SPACE BUSINESS Daily

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JODRELL TRANSCRIBES LUNIK IX TV PHOTOS. Television photos, transcribed from **LUNIK IX**'s transmissions from the lurain by Jodrell Bank scientists, show a rocky desert interspersed with small pebble features. Meanwhile, several hours of information have been obtained by Soviet scientists since **LUNIK IX**'s television camera began scanning the lurain and transmitting the photo data to Earth at 8:50 PM EST Thursday. The Soviets also may be taking magnetic field and temperature data in addition to the long-known plan to TV the lurain for transmission to Earth (SPACE Daily, April 3, 1963). Space was found aboard **LUNIK IX** for two Soviet pennants, one bearing the words "Union of the Soviet Socialist Republics" and a hammer and sickle. The TV photos will be shown publicly "in due course," the Soviets promise, while claiming that the photos will "provide the first clear picture of the nature of the Moon."

Manned Circumlunar Flights Confirmed. Cosmonaut Gherman Titov has reconfirmed the earlier reports of the Soviet plan to circumnavigate the Moon with cosmonauts, before the first landing, to collect scientific data and select the manned landing site. Titov also expressed the conviction that the Soviet scientists would return to the use of dogs for a biomedical analysis of lunar landing and return before the manned flights.

THE SECOND COMING OF SPUTNIK (An Analysis). How great must be the exhilleration and enthusiasm within the space leadership of the Soviet Union for having accomplished again what we consider the absolute and vital ingredient for a sustained and healthy stature of supremacy in the family of man. If being the first, the absolute first, to probe and test the mettle of our science against the unknown is not a desire or requirement of the man or the nation, then he or it cannot share with us the empty feeling of frustration of our stigma while admiring the aggressiveness of the competitor.

After these more than eight years we are tiring to the point of disgust of those who can with all their so-called wisdom tell us that a first is not a pre-requisite. We now know that these same people will be mouthing the same line if and when the Soviets land the first astronauts on the lurain. Unfortunately, some of these people believe earnestly that they are providing a vital service to their country by "putting the whole matter in perspective" and "reassuring" the pride of America. If ever there was a time for a revolution of criticism of the leadership being provided, this present moment could not be more crucial. In the face of continued Soviet demonstrations that they, the Soviets, can provide a more vigorous pace without the shame of being second to motivate them, our President gambles with the schedule of a quest for a major technology first that will linger in history as long as the history of man.

The gamble is blamed on the cost of our commitment to the Vietnam War when the real culprit is a quest for national non-aggressive comfort. Many years ago we criticized another Administration for not being able to see beyond a "**VANGUARD** space program," a stigma which remained for years after the flight of **SPUTNIK**. Now, we have an Administration which cannot see beyond another "**VANGUARD** space program," this time with a less aggressive, but heavily funded, name of **APOLLO**.

How very hard our scientific and engineering space leaders want the **APOLLO** to be not only first but the "vanguard" of continued space leadership supremacy. However, they are now being treated the same way a noted space leader was treated when he asked for money to develop a **SATURN** several years ago, i.e., this space leader's chief responded: "I have never seen a scientist that did not want more money." Again, several years ago, we were accused of hindsight by a noted newscaster on a national hook-up for outlining our neglect before **SPUTNIK** instead of emphasizing a plan of foresight. Since that date, Oct. 8, 1957, when we said "Let's go to the Moon," we have tried not to dwell on history except to highlight the wrong decisions.

One finds it extremely hard to be critical of a leader who turns space exploration into an "American enterprise" or his successor who for at least two years supports that Enterprise. But when a leader admits to us that any "delay which may develop in making the most effective use of the great investment in building space competence," hopefully will be "temporary in nature," when we have just about sold out our chances of meeting a doubtful schedule of a manned lunar landing in the 60's, it is not acceptable as a decision that is fighting for space supremacy. It is least of all acceptable when it is prefaced by putting the blame on Vietnam, with no mention of the welfare programs, as the reason for the "tempered priority" for funds "for other purposes."

Whether or not a possible adherence to a "latter part of 1969" is still acceptable as a competitive quest is dependent upon whose estimate or analysis of Soviet intentions is used as a comparison. If we use our own we find that the 50-50 chance some Administration officials use is not quite right. As a form of review, using the **LUNIK IX** as an integrator, we find that the earlier analyzed schedule of Soviet versus United States exploration efforts, prepared by SPACE Daily and published by Life magazine on March 3, 1961, lists the second Soviet lunar soft-landing attempts as beginning in late 1965 and continuing through 1966. The first attempt at the soft-landing by the Soviets was listed as possible from mid-1961 to the end of 1962 when the United States still had plans to set a survivable capsule **RANGER** down on the lurain. The Soviets made this first attempt on April 2, 1963, identified it as **LUNIK IV** and apparently dropped any further attempts, when we dropped the **RANGER** soft-lander plans for **SURVEYOR**, until **LUNIK V**. That same SPACE Daily schedule listed the time for a possible Soviet attempt at the manned landing on the lurain as the period from the first quarter of 1967 to the first of 1969. The present United States schedule, barring further interferences, is the last quarter of 1969.

Are the Soviets Out-Planning Us? While facing up to the reality that budgets affect schedules and budgets are therefore the projection of our determination, so must we ask ourselves some very vital questions. Can some of us defend our actions in the never-failing and immediate equating of Soviet efforts with some allied or alien efforts of our own? For instance, how is it possible to equate the **GEMINI** rendezvous mission with the success of **LUNIK IX**, as some have done?

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Should we not instead, ask whether the Soviet Union has out-analyzed us in this area, or, out-developed us, i.e., will the rendezvous and docking in Earth orbit prove to be the simplest maneuver of the Soviet's manned lunar landing? Further, we are still equating the **GEMINI** rendezvous in Earth orbit with **APOLLO** rendezvous in lunar orbit. One is a proof of theory while the other must remain a proof of technology competence. The Soviets can afford to fail in Earth orbit rendezvous and docking in the preparation of their lunar flight but we cannot afford to fail in the rendezvous and docking of the **LEM** to the **APOLLO** Command Module above the lurain.

Perhaps, just perhaps, the Soviets have determined (years ago) that development of the soft-landing technique and return to Earth is priority to rendezvous in Earth orbit. While doing this, is it not possible that the Soviets are working with dynamic scale models of their manned lunar landing **LEM** in the **LUNIK IX**-type of mission and are thereby answering not only the lurain texture and strength question but are learning to maneuver a scale model of their manned vehicle? Our **SURVEYOR** is not even remotely related in scale to the **LEM.**

Too many people have overlooked the fact that the Soviets did not have a **RANGER** program, except to probe the mysterious unknown of the Moon's back-side. Did the Soviets look far ahead and could not justify to the budget manipulators that a **RANGER** would resolve the lurain composition question, as our **RANGER**s proved they were unable to do? When we start asking these questions we can almost confidently surmise that the manned circumlunar flight by the Soviets is early on the agenda, perhaps in 1967 or early 1968, because as they must have surmised in debating the **RANGER/SURVEYOR** question, only a physical or near physical survey of the goal may be the only expeditious way, when the budget is controlled by those who do not allow for anything except conclusive returns on the investment.

It is too late to consider any major changes in the **APOLLO** program and still make it in the 1960's but if the President persists, with Congress' support, in borrowing from the national space quest, then some short-cuts instituted by space administrators may spell the difference between success and failure in providing us a chance of grabbing that so very vital first of the manned lunar landing.

LUNIK IX NOT EXPECTED TO AFFECT NASA BUDGET. Reps. Joseph E. Karth (D-Minn.) and Olin E. Teague (D-Tex.), members of the House Space Committee, agree that the successful soft-landing of the Soviet Union's **LUNIK IX** should not affect Congressional action on NASA's FY '67 budget. Teague added that if testimony during the budget hearings next month shows that either the 1970 lunar landing or post-**APOLLO** planning is being endangered by NASA's "inflexible" funding request, then he will attempt to add monies to the appropriation in order to alleviate that danger.

LUNIK IX MAY AFFECT SURVEYOR. The size and direction of the **SURVEYOR** lunar soft-lander program may have been placed in doubt by the success of the Soviet's **LUNIK IX** spacecraft. Congressman Joseph E. Karth (D-Minn.), Chairman of the Space Sciences Subcommittee, indicated that if the Soviet Union should make the data they are receiving on the nature of the lurain available to us, there might not be a need for as many **SURVEYOR** shots.

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The possibility of a cut-back in the Hughes program is echoed on the Senate side where observers point to the "fantastic cost" of **SURVEYOR** to date, and indicate that receiving data on the lurain from the Soviets might cause the Senate committee "to ask some questions" during the hearings about the need for proceeding with the full approved 10-spacecraft program. Some Congressional observers also feel that the success of **LUNIK IX** will assure that the **SURVEYOR** program is at least held to the 10-vehicle program instead of continuing to the originally conceived 16 spacecraft.

The **SURVEYOR** program, which has been subject to considerable cost over-runs and schedule slippages (SPACE Daily, Oct. 28) was recently extended to the full 10 spacecraft approved program (SPACE Daily, Jan. 17).

POST-APOLLO DATA "DISAPPOINTING". The post-**APOLLO** planning currently being done by private companies and the quality of data available from non-governmental sources are "disappointing" according to Congressman Olin E. Teague (D-Tex.), whose manned space flight subcommittee is completing a detailed study of post-**APOLLO** planning. Teague told SPACE Daily the information being solicited from private firms is "not in as much depth as we had hoped." The study may be released within three or four weeks.

BENDIX SELECTED FOR AA LUNAR MOBILITY STUDY. NASA-Marshall has picked Bendix Systems Division for a three-phase, 10-month study to evaluate several types of vehicles which could be evolved from the **APOLLO** spacecraft for use in transporting astronauts on the lurain. RFP's on the program were issued last fall (SPACE Daily, Sept. 24), but selection of contractor has been held up due to budgetary considerations. Three other major **AA** studies concerned with the lurain, also logjammed by lack of a firm funding plan (SPACE Daily, Dec. 17), are expected to be awarded soon. They are: Early lunar shelter design and comparison study; study of lunar dust removal/prevention techniques for radiators (**AA** payload); and study of lunar wheel and drive system experimental test program (**AA** payload).

Phase I of the $49,688 Bendix study will encompass comparison between the Mobile Lunar Excursion Module **(MOLEM)**, Mobile Command Module, and the Mobile Extended **APOLLO** Laboratory Module. Phase II will be involved with detailed comparison of the three vehicles; and Phase III will call for development of a "reasonable and orderly" mobility systems evolution plan.

NASA-Marshall has also extended Bendix's contract for development of lurain navigation techniques (SPACE Daily, Dec. 20). The new contract is for $50,472.

BOEING-IBM TEAM ON AA INTEGRATION CONTRACT. IBM's Space Systems Center and Boeing's Launch Systems Branch have teamed for the competition on the **APOLLO** Applications **(AA)** payload integration contract being RFPed by NASA-Marshall (SPACE Daily Jan. 17 & 20 and Feb. 2).

APOLLO GUIDANCE COMPUTER STUDIED FOR AA. Raytheon has been awarded $150,000 contract from NASA-Houston to study the feasibility of adapting the on-board **APOLLO** guidance computer for use in **APOLLO** Applications **(AA)** missions. Raytheon

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produces the on-board digital computer for the **APOLLO** Command Module and for the Lunar Excursion Module **(LEM)**. Work on the six-month **AA** contract will be carried out by Raytheon's Space and Information Systems Division.

The direction of **AA** is divided between NASA-Houston and NASA-Marshall (SPACE Daily, Dec. 20). Houston is reponsible for payload integration in the Command and Service modules, while Marshall has direction for **AA** work concerning **LEM**, the **SATURN** instrument units and the **S-IVB** stage. RFPs from Marshall for its end of the program are out (See SPACE Daily, Feb. 2). NASA is asking Congress for about $100 million for **AA** in FY '67 (SPACE Daily, Jan. 25).

OSSA REORGANIZED. NASA's Office of Space Science and Applications has been reorganized in order to facilitate the use of manned space flight capabilities for the scientific exploration of space. The Manned Space Science Programs Office has been renamed the Manned Flight Experiments Office and some personnel in this office have been transferred to the various program offices.

An Advanced Missions Staff has been created in the Office of the Deputy Associate Administration (Sciences) to coordinate all OSSA advanced study efforts. The Meteorological Program Office and the Communications and Navigations Program Office have been consolidated into a single Office of Space Applications Programs. The **PIONEER** program has been transferred from the Lunar and Planetary Office to the Physics and Astronomy Office. The Geodetic Satellite program (**GEOS** and **PAGEOS**) has been transferred from Physics and Astronomy Office to the new Space Applications Office as have all programs involving the acquisition of data through remote sensing. A Chief of Program Review and Resources Management has been established in each operating program office.

DOD/NASA UPDATE GEMINI AGREEMENT. The DOD and NASA have updated their **GEMINI** agreement of January 21, 1963, with a new "Memorandum of Understanding" between the DOD and the NASA concerning the manned space flight programs of the two agencies (SPACE Daily, Jan. 28). The new agreement establishes a joint Manned Space Flight Policy Committee with NASA Deputy Administrator Dr. Robert C. Seamans Jr. and DOD Director of Defense Research and Engineering Dr. John S. Foster Jr. as co-chairmen. The committee will attempt to resolve "those matters concerning the mutual participation in and support of" the **APOLLO** and **MOL** programs.

MCDONNELL CONTINUES MAW DEVELOPMENT. Army Missile Command is awarding a continuation contract to McDonnell for engineering development of **MAW** (Medium Anti-tank Weapon). McDonnell received an $80,000 **MAW** contract last fall (SPACE Daily, Sept. 13). The company has been developing and testing a wire-guided version of the weapon (SPACE Daily, Aug. 13,'64) while the Army has been developing a gyro-controlled system.

LUNIK IX LANDS ON HARD LURAIN. Television pictures monitored by Jodrell Bank from the Soviet Union's **LUNIK IX** spacecraft show that the lurain has a hard sponge-like substance like pumice stone, Jodrell Bank director Sir Bernard Lovell says. The

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pictures appear to show a dusty rocky desert surface, dotted with small lunar pebbles and craters. Lovell said the photos showed only little surface dust. "It would be perfectly satisfactory for landing heavy vehicles and men."

The **LUNIK IX** pictures, and Lovell's interpretation, support the "hard surface" lurain theory, as backed by Dr. Eugene M. Shoemaker, chief of the Branch of Astrogeology of the U.S. Geological Survey. Following the success of **RANGER VII** in July 1964, Shoemaker said: "I've had to change my personal opinion about the lunar surface. I think the dust layer must be thinner than I had thought because there aren's as many small craters...The surface is basically hard and fairly dense material up to within perhaps a foot at least, and perhaps even a few inches of the surface. The very top layer is quite porous, very finely pulverized material which has very low density. An astronaut should not be afraid to step out on the lunar surface." Dr. Shoemaker added: "We should check the maria in other locations, and I for one would want to check the texture of the surface in the centers of the large craters. We could expect this to be much different in texture from the surface of the maria." (Note: **LUNIK IX** landed in the maria, the Ocean of Storms.)

NASA NOT MONITORING SIGNALS FROM LUNIK IX. NASA says it is not monitoring signals from the Soviet Union's **LUNIK IX** spacecraft which is sending back television pictures of the lurain. Reason: "First, because the signals are being sent on different frequencies than our present deep-space tracking network is set for and it would take several days to recalibrate the instrumentation." (Jodrell Bank, which is monitoring the signals, was faced with the same problems of recalibration.) "Second, because our tracking facilities are presently operating at full capacity since we are receiving data from **PIONEER VI** in addition to tests and other preparations for the **SURVEYOR** launch and in addition to receiving data from other satellites."

WEBB SEES INFLEXIBLE BUDGET AS DANGER TO LUNAR LANDING. NASA Administrator James E. Webb has told SPACE Daily that NASA's "stringent" FY '67 budget request endangers a manned lunar landing by the 1970 target date. Webb confirmed that the BOB-approved budget contains no funds for any unforeseen emergencies in the NASA program and indicated that this is a great danger to the **APOLLO** program.

ABC SATELLITE DECISION DUE THIS WEEK. As reported in SPACE Daily December 20, the FCC's decision on the proposed ABC TV-radio satellite will be made early this month, and the Commission was hopeful of rendering it last week on schedule. The full Commission was unable to meet last week, however, so the expected date is now Wednesday. That day, according to the Commission, "is probable but not certain." ABC filed with the Commission last fall for the right to orbit its own payload for distribution of TV and radio signals to its affiliated American stations (SPACE Daily, Sept. 22 and Oct. 21).

COMSAT URGES FCC TO DENY ABC SATELLITE REQUEST. ComSat, in a last minute move, has filed a statement with the FCC to repeat its plea that the Commission reject ABC's application for authority to own and operate a communications satellite. The Corporation reiterated its long-standing argument that the Communications Satellite Act of 1962 provides only ComSat the right to satellite ownership.

FCC COMSAT DECISIONS DUE THIS MONTH. Expected since early last month (SPACE Daily, Jan. 5), the resolution of the "interface" and "user" questions posed by the existence of ComSat is now to come this month. The first decision will settle the question of whether ComSat will own and operate the interface facilities in "gateway cities" and the links between the facilities and their corresponding ground stations, or whether the common carriers will so own and operate. The second decision, likely to be made late this month, will define an "authorized user" of ComSat services--a phrase used but not defined in the Communications Satellite Act of 1962. The common carriers want to be the sole users (along with the Federal Government).

NEW FRANCO-SOVIET COMMUNICATIONS MEETING SET. April 1 has been scheduled as the date for the next, and third, technical meeting of French and Soviet telecommunications specialists. The group will study the results of another study group investigating a common system for European telecommunications, an investigation that is to be completed before the meeting with a firm recommendation for the common system.

A joint communique issued by the Soviet Union and France after their second meeting last year in Moscow (SPACE Daily, Nov. 4) expressed a "desire" to reach an "appropriate agreement" on a joint communications satellite project. The initial meeting, headed by Mstislav Keldych and Yvon Bourges, was held in Paris (SPACE Daily, Oct. 21).

D-1A LAUNCH FIRMED FOR FEB. 11. The launch of France's second satellite, **D-1A**, envisioned for the 11th or 12th of this month (SPACE Daily, Jan. 7), has been set for the 11th. If the countdown follows that used for the launch of **A-1A** on November 26 (SPACE Daily, Dec. 1), liftoff will come at 2 PM local time (3 PM Paris time, 9 AM EST) from the Hammaguir range in Algeria. The launch vehicle will be the three-stage **DIAMANT**, which was **A-1A**'s vehicle (SPACE Daily, Dec. 6).

HUMPHREY TO ADDRESS GODDARD MEMORIAL DINNER. For the second consecutive year, Vice President Hubert H. Humphrey will be the speaker at the National Space Club's Goddard Memorial Dinner. The dinner, which will be held at Washington's Sheraton-Park Hotel, is scheduled for the evening of March 16.

Awards to be presented at the dinner include The Robert H. Goddard Memorial Trophy, The Nelson P. Jackson Aerospace Award, The Astronautics Engineer Award, The National Space Club Press Award, The Robert H. Goddard Scholarship, and The Robert H. Goddard Historical Essay Award.

NORTHROP STUDYING GUIDANCE LAB FOR NASA. NASA-Cambridge has awarded Northrop-Nortronics' Precision Products Department a $97,330 contract for a feasibility study of an inertial guidance laboratory to aid the development and testing of "next-generation space probes." The study will consider lab location, design, and content. Northrop has built two such labs, one for itself and one for the Navy.

CITIBANK JOINS DEFICIT DIALOGUE

The First National City Bank of New York has joined Congressional Republicans (SPACE Daily, Jan. 19 & 26) in saying that the Administration has misrepresented the estimated national deficit for FY '67 by approximately $9 billion. The bank says that without the effects of "bookkeeping legerdemain," the administrative budget deficit might have well amounted to $10 billion or more, compared to the $1.8 billion cited in the President's budget message.

Citibank reports that budget receipts are expected to grow substantially as a result of the sharp growth of the economy. Acceleration of corporate tax payments, expected to boost Treasury revenues by $1 billion in fiscal 1966 and by $3.2 billion in 1967, is a one-shot proposition according to the bank, and neither the hurry-up schedule of corporate tax payments nor the shift to graduated income tax withholdings for individuals will effect profits or real incomes.

NASA ORDERS APOLLO MEDICAL KITS

NASA-Houston has contracted for development of emergency medical kits for all training and in-flight requirements for the **APOLLO** lunar mission. The kits will be used for the **APOLLO** Command and Lunar Excursion Modules.

Under terms of the $70,000 contract, awarded to Rodana Research Corp., Bethesda, Md., two training units will be delivered for each flight. In addition, one mock-up and six prototype models will be developed. Number of flight and backup kits will be determined by the number of flights scheduled. Work will be performed in three phases: design; testing and redesign; production.

MARTIN DELIVERS LUNAR TOOLS

Martin has delivered a prototype of a lunar tool box and 16 geological tools to be used by astronauts in gathering and storing samples of lunar material. The tool box can be carried on the lurain by a space suited astronaut and when opened can be "refolded" on its hinges to expose the tools. The new interior of the box becomes the storage area for the 80 pounds of lunar material which will be brought back. The lunar tools will include a battery-powered drill capable of drilling cores six inches into the crust, a dust scoop, a sample-weighing device, a hand-held magnifier which can be used through the space suit visor, several types of surveying instruments and rangefinders, and a small sample retriever.

GE CHANGES DIVISION NAME

General Electric's Radio Guidance Operation has changed its name to the Special Information Products Department of the Defense Electronics Division. The change is intended to more accurately reflect the broad range of products which the unit handles including guidance systems for the **GEMINI.**

John A. Teske has been appointed as assistant manager of Garrett-AiResearch. For the past two years Teske has been in charge of AiResearch's Torrance, Calif., facility.

AEROJET SALES/EARNINGS DOWN

Aerojet-General's sales for FY '66 were $499,019,111, down from last year's $611,-485,288. Earnings dropped correspondingly from $16,001,546 to $15,018,483. Company officials point out, however, that the 1966 earnings are a net increase after taxes of 3 per cent, compared with the 2.6 per cent increase a year ago.

NERVA TEST SUCCESSFUL

The AEC-NASA joint Nuclear Rocket Development Station has successfully completed a 15-minute "breadboard" test of the **NERVA** (Nuclear Engine for Rocket Vehicle Application) engine system at Jackass Flats, Nev. The test developed 40 per cent of the 55,000-pound thrust capability of the engine system.

TEXAS INSTRUMENTS EARNINGS UP 37 PER CENT

Texas Instruments' sales for 1965 were $436,369,000, up 33 per cent from last year's $327,578,903. Earnings for the period rose 37 per cent from $18,041,051 to $24,839,000. Year-end backlog jumped from $148 million in 1964 to $217 million.

HERCULES EARNINGS UP 12 PER CENT

Hercules Powder's sales and earnings both set new records during 1965 for the seventh consecutive year. Sales of $532,373,000, including space and defense billings of $128,000,000, compared to 1964's total of $530,976,000, which included $150,000,000 in defense and space work. Earnings rose 12 per cent from $37,966,000 to $42,621,-000.

CCP SALES UP FOR SIX-MONTH PERIOD

California Computer Products, a producer of digital plotting equipment, had sales of $2,400,000 for the first six months of FY '66, compared to last year's $2,006,923. Although sales were up, earnings fell 31 per cent from $226,725 (35 cents per share) to $172,000 (26 cents per share).

MOOG EARNINGS UP 138% FOR SECOND QUARTER

Moog Inc. had sales of $6,159,731 for the second quarter of its current fiscal year, up from the $4,569,782 recorded for the same period last year. Earnings rose 138 per cent from $88,249 to $210,822. For the six-month period ended December 31, earnings were $394,500 on sales of $11,001,134, compared with last year's $98,949 on sales of $8,267,729.

James N. Ebright, previously assistant secretary and chief counsel, has been selected secretary of Aerojet-General, succeeding T. E. Beehan who has retired.

NAS RECOMMENDS SPACE-ASTRONOMY PROGRAM--IV. The final section of Part II of the Woods Hole study by the Space Science Board of the National Academy of Sciences deals with the physical experiments that can be advantageously undertaken in space to answer questions of physics and geophysics.

Physics and Geophysics: The working group in this area was almost wholly concerned with the question: "What would physics be like if it had developed in a space environment?" The recommendations:

1) A program of experiments in relativity and gravitation should be undertaken as soon as practicable. Suggested experiments: a) Use of the asteroid Icarus or a special satellite for determining the relativistic rotation of the line of perihelion rotation of a planet or asteroid; b) Gravitational deflection of light; c) The precession of a spinning body in space; d) The secular change in gravitational constant through laser tracking of corner reflectors on the Moon to determine lunar deceleration; e) Use of a time-keeping satellite for studying changes in gravitational interaction; f) An (Eotvos) experiment in space for studying the relation of inertial and gravitational mass.

2) Development of a high-precision radar altimeter should be undertaken vigorously. Existing equipment should be used on presently available space vehicles to determine problems inherent in the conduct of precision measurements. Problems of a gravity gradiometer should be examined. Related studies, now underway, for the more precise determination of orbital constants should be continued.

3) NASA should incorporate the installation of corner reflectors on the Moon as part of the lunar landing program. Some consideration might also be given to the use of reflectors on long-lived satellites.

4) Support of ground-based experiments, and of balloon and rocket programs, should be expanded to provide information which is essential to supplement observations carried out with spacecraft or which cannot be obtained by spacecraft.

Man in Space: Most of the programs mentioned above lie in the future, do not depend on a man as a manipulator, but do depend on further technological developments. While most of the programs specified can be done by remote-controlled or automatic devices, there are some problems that will eventually require man, although science by itself cannot justify the costs of manned effort. Typical of the kinds of major problems to which a man can contribute are planetary investigations, emplacement and adjustment of large telescopic systems, and some plasma studies. It must be emphasized, however, that in space as on Earth, scientific investigations will call upon man and device as necessary to the research goal. The distinction or separation of space research into a manned category and an unmanned one is artificial. The nature of the problems and economics dictate how a given task can best be carried out.

This is the conclusion of Part II of the Woods Hole report, Space Research: Directions for the Future. Part III of the report--which will be out later this month--will deal with rocket and satellite research, space research and the university biology, medicine and physiology, and the role of man in space research. Part I, dealing with lunar and planetary programs, was reported last month (SPACE Daily, Jan. 17, 18, & 19). The report was prepared at the request of NASA.

Future Space Business

RADIATION SHIELDS FOR NUCLEAR ROCKETS

NASA-Marshall is opening a program of calculation methods for design and analysis of radiation shields for nuclear rocket systems.

Contact: Purchasing Office, George C. Marshall Space Flight Center, Huntsville, Ala., 35812, Attn: PR-ES,R. W. Clatworthy, Telephone: 842-2266. Reference: RFQ 1-6-28-00029. Due date: Feb. 11.

IN-SPACE LEAKAGE DETECTOR

NASA-Marshall is requesting proposals to design and fabricate prototypes of three pilot models of a leak detector that can be used in a space environment to detect external leakage from aerospace hardware.

Contact: Purchasing Office, Marshall Space Flight Center, Huntsville Ala., Attn: PR-RM, Duane Murray. Reference: RFQ 1-6-60-00038. Due date: Mar. 2.

SPACECRAFT ELECTRICAL CIRCUITRY FUSE

NASA-Goddard is initiating the development of a solid-state thin-film fuse suitable for use in spacecraft electrical circuitry.

The following firms are on the Center's original invitation list: Bunker-Ramo, Philco, Alpha Microelectronics, Texas Instruments, Fairchild Semiconductor, Melpar, Gulton Industries, Littlefuse Inc., McGraw-Edison Co., Westinghouse-Molecular Electronics, Hughes, General Microelectronics, Sprague Electric, Motorola, and Varo Inc.

Contact: Procurement Division, Code 247, Section B, Goddard Space Flight Center, Greenbelt, Md. 20771, Attn: George L. Evans, Code 247. Reference: RFP 716-89021/239. Due date: Feb. 15.

DOD NEGOTIATIONS

Aerojet-General Corp.--with the Bureau of Naval Weapons to evaluate the basic feasibility of a new high performance non-moving part throttable hyperthin injector.

Northrop Corp., Norair--with Air Force Systems Engineering Group for a program to provide the simulation tests of a combined temperature rate flight control and energy management system.

Brown Engineering Co.--with Army Material Command for engineering support services in support of the **NIKE-X** anti-missile missile system development.

NASA NEGOTIATIONS

Westinghouse Electric Corp.--with Goddard for a contract for **ATS** communications experiment data requirements and analysis.

Globe Exploration Co., El Paso, Tex.--with Goddard for sounding ranging support for rocket grenade payloads.

Ball Brothers Research Corp.--with Goddard for the following property and services for the orbiting solar observatory: 1) additional spacecraft experimental activities, and 2) special test equipment consisting of one eye current boost amplifier and one R. F. test rack.

Microcraft, Inc.--with Marshall for the design and fabrication of a **SATURN V** fluctuating pressure wind tunnel model.

DOD CONTRACTS

Army

Global Associates--$7.1 million for logistics/base support for the Kwajalein Test Site, Marshall Islands.

Canadian Commercial Corporation, Ottawa--$96,950 for study and analysis of propellant for use in meterological rocket program.

Navy

Aerojet General Corp.--$493,298 for long lead time effort for procurement of MK 27 MOD 2 rocket motors and igniters for **TARTAR**.

Space General Corp.--$99,925 for R&D to extend the partial missile borne array developed under a previous contract.

Aerochem Research Laboratories--$64,389 for R&D program directed toward ionization and radar interference effects in rocket propellant exhausts.

Raytheon Co.--$90,543 for fabrication of **SPARROW III** engine support.

NASA CONTRACTS

Goddard

Douglas Aircraft Co.--$115,000 for development of technical evaluation report for structural analysis.

University of New Mexico--$225,939 for experiment for **OSO-G** high energy neutron flux in space.