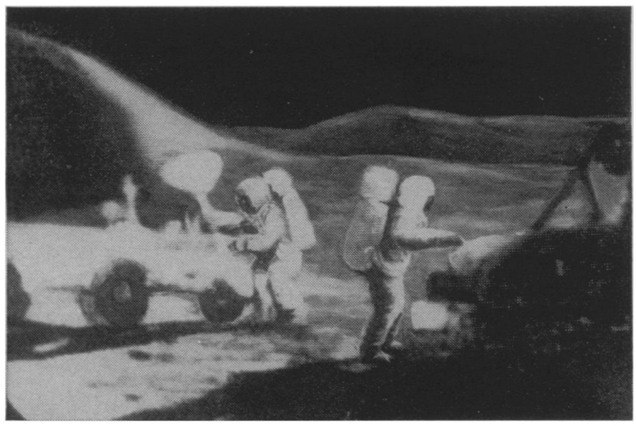
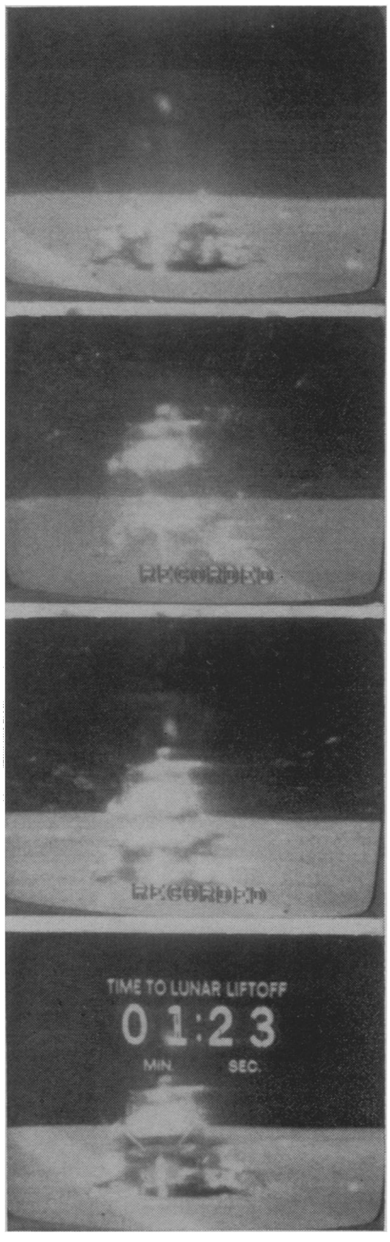
Paydirt at Hadley/Apennine

Apollo 15 is bringing back a lot for the boys in the back room



ESS



H. N. Doyle

Mind boggling, awesome, scientifically revolutionary—all these adjectives were inadequate to describe the weekend at Hadley/Apennine and the six days in lunar orbit of the journey of Apollo 15 (SN: 7/31/71, p. 74). About the data provided to earth's people by Astronauts David R. Scott, James B. Irwin and Alfred M. Worden; Gerald D. Griffin, flight director of the Manned Spacecraft Center in Houston said: "Without a doubt we have probably just witnessed the greatest day of scientific exploration that we've ever seen in all time—certainly in the space program."

The men landed 300 meters northeast of the targeted landing spot at 23.07 degrees north latitude and 3.65 degrees east longitude, lunar coordinates. Since the ground was obscured by dust, Commander Scott made an instrument landing on a slope of about 10 degrees. Pessimistic predictions about the landing site proved groundless although the general terrain around the site did vary from rugged to smooth. After Scott's first look at the Apennine Mountains he quipped, "Tell the guys in the back room [the geologists] to get ready because we really have something for them." Among Irwin's first comments was: "I can't believe we came over those mountains."

Scientists are just beginning to decipher what all that "something" is. The view that earthlings saw as the TV camera was turned on was of a serene but rugged landscape of towering, rounded mountains in sharp contrast to a deep "river" bed called a rille. The area immediately around the LM was undulating and Scott remarked that there were millions of craters that had been washed out on the training maps. During the first field trip in the lunar Rover, which the astronauts found to be a magnificent machine, took them to the rille and to a large crater called St. George at the base of Hadley Delta Mountain.

The second excursion took them again to the mountain front and to exactly the objects they had gone to the moon for: crystalline rocks. The men drove past a cluster of craters thought to be secondary impact craters (craters formed by ejecta from larger craters) to the base of the mountain and up part of the slope. There, near Spur Crater, Scott remarked, "I think we found what we came for." Most of the rocks returned so far from the Apollo program have been basaltic or brecciated. What scientists wanted most of all was crystalline rocks which had not suffered impacts and melting after formation and might be parts of the original lunar crust. The rock that Scott described was crystalline but only analysis on earth will tell whether the rock is a result of a fault that formed the mountain and exposed material dating from before the formation of Mare Imbrium (SN: 7/10/71, p. 28).

The third Rover trip went again to the rille where the astronauts gave the TV viewers a close-up view of the western side of the rille. Both men saw layers in the rille—an observation which already has destroyed the theory that the lava flow which formed the rille and flooded the mare was one event. The layering in the rille could mean that there were many lava flows. But geologist-astronaut Harrison Jack Schmidt says, "If lava flows did indeed form the rille then there should be levees on both sides of the rille rim and there was only a levee on one side." It could be, speculates Schmidt, that this rille was formed instead by a process that fractured the mare.

Layering up the side of Hadley Delta Mountain also amazed scientists. "That's the most organized mountain I've ever seen," said Scott.

In addition to the field trips the men also set up a very complex experimental station on the moon. The most time-consuming but perhaps the most rewarding of the experimental instruments was the lunar drill. Scott used it to drill two holes in which the men placed temperature sensors. They then used the drill to bore holes 8 to 10 feet deep to get core samples. These

would be the deepest samples from within the moon yet to be brought back. They could extend all the way through the regolith to the bedrock.

Worden, in orbit around the moon, was also wiping out theories by his observations of some 14 areas. A particularly surprising observation was cinder cones in the area around Littrow (a crater in an area thought to be the youngest mare area on the moon). He said, ". . . in the area where we noticed darker deposits, there are a whole series of small, almost irregular shaped cones. . . . It looks like a whole field of small cinder cones." If photographs bear out his visual observations, scientists say that the presence of these volcanic remnants in one of the youngest areas of the moon would extend the period during which the moon was hot by one billion years. Originally scientists thought this period lasted only from 4.6 billion to 3 billion years ago. But the new finding would mean that it extended to 2 billion years ago.

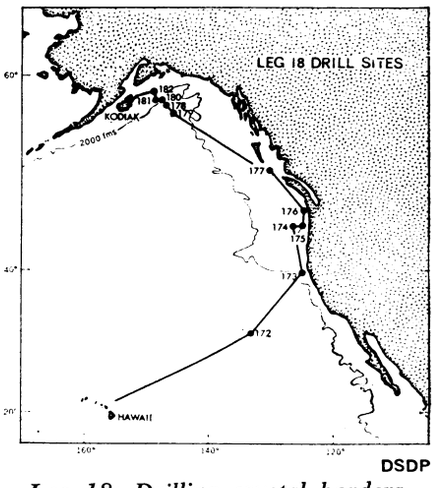
Another interesting observation Worden made was of layering in the central peak which protrudes up from the center of the crater Tsiolkovsky on the far side of the moon. This means that the peak was formed by pushing up from a depth rather than by piling up on the outside. The instruments operated in orbit are already giving scientists the mineral composition of 20 percent of the moon's surface and constituents found in the trace atmosphere around the moon.

Seismic data obtained from impacting of the Saturn 4-B stage and the ascent stage of the lunar module support theories that the structure of the moon is hard, brittle and crystalline, to a depth of 300 to 400 kilometers. Dr. Gary Latham of the Lamont-Doherty Geological Observatory had said, "If we see seismic waves 1,100 kilometers to the south at the Apollo 12 and 14 sites as well as from the Apollo 15 station, then our theory that the structure 300 to 400 kilometers deep is hard, brittle, crystalline material in which seismic waves would propagate well, is true." All three stations reported the signal.

Minor problems plagued the men, putting them behind schedule almost every mile of the way—from having to mop up 25 pounds of water to having to use tape to repair some of their equipment. But if all continued to proceed without major problems, the crew was expected to splashdown at 4:46 p.m., EDT, Aug. 7, setting in all accounts a new moon record and bringing back 175 to 180 net pounds of lunar rock and soil. Worden summed up the week pretty well: "I think we're going to give lots of people lots of things to do for a long time." □

DEEP-SEA DRILLING

Where plate meets plate



Leg 18: Drilling crustal borders.

At deep-sea trenches, where one crustal plate is being jammed underneath another, geophysicists believe that sediments that have accumulated on the underthrusting oceanic basin are scraped off and pile up against the edge of the overriding plate. The exact nature of this sedimentary deformation, however, has not been observed in active trenches. Up to now oceanographic instruments have been unable to show clearly the complex folded and faulted structures thought to be present.

Now scientists on Leg 18 of the Deep Sea Drilling Project, which ended July 19 at Kodiak, Alaska, have recovered cores showing sedimentary deformation from several sites along the Aleutian trench off Alaska, where oceanic crust is being thrust under the continent at a rate of more than two inches per year. At one site, number 180, the researchers, led by Drs. LaVerne D. Kulm of Oregon State University and Roland von Huene of the U.S. Geological Survey's Office of Marine Geology, drilled directly along the axis of the trench. A more productive site, however, was site 181 on the landward wall of the trench, where they drilled to a depth of 369 meters. The sediment layers there, says Dr. Kulm, appear to be quite jumbled up. The top 100 meters of the core were composed of softer sediments. Below were hard mudstones, with thin, highly deformed laminations.

At another site, off California's Cape Mendocino, the researchers recovered a spectacularly complete sedimentary record spanning the past 26 million years. Fossilized microscopic marine organisms in the core, such as diatoms and radiolaria, record periods of oceanic upwelling and of varying biological productivity. Evidence from marine-plant fossils in the sediments of the coastal mountain ranges of California and Oregon has offered a much less complete record than that now obtained by the scientists on the Glomar Challenger.

The character and type of marine organisms living in the surface waters of the oceans is highly sensitive to the temperature of these waters. Fossil remains from sediments thus give an indication of ocean surface temperatures—and therefore climate—that existed at the time the organisms were alive. The Leg 18 scientists found evidence in the sedimentary record of the climatic oscillations over the past 2 million years.

Over the years, the Columbia River, which divides Oregon and Washington, has washed tons of continental materials from the land and deposited them in the Pacific Ocean. In this way, an extensive fan-shaped sediment deposit, called the Astoria Fan, has developed at the foot of the continental slope off Oregon and Washington. Spores and pollen from trees, shrubs and grasses that are entombed in these sediments carry a record of land temperatures. Cores recovered from the Astoria Fan by the Deep Sea Drilling Project researchers show that the Pacific Northwest, over the past 2 million years, has never been warmer than it is now.

Evidence from the Astoria Fan also shows that during the ice ages, sediments were carried downriver much more rapidly than the average rate at which sediments are being deposited in the deep ocean today. The high rates of sediment accumulation, the scientists believe, indicate that glacial erosion of the continents was more vigorous than previously thought.

The Leg 18 scientists drilled at a total of 11 sites along the continental margin between Oregon and Alaska. By delineating geological structures at plate borders they hope to determine the rate and direction of large shifts in the earth's crust. The 56-day cruise began May 28 at Honolulu. □

ENERGY INDUSTRIES

Making synthetic fuel gas

Critics of the United States energy industry often allege that shortages of fuels and power result from increasing monopolistic control of the industry and influence over the policies of the Interior Department. In a press conference this week, Interior Secretary Rogers C. B. Morton denied some of these allegations. He may be correct, but it is hard for the public to judge since the companies are often as secretive about their activities as Balkan diplomats.

Whichever side may be correct, Morton this week signed a contract that appears, at least, to indicate that energy