

# Solid blow to lunar science

**Eliminating two Apollos  
dims the chance of  
solving basic questions**

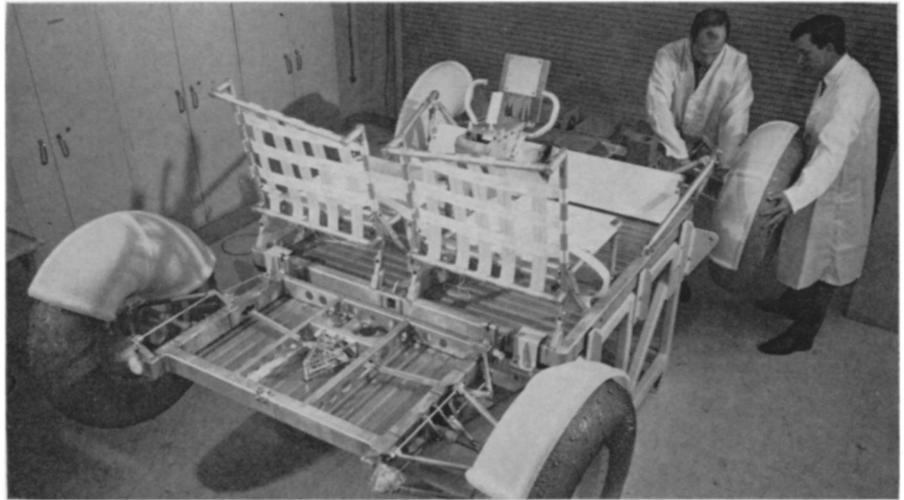
Scientists had feared it; the astronauts had expected it: last week, as predicted (SN: 8/29, p. 162), the space agency did what it had to do to survive President Nixon's budget restraints—it wiped out two more Apollo flights to the moon.

The announcement by Dr. Thomas O. Paine, outgoing Administrator of the National Aeronautics and Space Administration, that Apollos 15 and 19 would be deleted, leaves only four more lunar explorations, or a total of six, out of an initial schedule of 10 trips to the moon. The flights have been renumbered: Apollo 16, the first of the advanced "J series" spacecraft, becomes Apollo 15, and the last two become Apollos 16 and 17.

For the scientific community the repercussions will be severe. Two more landing sites are lost (the first was lost by cutting Apollo 20, the second, by the Apollo 13 abort), as well as more than 17 lunar surface experiments and more than 14 orbital experiments. The cut also reduces the chances of geologist-astronaut Dr. Harrison H. Schmitt to fly to the moon (he is now assigned as back-up crewman to Apollo 15). And fewer flight opportunities may discourage other astronauts from staying in the program.

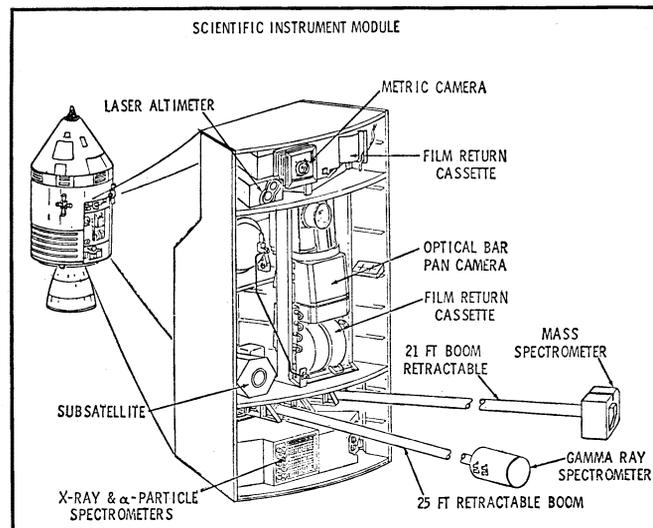
But the chief loss, says Dr. John W. Findlay, Chairman of the Lunar and Planetary Missions Board, "is the danger, the probability in fact, that we will (now) not get our first order scientific answers about the moon from the Apollo program."

Answers to basic questions—the origin of the moon, its internal structure and geological history and its relation to the rest of the solar system—depended not so much on flying new experiments each time; the scientific strategy instead was to fly the same experiments several times, but to different locations. For example, nine passive seismometers were to be placed in a



Boeing

*Lunar roving vehicle will allow astronauts to explore a 10-kilometer radius.*



NASA

*Orbital experiments have to meet new deadline.*

line across the near side of the moon. By measuring meteoroid impacts or lunar quakes in different locations, scientists might have been able to determine whether particular events were local or general and thus could have obtained good clues about the internal structure of the moon. Experiments such as the magnetometer, not scheduled to fly each time, would have flown often enough to give the scientists comparative and reliable data.

**The second requirement** of the scientists was for diversity in landing sites. Each site had been carefully chosen to yield rocks and materials from as many different lunar geological regions as possible: the highlands, or mountains, the older and younger craters, the rills, and the lowlands or seas. The loss of redundancy in experiments and diversity of landing sites will leave great gaps in lunar science.

However, just as it is a moot question to wonder how the history of America would have differed had Columbus not had to wait 10 years for the sovereigns

of Europe to make up their minds to fund his expedition, so it may be pointless for the scientific community to speculate too much about the effects of the present loss. Both successful lunar landings so far have yielded different data; the scientists, while they may have their theories, would be the first to admit that they don't know what they will find out about the moon; now they know only that it will not be as much.

The task facing NASA therefore is how best to redeem the loss in the last four flights. Several crucial steps lie ahead: the selection of three landing sites from the remaining eight prime sites, and the completion of the instruments for several surface and orbital experiments in time for the remaining flights.

The deletion of Apollo 15 rather than Apollo 18 was decided on the basis of expected scientific return: the advanced series of spacecraft beginning now with Apollo 15 can carry more than 1,000 additional pounds of scientific equipment than the earlier spacecraft. The spacecraft have from four to six more

days of flight capability. The improved life support systems and the use of the lunar roving vehicle will enable the astronauts to spend up to three days on the moon and from 40 to 54 hours on the surface. Previous geological field trips were limited to areas around the lunar module; the lunar roving vehicle, which will fly for the first time on Apollo 15, will enable the crew to explore out as far as 10 kilometers from the lunar module base.

In addition, one of the compartments or bays of the service module that has previously been empty will carry from 10 to 13 lunar orbital experiments (See p. 225).

Of specific concern are six experiments that were to fly in 1974 on Apollo 18 and 19. These will not have flown on the earlier missions, and must now be ready 18 months earlier than planned. Four are surface experiments to measure tidal changes on the moon, the direction and frequency of lunar ejecta and meteoroid impact, the electrical properties of the surface and the presence of subsurface layers, and surface atmospheric properties.

"We believe," says Donald A. Beattie, head of lunar surface science experiments, "that the surface experiments can be finished in time." The two orbital experiments may not be as easily accommodated. An electromagnetic sounder will have to be simplified, and the solar wind spectrometer may not meet the deadline.

**The sounder**, a pulsed radar system, is considered of prime importance; it is designed to measure the depth of the unconsolidated material covering the lunar bedrock, look for subsurface structure and layers and locate the presence of any water on the moon. Although the probability of discovering water is very low, the question is of such scientific importance that every effort is being made to fly a simpler version of the original.

In addition to the mini-sounder, NASA scientists are also discussing the possibility of adding a third subsatellite to the orbital science package. Two subsatellites are already scheduled for Apollos 15 and 17. The satellites, to be placed in 60-nautical-mile lunar orbits, will carry three experiments: one to detect particles, another to measure magnetic fields and a third to serve as a communication and tracking link. Most scientists believe that the moon has mascons, large concentrations of material beneath the surface which alter the orbital paths of spacecraft (SN: 5/10/69, p. 454). By tracking the satellites, scientists will be able to measure these perturbations.

"Getting funds for a dying program is difficult," says one space agency scientist. "But we are trying." □

## CHOLERA EPIDEMIC

### Southward to Guinea

In the seventh recorded pandemic of cholera, now moving through the world, the comma-shaped bacillus has spread to Guinea, the first time the disease has moved south of the Sahara Desert for a century. The World Health Organization reported 2,000 cases and 60 deaths in the West African country.

While several of the six countries bordering Guinea sealed their borders, United States public health officials said there was small risk that cholera could move to the United States or Europe from any of the 18 countries where it has been officially reported, more afflicted nations than at any time since the World Health Organization began epidemic reporting in 1948.

"Cholera moves almost entirely by a water supply contaminated by the feces



NIH

*Cholera bacilli: Spread continues.*

of those who have the disease," Dr. Eugene J. Gangarosa, cholera specialist of the U.S. Public Health Service's Center for Disease Control in Atlanta, says. "There is no person-to-person transfer. Here and in other advanced countries, adequate sewage disposal and a safe water supply make it virtually impossible for cholera to spread."

Although grapes and other fruits are shipped from Africa to the United States, the cholera bacillus dies in a few hours outside human carriers or out of water, according to Dr. Gangarosa.

**The last known cases** of cholera in the United States occurred in 1965 when two Washington, D.C., laboratory workers contracted the disease from handling experimental *Vibrio cholerae*. The last outbreak of the disease was in 1911, when steerage passengers from Italian ports brought the disease into New York harbor. Earlier epidemics caused hundreds of deaths in New York's garbage-strewn streets and filthy tenements.

Treatment with antibiotics (tetracycline is the drug of choice), plus saline solution to counter severe dehydration, has reduced cholera mortality from 50 to 2 percent, even in the less advanced countries. The bacillus implants itself in the intestinal wall and produces a toxin that triggers diarrhea. The diarrhea causes dehydration that can be fatal in six hours.

The World Health Organization is now training in Geneva a nucleus of doctors quickly assembled from the African countries, where lack of modern sanitation and of medical resources suggests that cholera may become endemic, as it is in India where 3,000 persons a year die of it.

**In some places**, the ancient terror of the disease that helped cause the fall of Athens and the decline of Rome is causing over-reaction. Mexico is insisting that entering travelers not only show the WHO-recommended vaccination (two shots within a six-month period) but also take an on-the-spot dose of tetracycline. When cholera broke out in Taiwan in 1964, Japan refused not only Taiwan's bananas and fish but also its lumber. Switzerland refused mail from Iran in the same year.

Victims of the El Tor strain of *Vibrio cholerae* now moving through the world carry live organisms in their feces for as long as three months. The older strain (isolated by Robert Koch in Egypt in 1883) produced an infectious period in humans of about three weeks.

For 30 years, from 1930 to 1960, El Tor smoldered in the Celebes Islands of Indonesia, a Dutch East Indies colony before independence. In that crowded and primitive country, efforts to check the disease were unsuccessful and it broke out in the 1960's. Some 1,228 deaths occurred in the Philippines in 1962, and a Hong Kong epidemic was reported. By 1964 El Tor reached South Korea and Vietnam, where a U.S. Navy medical research team fought it to a halt with the aid of vaccine shipped by Japan.

**At the end of August**, the Soviet Union reported some 453 cases, most of them at summer resorts on the Caspian Sea. Israel has reported 37 cases. Regional WHO officers think cholera is present in the United Arab Republic, although UAR has reported only quarantine and vaccination measures. A businessman returning from Guinea took the disease to Ghana last week, where it was believed contained by prompt quarantine.

Present vaccine gives only limited protection (50 to 80 percent of individuals) and even this drops sharply after six months. But annual booster shots being given at a U.S. Public Health Service field station in Pakistan are providing good immunity, Dr. Gangarosa says. □