning the "nature of the craters and the nature of the lunar surface . . ." (The Jodrell Bank radio telescope did not track Ranger Block III flights.) ("Britain Calls Moonshot 'Brilliant,'" Los Angeles Herald-Examiner, February 20, 1965.)

Feb. 20 cont. The Ranger 8 Post-Impact Press Conference convened at JPL, and selected photographs of the lunar surface were released. Dr. Gerard P. Kuiper, Principal Investigator on Project Ranger, announced that the most important results of this flight had been the discovery of a basic similarity in surface structure between the Mare Cognitum area of the Sea of Clouds and the Sea of Tranquility. He noted that there were several "odd depressed regions" in the photographs returned from Ranger 8 that could be areas where collapse had occurred, which might suggest the presence of lava fields. The surface was, he continued to believe, composed of very light, frothy material as is formed when rock is melted and allowed to resolidify in a high vacuum. His associate, Ewan A. Whitaker, concurred, but said he felt that the surface material had a consistency of crunchy snow, and would support a spacecraft. Dr. Urey also suggested that the surface material might have the consistency of crunchy snow, and he was now more inclined to agree that its bearing strength was sufficient to support spacecraft. He asserted, however, that surface "dimples" in the photos could indicate a kind of surface drainage into underground hollows. Edgar M. Cortright, NASA Deputy Associate Administrator for Space Science and Applications, observed: "Before July 31 we didn't have any spot smooth enough for a possible Apollo landing, then we knew we had at least one. Today we know there are at least two. The big question is--is the surface hard enough?" (Ranger VIII Post-Impact Press Conference, JPL Auditorium, February 20, 1965, JPLHF 2-904; also, Dave Swaim, "Lunar Crust Seems Able to Hold Man," Independent Star-News, Pasadena, February 21, 1965; and, Frank Donoghue, "Froth on the Moon," Los Angeles Herald-Examiner, February 21, 1965.)

Feb. 23 A meeting was held at NASA Headquarters to review plans for immediate release and dissemination of Ranger 8 photographs to scientists other than project experimenters. The favorable recommendation of the project experimenters on February 10, and Planetology Subcommittee recommendations on February 22, were concurred in by OSSA. (NASA, memo to Files from N.W. Cunningham, March 1, 1965, loc. cit.)

Dr. Homer Newell, NASA Associate Administrator for Space Science and Applications, expressed congratulations to JPL Ranger Project personnel on the successful flight of Ranger 8. "These achievements set a pattern to which every one in the space program can turn to with pride. . . ." (NASA, letter from H.E. Newell to H.M. Schurmeier, February 23, 1965, JPLHF 2-2027.)

Feb. 23 cont. Dr. Gerard P. Kuiper informed Dr. Homer Newell that the lunar surface depressions identified in Ranger 7 and 8 photographs were caused by "different degrees of cave-in similar to karst formations on earth resulting from solution of limestone. Lunar depressions being caused by volume decrease due first to freezing of magma. second, cooling of rock, third, escape of gasses. Dimensions indicate surface rock froth layer about 10 meters thick. . . ." (Telegram from G.P. Kuiper to H.E. Newell, February 23, 1965, JPLHF 2-144.)

Feb. 26 The Ranger 8 postflight mission anlaysis meeting was conducted at JPL with representatives from RCA and NASA. (Ranger VIII Post Flight Analysis Meeting, February 26, 1965, JPLHF 2-1995.)

Mr. W.E. Giberson, JPL Surveyor Project Manager, requested that the Ranger Project select an impact site for Ranger 9 "to coincide with the prime site selected for Surveyor. . . ." (JPL, IOM from W.E. Giberson to H.M. Schurmeier, February 26, 1965, JPLHF 2-2029.)

Mr. Oran Nicks, NASA Director of Lunar and Planetary Flight Programs in OSSA, congratulated JPL Ranger Manager Bud Schurmeier on the success of Ranger 8: " . . . the consecutive successes [Rangers 7 and 8] should preclude even the critics from attributing the results to luck. . . ." (NASA, letter from O.W. Nicks to E.M. Schurmeier, February 26, 1965, JPLHF 2-143.)

Feb. 27 The Ranger 9 Target Selection Meeting was held at JPL with participation from Apollo and Surveyor personnel. A general recommendation by all participants was that a terminal maneuver should be performed in order to realize the full resolution capabilities of the Ranger TV system. Various target suggestions were considered and tentative objectives established:

1. Final targets would be in highland regions or other areas of specific scientific interest such as areas where surface outgassing was recently observed.
2. Because of previous accuracy of Ranger flights, target areas would be chosen closer to the terminator.
3. Predicted brightness at the target area should be between 200 and 300 ft.-lamberts to avoid saturating the more sensitive cameras.

(JPL, Ranger D Target Selection, plan presented to Homer Newell in Washington, D.C. on March 10, 1965, by H.M. Schurmeier, JPLHF 2-856.)

1965

During February

Ranger Block III. Ranger 8 underwent final tests and assembly operations at Building AO and at the ESA between February 3 and February 14. (The TV cameras were aligned and calibrated, the high gain antenna was installed and tested, and the midcourse motor was fueled, etc.) Ranger 8 was mated with the Atlas Agena boosters at Launch Complex 12 on February 15 and completed pre-countdown tests through actual launch on February 17. (JPL, Space Programs Summary No. 37-32, Vol. VI, op. cit., 2.)

Post environmental inspection of Ranger 9 was conducted at the JPL SAF between February 1 and 10. Following NASA acceptance of the spacecraft on February 9, Ranger 9 was shipped to Cape Kennedy on February 18, arriving on February 22. Final test and assembly operations at Building AO and ESA occupied the final days of the month. (Ibid., 3; and, Space Programs Summary No. 37-32, Vol. I, op. cit., 4-5.)

DSN. The Deep Space Tracking Station at Canberra, Australia was completed and became operational on February 1, 1965. (NASA, 13th Semiannual Report to Congress, January 1 - June 30, 1965, GPO, Washington, D.C. 1966, 135.)

Mar. 1

Missiles and Rockets reported that a computer system developed by Dr. Robert Nathan at JPL was doubling the resolution of Ranger lunar photographs. The computer picture enhancement technique was used to remove noise distortion which brought "a dramatic increase in resolution." (Cited in NASA, Astronautics and Aeronautics, 1965: Chronology on Science, Technology, and Policy, SP-4006, Washington, D.C., 1966, 100-101.)

Dr. Gerard P. Kuiper, Principal Investigator on Project Ranger, requested of JPL that, before his own contribution to the Ranger 7 experimenters' report be regarded in final shape, he be given the opportunity to review the manuscripts submitted by other co-experimenters. (Letter from G.P. Kuiper to H.M. Schurmeier, March 1, 1965, JPLHF 2-2030.)

Editoralizing in Missiles and Rockets, William Coughlin suggested a "useful mission" for which Ranger 9 might be adapted: "Our unsolicited proposal to NASA is that Ranger be employed to return to Earth photographs of Earth from space. Satellites have told us the Earth is 'pear shaped' rather than round and that it draws a perhaps invisible but comet-like tail after it through space. Photographs of the entire Earth globe as seen from space would have high scientific value. As a propaganda triumph, it would be unequalled. . . ."

Mar. 2 Mr. R.L. Heacock, Mr. E.A. Whitaker, and Mr. D.E. Willingham met at JPL to establish a set of preliminary targets for Ranger 9, considering lunar lighting constraints and the objectives established at the Ranger experimenters meeting of February 27. Preliminary selections were then reviewed separately with Drs. Kuiper, Urey, and Shoemaker. Resulting discussion emphasized the division of opinion on target priority, and the final recommendation to NASA was a compromise accepted by all Ranger experimenters:

1. The first two days of launch window (March 19, 20) were dropped from consideration because no general agreement was reached.
2. The first choice was the Crater Alphonsus on the third day of the launch window (March 21).
3. The second target was the Crater Copernicus (fourth day, March 22).
4. The third target was the Crater Kepler (fifth day, March 23).
5. The fourth target was the Crater Aristarchus (sixth day, March 24).
6. The fifth and last day target was the highland terrain east of Grimaldi.

(Plan presented to H.E. Newell by H.M. Schurmeier on March 10, 1965, entitled "Ranger D Target Selection," dated March 8, 1965, 4-5, JPLHF 2-856.)

Dr. Thomas Gold, an astronomer at Cornell University, suggested that the long, narrow rills and irregular depressions on the lunar surface could be caused by the moon's surface collapsing into crevasses opened by glacial ice hidden beneath the dust. He attributed gently rounded shapes to a shifting of small particles of surface material by electrostatic forces which, on earth, were inhibited by the atmosphere. (NASA, Astronautics and Aeronautics, 1965, op. cit., 104.)

Mar. 3 Dr. J. Allen Hynek, Director of Northwestern University's Dearborn Observatory, submitted a proposal to NASA for the Apollo program calling for the astronauts to erect a 12-inch telescope on the moon. Once in operation and checked out, the telescope would continue automatically to televise its observations and radio the data back to earth. ("Astronomer Wants Lens on the Moon," The Kansas City Star, March 3, 1965.)

Mar. 4 Testifying before the House Committee on Science and Astronautics, Dr. Homer E. Newell, NASA Associate Administrator for Space Science and Applications, observed that the moon's surface did not appear to be hard. "On a hard surface we see rubble and rocks. But the surface seems to be sufficiently yielding so that even boulders and rocks glancing off it become buried." Evidence suggested dust of some kind, he said; however he was "greatly encouraged by the fact that the surface was relatively smooth." (Gene Bylinsky, "NASA Underestimated Soft Surface," The Houston Post, March 7, 1965.)

In testimony the next day, on March 5, Dr. Newell asserted that "the Ranger pictures represent our major scientific achievement in 1964. . . ." (NASA, Astronautics and Aeronautics, 1965, op. cit., 108.)

Mar. 10 JPL informed NASA Headquarters of the results of Ranger 9 target discussions, with the Crater Alphonsus selected for the first attempt on the third day of launch window (see March 2, 1965). Dr. E. Shoemaker, however, continued to prefer Flammarion on the third day. Mr. R.L. Heacock, JPL Manager of the Lunar and Planetary Instruments Section of Space Science Division and co-experimenter on Project Ranger, urged NASA approval of the proposed highland sites, pointing out that "the Ranger experimenter team was not selected with the intent of only supporting other NASA programs, but rather to contribute to man's total knowledge of the moon. . . . Two impacts into mare areas have created a bad impression in terms of the Ranger's ability to provide useful [scientific] data. The contribution to Apollo has been very valuable; but this is not generally recognized or appreciated. . . . It seems only reasonable for NASA to allow the Ranger experimenters a free choice on this last mission. . . ." (JPL, letter from R.L. Heacock to N.W. Cunningham, March 9, 1965, JPLHF 2-2031; and, "Ranger D Target Selection," loc. cit.)

Mr. Oran Nicks, NASA Director of Lunar and Planetary Programs, recommended that NASA adopt the Ranger 9 target sites submitted by the experimenters who were seeking to determine with certainty

Mar. 10 cont. whether volcanic activity was present on the moon:

March 21 Crater Alphonsus
March 22 Crater Copernicus
March 23 Crater Kepler
March 24 Crater Aristarchus
March 25 Near Crater Grimaldi

(NASA, memo from O.W. Nicks to H.E. Newell, March 10, 1965, JPLHF 2-1517.)

JPL informed NASA that the loss of RF output from the Ranger 8 transponder for twenty-five minutes during midcourse maneuver was concluded to have stemmed from a short caused by a floating particle, which was later dislodged when the midcourse motor was fired. JPL recommended that the Ranger 9 transmitter be flown "as is," rather than delay one month for complete disassembly and requalification of the unit. (JPL, TWX from H.M. Schurmeier to N.W. Cunningham, March 10, 1965, JPLHF 2-1997; see also, IOM from S.A. Brunstein to H.M. Schurmeier, March 12, 1965, JPLHF 2-1998.)

Mar. 12 Dr. Harold Urey, a Ranger co-experimenter and professor at UC San Diego, suggested that most of the stone meteorites found on earth originated on the moon. "Included in these may well be the carbonaceous chrondrites of the Orgueil type and this indicates that contamination of the moon with terrestrial water has occurred. . . ." While there was no agreement on the origin of the moon itself, Dr. Urey observed that only two of three possible origins were now discussed: (1) the moon escaped from the earth; or (2) the moon was captured by the earth. Dr. Urey continued to favor the latter hypothesis. That the moon might have coalesced at the same time as the earth was no longer considered. (H.C. Urey, "Meteorites and the Moon," Science, March 12, 1965, JPLHF 2-2057.)

March 15 NASA OSSA informed Robert Seamans Jr., Associate Administrator, of the approved experimenter-selected targets for the Ranger 9 flight for the period March 21 to March 25, 1965. (NASA, memo from H.E. Newell to R.C. Seamans, March 15, 1965, JPLHF 2-1518.) (See March 10, 1965.)

Mar. 16 NASA Associate Administrator Dr. Robert Seamans Jr. announced a one day delay of the Gemini 3 manned space flight, from March 22 to March 23, to prevent interference with the launch of Ranger 9 during the first few days of the lunar launch window. Gemini 3,

Mar. 16 cont.	however, held launch priority on the 23rd and any practicable date thereafter for the remainder of the week. ("Ranger Gets Priority by Day Over Gemini; Unions Told to Work," The Cocoa [Florida] Tribune, March 16, 1965; TWX from E.E. Christensen, Director of Mission Operations, NASA, to JPL, et. al., March 16, 1965, JPLHF 2-1999.)
	A Ranger 9 final prelaunch status review was held at AMR among representatives of NASA, JPL, LeRC, and RCA. Ranger 9 was approved for launch. (Ranger D Status Review at ETR, March 16, 1965, JPLHF 2-2039; also, NASA, memo from N.W. Cunningham to O.W. Nicks, March 19, 1965, JPLHF 2-1519.)
Mar. 18	USSR's Voskhod II, piloted by Col. Pavel Belyayev with copilot Lt. Col. Alexei Leonov, was launched from Baikonur Cosmodrome in Kazakhstan. During the second orbit Lt. Col. Leonov clad in a spacesuit with a life support system and tether stepped into space and "successfully carried out prescribed studies and observations." In Moscow "a Soviet space official said 'the target now before us is the moon, and we hope to reach it in the not too distant future.' In the U.S., a spaceman said glumly, 'the Russians upstage us every time.' The remarks reflected contrasting moods in the two countries . . ." (Walter Sullivan, "A Russian Steps Into Space," New York Times, March 21, 1965; and, NASA, Astronautics and Aeronautics, 1965, op. cit., 131-132.)
Mar. 19	In recognition of the first closeup pictures of the moon's surface returned by Ranger 7, JPL Director Dr. William Pickering was awarded the Robert H. Goddard Memorial Trophy for 1964 by the National Space Club, in Washington, D.C. (Ibid., 137.)
	Mr. H.M. Schurmeier, Ranger Project Manager at JPL, was awarded the "Astronautics Engineer Award" for 1964 by the National Space Club, in Washington, D.C.
Mar. 21-24	Liftoff of Ranger 9, Atlas 204D, Agena B 6007, occurred at 1:37 p.m. PST from Cape Kennedy after a normal countdown. (The launch period had been reduced to two days, first for targeting considerations and then to accommodate the scheduling of Gemini Mission GT-3 on March 23.) Mission objectives and content were the same as programmed for Ranger 6 (see January 30-February 2, 1964). Launch vehicle performance was excellent, and Ranger 9 was injected into a very accurate lunar transfer trajectory that, uncorrected, would impact the moon approximately 400 miles due north of the planned target, the Crater Alphonsus. Ranger 9's solar panels properly extended and normal

Mar. 21-24 cont. cruise mode operations were established four hours after launch.

Because of the precise trajectory, a midcourse correction maneuver to alter Ranger 9's line of flight directly into the Crater Alphonsus was initiated thirty-eight hours after launch, on March 23, instead of the normal sixteen hours. Turn commands from Goldstone tracking station were properly accepted and acted upon by the spacecraft. At 4:30 a.m. PST the midcourse rocket engine ignited for 31 seconds, and by 5:33 a.m. PST Ranger 9 had satisfactorily completed the maneuver and returned to normal cruise mode operations once again, on course for an impact inside the Crater Alphonsus--only four miles from the intended target point. At a press conference after the maneuver was accomplished, JPL Director Dr. William Pickering assured reporters that the landing would take place well out of the shadow cast by the towering peak in the center of the crater--a possibility that had caused concern for the loss of the final pictures if the spacecraft passed into this darkened region just before impact. Later the same morning JPL also announced that a television electronic scan converter would be tested for the first time which was capable of "translating" the signal from the 1,153-lines-per-picture of the Ranger 9 TV system to the standard 500-line picture used in commercial television. If successful, pictures of the moon returned by Ranger 9 could be broadcast live to the nation by the television media.

For the first time in the Ranger Project, as Ranger 9 neared the moon on March 24, an active terminal maneuver was initiated to align the camera axis along the impact velocity vectors (cameras viewed the moon directly down the line of flight). At 3:58 a.m. PST, codes for the pitch and yaw movements were sent to Ranger 9, were acted upon, and by 5:31 a.m. PST, half an hour before impact, the spacecraft had assumed the desired terminal orientation. Successful completion of this maneuver minimized image motion in the pictures to follow, and also maximized coverage of the points of interest within Alphonsus. (Figure 65.)

Twenty minutes before impact, at 5:48 a m. PST, the TV system was ordered into warmup--the unhappy milestone that spelled failure for Ranger 6. Almost immediately word followed that Goldstone was receiving pictures from the spacecraft, and the first "live" close-up pictures of the moon filled television screens at JPL and around the nation. Most of the pictures selected for the scan converter were returned from the F-b camera, which was equipped with a 76 mm telephoto lens. Now and then, however, pictures from the F-a camera equipped with a wide angle 25 mm lens would alternate with the full-scan camera. Transmissions from Ranger 9, the last spacecraft in NASA's first ambitious unmanned deep space program, ceased upon impact at 6:08 a.m. PST, on March 24, after transmitting 5,814 pictures

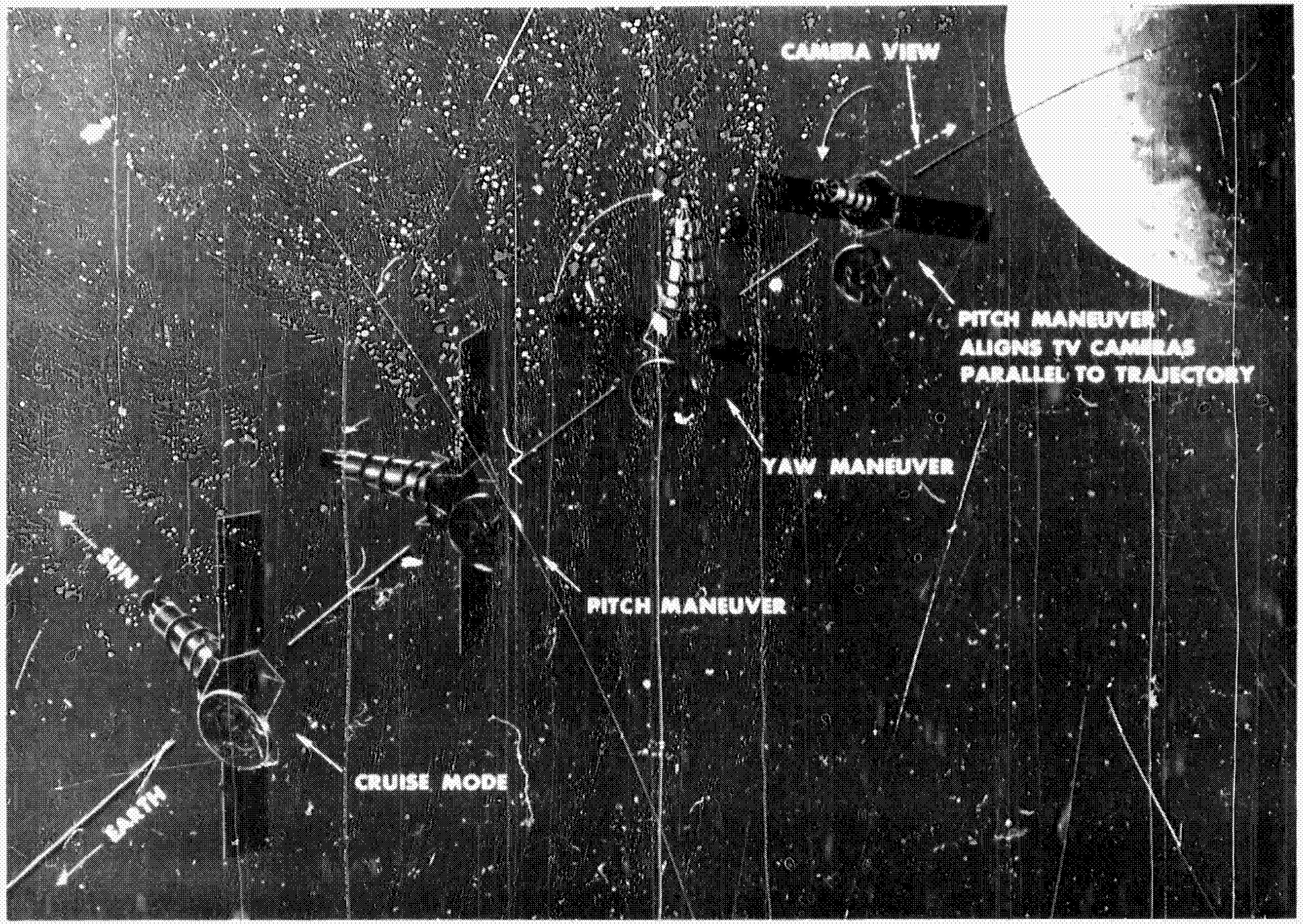

Figure 65: Ranger Block III terminal maneuver sequence of events.

Mar. 21-24 cont. of the Crater Alphonsus and the surrounding lunar highland area. (JPL, Technical Report No. 32-800, Ranger VIII and IX, Part I, Mission Description and Performance, loc. cit.; Gladwin Hill, "Ranger Hits Moon and Sends Photos Seen Live on TV," New York Times, March 25, 1965; Ranger 9 Log, undated.) (Figures 66 and 67.)

Mar. 24 At the final Ranger Post-Impact Press Conference held a few minutes later, Mr. Oran W. Nicks, NASA Director of Lunar and Planetary Programs, read from the text of the NASA guideline letter of December 21, 1959, which established Project Ranger. Among the experiments then planned was closeup photography of the lunar surface prior to impact. "I think you could see for yourself this morning that those [TV] objectives were fulfilled in the Ranger Program," Mr. Nicks observed. "What you couldn't see and what we couldn't see in the beginning of this project were some of the other things that Ranger would do. It was not in the guideline letter, for example, that Ranger should provide the capability for doing Mariner II to Venus [1962] in a very short time. It wasn't in the letter that Mariner IV [1964], which is now on its way to Mars, would be a direct descendant of Ranger and use much of its technology. It also wasn't in the letter that it should develop the attitude control system, the tracking capability, the midcourse maneuver system, and the TV advancements which are so obvious today in reviewing this performance. . . ." JPL Director Dr. William Pickering responded that "the Ranger Program that we reflect upon today has been a long and difficult road since 1959. We had our problems in the early days of the program; I think the achievements of the last three flights have shown that Ranger provided a working system capable of carrying out these deep space missions under remote command, that Ranger has indeed demonstrated the soundness of the basic system design, and that the closeup photographs that we have taken with Ranger have opened a completely new field of exploration of the moon. . . ." ("Ranger 9 Press Conference," March 24, 1965, JPLHF 2-2034a.)

Later in the day and experimenters press conference was convened at JPL to discuss Ranger 9 photographs of the Crater Alphonsus. Experimenters concurred that the pictures were the best of the three successful flights in the Ranger series. Dr. Eugene Shoemaker noted the dark halo craters which were observed in the pictures appeared to be volcanic features. Dr. Harold Urey agreed that the dark halo craters might be due to some sort of plutonic activity beneath the surface of the moon, and he remarked that selection of the Crater Alphonsus as a target of

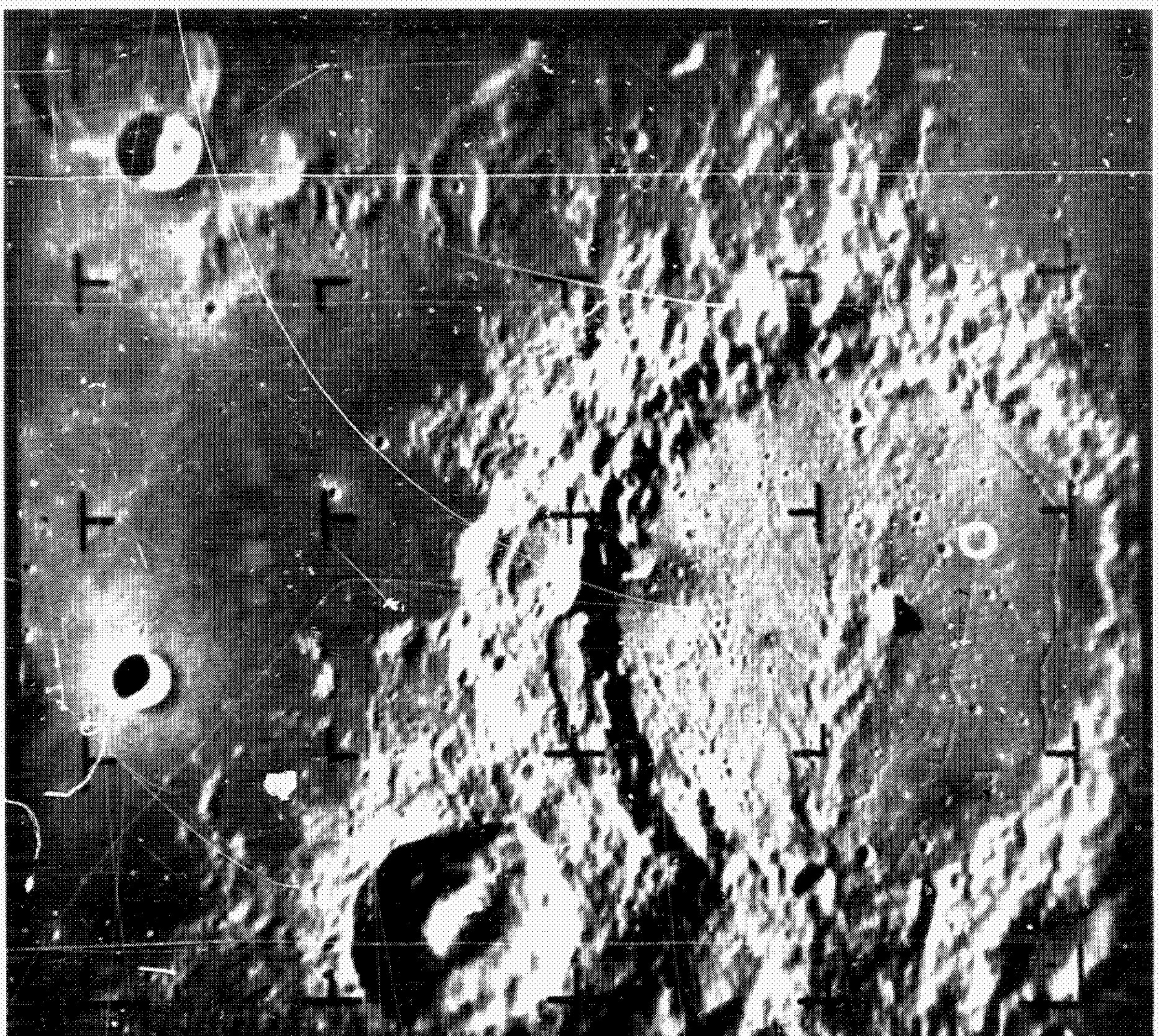

Figure 66: Ranger 9 photograph of the Crater Alphonsus with impact area identified.

Figure 67: Ranger 9 photograph, closeup of the crater floor.

Mar. 24 cont. scientific interest was prompted by the Soviet astronomer Kozyrev's observations of a cloud of dust or gas over the central peak in 1958.

In response to questions from the press, Dr. Shoemaker commented that the most significant finding to result from these most recent closeup pictures of the moon was the apparent smoothness of the crater walls and portions of the crater floor. Dr. Kuiper added that, in his opinion, the bearing strength of the lunar surface was on the order of "a few tons per square foot." ("Ranger IX Post-Impact [Experimenters] Press Conference," March 24, 1965, JPLHF 2-2034b; also, Richard West, "Pictures Indicate Moon is Volcanic," Los Angeles Times, March 25, 1965; and, Kimmis, "Ranger 9 Sends Back Best Photos of Moon," Christian Science Monitor, March 25, 1965.)

Mr. Earl D. Hilburn, NASA Acting Associate Administrator, wired congratulations to JPL Director Dr. William Pickering: "A brilliant finish to a most successful program. Heartiest congratulations to you, Bud [Schurmeier] and the whole Ranger team." (NASA, TWX from E.D. Hilburn to W.H. Pickering, March 24, 1965, JPLHF 2-2056.)

Mar. 25 President Johnson issued a statement:

> "Ranger 9 showed the world further evidence of the dramatic accomplishments of the United States space team. Coming so close after yesterday's Gemini success, this far-out photography reveals the balance of the United States space program. Steps toward the manned flight to the moon have become rapid and coordinated strides as manned space maneuvers of one day are followed by detailed pictures of the moon on the next. I congratulate the scientists, the engineers, the managers--private contractors as well as Government--all who made this Ranger shot and the success of its predecessors the great space advances that they have been."

("President Cheers Ranger's Success: He Also Announces Plans for Honoring Astronauts," New York Times, March 25, 1965.)

A New York Times editorial declared that:

> "The Ranger series [which] concluded yesterday represents the finest type of space research at this stage of history. With no risk to human life and at relatively little cost as compared with the huge expenditures on the Apollo project for manned landing on the moon, the three successful Ranger flights have

Mar. 25 cont.

enormously expanded man's knowledge of the geography and topography of earth's nearest neighbor. They have shown irrefutably the great value to science of space research done with instrument-carrying rockets."
(Editorial, "Eyes on the Moon," New York Times, March 25, 1965.)

Dr. Homer E. Newell, NASA Associate Administrator for Space Science and Applications, sent his congratulations to Bud Schurmeier, JPL Ranger Project Manager, and to all members of the project at JPL. (NASA, letter from H.E. Newell to H.M. Schurmeier, March 25, 1965, JPLHF 2-2033.)

Tass reported that scientists in the Soviet Union were making extensive use of Ranger 7 photographs that had been presented to the Pulkovo Observatory by NASA. Professor Alexander Markov, who supervised study of the photos, informed a Tass correspondent that the photographs would be used to study the size and distribution of craters, and to ascertain the development of the lunar surface "in view of the landing of spacecraft on the lunar surface planned for the near future." (NASA, Astronautics and Aeronautics, 1965, op. cit., 153.)

Mar. 26

NASA Administrator James E. Webb briefed President Johnson and his cabinet on the Ranger 9 mission. He informed the President that Ranger 9 had pinpointed at least two potential hard landing areas on the moon for Project Apollo. "Later he told newsmen that because of the high resolution of the pictures, space experts 'now know there are two spots--probably three--where we can land on the moon.'" ("Ranger Pinpointed Two Landing Areas on Moon," Los Angeles Times, March 26, 1965.)

President Johnson awarded JPL Ranger Project Manager Bud Schurmeier the NASA Exceptional Scientific Achievement Medal in ceremonies at the White House rose garden. Gemini Astronauts Virgil Grissom and John Young received the NASA Exceptional Service Medal. ("JPL Scientist to Get Medal for Ranger Feat," Independent (Pasadena), March 26, 1965.)

During March

JPL Mathematicians W.L. Sjogren and D.W. Trask reported that analysis of Ranger 6 and 7 tracking data allowed various DSIF station locations around the world to be determined to within 10 meters in the radial direction normal to the Earth's spin axis. The moon's radius had been found to be 3 km less than was thought, and knowledge of its mass had been unproved by an order of magnitude. ("Ranger Pinpoints DSIF Stations," Missiles and Rockets, March 22, 1965, p. 23.)

Project Ranger: Terminal Events

Apr. 1 JPL Ranger Project Manager Mr. H.M. Schurmeier announced additional testing of the Ranger Block III STM and PTM spacecraft to evaluate Ranger 7, 8 and 9 RF transmission phenomena encountered at lunar impact. Investigations were directed toward an understanding of the phenomena itself and its relationship to potential surface bearing strength. (JPL, IOM from H.M. Schurmeier to Distribution, April 1, 1965, JPLHF 2-2035.)

Apr. 5 Mr. N.W. Cunningham, NASA Ranger Program Manager, sent his own congratulatory message to H.M. Schurmeier at JPL:

"I suspect your desk is filling up with congratulatory messages by this time; however, I would like to add my own note of thanks for a job well done. It would be next to impossible to express in a letter my feelings and depth of satisfaction for the total task which you and the Ranger team have performed. When I look back at some of the low periods in the Program and remember what I thought of our chances at that time (political as well as technical), I can now easily conclude that the success we enjoy today was made possible only by the superior ability and extra efforts put forth by you and your entire organization."

(NASA, letter from N.W. Cunningham to H.M. Schurmeier, April 5, 1965, JPLHF 2-2036.)

Apr. 6 Mr. Donald E. Sowle was appointed Assistant Laboratory Director for Financial Management and Procurement at JPL. (JPL, IOM from A.R. Luedecke to Senior Staff, et. al., April 6, 1965, JPLHF 2-285.)

Apr. 8 Eastman Kodak Company Bimat Film Processing was used experimentally by JPL in digital video processing of Ranger 9 photographs to supply science users with dry positive and negative prints on the morning of March 24. The new Bimat film process was recommended as a promising technique for use in unmanned space projects where photographs were involved, although improved packaging and other developments were desirable. (JPL, IOM from F.C. Billingsly to Distribution, April 8, 1965, JPLHF 2-2037a; and, enclosure to above, input to Space Programs Summary No. 38-33, Vol. IV, JPLHF 2-2037b.)

In an interview at Rice University, Dr. Eugene Shoemaker defended the costs of Ranger Program. (Noe Perez, "Ranger Shots Cost Defended: One Success not Enough," The Houston Post, April 8, 1965.)

Apr. 15-16 World scientists met for a special conference on the "Nature of the Surface of the Moon" sponsored by the International Astronomical Union and NASA Goddard Space Flight Center at Greenbelt, Maryland. Dr. Boris J. Levin, of the Soviet Academy of Sciences, said that studies based on radioactive emissions from meteorites and on other lunar data indicate that the interior of the moon partially melted several billion years after the formation of the body. Dr. Levin continued to believe that the moon was formed simultaneously with the earth but was not originally a part of the earth. Dr. Bruck Hapke, of Cornell, suggested a lunar surface with dust resembling baking powder, which would stick to an astronaut like flour. Dr. A. Dollfus, of the Paris Observatory, believed that the moon's polarized light most nearly resembled reflection from broken lava or volcanic ash.

Dr. John Clark, NASA Director of Space Sciences in OSSA, stated that Ranger had provided the lunar topographical data necessary to confirm the design of the Apollo lander, and that Surveyor would furnish the remaining information on the bearing strength of the moon's surface. However, Mr. Ewan A. Whitaker presented a paper for Dr. Gerard P. Kuiper of the Lunar and Planetary Laboratory at the University of Arizona in which Dr. Kuiper concluded the lunar surface had a bearing strength between one and two tons per square foot, based on data returned from Ranger 9. Drs. Harold Urey and Thomas Gold took exception to Dr. Kuiper's contention, stating that this figure was much too high. Dr. Gold said that after analysis of Ranger 9 photographs he would not dare to land on the moon's surface. Dr. Urey concurred, stating that the Ranger 9 photographs "scared me more" than data from preceding flights due to so much evidence of a collapsing surface and sinking craters. Dr. Eugene Shoemaker of the U.S. Geological Survey responded that "not everybody is scared," and that chances the moon's surface was indeed too soft for the fifteen-ton Apollo lander was "almost vanishingly remote."

No general consensus on the nature of the moon was apparent at the conference. Dr. Gold later quoted a friend who had stated: "The Ranger pictures are like a mirror and everyone sees his own theories reflected in them." ("Lunar Debate Still Rages Despite Ranger," Aviation Week, April 26, 1965, 34; Neal Stanford, "Moon Experts Disagree in 'Reading' Ranger Photos," The Christian Science Monitor, April 26, 1965; Howard Simons, "17,259 Photos Fail to Promise Safe Landing," The Washington Post, April 16, 1965; Gerard P. Kuiper, "Preliminary Determination of the Bearing Strength of the Floor of the Crater Alphonsus," undated, JPLHF 2-663; and, "Talk of the Town," The New Yorker, May 8, 1965, 35.)

Apr. 21 A Ranger 9 Post Flight Analysis Meeting and the final Ranger Quarterly Review were held at JPL. Both meetings were attended by representatives from Lewis Research Center, DSN, and the spacecraft area. Among the more interesting findings of the Post Flight Analysis meeting were: (1) although a terminal maneuver was employed on Ranger 9, the spacecraft remained on solar power, and only 11% of the battery capacity was used; (2) gas required by the attitude control system was so negligible it could not be measured. Estimates of spacecraft lifetime based on gas consumed ran between five and six years; (3) launch vehicle injection guidance for the RA-9 mission was so accurate that the midcourse maneuver could have been postponed to sixty hours after launch (five hours before impact) with full midcourse correction capability. ("Ranger IX Postflight Analysis Meeting," April 21, 1965, JPLHF 2-2002; JPL, IOM from H.M. Schurmeier to Distribution, May 11, 1965, JPLHF 2-2041; and, NASA, OSSA Review of May 6, 1965, JPLHF 2-1505.)

Dr. Homer E. Newell, NASA Associate Administrator for Space Science and Applications, was named among ten outstanding Federal Government employees chosen by the National Civil Service League to receive Career Service Awards. (NASA, Astronautics and Aeronautics, 1965, op. cit., 194.)

The USAF Aeronautical Chart and Information Center (ACIC) submitted a proposal to JPL to produce a series of Ranger 8 and 9 topographical charts based on the photographs returned. (Letter from R.W. Carder, Technical Planning Division of the Aeronautical Chart and Information Center, April 21, 1965 enclosing proposal dated April 20, 1965, JPLHF 2-2003.)

Apr. 30 NASA awarded a $300,000 grant to the Department of the Interior's Bureau of Mines for a research program on the potential use of lunar materials to support exploration of the moon by man. (NASA, Astronautics and Aeronautics, 1965, op. cit., 209.)

May 6 Steps to speed Ranger data processing in support of Project Surveyor were established at JPL. (JPL, IOM from G. Smith/ R. Nathan to E.R. Lawrence, May 6, 1965, JPLHF 2-2040.)

May 9 The Soviet Union successfully launched a 3,254-lb. moon probe, Luna V. A Tass announcement indicated that Luna V would soft-land on the moon and transmit data to earth. Three days later, on May 12, Luna V impacted the moon and was destroyed: "instead of a gain, the Russians suffered a well-publicized loss, reminiscent of the American failures in the early Ranger moon

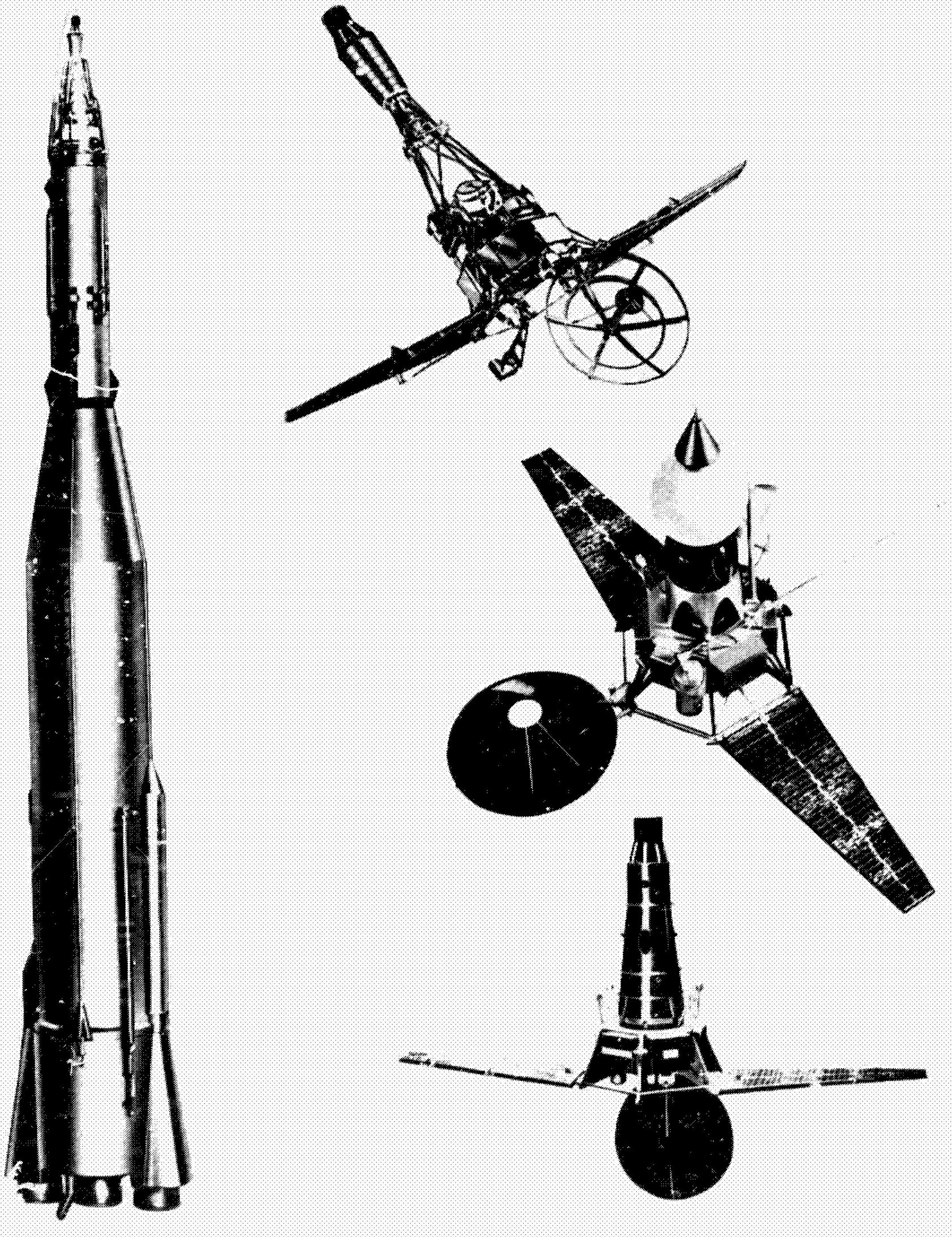

Figure 68: Ranger spacecraft and Atlas D-Agena B launch vehicle system, Blocks I, II, and III.

May 9 cont. shots. For NASA officials there was another plus. They expect to find it easier to convince Congress that the exhaustive pre-flight tests of the Surveyor are justified." ("Lunik Failure Stirs no Sadness in Capital," Los Angeles Times, May 14, 1965; Vincent Bruce, "Lunik Fails in Attempt at Soft Moon Landing," Los Angeles Times, May 13, 1965.)

May 12 A Ranger Experimenters Meeting was held at JPL. A decision was reached that Robert Nathan's digital computer technique for removing coherent noise in Ranger photographs was superior to a similar analog technique, and the digital technique was adopted for processing selected photographs in the Ranger atlases. A date of September 13, 1965 was established for distribution of the completed Ranger 8 and 9 Experimenters Report. ((JPL, Minutes of the Ranger Experimenters Meeting at JPL, May 12, 1965, JPLHF 2-2042.) (See February 10, 1965.)

May 14 The final Ranger Block III Biweekly Status Report was issued by JPL. The remaining closeout tasks for Project Ranger consisted of: (1) completion of Ranger Reports, (2) storage and disposition of Ranger hardware, and (3) record consolidation and disposition. ((Ranger Block III Biweekly Status Report, May 14, 1965, JPLHF 2-2005.) (Figure 68.)

May 18 JPL Ranger Project Manager H.M. Schurmeier requested that Ranger contract effort at RCA be extended beyond the May 30 cutoff date in support of investigations of the TV signal transmission performance during impacts that could be related to the interaction of the spacecraft and the lunar surface, indicating lunar surface properties. (JPL, IOM from H.M. Schurmeier to R. Serlin, May 18, 1965, JPLHF 2-2044.)

May 19 Mr. Clifford Nelson, NASA Lunar Orbiter Project Manager at Langley Research Center, extended his thanks to JPL for Ranger-related assistance:

> "I should also like to thank you for the invitations extended to Lunar Orbiter Project personnel to participate in the Ranger 8 and 9 missions. The knowledge and experience gained by our people during these missions will contribute greatly in the formulation of mission procedures for the Lunar Orbiter."

(NASA, memo from C.H. Nelson to H.M. Schurmeier, May 19, 1965, JPLHF 2-2045.)

May 24 Project Ranger hardware inventory was completed. (NASA, memo from N.W. Cunningham to O.W. Nicks, May 24, 1965, JPLHF 2-1521.)

1965

May 26 — NASA Headquarters approved additional testing at JPL and RCA beyond May 30 in support of the TV signal investigation. (See May 18, 1965.)

May 28 — JPL issued Modification No. 56 to RCA Contract No. 950137 for continuing investigations of Ranger TV signal characteristics at impact. Period covered was June 1 through June 30, 1965. (JPL, IOM from G.E. Nichols to R. Serlin, July 1. 1965, JPLHF 2050a.)

During May — In a reprint of a speech "Objectives of the Space Program, delivered at Mount St. Mary's College, Dr. Lee A. DuBridge, President of Caltech, asserted "we do know one thing: that scientific research which has been aimed at purely practical problems, though it often has been of great value, has over a long run been of less value in producing wholly new things than has the research aimed solely at the extension of knowledge. The extension of man's knowledge is the basic and the overriding purpose of the space exploration program." (JPL Lab-Oratory, May 1965, 12.)

June 3-7 — NASA's Gemini IV was successfully launched on a four-day earth orbital mission. Edward H. White became the first American to leave his spaceship and "walk" in outer space during the flight. (NASA, Astronautics and Aeronautics, 1965, op. cit., 265.)

June 7 — JPL Ranger Project Manager H.M. Schurmeier announced an additional series of tests aimed at defining the spacecraft/TV system performance at lunar impact. (JPL, IOM from H.M. Schurmeier to Distribution, June 7, 1965, JPLHF 2-2047.)

June 8 — The Soviet Union launched Luna VI toward the moon in a purported soft landing attempt. Two days later, on June 10, Tass announced that Luna VI would miss the moon by 100,000 miles due to a failure to accomplish the planned midcourse correction. ("Russia Again Tries for Soft Moon Landing," Los Angeles Times, June 9, 1965; and "Switch Failure Causes Lunik 6 to Miss Moon," Los Angeles Times, June 11, 1965.)

July 2 — JPL issued a "Summary Report" on the results of the RCA and JPL studies of Ranger impact phenomena. (G.E. Nichols, "Summary Memo Report," July 1, 1965, JPLHF 2-2050b; also, JPL, IOM from R. Serlin to G.E. Nichols, July 6, 1965, JPLHF 2-2049.)

July 5-18	Specialists from several scientific disciplines convened for a Summer Study at Woods Hole, Massachusetts, sponsored by the Space Science Board of the National Academy of Sciences and by NASA. The results of this Summer study appeared in Space Research: Directions for the Future, released later in the year. After deliberation the group recommended to NASA "planetary exploration as the most rewarding scientific objective for the 1970-1985 period. In pursuing this goal we recommend a reasonable balance between lunar and planetary programs. . . ." (page iii) (See June 17 - August 10, 1962.)
July 13	Under terms of the revised NASA contract NAS7-100 with Caltech for the operation of the Jet Propulsion Laboratory, NASA OSSA concluded the first semiannual performance evaluation of JPL. Project Ranger was rated "outstanding." (NASA, memo from O.W. Nicks to H.E. Newell, July 13, 1965, JPLHF 2-1731.)
July 14	Mariner IV approached within 5,500 miles of Mars and took the first closeup pictures of the planet. A total of 21 photographs were transmitted to earth during the next three days. Digital computer enhancement to eliminate coherent noise, developed for Project Ranger, was also employed in processing Mariner IV pictures. (NASA, Astronautics and Aeronautics, 1965, op. cit., 336.)
July 18	The Soviet Union launched Zond III into a heliocentric orbit. The first clear pictures of the far side of the moon, taken by Zond III, were released on August 20. (Ibid., 337.)
July 19-31	A Lunar Exploration and Science Conference was conducted by NASA at Falmouth, Massachusetts, immediately following completion of the Space Science Summer Study at Woods Hole, Massachusetts (see July 5-18, 1965). The conference was conducted by the NASA OSSA Manned Space Science Coordinating Committee, established to advise Willis B. Foster, Director of the Manned Space Science Program, OSSA, of a sound, scientific exploration program for the moon. (Members of the Manned Space Science Coordinating Committee consisted of one member from each of the SSSC subcommittees, and one from each of the seven discipline-oriented SSSC Working Groups.) Conference recommendations for lunar exploration were divided among planned missions: Apollo, Lunar Orbiter, Apollo Extension System (AES)-Manned Lunar Orbiter, AES-Manned Surface, and Post AES. (NASA, SP-88, NASA 1965 Summer Conference on Lunar Exploration and Science, Falmouth Massachusetts, July 19-31, 1965, 1 and 7.)

July 22 Mr. H.M. Schurmeier, former Ranger Project Manager, was named by JPL as Voyager Deputy Project Manager and Voyager Capsule Systems Manager.

July 28 JPL issued a detailed operating plan for support of flight projects by technical divisions which established firm procedure for all division and project personnel involved in supporting project activities at the Laboratory. (JPL, IOM from A.R. Luedecke to Distribution, July 28, 1965, JPLHF 2-424.)

July 29 Dr. Gerard P. Kuiper, Ranger Principal Investigator, recommended that JPL slip the deadline for submitting manuscripts for the Ranger 8 and 9 experimenters report in view of the serious differences of opinion still in evidence among Ranger experimenters. (Letter from G.P. Kuiper to H.M. Schurmeier, July 29, 1965, JPLHF 2-2051.)

Aug. 6 JPL accorded a delay in the submittal deadline for manuscripts for the Ranger 8 and 9 experimenters report to September 7, 1965. (JPL, letter from H.M. Schurmeier to G.P. Kuiper, August 6, 1965, JPLHF 2-2052.)

Aug. 9 JPL issued EPD 302, <u>Space Flight Operations Memorandum, Rangers VIII and IX</u>.

Aug. 25 George Nichols of JPL presented a briefing to NASA OSSA and OMSF personnel in Washington, D.C. on the results of the Ranger dynamic impact studies. (NASA, letter from O.W. Nicks to A.R. Luedecke, September 23, 1965, JPLHF 2-2053.)

Sept. 27 NASA OSSA and OMSF issued a Lunar Exploration Plan to guide future experiment selection and development in the manned and unmanned lunar program. The broad program was designated to:

1. Obtain information from the moon to determine its environment, composition and gross body properties and assure the timely analysis of the data.
2. Utilize the unique characteristics of the moon to establish observatories and laboratories for long-term scientific investigations.
3. Determine if lunar resources should be used for extended lunar operations, future interplanetary exploration, and terrestrial purposes.

Project Ranger was deemed a success by providing the first

Sept. 27 cont. "detailed look at the features on the surface which could not be resolved by Earth-based telescopes. As a result of the Ranger photographs, we now know that there are areas on the lunar surface where the roughness does not exceed the design parameters of the Apollo landing gear. . . ." (NASA, memo from G. Mueller to H.E. Newell, September 27, 1965, pp. 1 and 4, JPLHF 2-853.)

Oct. 4-7 Soviet Luna VII was successfully launched on a lunar trajectory. The 3,318-pound payload was intended as a lunar soft landing vehicle. Some eighty hours later the British radio astronomy group at Jodrell Bank reported that Luna VII had reduced its speed near the moon, indicating that retrorockets had been fired. The spacecraft apparently experienced a landing system failure and ceased operation upon impact. (W. Shelton, Soviet Space Exploration, The First Decade. New York: Washington Square Press, Inc., 1968, 221.)

Nov. 16-18 A National Conference on Spacecraft Sterilization Technology was held at Caltech.

Dec. 2 NASA directed JPL to dispose of all inventoried Ranger hardware since NASA programming did not include the possibility of another Ranger mission. (NASA, letter from O.W. Nicks to A.R. Luedecke, December 2, 1965, JPLHF 2-1524.)

Dec. 3-6 Soviet Luna VIII was successfully launched on a lunar trajectory. (See October 4-7, 1965.) Fifth in a series of Soviet soft landing vehicles, Luna VIII retrorockets were also observed to have fired as the craft approached the moon three days later. No radio transmission was received after impact, indicating another landing system failure. (Soviet Space Exploration, The First Decade, op. cit., 222.)

Dec. 8 NASA Headquarters requested that JPL obtain remaining manuscripts for the Ranger 8 and 9 experimenters Report (Drs. Kuiper and Shoemaker) by December 15 or establish "acceptable arrangements . . . for the completion of the report." (NASA, letter from N.W. Cunningham to H.M. Schurmeier, December 8, 1965, JPLHF 2-2054.) The Ranger 8 and 9 mission and experimenters reports (JPL Technical Report No. 32-800, Parts I and II) were printed and released on March 15, 1966.

Dec. 28 NASA Associate Administrator for Space Science and Applications Homer E. Newell directed a letter to JPL Director William H. Pickering: "As 1965 draws to a close, I wish to express to you and the JPL team my appreciation for the strong support given the space science and applications program by the Laboratory during the past year. I particularly wish to commend all of you on the remarkable success of the Ranger and Mariner Programs achieved during 1965. The history books of the future will write of the space firsts that the Jet Propulsion Laboratory achieved during this past year, and you all may take justifiable pride in your individual shares in those accomplishments." (NASA, letter from H.E. Newell to W.H. Pickering, December 28, 1965, JPLHF 2-148.)

APPENDIX A: Lunar Missions, 1958-1965

LUNAR MISSIONS: 1958-1965

U.S.A.			Results	U.S.S.R.		
Launch Date	Name	Mission		Mission	Name	Launch Date
Aug. 17, 1958	Able I	Flyby	Launch failed; booster explosion at 74 sec; designed to photograph backside of Moon.			
Oct. 11, 1958	Pioneer I	Flyby	Uneven separation of 2nd and 3rd stages, apogee 70,700 miles; same payload as Able I.			
Nov. 8, 1958	Pioneer II	Flyby	3rd stage ignition failure, apogee 963 miles; same payload as Pioneer I.			
Dec. 6, 1958	Pioneer III	Flyby	Premature booster cutoff, apogee 63,500 miles; discovered two radiation shells around Earth.			
			Passed within 3728 miles of Moon; measured lunar magnetic field and radioactivity.	Undisclosed	Luna I	Jan. 2, 1959
Mar. 3, 1959	Pioneer IV	Flyby	Missed Moon by 37,000 miles, tracked to 406,000 miles; injection velocity low; measured cosmic radiation.			
			First lunar impact; found Moon to have virtually no magnetic field.	Impact	Luna II	Sept. 12, 1959
Sept. 24, 1959	Atlas Able-4	Lunar Orbit	Pad explosion; planned for launch in October, exploded during static tests.			
			Circled Moon; successfully photographed 60 percent of backside hemisphere of Moon.	Circumlunar	Luna III	Oct. 4, 1959
Nov. 26, 1959	Pioneer (P-3)	Lunar Orbit	Launch failed; shroud fell off payload during launch, destroying satellite.			
Sept. 25, 1960	Pioneer (P-30)	Lunar Orbit	Launch failed; second stage malfunctioned.			
Dec. 15, 1960	Pioneer (P-31)	Lunar Orbit	Launch failed; booster exploded at 70 seconds.			
Jan. 26, 1962	Ranger III	Seismic capsule rough landing	Missed Moon by 22,862 miles; Atlas and Agena guidance system failures, Ranger mid-course maneuver was mirror image of planned course correction.			
Apr. 23, 1962	Ranger IV	Seismic capsule rough landing	Lunar impact; Ranger computer-timer failure caused loss of mission.			
Oct. 18, 1962	Ranger V	Seismic capsule rough landing	Missed Moon by 450 miles; Ranger power failure rendered midcourse correction and operation of most experiments impossible.			
			Apparently intended as soft lander, missed Moon by 5282 miles; cause of failure not disclosed.	Undisclosed	Luna IV	Apr. 2, 1963
Jan. 30, 1964	Ranger VI	Television impactor	Precise lunar impact (Sea of Tranquility); returned no pictures, television transmission failed.			
Jul. 28, 1964	Ranger VII	Television impactor	Precise lunar impact (Sea of Clouds); returned first high resolution pictures of lunar surface.			
Feb. 17, 1965	Ranger VIII	Television impactor	Precise lunar impact (Sea of Tranquility); returned additional high resolution pictures of lunar surface.			
Mar. 21, 1965	Ranger IX	Television impactor	Precise lunar impact (Crater Alphonsus); returned first high resolution pictures of lunar crater.			
			Lunar impact, intended soft landing failed; cause of failure not disclosed.	Soft lander	Luna V	May 9, 1965
			Missed Moon by 100,000 miles; midcourse correction failed.	Soft lander	Luna VI	Jun. 8, 1965
			Solar orbit; returned first clear pictures of backside of Moon.	Photographic flyby	Zond III	Jul. 18, 1965
			Lunar impact; intended soft landing failed; landing system failure.	Soft lander	Luna VII	Oct. 4, 1965
			Lunar impact, intended soft landing failed; landing system failure.	Soft lander	Luna VIII	Dec. 3, 1965

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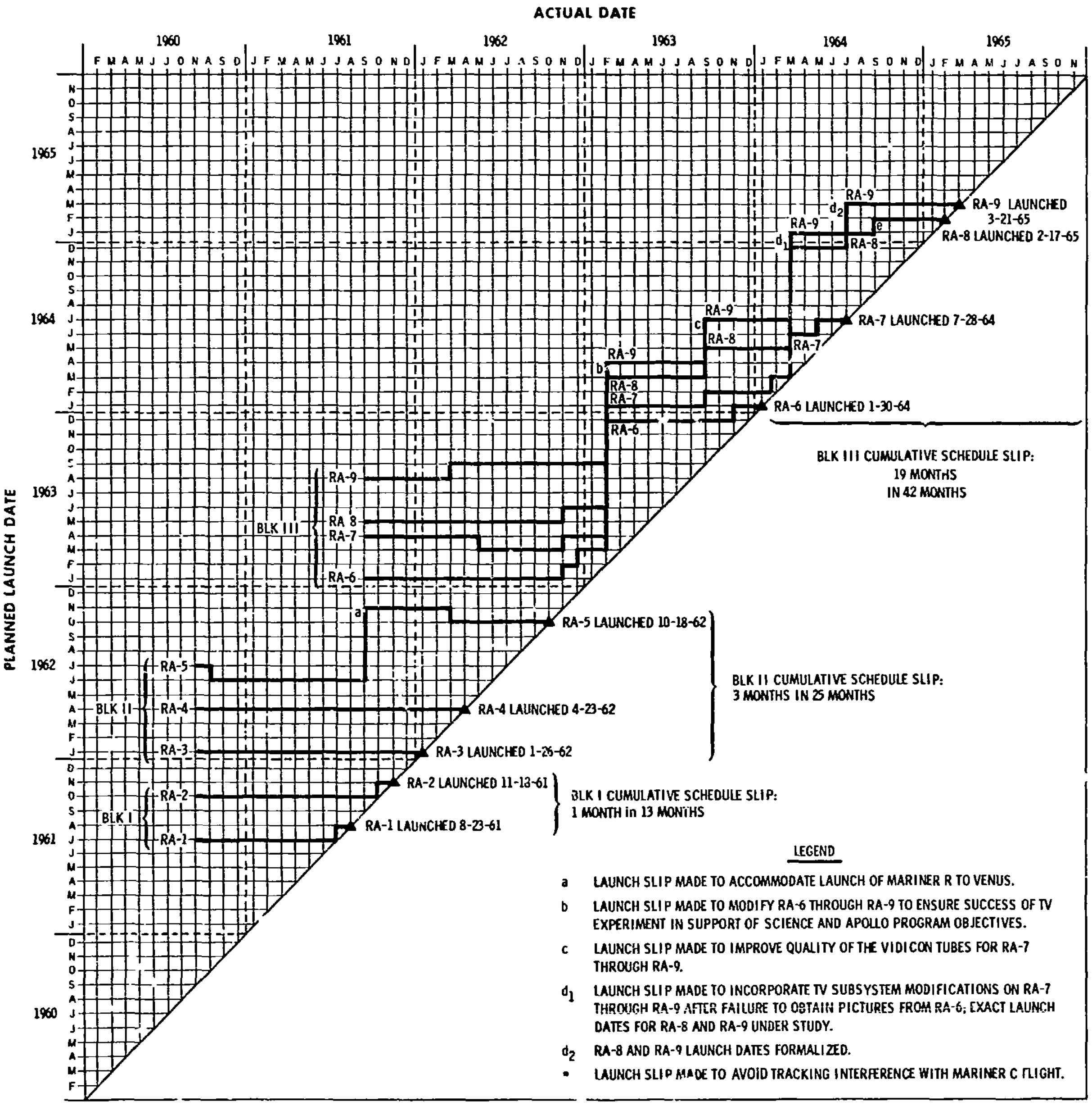
APPENDIX B: Ranger Schedule History

RANGER SCHEDULE HISTORY



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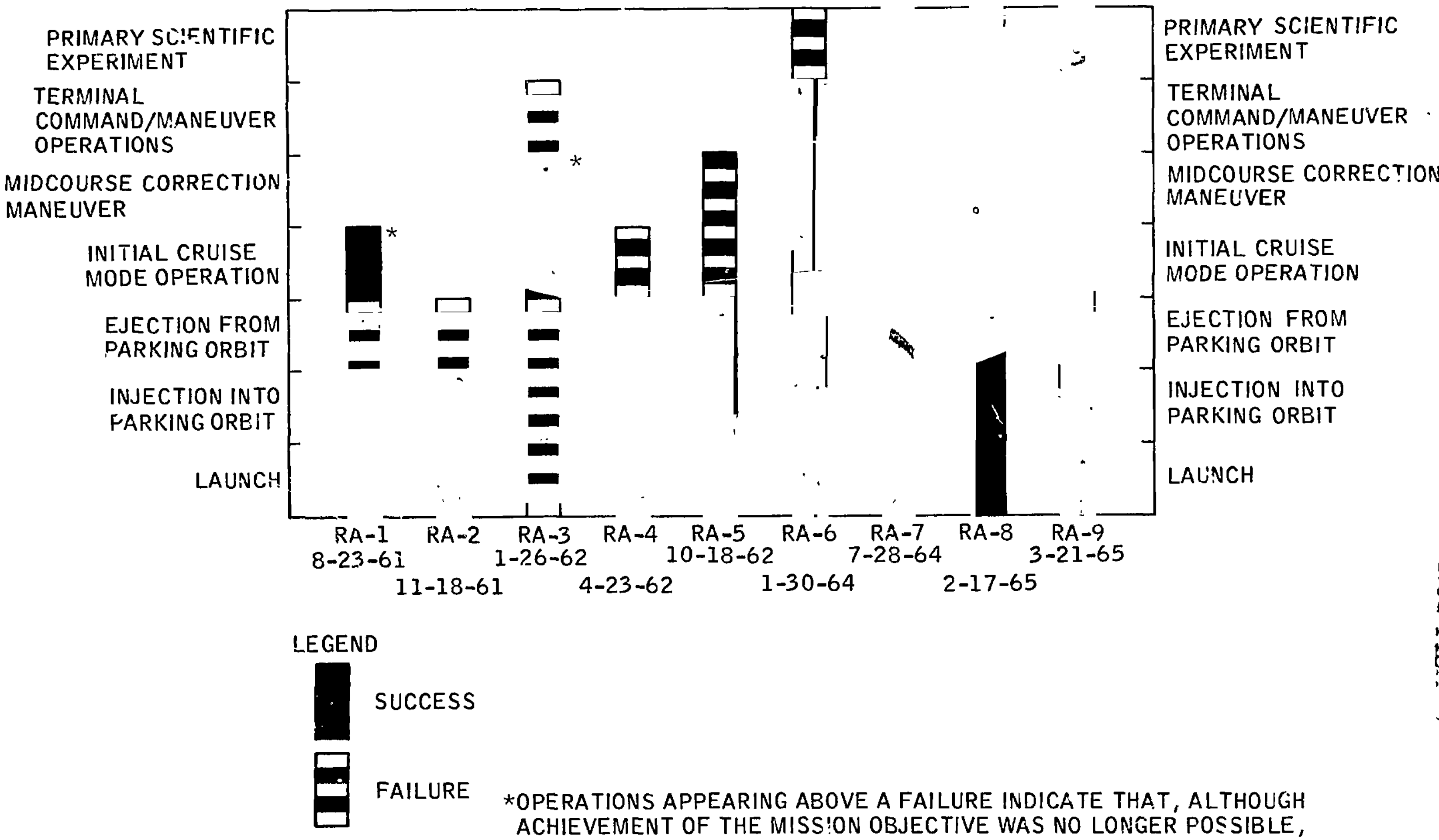
APPENDIX C: Ranger Performance History

RANGER PERFORMANCE HISTORY



*OPERATIONS APPEARING ABOVE A FAILURE INDICATE THAT, ALTHOUGH ACHIEVEMENT OF THE MISSION OBJECTIVE WAS NO LONGER POSSIBLE, SPECIFIC EXERCISES OF THE SPACECRAFT WERE CONDUCTED FOR TESTING PURPOSES.

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RANGER PERFORMANCE HISTORY

FLIGHT	LAUNCH DATE	LAUNCH VEHICLE	SPACECRAFT	PRIMARY EXPERIMENT
BLOCK I				
I	8-23-61	○	◐	+
II	11-18-61	○	+	+
BLOCK II				
III	1-26-62	○	◐	+
IV	4-23-62	◐	○	+
V	10-18-62	●	○	+
BLOCK III				
VI	1-30-64	●	◐	○
VII	7-28-64	●	●	●
VIII	2-17-65	●	●	●
IX	3-21-65	●	●	●
BLOCK IV		CANCELLED		
BLOCK V		CANCELLED		

LEGEND

● SUCCESS

○ FAILURE

◐ PARTIAL SUCCESS ACHIEVED THROUGH EXERCISE OF IMPORTANT SPACECRAFT SYSTEMS

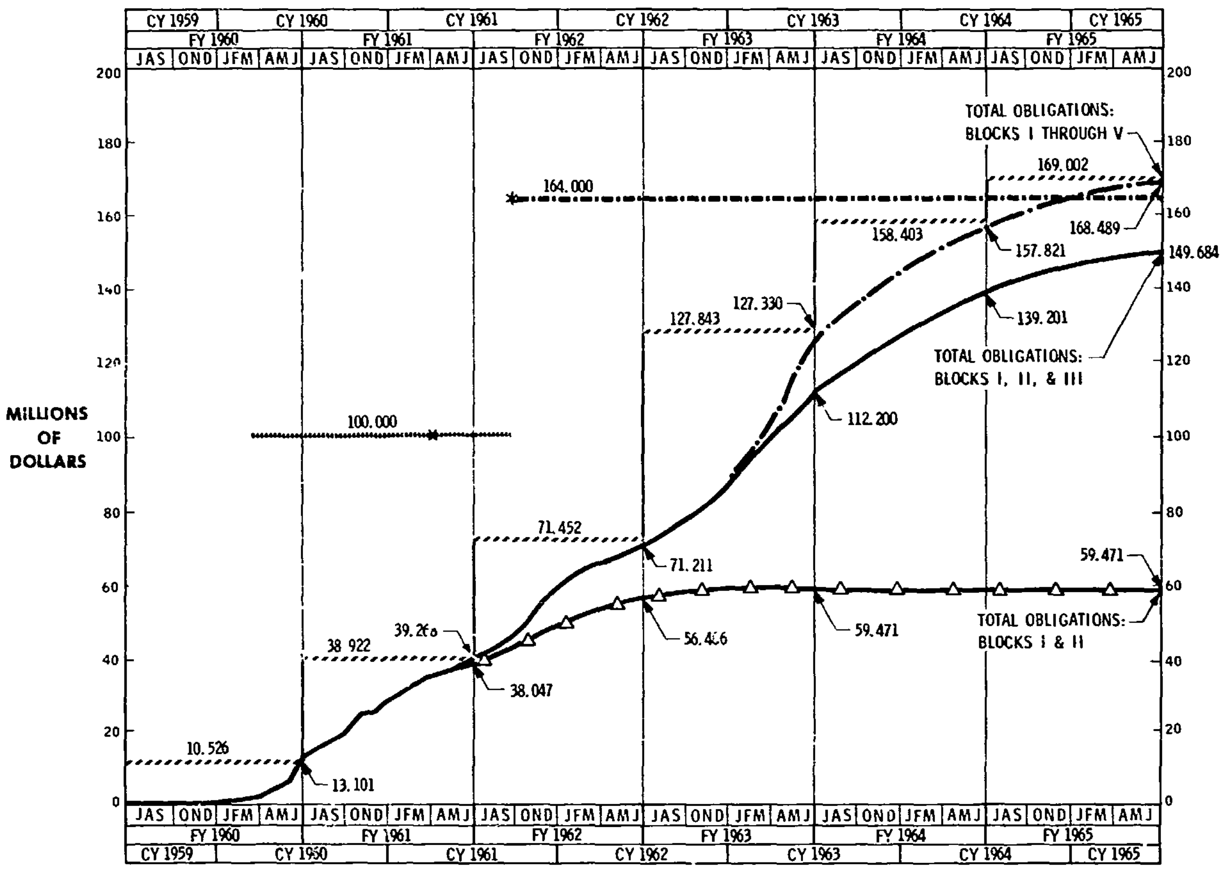
\+ NO TEST

[redacted]

APPENDIX D: Ranger Financial History

RANGER FINANCIAL HISTORY

AS OF JANUARY 31, 1971



LEGEND (ALL FIGURES EXCLUDE LAUNCH VEHICLES AND DSN DEVELOPMENT AND OPERATIONS)

- CUMULATIVE CONGRESSIONAL APPROPRIATIONS FOR PROJECT RANGER RESEARCH AND DEVELOPMENT (SOURCE: NASA FINANCIAL MANAGEMENT DIVISION - BFA)
- CUMULATIVE OBLIGATIONS, RANGER BLOCKS I & II (SOURCE: JPL RANGER PROJECT OFFICE RECORDS, NASA - BFA)
- CUMULATIVE OBLIGATIONS, RANGER BLOCKS I, II, & III (SOURCE: JPL RANGER PROJECT OFFICE RECORDS, NASA - BFA)
- CUMULATIVE OBLIGATIONS, RANGER BLOCKS I THROUGH V (SOURCE: JPL RANGER PROJECT OFFICE RECORDS, NASA - BFA)
- JPL ESTIMATE OF COST TO COMPLETION FOR RANGER BLOCKS I AND II (SOURCE: JPL RANGER PROJECT DEVELOPMENT PLAN ISSUED AT *; THIS FIGURE INCLUDED LAUNCH VEHICLE COSTS)
- JPL ESTIMATE OF COST TO COMPLETION FOR RANGER BLOCKS I, II, AND III (SOURCE: JPL RANGER PROJECT DEVELOPMENT PLAN, SUPPLEMENT A, ISSUED AT *; SUBSEQUENT ESTIMATES OF COST TO COMPLETION FOR RANGER BLOCKS IV AND V ARE EXCLUDED AS FLIGHTS WERE CANCELLED)

NOTE: LAUNCH VEHICLE PROCUREMENT OBLIGATIONS FOR PROJECT RANGER, BLOCKS I THROUGH V, ESTIMATED AT $95.236 MILLION (SOURCE. JPL RANGER PROJECT OFFICE RECORDS)

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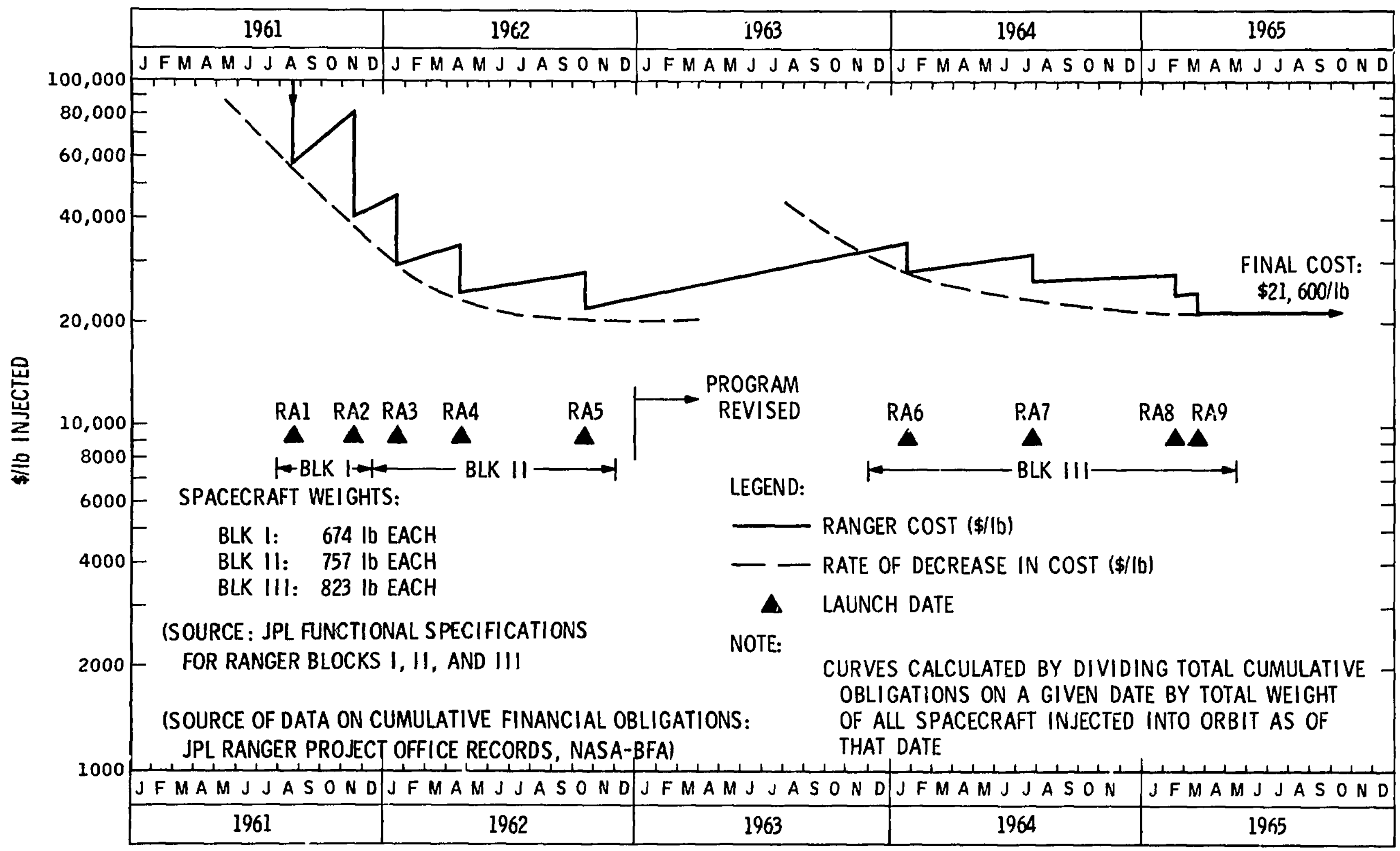
APPENDIX E: Ranger Cost History

A RANGER COST HISTORY (DOLLARS PER POUND OF SPACECRAFT INJECTED INTO ORBIT)



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APPENDIX F: Ranger Manpower History

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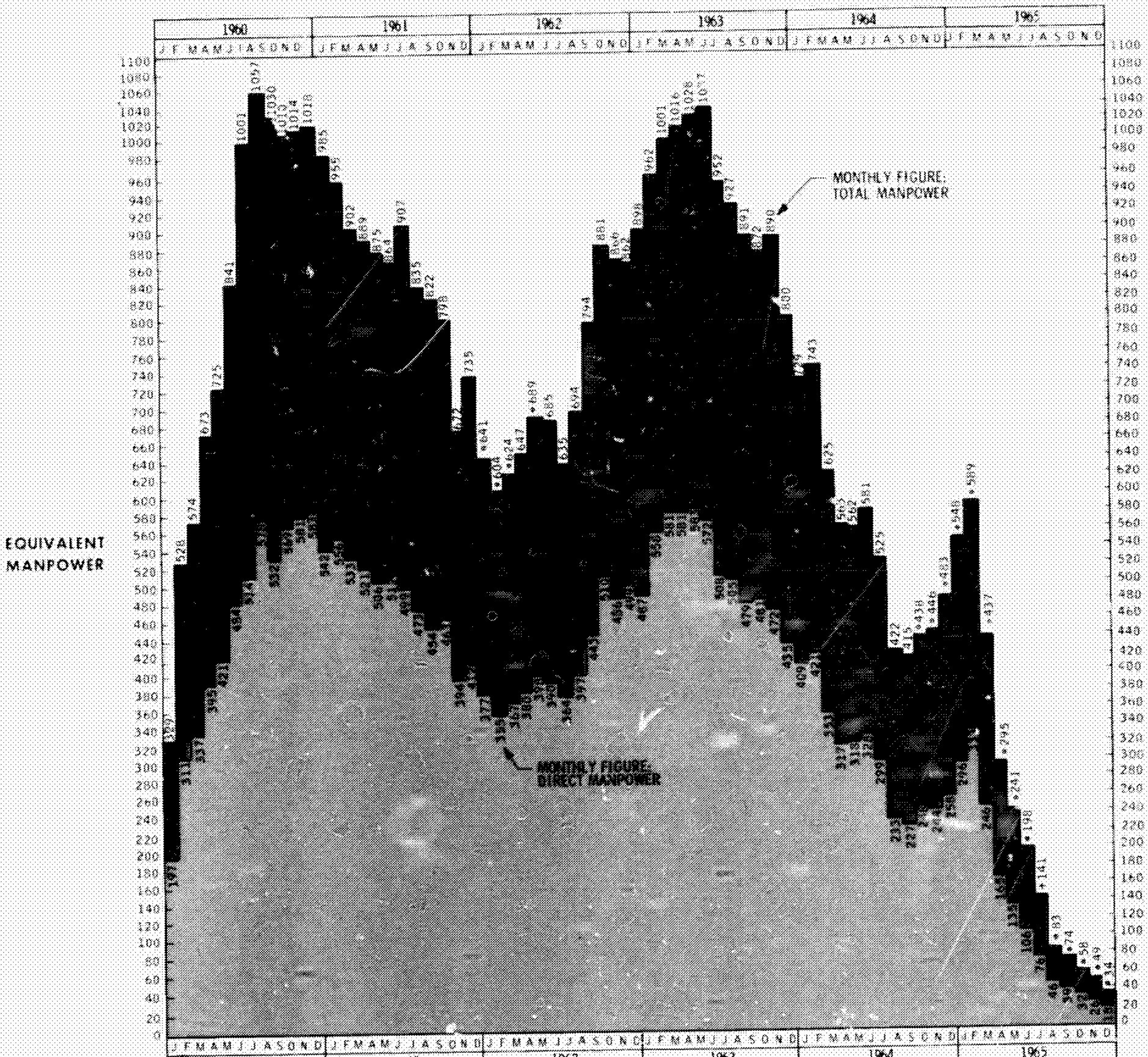
RANGER MANPOWER HISTORY (EQUIVALENT MANPOWER-JPL ONLY)



LEGEND (SOURCE: JPL EQUIVALENT MANPOWER REPORTS, JPL FINANCIAL PLANNING, CMR 26-63, PERMANENT FILES.)

DIRECT SUPPORT (MANPOWER ASSIGNED DIRECTLY TO THE RANGER PROJECT, INCLUDING SCIENTISTS, ENGINEERS, TECHNICIANS, AND ADMINISTRATIVE SUPPORT)

INDIRECT SUPPORT (MANPOWER ASSISTING THE RANGER PROJECT AS ONLY A PART OF THEIR PERMANENT FUNCTION, e.g. PAYROLL COMPUTATION)

* FIGURES COMPUTED FROM RELATED DATA

+ DATA NOT AVAILABLE; FIGURES SHOWN ARE AN AVERAGE OF THE PREVIOUS AND THE FOLLOWING MONTHS.

NOTE: EQUIVALENT MANPOWER REPRESENTS ACTUAL MAN-MONTHS EXPENDED ON THE RANGER PROJECT; IT IS COMPUTED BY SUBTRACTING PAID LEAVE FROM TOTAL PAID HOURS IN A TWO-WEEK PAY PERIOD AND THEN DIVIDING BY 80.

APPENDIX G: Ranger Project Organization, 1960-1965

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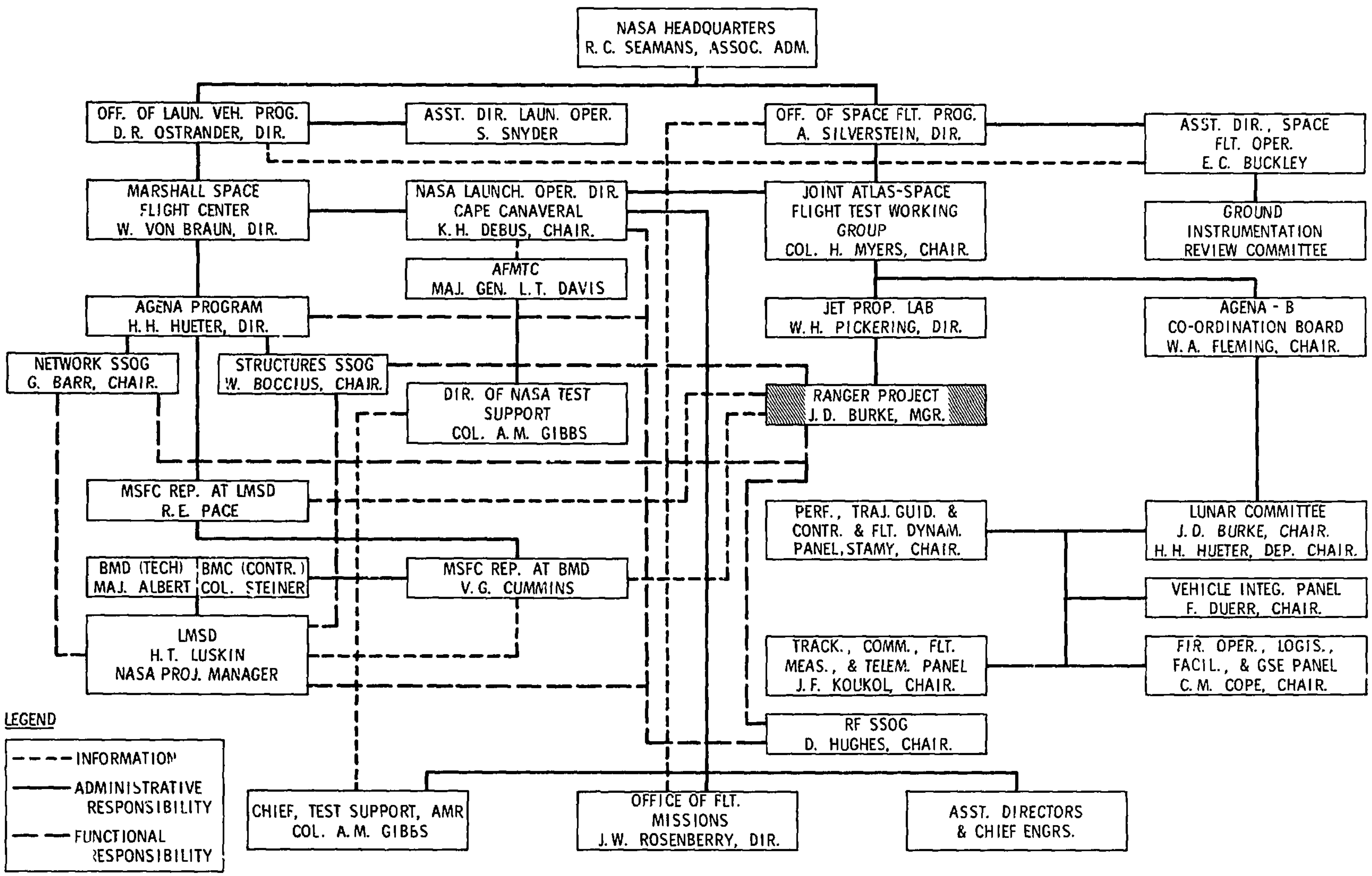
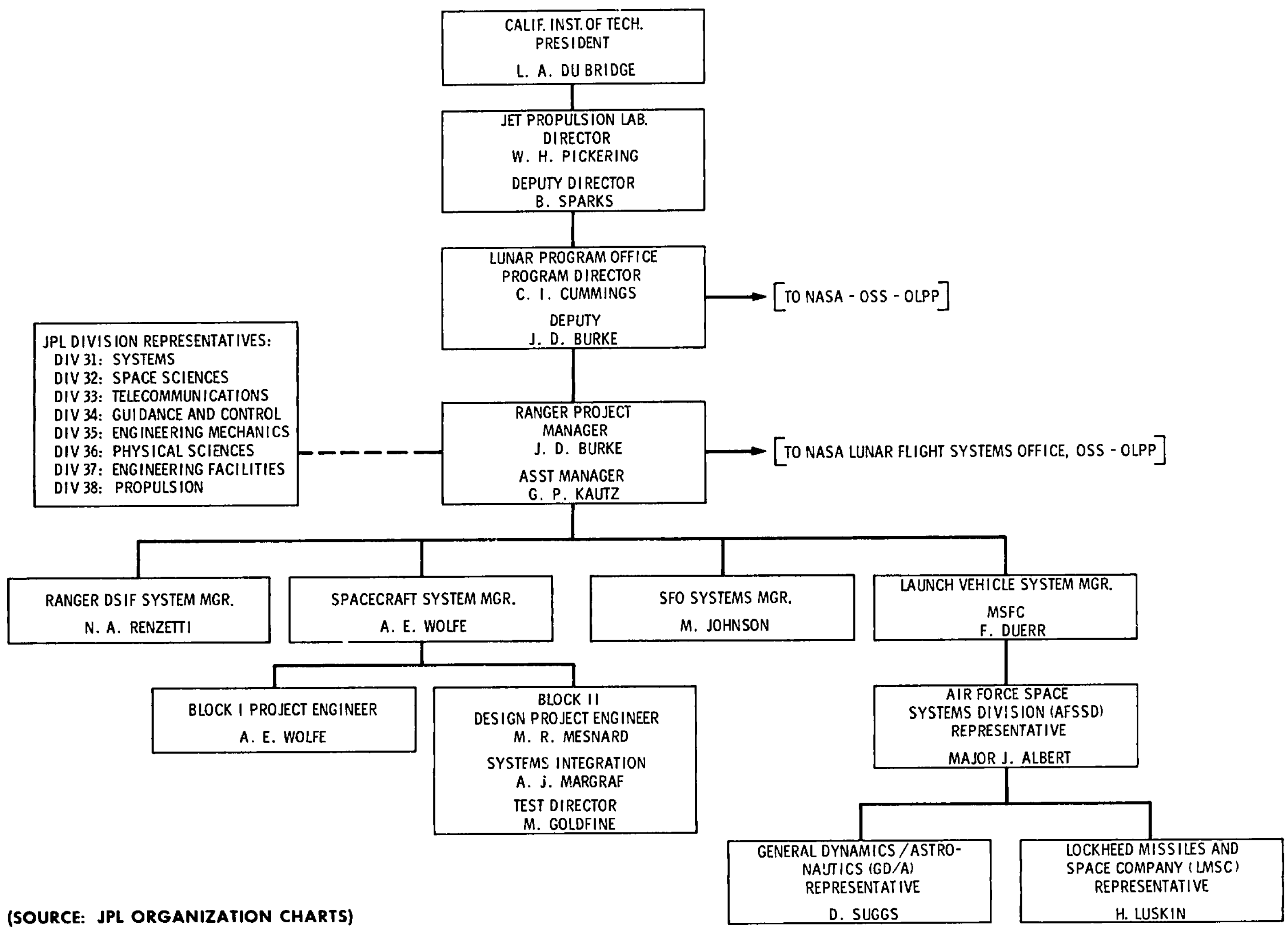
NASA-JPL RANGER PROJECT ORGANIZATION: 1960



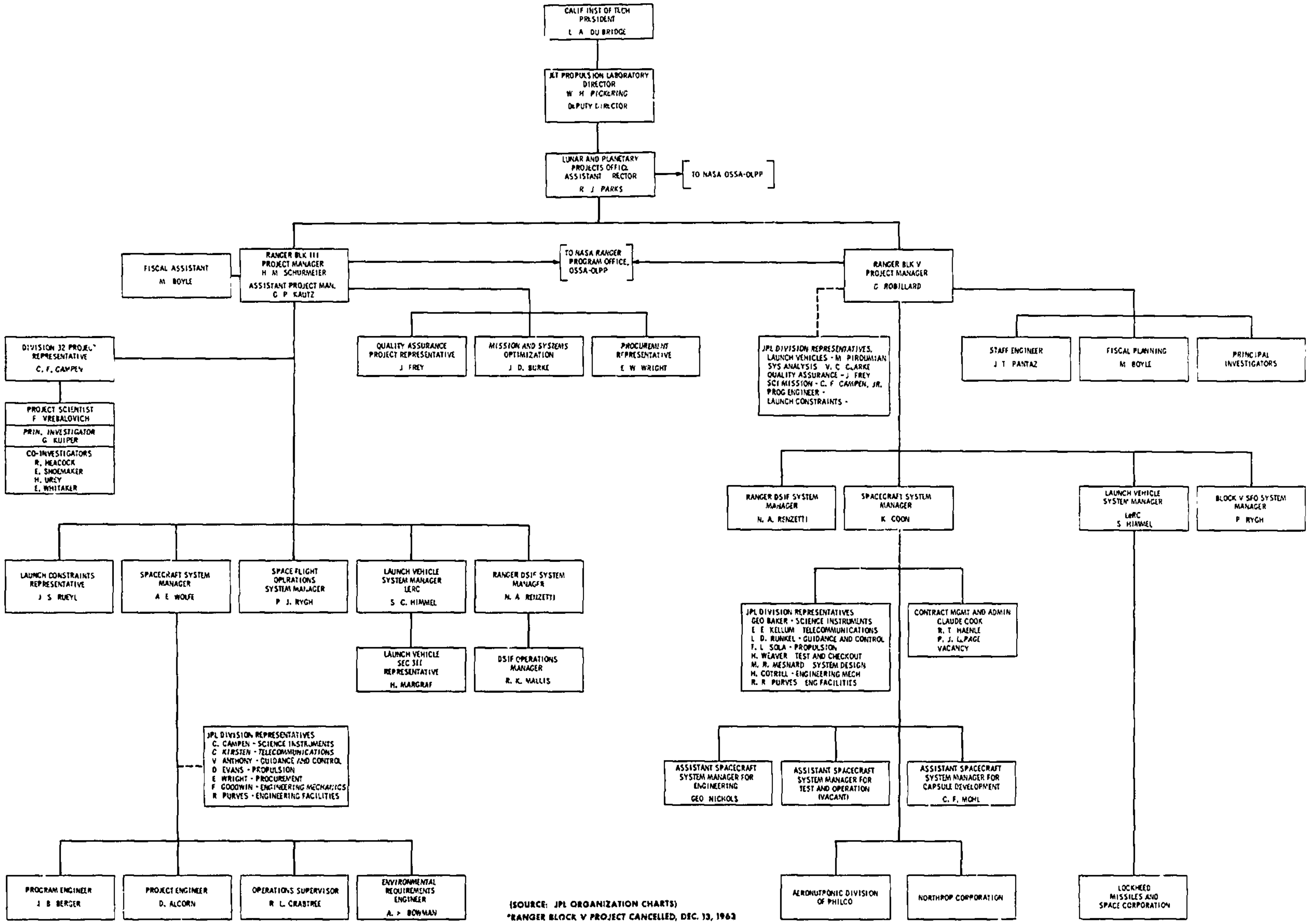
(SOURCE: JPL ORGANIZATION CHART R-5, AUGUST 15, 1960)

JPL-RANGER ORGANIZATION: 1961-1962



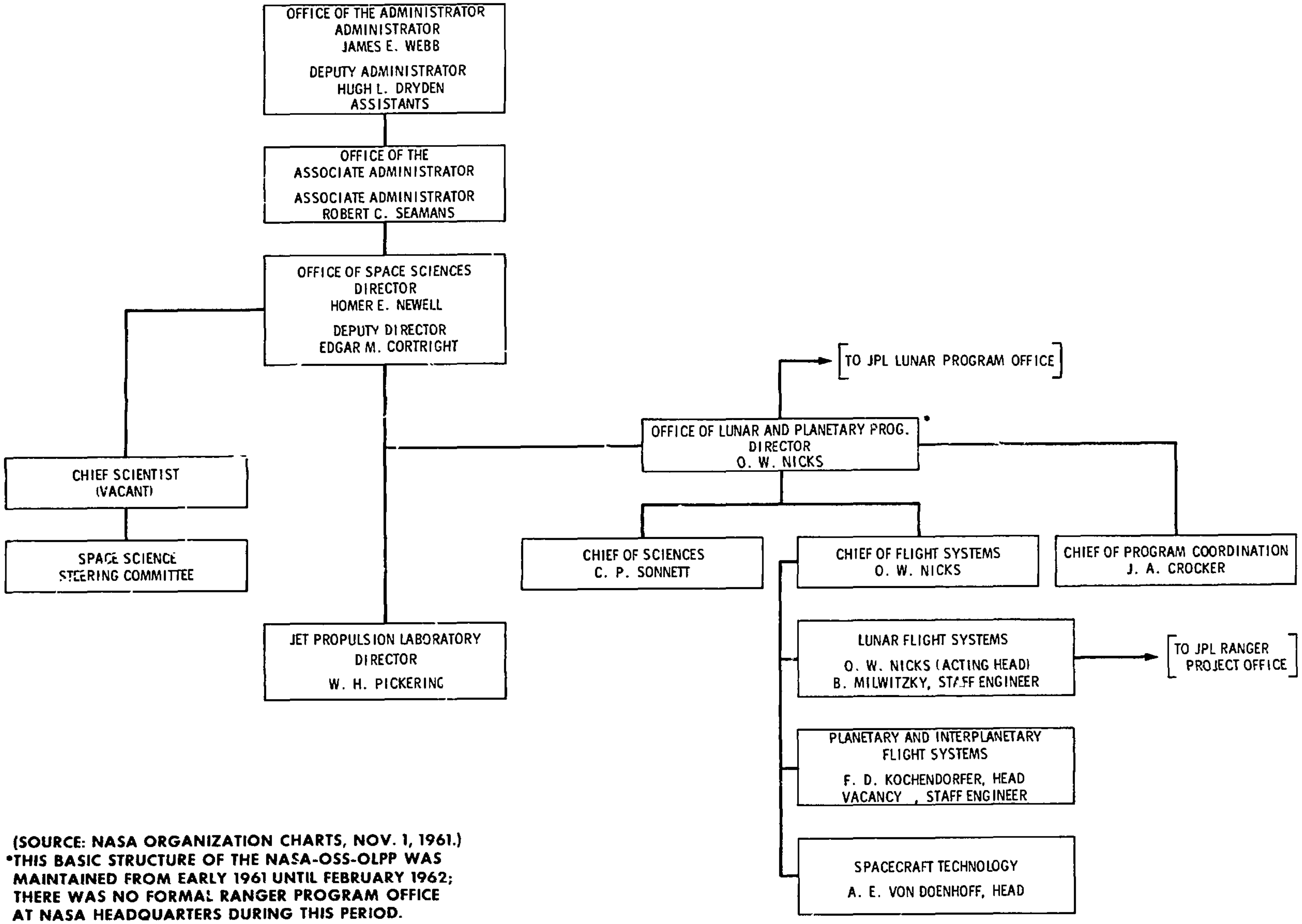
(SOURCE: JPL ORGANIZATION CHARTS)

JPL-RANGER ORGANIZATION: 1963-1965



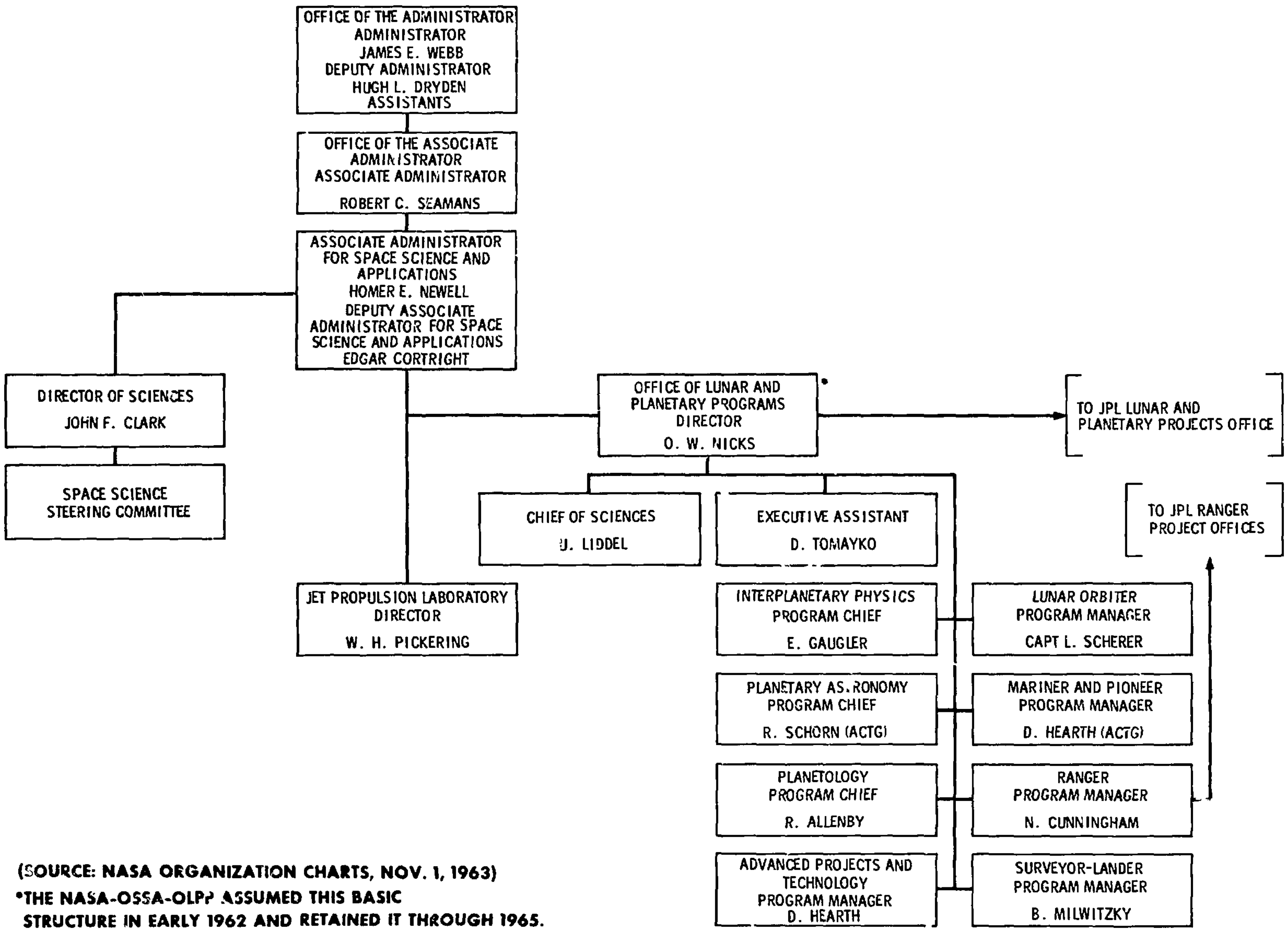
(SOURCE: JPL ORGANIZATION CHARTS)
*RANGER BLOCK V PROJECT CANCELLED, DEC. 13, 1963

NASA-OSS-OLPP ORGANIZATION: NOVEMBER 1, 1961



(SOURCE: NASA ORGANIZATION CHARTS, NOV. 1, 1961.)
***THIS BASIC STRUCTURE OF THE NASA-OSS-OLPP WAS MAINTAINED FROM EARLY 1961 UNTIL FEBRUARY 1962; THERE WAS NO FORMAL RANGER PROGRAM OFFICE AT NASA HEADQUARTERS DURING THIS PERIOD.**

NASA-OSSA-OLPP ORGANIZATION: NOVEMBER 1, 1963



(SOURCE: NASA ORGANIZATION CHARTS, NOV. 1, 1963)

***THE NASA-OSSA-OLPP ASSUMED THIS BASIC STRUCTURE IN EARLY 1962 AND RETAINED IT THROUGH 1965.**

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APPENDIX H: Ranger Space Science

RANGER PROJECT SCIENTIFIC EXPERIMENTS BLOCK I

SPACECRAFT	INSTRUMENTS FIRST APPROVED	AGENCY AND SCIENTIST	INSTRUMENTS ACTUALLY FLOWN
RA 1-2	1 - ELECTROSTATIC ANALYZER FOR SOLAR PLASMA	JET PROPULSION LABORATORY - M. NEUGEBAUER, C. SNYDER	1 - ELECTROSTATIC ANALYZER FOR SOLAR PLASMA
	2 - PHOTOCONDUCTIVE PARTICLE DETECTORS a - CdS PHOTOCONDUCTOR b - THIN-WALLED GEIGER c - MEDIUM-WALLED GEIGER d - Au-Si COUNTER	STATE UNIVERSITY OF IOWA - J. A. VAN ALLEN UNIVERSITY OF CHICAGO - J. A. SIMPSON	2 - PHOTOCONDUCTIVE PARTICLE DETECTORS a - CdS PHOTOCONDUCTOR b - THIN-WALLED GEIGER c - MEDIUM-WALLED GEIGER d - Au-Si COUNTER
	3 - RUBIDIUM VAPOR MAGNETOMETER	GODDARD SPACE FLIGHT CENTER - J. P. HEPPNER	3 - RUBIDIUM VAPOR MAGNETOMETER
	4 - TRIPLE COINCIDENCE COSMIC RAY TELESCOPE	UNIVERSITY OF CHICAGO - J. A. SIMPSON	4 - TRIPLE COINCIDENCE COSMIC RAY TELESCOPE
	5 - COSMIC RAY INTEGRATING IONIZATION CHAMBER	CALTECH - J. V. NEHER JET PROPULSION LABORATORY - H. R. ANDERSON	5 - COSMIC RAY INTEGRATING IONIZATION CHAMBER
	6 - LYMAN ALPHA SCANNING TELESCOPE (HYDROGEN GEO-CORONA)	NAVAL RESEARCH LABORATORY - T. A. CHUBB	6 - LYMANALPHA SCANNING TELESCOPE (HYDROGEN GEO-CORONA)
	7 - MICROMETEORITE DUST PARTICLE DETECTORS	GODDARD SPACE FLIGHT CENTER - W. M. ALEXANDER	7 - MICROMETEORITE DUST PARTICLE DETECTORS
		LASL/SANDIA CORP - J. A. NORTHROP	8 - X-RAY SCINTILLATION DETECTORS (VELA HOTEL)

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RANGER PROJECT SCIENTIFIC EXPERIMENTS BLOCK II

SPACECRAFT	INSTRUMENTS FIRST APPROVED	AGENCY AND SCIENTIST	INSTRUMENTS ACTUALLY FLOWN
RA 3-4-5	1 - TELEVISION CAMERA	JET PROPULSION LABORATORY - A. R. HIBBS, R. L. HEACOCK, E. F. DOBIES U OF ARIZONA - G. P. KUIPER U. S. GEOLOGICAL SURVEY - E. M. SHOEMAKER UC SAN DIEGO - H. C. UREY	1 - TELEVISION CAMERA
	2 - GAMMA RAY SPECTRO-METER	UC SAN DIEGO - J. R. ARNOLD LASL - M. A. VAN DILLA, E. C. ANDERSON JET PROPULSION LABORATORY - A. METZGER	2 - GAMMA RAY SPECTRO-METER
	3- SINGLE AXIS SEISMOMETER a - CAPSULE TEMPERATURE MEASUREMENT b - MAXIMUM DECELERATION AT IMPACT MEASUREMENT	CALTECH - F. PRESS COLUMBIA UNIVERSITY - M. EWING	3 - SINGLE AXIS SEISMOMETER a - CAPSULE TEMPERATURE MEASUREMENT
		JET PROPULSION LABORATORY - W. E. BROWN JR	4 - SURFACE SCANNING PULSE RADAR

RANGER PROJECT SCIENTIFIC EXPERIMENTS BLOCK III

SPACECRAFT	INSTRUMENTS FIRST APPROVED	AGENCY AND SCIENTIST	INSTRUMENTS ACTUALLY FLOWN
RA 7-8-9; RA 6	1 - TELEVISION CAMERA	U OF ARIZONA - G. P. KUIPER PRIN INVESTIGATOR U. S. GEOLOGICAL SURVEY - E. M. SHOEMAKER CO-EXPERIMENTER UC SAN DIEGO - H. C. UREY JET PROPULSION LABORATORY - R. R. HEACOCK	1 - TELEVISION CAMERA
RA 7-8-9; RA 6	2 - NEHER IONIZATION CHAMBER	JET PROPULSION LABORATORY - H. R. ANDERSON, et al	
RA 7-8-9	3 - GEIGER COUNTER ASSEMBLY	JET PROPULSION LABORATORY - H. R. ANDERSON, et al	
RA 7-8-9	4 - ELECTRON FLUX MEASUREMENTS	APPLIED PHYSICS LAB - G. F. PIEPER	
RA 7-8-9	5 - LOW ENERGY SOLAR PROTON DETECTOR	AMES RESEARCH CENTER - M. BADER	
RA 7-8-9	6 - DUST PARTICLE DETECTOR EXPERIMENT	GODDARD SPACE FLIGHT CENTER - W. M. ALEXANDER	
RA 7-8-9	7 - SEARCH COIL MAGNETOMETER	JET PROPULSION LABORATORY - E. SMITH	
RA 7-8-9	8 - ELECTRON-PROTON SPECTROMETER	U. C. LOS ANGELES - T. A. FARLEY, N. SANDERS	
RA 7-8-9	9 - LOW ENERGY PROTON	GODDARD SPACE FLIGHT CENTER - G. P. SERBU, R. E. BOURDEAU	

RANGER PROJECT SCIENTIFIC EXPERIMENTS BLOCK IV

SPACECRAFT	INSTRUMENTS FIRST APPROVED	AGENCY AND SCIENTIST	INSTRUMENTS ACTUALLY FLOWN
RA 10-11-12	1 - TELEVISION CAMERA	U OF ARIZONA - G. P. KUIPER PRIN INVESTIGATOR U. S. GEOLOGICAL SURVEY - E. M. SHOEMAKER CO-EXPERIMENTER UC SAN DIEGO - H. C. UREY JET PROPULSION LABORATORY - R. R. HEACOCK	PROJECT CANCELLED
	2 - GAMMA RAY SPECTROMETER	UC SAN DIEGO - J. ARNOLD	
	3 - SURFACE SCANNING RADAR	JET PROPULSION LABORATORY - W. E. BROWN JR	

BLOCK V

SPACECRAFT	INSTRUMENTS FIRST APPROVED	AGENCY AND SCIENTIST	INSTRUMENTS ACTUALLY FLOWN
RA 13-14-15-16-17	1 - SINGLE AXIS PASSIVE SEISMOMETER CAPSULE	CALTECH - F. PRESS	PROJECT CANCELLED
	2 - GAMMA RAY SPECTROMETER	UC SAN DIEGO - J. ARNOLD	
	3 - SURFACE SCANNING RADAR	JET PROPULSION LABORATORY - W. E. BROWN JR	
	4 - APPROACH TV	U OF ARIZONA - G. P. KUIPER	

APPENDIX I: Ranger Spacecraft Major Subcontractors

RANGER SPACECRAFT MAJOR SUBCONTRACTORS

Block I

American Missile Products Co. Lawndale, California	Telemetry encoders, power switching and logic assembly
Consolidated Systems Corp. Monrovia, California	Lyman Alpha telescope
Eagle Picher Company Joplin, Missouri	Spacecraft batteries
Hoffman Electronics Corp. El Monte, California	Solar cells
Motorola, Inc. Scottsdale, Arizona	Transponders and radio command decoder
Nortronics Div. of Northrop Corp. Hawthorne, California	Sun and earth sensors
Spectrolab Div. of Textron North Hollywood, California	Lyman Alpha mirror
State University of Iowa Iowa City, Iowa	Radiation detector
Texas Instrument Apparatus Division Dallas, Texas	Ground support equipment, flight data encoders
United Electrodynamics Pasadena, California	Pole beacon encoders, flight friction and ground test sets

RANGER SPACECRAFT MAJOR SUBCONTRACTORS

Block II

Aeronutronic, Division of Ford Motor Co. Newport Beach, California	Lunar rough landing capsule
American Missile Products Co. Lawndale, California	CC&S flight subsystem and ground support equipment; power switching and logic; antenna change-over switch
California Institute of Technology Seismological Laboratory Pasadena, California	Single axis seismometer
Electric Storage Battery Co. Raleigh, North Carolina	Spacecraft batteries
Hercules Powder Company Bacchus, Utah	Capsule retro motor
Hoffman Electronics Corp. El Monte, California	Solar cells
International Telephone & Telegraph Industrial Products Division San Fernando, California	Static power converter modules
Lockheed Aircraft Corp. Missiles and Space Division Van Nuys, California	Sterilization of Agena shroud
Minneapolis-Honeywell Regulator Co. Aero Division Minneapolis, Minnesota	Gyroscopes
Motorola Inc. Military Electronics Div. Scottsdale, Arizona	Flight transponder, flight data encoder, radio command decoder
Nortronics Div. of Northrop Corp. Hawthorne, California	Attitude control and midcourse auto-pilot electronic subsystems; sun sensors; earth sensors, attitude control gyro modules

RANGER SPACECRAFT MAJOR SUBCONTRACTORS

Block II

(cont.)

Radio Corp. of America Astro Electronics Division Princeton, New Jersey	Lunar impact TV camera
Space Electronics Corp. Glendale, California	Ground command system demodulators; data encoder ground support equipment
Texas Instruments Apparatus Division Dallas, Texas	Spacecraft command subsystem and ground support equipment
Wiley Electronics Company Phoenix, Arizona	Radio altimeter

RANGER SPACECRAFT MAJOR SUBCONTRACTORS

Block III

Astrodata, Inc. Anaheim, California	Time code translators, time code generators, ground command read-write and verify equipment
Electro-Optical Systems Pasadena, California	Power subsystem
Electric Storage Battery Co. Raleigh, North Carolina	Spacecraft batteries
Heliotek Division Textron Electronics Inc. Sylmar, California	Solar cells
Link Division General Precision, Inc. Palo Alto, California	Video processing film converter
Minneapolis-Honeywill Regulator Co. Aero Division Minneapolis, Minnesota	Gyroscopes
Motorola Inc. Military Electronics Div. Scottsdale, Arizona	Spacecraft data encoders, transponder, and radio command decoder
Nortronics Div. of Northrop Corp. Palos Verdes, California	Spacecraft CC&S subsystem, attitude control subsystem, and associated operational support equipment
Radio Corporation of America Astro Electronics Division Princeton, New Jersey	Lunar impact television subsystem and associated operational support equipment
Rantec Corp. Calabasas, California	Directional couplers, diplexers, and curculators for RF subsystem
Texas Instruments Apparatus Division Dallas, Texas	Spacecraft command subsystem and associated operational support equipment

GLOSSARY

OF TERMS, ABBREVIATIONS AND ACRONYMS

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GLOSSARY OF TERMS, ABBREVIATIONS AND ACRONYMS

AAAS	American Association for the Advancement of Science
AACB	Aeronautics and Astronautics Coordinating Board
ABMA	Army Ballistic Missile Agency
ACIC	Aeronautical Chart and Information Center (USAF)
ADF	Aeronutronic, Division of Ford
ADP	Aeronutronic, Division of Philco
AEC	Atomic Energy Commission
AED	See RCA-AED
AEDC	Arnold Engineering Development Center
AES	Apollo Extension System
AFBMD	Air Force Ballistic Missiles Division (superseded by AFSSD)
AFMTC	Air Force Missile Test Center
AFSSD	Air Force Space Systems Division
AMR	Atlantic Missile Range
AMROO	Atlantic Missile Range Operations Office
AOMC	Army Ordnance Missile Command
ARDC	Air Research and Development Command
ARGMA	Army Rocket and Guided Missile Agency
ARPA	Advanced Research Projects Agency
ARS	American Rocket Society
Az-El	Azimuth Elevation
BMC	Ballistics Missile Center (USAF)
BMD	See AFBMD
bus	Basic spacecraft less mission peculiar experiments
CC&S	Central Computer and Sequencer
CETEX	Committee on the Exploration of Extraterrestrial Space
CIG	Committee on International Geophysics
CIT	California Institute of Technology
CMLC	Civilian-Military Liaison Committee
COSPAR	Committee on Space Research
CSAGI	Comitè Spècial de l'Anèe Gèophysique International
CVA	Convair, Astronautics Division
DAMP	Downrange Antiballistic Measurement Program
DCS	Data Conditioning System
DEV	Design Evaluation Vehicle
DOCF	Data Operations and Control Facility
DOD	Department of Defense
DSIF	Deep Space Instrumentation Facility
DSN	Deep Space Network (composed of DSIF, SFOF, and communications links)

GLOSSARY OF TERMS, ABBREVIATIONS AND ACRONYMS

EASTEX	East Coast group sponsored by the NAS-SSB to investigate problems connected with the detection of extraterrestrial life and prevention of contamination of celestial bodies with terrestrial organisms.
ECR	Engineering Change Requirements
EPD	Engineering Planning Document
ESA	Explosive Safe Area
ETM	Engineering Test Model
ETO	Ethylene Oxide
ETR	Eastern Test Range (same as AMR)
FA	Flight Acceptance (tests)
FLOX	Liquid Fluorine and liquid Oxygen
FM	Flight Model
FRD	Flight Readiness Demonstration
GALCIT	Guggenheim Aeronautical Laboratory, California Institute of Technology
GD/A	General Dynamics/Astronautics
GE	General Electric
GMI	General Management Instructions
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
Ha-Dec	Hour-Angle Declination
HRF	High Resolution Facsimile
IAF	International Astronautical Federation
ICBM	Intercontinental Ballistic Missile
ICSU	International Council of Scientific Unions
IGC-1959	International Geophysical Cooperation--1959
IGY	International Geophysical Year
IOM	Interoffice Memo
IPY	International Polar Year
IRBM	Intermediate Range Ballistic Missile
ISM	Instrumentation Support Manager
JATO	Jet-assisted Takeoff
J-FACT	Joint Flight Acceptance Composite Test
JPLHF	Jet Propulsion Laboratory Historical Files

GLOSSARY OF TERMS, ABBREVIATIONS AND ACRONYMS

LASL	Los Alamos Scientific Laboratory
L-band	Radio frequency band between 960-1450 mc
LeRC	Lewis Research Center
LFC	Lunar Facsimile Capsule
LM	Lunar Module
LMSC	Lockheed Missiles and Space Company
LMSD	Lockheed Missiles and Space Division
LOA	Launch Operations Agency (part of OLVP, and formerly AMROO)
LOC	Launch Operations Center
LOD	Launch Operations Directorate (superseded by LOC)
LOR	Lunar Orbit Rendezvous
LOX	Liquid Oxygen
LSHFC	Lunar Surface Hardness and Facsimile Capsule
LSPC	Lunar Surface Photoreconnaissance Capsule (same as LFC)
LTV	Life Test Vehicle
LVOD	Launch Vehicle Operations Division
mc	Megacycle(s)
MIT	Massachusetts Institute of Technology
MSC	Manned Spacecraft Center
MSFC	Marshall Space Flight Center
MTM	Mechanical Test Model (later called Structural Test Model [STM])
NAA	North American Aviation
NACA	National Advisory Committee on Aeronautics
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NASA-WOO	National Aeronautics and Space Administration-Western Operations Office
NAS-SSB	National Academy of Sciences-Space Science Board
n.d.	No date
n.m.	Nautical miles
NOTS	Naval Ordnance Test Station
NRL	Naval Research Laboratory
NSF	National Science Foundation
NSL	Northrop Space Laboratory
OART	Office of Advanced Research and Technology (NASA)
OFM	Office of Flight Missions (NASA)
OLPP	Office of Lunar and Planetary Programs (NASA, in OSSA)
OLVP	Office of Launch Vehicle Programs (NASA)
OMSF	Office of Manned Space Flight (NASA)
ONR	Office of Naval Research (U.S. Navy)
OSE	Operations Support Equipment
OSFD	Office of Space Flight Development (NASA, formerly OSFP

GLOSSARY OF TERMS, ABBREVIATIONS AND ACRONYMS

OSFP	Office of Space Flight Programs (NASA)
OSS	Office of Space Sciences (NASA, formerly OSFD)
OSSA	Office of Space Science and Applications (NASA, formerly OSS)
OTDA	Office of Tracking and Data Acquisition (NASA)
PDP	Program Development Plan
PERT	Program Evaluation Review Technique
PMR	Pacific Missile Range
PRD	Program Requirements Document
PSAC	President's Scientific Advisory Committee
PSP	Program Support Plan
PTM	Proof Test Model
RCA-AED	Radio Corporation of America-Astro Electronic Division
RF	Radio Frequency
RFP	Request for Proposal
ROM	Rough Order of Magnitude
RTC	Real Time Command
RTG	Radio-Isotope Thermal Electric Generator
RTV	Reentry Test Vehicle
SAC	Strategic Air Command (USAF)
SAF	Spacecraft Assembly Facility
S-band	Radio frequency band between 2200-3300 mc
SCAR	Scientific Committee on Antarctic Research
SCOR	Scientific Committee on Oceanographic Research
SCR	Silicon Controlled Rectifier
SDAT	Spacecraft Data Analysis Team
SEB	Sourch Evaluation Board
SEPC	Space Exploration Council
SFO	Space Flight Operations
SFOC	Space Flight Operations Center
SFOF	Space Flight Operations Facility (formerly DOCF)
SL	Designation of the NASA Office of Lunar and Planetary Programs, OSSA
SSB	See NAS-SSB
SSD	See AFSSD
SSF	Space Simulator Facility
SSSC	Space Sciences Steering Committee (NASA Office of Space Sciences)
STC	Systems Test Complex
STL	Space Technology Laboratory
STOR	System Test and Operations Report
SURMEC	Surface Measurement Capsule

GLOSSARY OF TERMS, ABBREVIATIONS AND ACRONYMS

TA	Type Approval (tests)
TCM	Thermal Control Model (also Temperature Control Model)
TIROS	Television Infra-Red Observation Satellite
TOP	Test and Operations Plan
TR	Technical Report
TRAC(E)	Tracking and Communications, (Extraterrestrial) (redesignated WTN)
TTM	Thermal Test Model
TWX	Teletypewriter Exchange (message)
UCLA	University of California, Los Angeles
UCSD	University of California, San Diego
USAF	United States Air Force
USNC/IGY	United States National Committee for the International Geophysical Year
VIGS	Vega Injection Guidance System
WESTEX	West Coast group sponsored by the NAS-SSB to investigate problems connected with the detection of extraterrestrial life and prevention of contamination of celestial bodies with terrestrial organisms.
WSMR	White Sands Missile Range
WTN	World Tracking Net (redesignated DSIF)

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AUTHOR

R. Cargill Hall is the Historian for the Jet Propulsion Laboratory, operated by the California Institute of Technology for the National Aeronautics and Space Administration. He came to Cal Tech in 1967 from Lockheed Missiles & Space Company, where he was an operations research analyst and a historian. He is now writing a history of Project Ranger and serving as Coordinator-Editor of the "Annual Chronology of Astronautical Events" of the International Academy of Astronautics.

Mr. Hall received his B.A. degree in political science from Whitman College in 1959 and his M.A. in political science and international relations from San Jose College in 1966. He was awarded the Goddard Historical Essay Trophy by the National Rocket Club in 1962 and 1963 and was named one of the Outstanding Young Men of America in 1968.

His publications have appeared in the American Journal of International Law, Journal of Air Law and Commerce, The Airpower Historian, and Technology and Culture. He lives with his wife and three children in Pasadena, California.