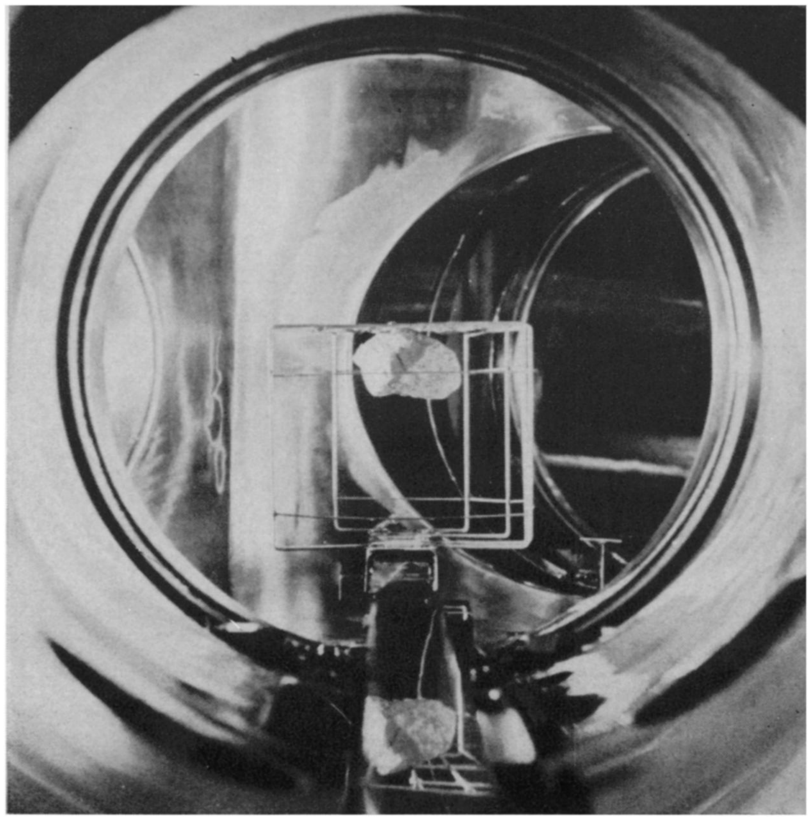
LUNAR RECEIVING LABORATORY

80 pounds of rock

A sealed-tight installation will welcome the moon chunks brought back by Apollo

by Jonathan Eberhart



photos: NASA

Samples in glove boxes are handled without touching.

In Houston, Tex., is a scientific facility designed from scratch to keep the outside out and the inside in. The National Aeronautics and Space Administration's Lunar Receiving Laboratory is dedicated to seeing that the moon samples brought back by Apollo astronauts this summer stay as free as possible of earthly contamination (SN: 5/17, p. 486). At the same time, it guards against the unlikely, potentially life-or-death, possibility that some dangerous microorganism or substance may be brought back with the samples.

The samples themselves will be 80 pounds or less of lunar rocks and dust, together with any gases that may be trapped in the hermetically double-sealed aluminum containers in which they will be brought to earth. It is likely that they will be about what the automatic chemical analyzers on surveyor robots 5, 6 and 7 indicated: oxygen-rich silicates, small percentages of sulfur and various metals, and traces of carbon and sodium. There could be other elements, however, or unexpectedly sophisticated molecules, or even—though it's a million-to-one long shot—life itself.

In preparation for the samples' arrival, the LRL was sealed in February, except for administrative offices, some maintenance facilities and the public half of a glass-divided press room. Even NASA scientists have a difficult time getting in. One space agency researcher tried for weeks to get some test samples into the LRL for analysis before turning in frustration to a nearby university laboratory.

The precautions began even while the LRL was still under construction. Samples of paint, structural materials, welding wire, even pieces of electronic equipment were checked at the Atomic Energy Commission's Y-12 plant in Oak Ridge, Tenn., to make sure that their natural background radiation was low enough not to affect measurements made in the LRL. The laboratory's radiation counting facility is claimed by NASA to have the lowest background count of any such installation in existence. Buried 50 feet underground, it has concrete walls five feet thick, lined with three additional feet of a crushed radiation-absorbent material called dunite. The dunite, held in place by a three-eighth-inch steel plate that offers still more protection, consists largely of a mineral called olivine, or magnesium silicate, and was specially obtained from the deep, well-protected Balsam Gap mine in North Carolina. Finally, the radiation-measuring instruments themselves are protected by 26 tons of lead shielding.

From the time the lunar samples arrive on earth, they will be the most pampered rocks in history.

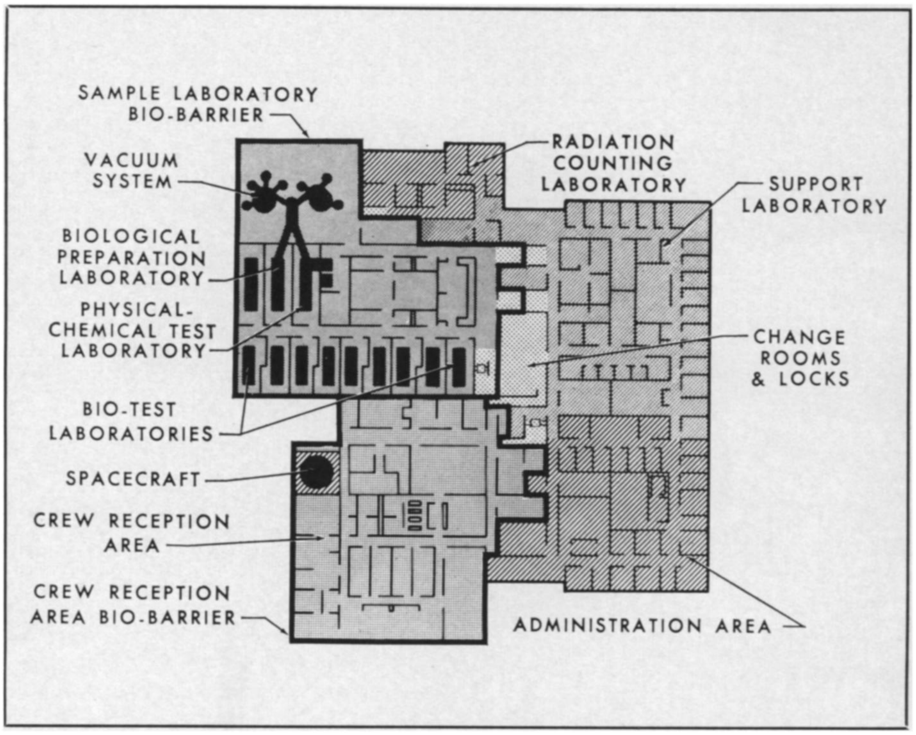
The astronauts will not reach the LRL for several days after landing, since they must wait until the recovery ship reaches port for their quarantine van to be picked up and delivered by aircraft. The samples, however, must be delivered as quickly as possible, to aid such measurements as radiation levels and gas absorption, which change significantly with time. Thus, the samples, along with medical samples from the astronauts, will be passed out from the quarantine van, through a safety lock which soaks the exterior of the packages for 15 minutes in a decontaminant solution. They will then be packed in shock-proof containers and flown directly to the LRL.

Making the LRL clean enough to receive them has not been an easy task, and the first test of its abilities, in a simulation run last October, came as a shock even to the scientists working on it. Numerous unexpected problems appeared, and the staff subsequently recommended 82 "substantial engineering changes." Vacuum, data-handling and other difficulties were found, but the worst, says Dr. Wilmot N. Hess, director of science at the Manned Spacecraft Center, home of the LRL, was with the glove-cabinets designed to let researchers manipulate the samples inside test chambers without actually touching them. The gloves leaked badly, apparently because the adhesive used in sealing them was damaged by the heat required to sterilize the chambers. In addition, because the vacuum system was completed only two weeks before the test, several mechanical handling systems—used with the sample throughout the LRL in place of contaminated human hands—could not be fully tested.

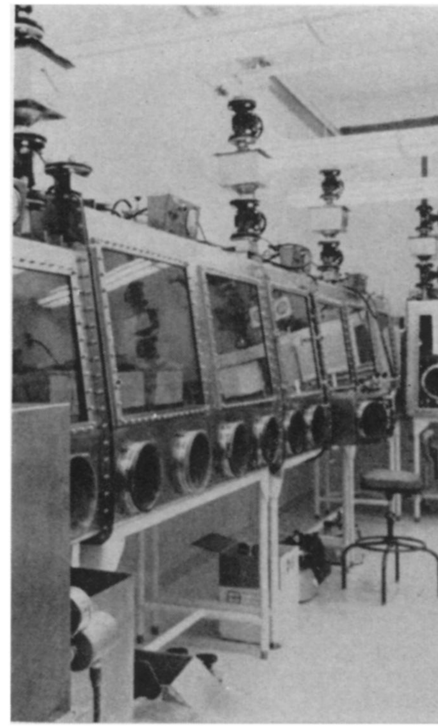
"The simulation," says Dr. Hess, "was a humbling experience."

The second test run, in February, had its problems too. There are seven separate air conditioning systems, largely devoted to keeping air from contaminated areas out of uncontaminated ones; shortly after the February test began, however, a filter broke down and reportedly let mock-contaminated air pour out into the laboratory parking lot.

It is likely that most of the knowledge to be gained from the lunar samples will be obtained in physical and chemical tests—clues to the origin of the moon, and possibly of the earth and the solar system itself. It is the biolog-



Men and moon each have separate quarters in sealed-off section of the LRL.



Samples enter Bioprep lab in vacuum.

ical possibilities, however—the chances of life and the dangers of contamination of the earth—which have had the greatest effects on the evolution of the LRL. The concerns, for example, of the Department of Agriculture, which examines all crops and animals entering the country, the Customs Bureau and the Public Health Service have had a great deal to do with raising the cost of the LRL to almost $11 million, almost double that of the $6 million rock study center it was originally intended to be.

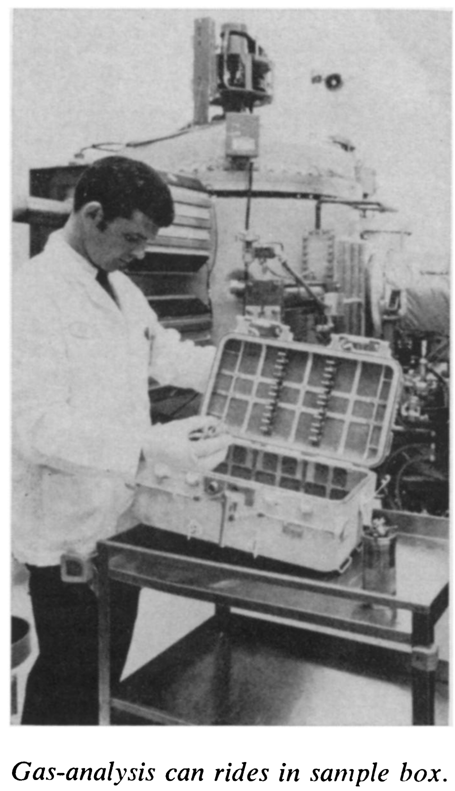
The biological test program includes exposing a multitude of plant and animal life forms to lunar material to see if there are any effects, dangerous or otherwise. More than 30 plant varieties will be tested, including algae, mosses and ferns, as well as major crops such as corn, wheat, rice, soybeans and citrus fruit. Besides the varied flora, creatures such as frogs, fish, oysters cockroaches, mice and a variety of microorganisms are included in the animal side, many of them at several growth stages such as eggs and larvae, along with tissue cultures.

During the February simulation, however, one of the laboratory's germ-free mice, presumably born and raised under completely sterile conditions, reportedly was found dead in its cage from a common parasite. And the discovery of the mouse's corpse is said to have come just on the heels of the finding of the inanimate body of another test creature, a fat-head minnow, victim of a fungus infection.

Such mishaps are not likely to throw scientists looking for lunar life into mistaken panic. If any of the LRL biologists observes anything resembling a positive response in one of his experiments, the affected organism will be meticulously compared with all known related earthly organisms before extraterrestrial origin is considered. Samples from later moon landings will also be compared with organisms isolated from previous Apollo astronauts.

Several of the LRL studies will be carried out in such fine detail that finding earthly standards for comparison is difficult. Scientists doing electron-probe analysis of lunar minerals, for example, would like to be able to compare them with terrestrial minerals that match as closely as possible in both mineral state and composition. Unfortunately, says LRL researcher Isador Adler, "Obtaining such samples is frequently a bootstrap operation." The reason is that the composition of the earthly standards must be thoroughly and accurately known, which means that they must be large enough for analysis by independent means (to match with the comparative analysis by the electron-probe), yet homogeneous enough to insure that all pieces distributed for independent analysis are thoroughly representative of the original standard sample.

While the samples are being analyzed in one part of the LRL, astronauts, together with doctors, scientists, technicians and support personnel, will be living out their quarantine in another. Their isolation will be inviolate; not even President Nixon could get farther than the unsealed administrative offices. It was only after some argument, in



Gas-analysis can rides in sample box.

fact, that the LRL scientists agreed that if one of their number suffers a heart attack, he may be moved, under suitable safeguards, to a hospital for treatment.

Assuming the likelihood that no dangerous lunar organisms are discovered on the samples, the rocks will be distributed after the quarantine periods to eagerly waiting scientists around the world. At present, the number of selected beneficiaries stands at 142, including 27 researchers from 8 foreign countries, but the number could be considerably smaller; if any outside scientists plans to look for a particular substance, for example, such as radioactive argon, and the preliminary LRL analysis shows no traces of it, the decision may be made to conserve that scientist's sample for more fruitful purposes.

Such a decision, affecting the handling of an unprecedented piece of another world, is in the domain of an organization called the Lunar Science Institute, set up by the National Academy of Sciences, funded by NASA and to be administered by a consortium of universities. So coveted are the lunar samples that any LSI decision concerning them is likely to be viewed by some scientists as playing God. But the institute at least offers a more broadly based decision-making apparatus than the little coterie behind the closed walls of the LRL.

As the most direct link with the receiving laboratory, and through it the new knowledge of the moon, the institute will stand in a strong position of influence in planning future missions. However, according to LSI head Dr. William W. Rubey of the University of California at Los Angeles and Rice University in Houston, the institute's role will not pre-empt that of existing bodies such as the NASA Lunar and Planetary Missions Board, but will simply pass on recommendations to them.

Even before the first samples have arrived, the institute's LRL-managing duties are complicated enough, but Dr. Rubey feels that once the scientific work has begun in earnest, the pace will strain the scientists' abilities to get the most out of their samples. He has even been reported as hoping that not more than one or two missions will be conducted each year, though it is likely that they will be more frequent.

Within the LRL, however, efforts are being made to insure that the maximum possible information is gleaned from each tiny bit of the moon. As each sample moves through the LRL, a detailed record will be kept of its history. Every person that handles it, every movement it makes, every test procedure to which it is exposed, all will be recorded, microfilmed, stored in a central data retrieval system and passed on to the scientists who next get it. And when the outside experimenters have finished their analysis, the samples are to be sent back to the LRL for further study.

Those few pounds of lunar rock will be one of the major prizes of the Apollo program, a physically small reward for a $24 billion expenditure. The LRL is dedicated to making that reward as valuable as possible. ◇