APOLLO ROCKS ANALYZED

Tracing the moon's origin

This week, the National Aeronautics and Space Administration finally stopped treating Apollo 11 Moon Astronauts Neil Armstrong, Buzz Aldrin and Michael Collins like bearers of the plague and began treating them like national heroes —though the rigorous schedule of tours, speeches and fetes is likely to prove considerably more exhausting than the two-week quarantine they underwent in the Lunar Receiving Laboratory.

Still at work within the LRL, however, are the researchers seeking to unlock as many of the moon's secrets as possible, before they have to relinquish their precious bits of lunar rock to other scientists eagerly waiting in laboratories around the world.

One disappointing, though expected, absence has been any signs of life. A variety of tests produced negative results, including a search with an electron microscope that failed to turn up even fossilized remains of primitive microorganisms that might have existed millions of years ago.

At one point, a trace of carbon was detected, suggesting a potentially life-supporting organic chemistry, but it was part of a volatile hydrocarbon that is more likely to be contamination from lubricating oil on tools or from the sample cabinets.

Fortunately, contamination has not been as serious as scientists feared it would (SN: 5/17, p. 486). Dr. Ross Taylor of the Australian National University, Canberra, has been engaged in painstaking spectral analyses of pinhead-sized samples which, apparently, have all been blessedly clean. Using an emission spectroscopy technique capable of finding elements as rare as one part per million, he has catalogued some 30 elements, along with negative data on 35 more, from samples weighing a total of scarcely one-tenth of an ounce.

The best indication that the samples were contamination-free, Dr. Taylor says, is that they revealed traces of neither niobium, from the lunar module's descent engine skirt, nor indium, from the seals around the boxes in which the moon rocks were returned to earth.

Some of the elements that did appear, however, may shed light on one of the moon's major mysteries: its relationship to the earth. Included in the moon-rock spectra are unusually high amounts of several refractory, or high-melting-point, metals including titanium, zirconium and yttrium—amounts higher than those present either in earthly rock or in estimates of elemental abundances in the universe.

Contrary to what intuition might suggest, Dr. Taylor believes that these abundances could imply that the moon was formed from the remains of a huge, seething dust cloud whose center had already condensed to form the earth. Had the moon been torn, already congealed, from earth's side, its refractory abundances ought to match those of the earth; if it were a visitor from outer space, captured by earth's gravity, the abundances would be more likely to match the cosmic averages.

Some bad news for lunar scientists, however, may have been last week's announcement of the crews for the Apollo 13 and 14 missions. None of the four prime and backup crews include any of NASA's scientist-astronauts, nor do the previously selected prime and backup crews for Apollo 12 this November. To make matters worse, since backup crewmen often become prime crew members two flights later, this could mean that no scientist-astronauts will be chosen until at least Apollo 17, now planned for the summer of 1971.

Apollo 12 is to be commanded by Astronaut Charles "Pete" Conrad, with Alan Bean joining him on the lunar surface while Richard Gordon orbits the moon in the command module. The backup crew includes David Scott, Alfred Worden and James Irwin. Prime crew for Apollo 13 is James Lovell Jr. (who orbited the moon on Apollo 8), Thomas Mattingly II and Fred Haise Jr., backed up by John Young, Jack Swigert and Charles Duke. Apollo 14 is to carry Alan Shepard (America's first man in space), Stuart Roosa and Edgar Mitchell, with Eugene Cernan, Ron Evans and Joe Engle as backup.

CO_2, H_2O, CH_4, NH_3

Mars probe controversy

It seems to be the nature of planetary probes this year to create new questions as well as answer old ones.

First the Soviet's Venera 5 and 6 reported widely varying altimeter readings above Venus, causing debate on whether mountains had been found or one instrument was wrong (SN: 6/28, p. 610).

Now two instruments aboard the United States' Mariner 7 have produced differing inferences about the composition of Mars' south polar cap. And another measurement has detected the presence of methane and ammonia gases in the polar atmosphere. These, on earth at least, are signs of biological decay. Mariner 6 did not find the gases in its pass five days earlier (SN: 8/9, p. 111), but it passed over only the equator.

On Mariner 7 the 200 measurements of the polar cap made by the infrared radiometer showed a flat temperature profile of minus 190 degrees F. "The circumstantial evidence is very strong that this temperature indicates the caps are composed of frozen carbon dioxide, not frozen water," says Dr. Gerry Neugebauer of the California Institute of Technology.

But readings from another infrared sensor, a spectrometer, indicated much warmer temperatures, minus 94 degrees F., near the cap's edge, which are interpreted by Dr. George C. Pimentel of the University of California at Berkeley as an indication the snow there is composed of water.

This week neither man had changed his opinion about the temperature readings. But Dr. Pimentel acknowledges that a possible source of the discrepancy is the uncertainty of the spacecraft's exact position during the measurements, due to its earlier encounter with a micrometeroid before reaching Mars.

"The implication is that no one is quite certain where the instrument was pointed," says Dr. Pimentel. "It is conceivable that we were looking at different parts of the planet."

Dr. Neugebauer feels that Dr. Pimentel's spectrometer, which has a much wider field of view than the radiometer, was indeed recording temperatures at least in part beyond the edge of the polar cap. As for his own experiment, "I'm convinced that we were looking at the cap."

The finding of methane and ammonia near the edge of the polar cap was less subject to doubt. Methane bands were recorded twice and ammonia bands once on each of 18 successive spectra, says Dr. Pimentel.

On earth practically all the atmospheric methane is the product of biological decay, and this has understandably provoked animated discussion about the possibility the gases are an indication of organisms on Mars.

But Dr. Norman H. Horowitz, a Caltech exobiologist, continues to urge extreme caution on such thinking. "It's silly to say that only biological processes could be responsible. Remember, there's an awfully lot of methane and ammonia in the universe."

All the planets had methane and ammonia in their primordial atmospheres, but only the heavier ones, such as Jupiter and Saturn, were able to retain these light gases.

The most likely non-biological explanation seems to be that the molecules were trapped in the planetary interior, when Mars still had its original atmosphere, and are now being released.

"At the moment," says Dr. Horowitz, "it's an unresolved mystery. I will say it is certainly an interesting finding."