SPACE PHOTOS

For geodesy, selenodesy

At first glance, they look like ordinary, undistinguished photographs of the moon, prime candidates for some astronomer's wastebasket. Upon closer scrutiny, however, there appear some tiny, barely perceptible white flecks, which make these pictures unique.

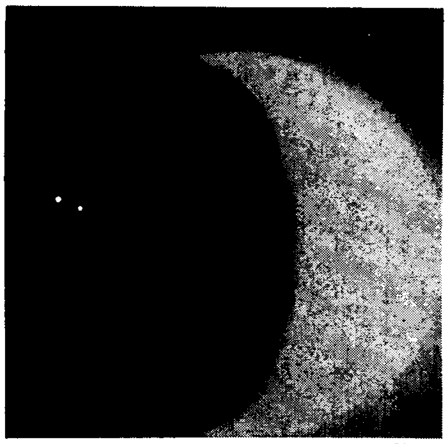
One of the pictures isn't of the moon at all. Instead, it shows a crescent earth, photographed from the moon by the television camera aboard the Surveyor 7 spacecraft. Faintly visible on the earth's dark edge are a pair of small, light smudges. These are laser beams, shining up from the earth almost a quarter of a million miles away.

One of the spots—the farther of the two from the light crescent—originated in California, where it was projected through a 24-inch telescope at Table Mountain Observatory near Wrightwood. The other was sent moonward through the solar telescope at Kitt Peak National Observatory, some 500 miles away in Arizona. The beams, which began less than an inch in diameter, because of their coherent light reached the moon still only a few miles across. This is why they were visible at all—their light was concentrated into a narrow cone with an angle of only about three seconds of arc.

Four other laser beams were shining at the moon at the same time, but they don't appear to be visible in the photograph. They had several things going against them: weather, the fact that they were farther east and thus nearer the obscuring glare from the light side of the earth, and the fact that only one of them had its beam boosted by passing through an observatory telescope. The researchers, however, including Drs. Carroll O. Alley Jr., and Douglas G. Currie of the University of Maryland, have been processing the photo and others like it with a computer to exaggerate the differences between shades of gray, in hopes of finding a pattern of gray tones that matches the locations of the four missing spots. The search, Dr. Alley hopes, will bear fruit this week.

Besides communicating with astronauts, earth-to-moon lasers could be valuable tools for pinpoint measurement of the orbits of both spheres, as well as for studying other phenomena including the possibility of continental drift.

A second remarkable space photo, released last week by the space agency, does show the moon, but with one additional detail never before found in a picture of earth's natural satellite: a manmade spacecraft in orbit around it. Like the laser spots, the craft appears only as a smudge, marked by the sunlight reflecting from its solar panels. The vehicle is Lunar Orbiter 5, last of its kind, photographed through a 61-inch telescope only 10 days before mission controllers signaled it to crash onto the lunar surface.

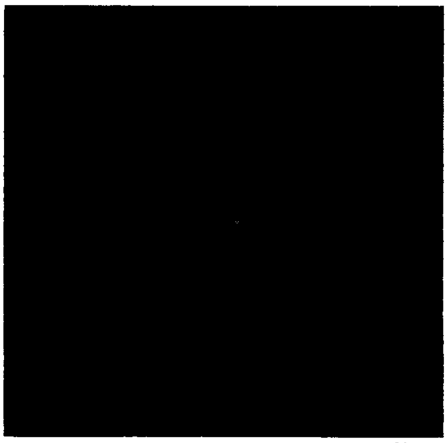


NASA

Surveyor 7 seeing spots on earth.

Light-proof baffles were placed around the telescope to prevent confusing multiple images on the photographic plates, but to be on the safe side, scientists took some 80 photos of the sky where Orbiter was expected to be.

It appeared in 52 plates each time as a line instead of a point, due to the exposure time of 5 or 10 seconds and to the combined motion of the moon around earth and the spacecraft around the moon.



NASA

Lunar Orbiter 5 photographed on duty.

Measurements of these lines, together with orbital coordinates and NASA radar tracking data, will enable more accurate measurement of the distance between the moon's center of mass and its visible limb, or edge.

RESEARCH BUDGET

Defense looks to solid state

In future funding of physical science research the Department of Defense intends to take a hard line—what might almost be called a hardware line. Departing Secretary Robert S. McNamara told the Senate Armed Services Committee during February that research projects must be relevant to long-term national defense needs to merit DOD support.

A few days later, Dr. John S. Foster Jr., director of Defense Research and Engineering, added testimony that such projects should be "coupled and integrated wherever feasible with the anticipated needs of advanced and engineering development programs."

The sort of coupling and the length of term they have in mind is perhaps to be read in Dr. Foster's later warning that payoffs from research can be expected only after a number of years—at least 10. The payoffs to be sought are new capabilities, improved operations, and reduced cost.

Historically some branches of physical science have not paid off so fast. It was more than 40 years from Michael Faraday's researches on electric fields (in the middle of the 19th century) until practical electric motors began coming into general use. Natural atomic radioactivity was discovered in the middle 1890's; practical development of power-producing devices came in 1943.

To stay in the shorter time-spans DOD is bowing out of high-energy nuclear physics (SN: 2/10 p. 136), but will continue to support solid state physics.

High-energy physics nowadays is far beyond any relevance to defense needs—certainly not in 10 years and probably not in 40.

In fiscal 1969 the Department proposes a 50 percent cutback in its high-energy support; in fiscal 1970 DOD wants to get rid of high-energy physics entirely.

How much money is involved is difficult to determine. "Physical Sciences proper" is the narrowest category into which published budget figures are broken down, and this includes items that DOD intends to retain and even strengthen. For this category the Department spent 53 percent of its basic research funds in fiscal 1967, about $152 million. In the same year all government agencies together spent $1 billion for basic research in physical sciences proper. The Defense Department spent less than the Atomic Energy Commission ($218 million), and the National Aeronautics and Space Administration which spent $490 million.

The dropping of certain projects does not appear to be a budget cutting move per se. Secretary McNamara asked for $450 million as the department's total authorization for research, $79 million more than Congress provided in fiscal 1968, and justified the increase by referring to the need for vigorous support of areas of research that will yield defense payoffs. What seems likely is a shift of some funds from dropped projects to continuing or new ones in other areas.

A serious money famine in high-energy physics is not anticipated. Seeking to prepare a cushion for the people it would drop, DOD negotiated with the Atomic Energy Commission and the National Science Foundation to see if they would help. As a result, the NSF has asked for $6.8 million more than Congress gave it in 1968 for physical science research to take up some of the slack.

Meanwhile, at the Pentagon, solid state physics remains in high favor. Dr. Foster has expressed satisfaction with such developments as transistors, integrated circuits, and, the most recent of all, a subminiaturized microwave frequency antenna "which offers entirely new possibilities in communication and control for supersonic aircraft and missile systems." Superconductivity—the loss of all electrical resistance in certain metals at temperatures near absolute zero—was also on Dr. Foster's commendation list. It offers improvement in reconnaissance, surveillance and anti-intrusion devices. It is because of this sort of payoff that the Navy will continue (despite previous hints to the contrary) to fund development of a superconducting particle accelerator at Stanford University — the only Defense supported high-energy project expected to escape the ax.

Another subject DOD likes is lasers. Dr. Foster stressed their possibilities in communications. Because the frequency of visible light is so much greater than the usual radio, a laser signal can carry a great deal more information than a radio signal.

Computers and the mathematics associated with them will also be pushed. The Defense Department claims to be the world's biggest user of advanced computers. Projects in parallel processing and advanced computer languages are underway. Better input-output devices are being sought, along with improved man-machine communication. In mathematics, Dr. Foster says development of a procedure known as fast Fourier transform should in many cases reduce computational effort 1,000 times or more. Work on calculus of variations and matrix operations will also be carried on.

INTELLECTUAL ARMY

Graduate students face draft

Probably no one in the Government wants an army of intellectuals. Nor does it seem good policy to force a two-year breach in higher education by drafting 50 percent or more of all first and second year graduate students.

Yet both are about to happen. As matters now stand, some 320,000 graduating seniors, freshmen graduate students and masters degree candidates will face the draft next summer; because of their age, they will go first.

How did it happen? The answer lies in a blend of politics, draft complexities and resentment against a history of graduate deferments.

The academic community is now heir to considerable antagonism for the years when graduate students were able to pyramid deferments into exemption from service. There is a sense in the House Armed Services Committee that now the educated will have to pay their dues for not serving before, even if that means they serve in inordinately large numbers, leaving no draft slots for younger, non-college men.

It was this kind of feeling in Congress that set the stage for the current situation. When Congress rejected last year the President's plan for a random draft or lottery, it rejected a reasonable alternative to the current policy of calling oldest men first—a policy followed since 1940.

At the same time, Congress left President Johnson the authority to decide on graduate deferments, to grant some in the national interest or to wipe them out.

Deciding these days whether physics is more important than urban sociology is a tricky thing. Moreover the academic community has long disliked special categories of deferment; they set up science as more important than the humanities.

So, in his latest move, the President did what could be expected—he did shut down the list of special graduate deferments altogether. But he left intact the World War II system of calling up draftees by age.

President Johnson could have changed the order of callup, spreading it out over seven age levels, 19 to 26. That he didn't has caused bitterness and disillusionment among academic leaders facing serious financial and educational disruption next fall, as all draft candidates come out of selected class groups.

They see the president's inaction as politically motivated. "Graduate education is not popular with the great masses in the country," says Dr. Gustave O. Arlt, president of the Council of Graduate Schools. "Those who have a political interest in this (draft policy) know whose side their votes are on."

Dr. Arlt emphasizes that university leaders are not asking for graduate deferments, but only for a "rational system of selective service which would draw from all segments of society, not just the graduate students."

Actually the Administration has another reason for not changing the order of callup. Without a random selection system, draft boards would still take eldest men first, but within each of the age levels, requiring them to follow birthdays month by month and week by week.

"There would be a terrible job of identifying the eldest men," says Colonel Bernard T. Franck III, of the Selective Service System. Moreover, such a policy would put every man under maximum liability with each new year. Random selection is essentially the only alternative to current practice, says Col. Franck, and that alternative was closed by Congressional action.

Col. Franck, however, left a small opening for change. There has been no decision to change the order of callup now, he says, "but that might not be true next month. I don't think the issue has been put to rest. Things can change pretty rapidly."

OCEANOGRAPHY

First sea grants

After years of wide discussion, the National Science Foundation has thrown its weight—and wallet—behind the growing interest in the world's oceans, with the announcement of the first set of grants in the National Sea Grant program. The program was established by Congress in 1966 to encourage the development of the nation's marine resources.

Of the nine grants, totaling nearly $2 million, three are to help universities develop broadly based major programs. These went to Oregon State University in Corvallis, the University of Rhode Island in Kingston and the University of Washington in Seattle.

The other six grants are for specific projects ranging from attempts to increase shrimp and kelp production to the establishment of new education programs. The recipients are the University of Miami, Fla.; Florida Atlantic University, Boca Raton; California Institute of Technology, Pasadena; Massachusetts Institute of Technology, Cambridge; Francis T. Nicholls State College, Thibodaux, La.; and the American Association of Junior Colleges in Washington, D.C.

Every Sea Grant recipient must provide matching funds equal to at least half the amount of the grant.