The wealth from the moon

With the return of Apollo 17 next week, the nation will have an irreplaceable store of lunar material. Scientists are concerned that the data be properly studied as well as meticulously preserved for future generations.

by Everly Driscoll

The Apollo flight phase of the exploration of the moon ends this week with the splashdown of the spacecraft "America" and its cargo of lunar valuables from Taurus Littrow and the Apollo 17 astronauts Eugene Cernan, Ronald Evans and Harrison (Jack) Schmitt.

But for the 800 or more scientists involved in analyzing the samples and data, the work has just begun. "We've only had time to tap the real wealth of Apollo," says one investigator of his harried schedule for three and one-half years.

On hand at the completion of Apollo 17 will be a national treasure house of priceless material. The reservoir will include about 800 pounds of rocks and soil, about 10 miles of film including panoramic and metric quality film of the surface, motion pictures and still photos, and 5 active geophysical observatories on the outpost of the moon.

To assess the state of lunar science and to ensure that "man does indeed derive full benefit from this effort" a group of some 45 scientists gathered for a week's study at La Jolla, Calif., in July. "We found that most of the questions about the moon posed in 1965 by the National Academy of Sciences' Space Sciences Board had been answered," said Robert Phinney of Princeton University in a presentation to NASA's Physical Sciences (Advisory) Committee (SN: 10/7/72, p. 236). "What we have now are a new set of questions."

A summary of this study including major recommendations to NASA and a capsule account of what has been learned about the earth-moon system from the Apollo age is summarized in the report "Post-Apollo Lunar Science" released this month by the Lunar Science Institute in Houston.

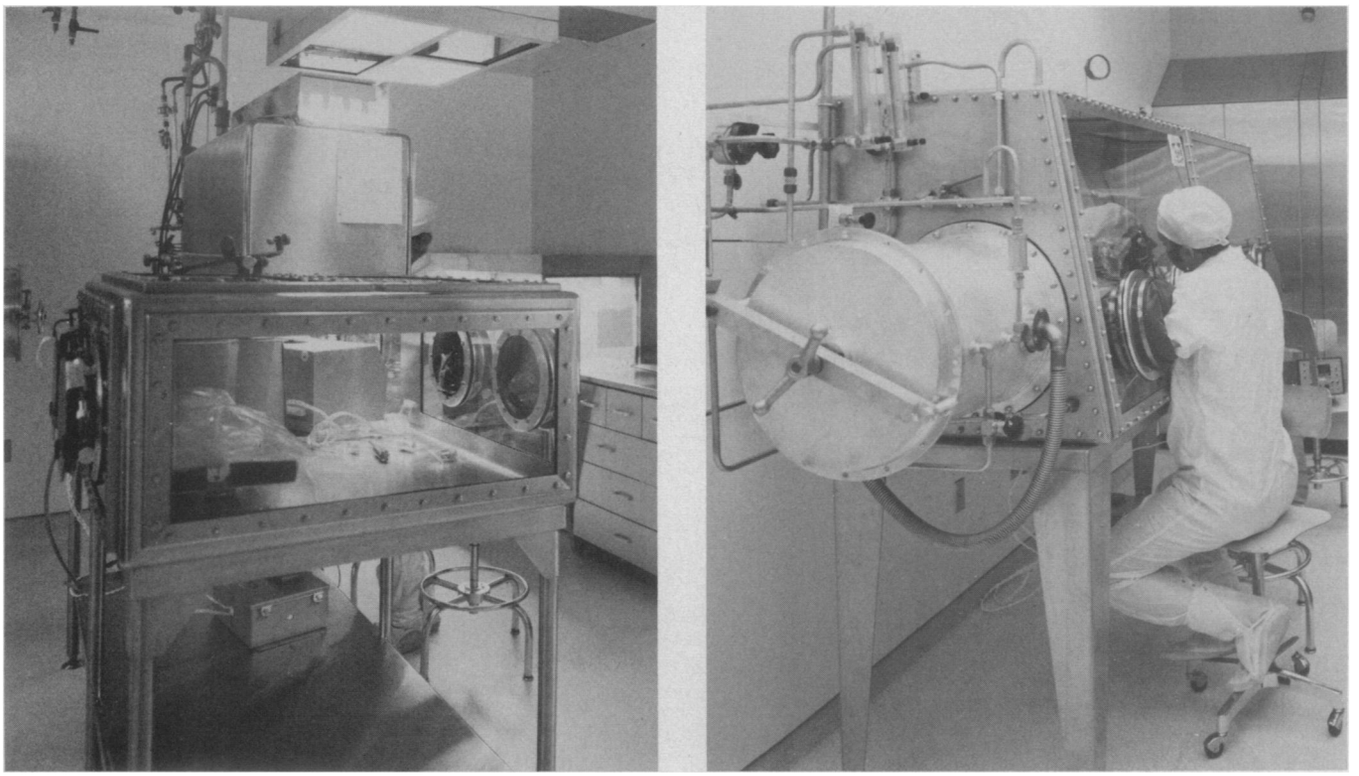
The scientists concluded that "the collection of lunar samples, photography and instrument data resulting from Apollo is a unique and generally irreplaceable resource that must be zealously conserved, yet also made available for scientific study." The eventual goal is to synthesize all of the useful knowledge from ground-based studies, astronauts' observations, sample investigations and data from Apollo instruments with experiment and theory. Out of this should come a thorough understanding of the moon, a general glimpse of the history of the sun and a better handle on the evolution of the earth and the terrestrial planets. An added bonus would be hints from cosmic debris found in the lunar material about the early history of the solar system as the solar system made about 50 revolutions through the Milky Way galaxy.

These lofty aspirations are achievable, say the scientists. But only if steps are taken now to ensure the preservation of the material in its pristine state, to provide proper analysis and adequate funding for diverse investigations. The data must be documented, indexed and catalogued for multidisciplinary use by the scientific community at large, and they must be stored for future generations. What a ludicrous legacy indeed it would be, says one of the scientists, if after one of the most extensive data-gathering efforts in the history of exploration, the collected wealth should be allowed to fall into disuse and contamination because of current budgetary restraints.

The La Jolla group recommended to NASA an orderly procedure of study to last at least until 1976. They reviewed the current NASA structure and organization and the facilities available to carry out the completion of the scientific objectives and found several of them inadequate. They encouraged continued efforts in international cooperation for space exploration. For that nebulous period in the future when the American people decide to return to

Photos: NASA

The returns of the Apollo program are studied at the Lunar Science Institute near the Manned Spacecraft Center.



Opening and handling of samples take place in special glove boxes to avoid contamination by terrestrial matter.

this new outpost in space, the group recommended that NASA fly a high-inclination orbital mission to allow instrument coverage of the still unexplored polar regions of the moon.

What they envision and what NASA agrees must be done is a three-phased attack. The first phase, which has been going on between moon flights since 1969 and will continue to 1974 is the mission-oriented mode, involving the completion of the preliminary examination of the samples and data. The next is the systematic intermediate stage (basic description phase) in which the samples and data are comprehensively and broadly studied with the object of putting them in a proper archival setting. It is expected to end about 1976. A transitional period from sample-oriented study to problem-oriented phase is aimed at using the data base for research on the broad and fundamental questions. This latter mode, described as the "intellectual core of the program" has already begun on a limited scale, but will become the major focus of work after 1976.

This post-Apollo period will focus on the samples, the data from ALSEPS (the five geophysical stations on the moon) and from orbital instruments, and the photography.

The scientists recommended that the scientific support effort and the curatorial facilities at NASA's Manned Spacecraft Center be maintained at a high caliber. Even as they wrote, however, the staff of the curatorial facilities at MSC, where the moon gems are processed, distributed and stored was reduced by 30 percent. This reduction in staff, although NASA-wide, has delayed the distribution of Apollo 16 material to many investigators. With this backlog, the laboratory is now awaiting the onslaught of the Apollo 17 tasks. It faces further staff reductions this spring to what is called "the minimum working level" of 45 employes.

The curatorial area is the heart of the sample work. There each sample is unpacked from the moon bags and sealed containers in which they were placed. This is done in low-pressure chambers in a non-interfering atmosphere of nitrogen. This process alone takes weeks. The samples are very fragile. Some crumble. Others, if exposed to earth's atmosphere, get rusty. This led one investigator recently to announce, "I don't want any oil-field hand or butcher handling my sample." Many of the people who work in the lab are not professional petrologists, but electronics engineers and mechanical aides. "Unless adequately trained and qualified personnel are associated with the samples, there is a grave danger that accidental loss and injury to the sample will definitely take place," he says.

At the lab the sample goes through detailed description and analysis, comprising photography, basic mineralogy-petrology and major element chemistry. "Together with site-photography, photogeology and cartography and ALSEP and orbital data, these basic descriptions will permit rock samples to be placed in the local and regional geologic context. Much of the long-term scientific potential of the Apollo missions will never be realized unless this task is adequately carried out," states the report.

All of the samples are stored in one building, and the scientists are concerned that a hurricane or other natural disaster could wipe out the whole lot. NASA has already begun working on this problem, looking for an adequate place elsewhere for material that won't be used in the near future.

The study group also recommended that facilities be made available so that scientists would have more access to the samples. Even viewing the samples is difficult. "We don't want them buried at Fort Knox," quips one.

ALSEP is essential to the whole scheme. The group recommended that the five stations, which have reached their full potential now with Apollo 17, and the subsatellite be operated "continuously as long as significant new findings come out of their operations." They suggested that these stations be declared national observatories and the data reduced and made usable to all interested scientists. They recommend that NASA create an advisory group similar to the Lunar Sample Advisory Planning Team and the Lunar Sample Review Board for the surface and orbital instruments and the photography.

The data from the instruments left on the moon go to Houston to be formatted and documented. The tapes then go to the scientist in charge who analyzes the data. Ideally, he then sends a selected amount of processed data to the Goddard data center. While the shelf life of these tapes is 20 years,

they are unusable to most scientists in their current form. The scientists recommended that the principal investigators (PI's) now using the material take out the good data ("event tapes") so that they could be reproduced (not all the data are of use). These PI's should describe the experiment including hardware, performance of the instrument and calibration data used. This material would then be placed in a central repository for distribution to others. The data should be indexed and catalogued.

Many of the same problems exist with the photography. "Original flight film is presently unaccessible to the scientific community." The study group added that "the storage and processing facility at the MSC photography laboratory is inadequate to meet all the requirements for preserving the film. . . . We recommend the establishment of an Apollo photographic archive attached to the . . . facility."

Only a negligible fraction of the photographs have been studied in detail so far, and these were studied primarily in support of the next Apollo mission. The photography has to be described and related to the geophysical and geochemical data and the samples from the sites for production of photogeology maps. "Particular rectified photomaps, topographic maps and geological maps, obtained from the original photographs, are essential as a base for plotting of other Apollo results." Contour, metric and base maps must be made. "This will mean then that nearly the whole front side of the moon can be mapped and tied back to known surface conditions." Then combined indices and catalogues of all Apollo photographs and related products should be made and distributed. The scientists recommended that NASA have a "small, judiciously managed program of mission planning to provide the desired continuity between the present and the future."

"We recommend that the Apollo Lunar Exploration Office at headquarters form an advisory committee of non-NASA scientists from the lunar program." Finally, the group urged that the administrative structure of the lunar program at headquarters be arranged to maximize communications with the planetary program so that the knowledge gained from Apollo could be used most fruitfully in planning.

The task ahead seems almost as rugged as the journey just completed. But, in the panel's view the funds needed to "go this last inch" are modest. The best estimates are about $20 million a year, compared to the more than $30 billion already invested. "This," said one member of the panel, "is a small price indeed for end result." ☐