

has called on all Federal health officials to send him further recommendations.

In addition to recommending economic incentives to improve efficiency and quality, the Commission listed over 50 other specific proposals including suggestions that:

- The 7,000 foreign medical graduates who enter the U.S. every year be required to pass examinations equivalent to those given to American medical graduates.

- Attention be directed to expanding existing medical schools—with a view to maintaining quality while inducing

new and more flexible curricula—instead of creating new institutions.

- Nursing should be made a more attractive profession by greater utilization of professional skills. Higher salaries and more flexible hours for married women should draw some of the half million accredited but unemployed nurses back to work.

- The Government revise and expand its Health Professions Education Assistance Programs to make available student loans covering tuition and living expenses during professional education. ♦

## FIRST LUNAR TAKEOFF

### Precise Measurements Result from Surveyor's Leap

Luniks, Rangers, Surveyors, Lunar Orbiters. The United States and the Soviet Union have placed no fewer than 18 spacecraft of various kinds on the moon, six of them gently, the rest abruptly. Until recently, however, no man-made object had ever taken off from the lunar surface. In the still-dark hours of the morning on Nov. 17, eight days after Surveyor 6 landed, scientists at the Jet Propulsion Laboratory in Pasadena, Calif., ordered its three small vernier rockets to fire for two and a half seconds. Obediently, the engines blasted, the spacecraft rose 10 feet and came down again, some eight feet from where it had stood.

Surveyor had taken 12,754 photographs of the moon before its hop. From its slightly different viewpoint, JPL then directed it to take thousands more of the same terrain. Scientists will be able to combine the two sets in stereoscopic pairs from which distance and size of lunar features can be determined. The result, says Surveyor program manager Benjamin Milwitzky, will be the first "absolutely certain, unequivocal, unambiguous" such measurements ever made from the surface.

One prominent lunar feature that has intrigued the investigators is a rocky wrinkle ridge some 650 yards from the spacecraft. Photographs taken from Lunar Orbiter 4 overhead had helped fix the distance of the ridge, but not until Surveyor's hop had there been a way to measure its height; the photos have all been taken and are presently undergoing analysis.

Surveyor unfortunately suffered a casualty as a result of its brief trip. The spacecraft had been analyzing the lunar surface with its alpha scattering device, an automatic chemical laboratory (SN: 9/23), which was olwered to the ground on a flexible cable shortly after the initial landing. There was no way to pull it back up again before re-

firing the rocket engines. As a result, the experiment bumped along on its cable until Surveyor was in the air, then hung free and finally was the first thing to hit the ground in the descent.

At first, when the device was found to be "talking funny," JPL engineers thought there might be hope for it. Then the spacecraft's camera revealed the experiment's gold-plated box, lying on its side bracketed by Surveyor's three feet.

Even if the hop had ended in the whole spacecraft's being reduced to junk, however, it would have proved something. All previous U.S. moon probes had been directed at finding and photographing potential landing sites for the manned Apollo spacecraft. That the National Aeronautics and Space Administration allowed Surveyor 6 to be risked as it was underlines what NASA had already indicated—that there are now enough moon pictures to satisfy Apollo—probably several times over.

On earth, where the spacecraft weighed 2,223 pounds, the hop could never have been made, since the tiny vernier engines can only produce a total of 312 pounds of thrust. Just before touchdown on the moon, however, Surveyor jettisoned its big retrorocket motor, which itself weighs 1,395 earth pounds. The remaining weight was reduced still further by the consumption of fuel and attitude control gas, and in moon's reduced gravity, only one-sixth that of earth, the verniers had to pick up less than 110 pounds for the hop.

Weight was not the only pre-hop problem, however. A whole set of conditions had to be met before the move could be possible. Most important was the alpha scattering experiment, with which NASA had promised to provide 18 hours of analysis of the lunar surface; it got 27. In addition, photos had to be carefully checked to make sure

the spacecraft had a clear field to jump in, and would not come down on some irregularity such as a boulder or crater. There had to be enough pressure in the helium-filled bladders that control the fuel shutoff valve, so that the rockets would stop firing at exactly the right instant; and finally, the temperature around all three rockets had to be low enough that the nylon solenoids controlling the bladders would not expand and stick open.

Shortly before the hop, all the conditions had been satisfied except one: the rockets, exposed to the glare of the lunar day, were too hot. At last, when the sun was directly overhead, shadows from Surveyor's solar panel and high-gain antenna fell on the rockets and solenoids, causing them to cool to a safe level. A signal was radioed from JPL, and Surveyor jumped.

The success of the hop prompted the Surveyor team to consider a second one, but at a meeting early last week the idea was dropped. One reason, says JPL, was that a scientifically useful jump would have to travel at least 1,000 feet across the lunar surface and go through the whole radar-guided soft-landing procedure again, in contrast to the first hop, which the engineers called a simple ballistic "kick in the pants." The other reason was that Apollo officials, though they had enough landing site photos, decided they wanted a longer look at the rocket blast impressions of the first hop, which could be photographed by the spacecraft from its new position.

## WET AND METRIC

### English Measurements Take a Setback

Another breach has been opened in the dam keeping the metric system out of the United States. Henceforth, water quality data issued by the U.S. Geological Survey will be in metric units.

The concentrations of dissolved materials, for example, will be reported in milligrams per liter instead of parts per million, and stream temperatures will be changed from degrees Fahrenheit to Celsius (Centigrade). The metric units are those used for international standards, and will also do away with the need for corrections to compensate for changes in water density.

The changeover, which followed a year-long study of the problem, will not be a complete one, however, according to the Survey's chief hydrologist, Ernest L. Hendricks. "It is applicable only to certain water chemical data," he says, "and not to the full spectrum of hydrologic data such as streamflow, ground water conditions and reservoir contents, which will continue to be reported in English units."