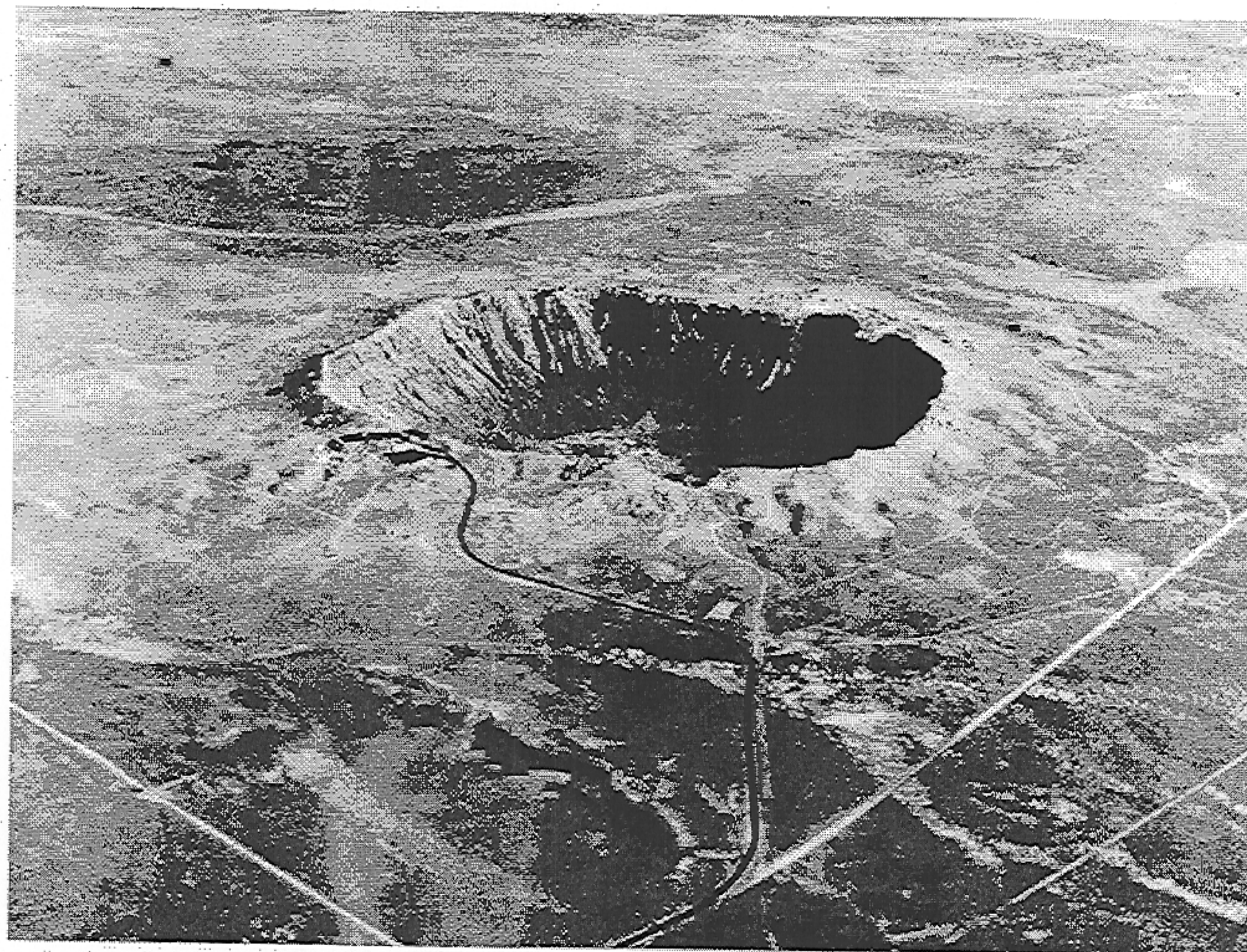

FIGURE 10.—Meteor crater. This crater, about a half mile across, 600 feet deep, and located near Flagstaff, Arizona, was caused by the impact of a large meteorite with the Earth in prehistoric times. Thousands of pieces of the meteorite have been found in the surrounding area. This feature has been studied extensively by members of the U.S. Geological Survey and has shed light on the details of crater formation. Note the raised rim, a characteristic of many lunar craters. The crater, readily accessible by automobile, is well worth the small time required to visit if one is nearby. Photo courtesy of U.S. Geological Survey.

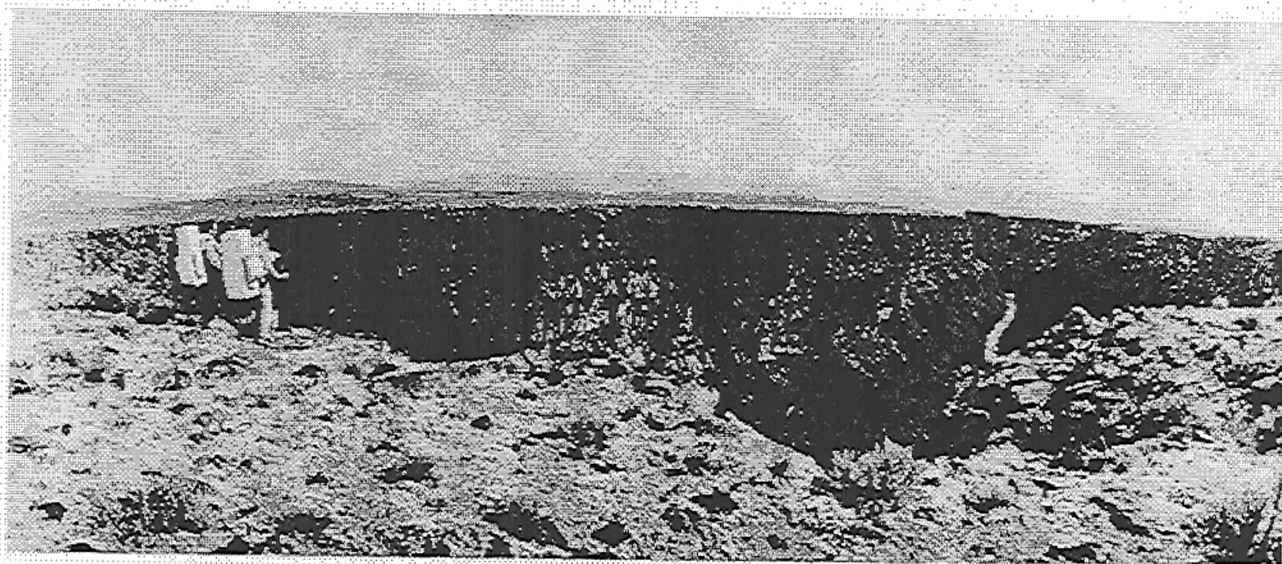

FIGURE 11.—A terrestrial model of Hadley Rille. The astronauts study the Rio Grande Gorge, near Taos, New Mexico, in preparation for their study of Hadley Rille. Shapes of the two features are similar and the rocks may possibly be similar but the origins of the two features are almost certainly different. During field training exercises, both Scott and Irwin shown here, carried mocked-up PLSS's.

Lunar Roving Vehicle

Inside the LM the astronauts will take with them to the surface a four-wheeled vehicle that can be used to transport themselves and equipment over the lunar surface. It is termed the Lunar Roving Vehicle (LRV) or Rover (figure 12). It is powered by two silver-zinc, 36-volt batteries and has an individual electric motor for each of the four wheels. An early version of the Rover, used for astronaut training, is shown in figure 13. The Rover deployment scheme is shown in figure 14. There is a navigation system that contains a directional gyroscope and provides information as to distance traversed as well as heading. In addition to the astronaut's oral descriptions, television pictures are telemetered back to Mission Control in Houston from the Rover. These pictures will be shown over the commercial TV networks.

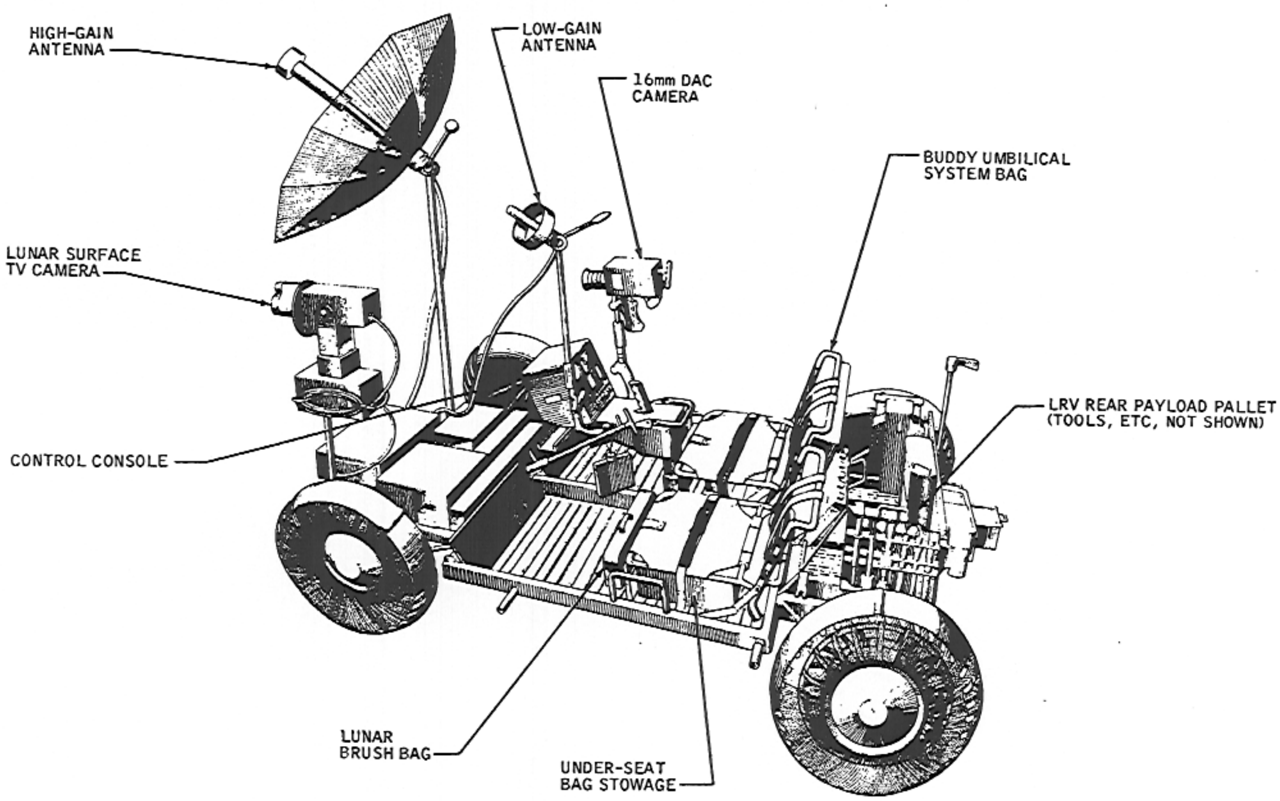

FIGURE 12.—The lunar Rover. Both astronauts sit in seats with safety seat belts. About 7 minutes are require to fully deploy Rover. The capacity of the Rover is 970 pounds. The vehicle will travel about 10 miles per hour on level ground. The steps necessary to remove it from the LM and to ready it for use are shown in Figure 14.

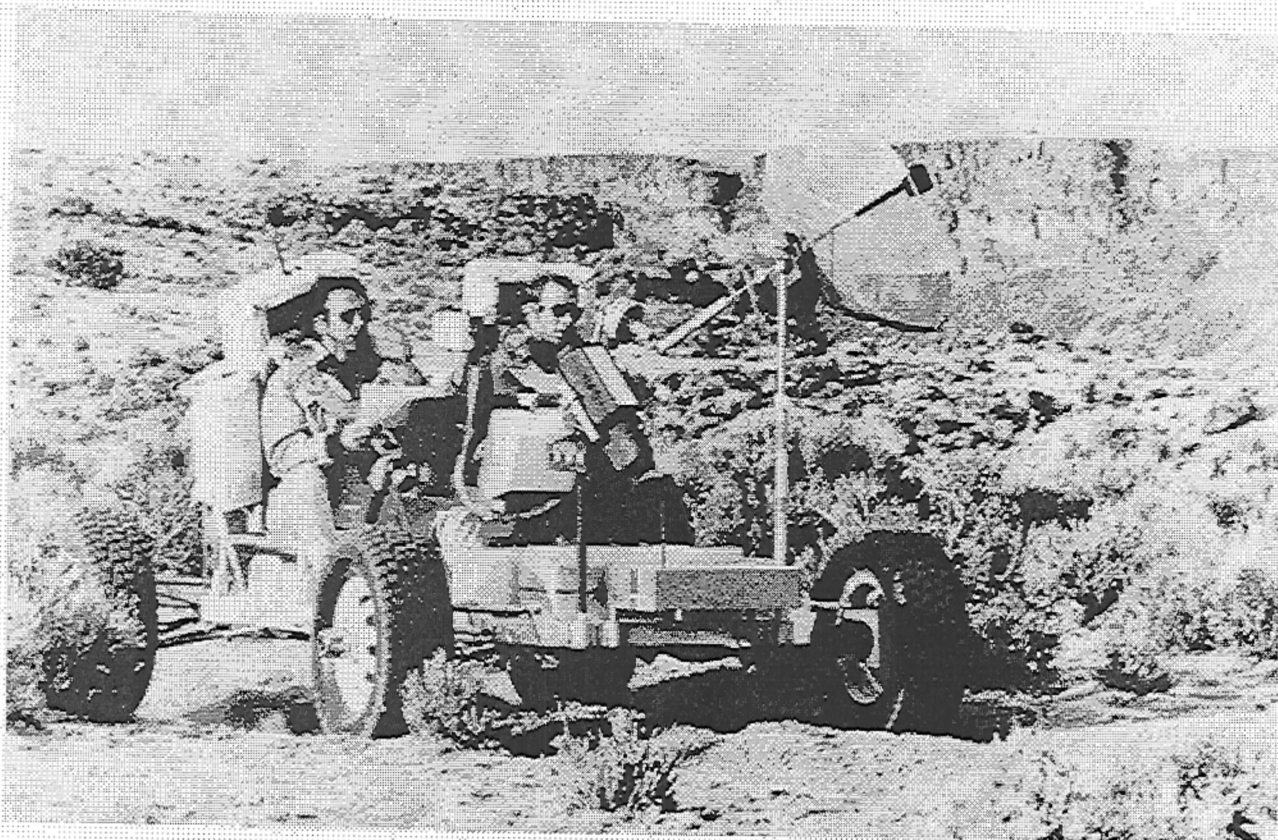

FIGURE 13.—This model of the lunar Rover, nicknamed "Grover", was used in astronaut training exercises. The canyon in the background is the Rio Grande Gorge, a natural terrestrial model of Hadley Rille, near Taos, New Mexico. Shown on Grover are Irwin and Scott, the "surface" astronauts of Apollo 15.

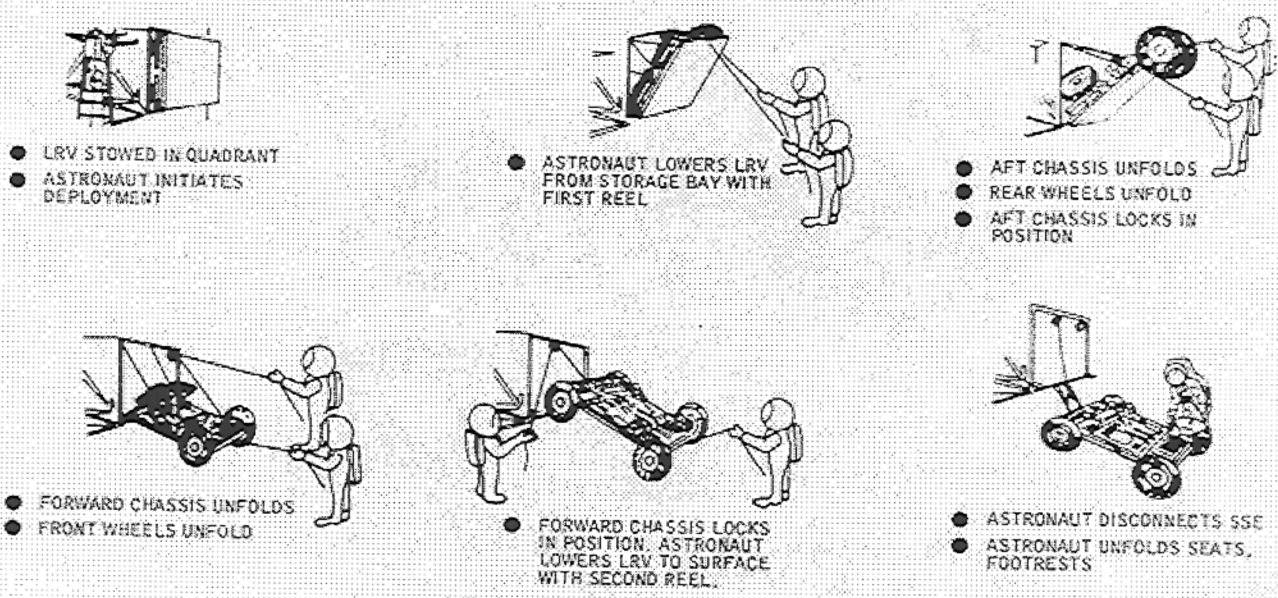

FIGURE 14.—Deployment sequence for the Lunar Roving Vehicle.

Surface Science Activities

Each of the two astronauts that descend to the lunar surface in the LM will spend about 20 hours in three periods of 7, 7, and 6 hours outside the LM working on the lunar surface. Most of that time will be used to study geological features, collect and document samples of rocks and soil, and set up several experiments that will be left behind on the lunar surface when the astronauts return to Earth.

The surface traverses described in this guidebook, which was written about 3 months before launch, should be considered as general guides for the astronauts to follow. From previous Apollo missions, we have learned that although some minor changes in plans are likely to occur, major changes are unlikely. On each mission a few changes were made by the crew because of unforeseen conditions. Instructions to the astronauts have always been "to use their heads" in following the detailed plans and this mission is no exception. In addition, the astronauts may consult over the radio with a group of scientists located in Mission Control at Houston and decide during the mission to make some changes. Undoubtedly, some details of the traverses will change. Equipment changes, on the other hand, are very unlikely to occur because all of the equipment has been built and is now being stowed in the spacecraft.

TRAVERSE DESCRIPTIONS

The planned Rover traverses are shown in figures 15 and 16. The activities at each of the stops

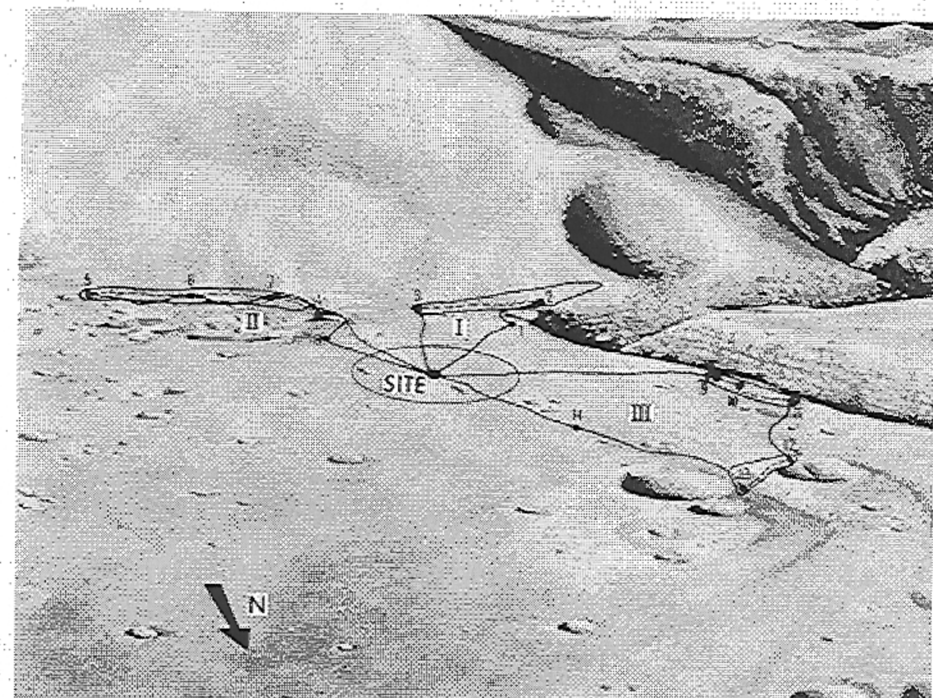

FIGURE 15.—The traverses planned for use with the Lunar Roving Vehicle. The Roman numerals indicate the three EVA's. The numbers are station stops. The station stops are keyed to the information given in Table 2. These same traverses are shown in figure 16, an overhead view of the landing site.

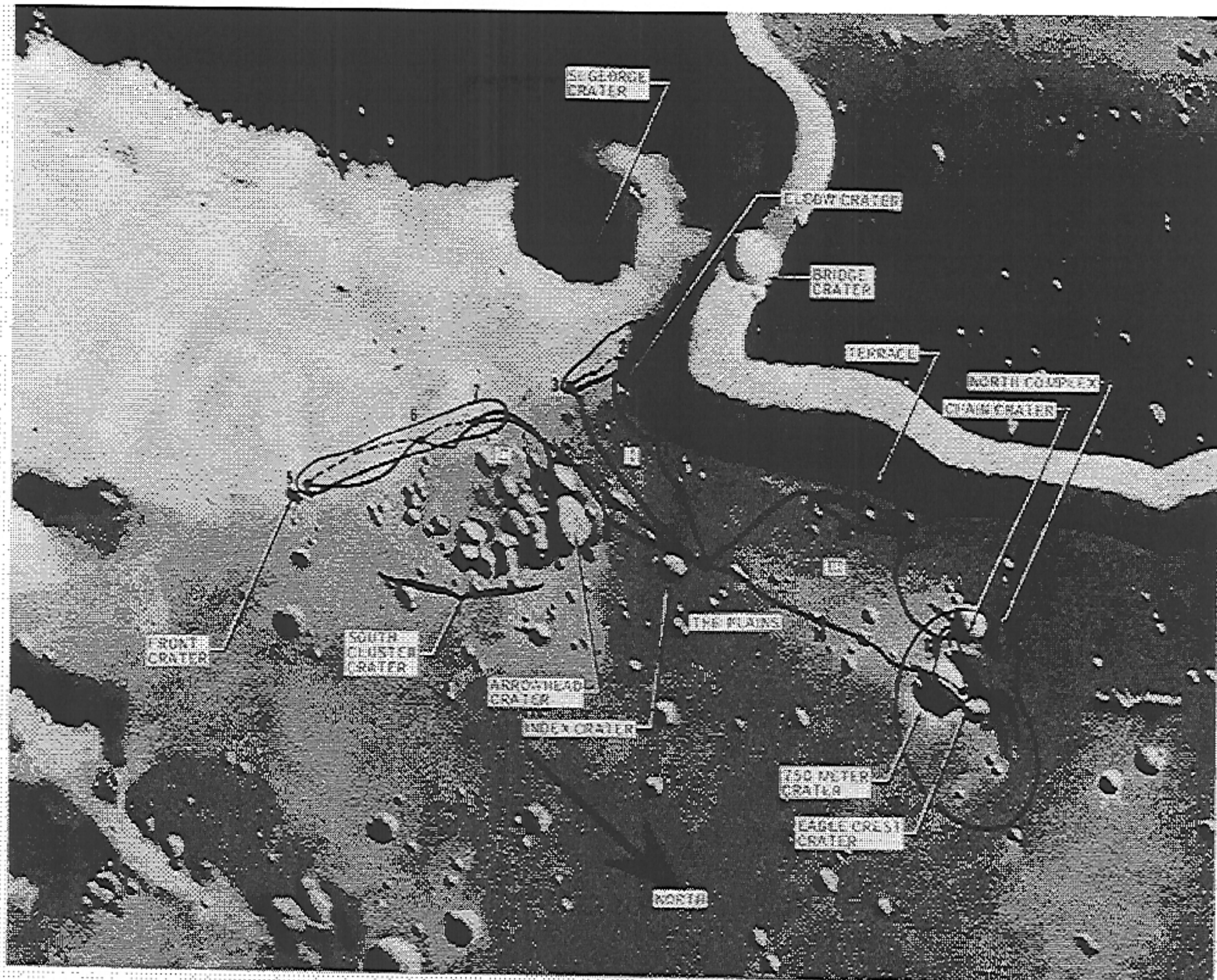

FIGURE 16.—Rover traverses. See explanation of Figure 15.

on all three traverses and along each traverse between stops are shown in Table 2. In order to use Table 2 effectively, the reader must have scanned most of the next section, "Surface Scientific Experiments and Hardware", and to have read the section "Lunar Geology Experiment".

The numbers assigned to each of the traverse stations shown in the figures and tables of this guidebook will not change. However, extra stations may be added before, as well as during, the mission. These extra stations will be termed "supplementary sample stations" to avoid confusing them with the existing stations.

In the event that the Rover becomes inoperative sometime during the mission, a series of walking traverses has been planned. (Figure 17.)

LUNAR SURFACE SCIENTIFIC EXPERIMENTS AND HARDWARE

In addition to the observations made by the astronauts and the collection of samples of lunar material to be returned to Earth, several scientific experiments will be set out by the astronauts on the lunar surface. The equipment for these experiments will remain behind on the Moon after the

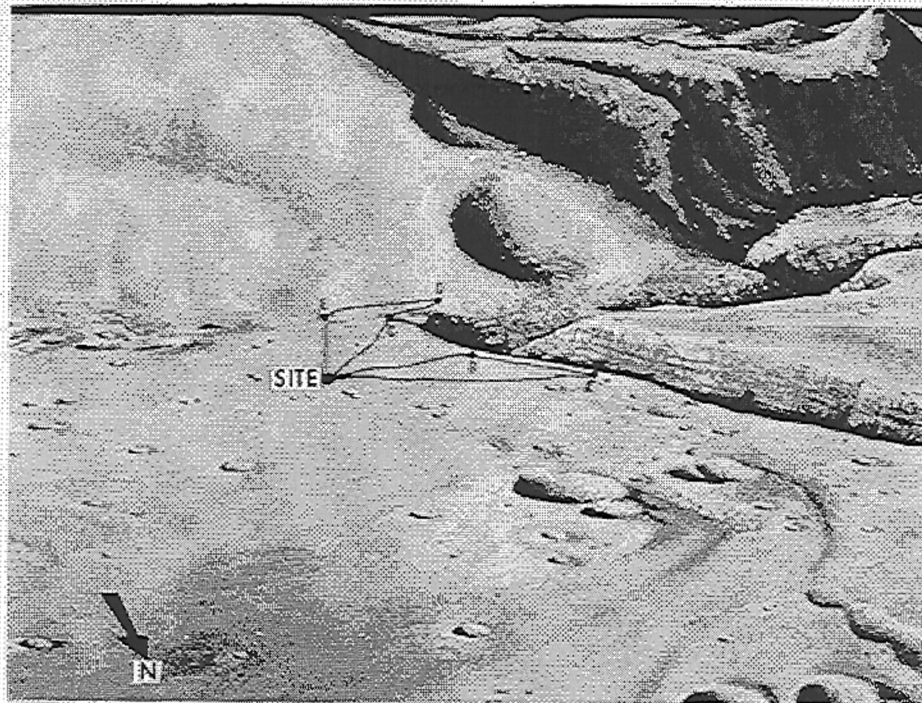

FIGURE 17.—Walking traverses. These alternate traverses can be done on foot. They will be used if the Rover becomes inoperative.

astronauts return to Earth. Data from these experiments will be sent to Earth over microwave radio links, similar to the ones used extensively for communications on Earth.

Apollo Lunar Surface Experiments Package (ALSEP)

Several of these experiments are a part of the Apollo Lunar Surface Experiments Package (ALSEP). General layout of the equipment on the lunar surface is shown in figure 18. A photograph of the Apollo 14 ALSEP is shown in figure 19. The ALSEP central station, figure 20, although obviously not an experiment, provides radio communications with the Earth and a means for control of the various experiments. The experiments connected electrically to the central station are the Passive Seismic Experiment, the Lunar Surface Magnetometer, the Solar Wind Spectrometer, Suprathermal Ion Detector, Heat Flow Experiment, Cold Cathode Ion Gauge, and Lunar Dust Detector. I discuss briefly each of these experiments.

Electrical power for the experiments on the lunar surface is provided by the decay of radioisotopes in a device termed Radioisotope Thermoelectric Generator (RTG), shown in figure 21. A total of roughly 70 watts is delivered. Let me draw special attention to this power of 70 watts. It is truly incredible that all of the experiments together use approximately the amount of power that is consumed by an ordinary 75 watt light bulb! The electrical wires are flat, ribbon-like cables that may be seen in figure 19. The RTG is filled with fuel after the astronauts place it on the lunar surface.

During EVA 1, the astronauts remove the ALSEP equipment from the LM, carry it to a site at least 300 feet from the LM, and place it on the lunar surface. A summary of these ALSEP operations is given in Table 3. A list of the principal investigators and their institutions is included in Table 4.

Heat Flow Experiment (HFE)

Heat flows from hot regions to cold regions. There is no known exception to this most general law of nature. We are certain that the interior of the Moon is warm. It may be hot. Therefore heat flows from the interior of the Moon to the surface

FIGURE 18.—General layout of the ALSEP. The sizes of the astronaut, equipment, and lunar features are drawn to different scales. Locations are shown in true relation to the surface features of the Moon.

where it is then lost into cold space by radiation. It is the function of the Heat Flow Experiment (HFE) to measure the amount of heat flowing to the surface at the Hadley-Apennine site.

At the present time, the heat flowing to the surface of the Moon from the interior has been produced mostly by decay of the natural radioactive elements thorium, uranium, and potassium. Measurements made directly on the lunar samples returned to Earth by Apollo 11, 12, and 14 have revealed the presence of significant amounts of these elements. The normal spontaneous decay of these elements into other elements slowly releases energy. The decay process is similar to that used in nuclear reactors on Earth to generate electrical power from uranium. In the Moon, most of the energy appears in the form of heat which raises the temperature of the interior of the Moon.

In addition to the amount of radioactive material present, the internal temperature of the Moon depends on other parameters. The thermal properties of lunar rocks are equally important. The thermal conductivity of a material is a measure of the relative ease with which thermal energy flows through it. Rather well-known is the fact that metals are good conductors and that fiberglass, asbestos, and bricks are poor conductors. Most of us would never build a refrigerator with copper as the insulation. Values of the thermal properties of rocks are closer to the values of fiberglass than to those of copper and other metals. Rocks are fairly good insulators.

The Heat Flow Experiment has been designed to measure the rate of heat loss from the interior of the Moon. To obtain this measurement, two holes are to be drilled into the surface of the Moon

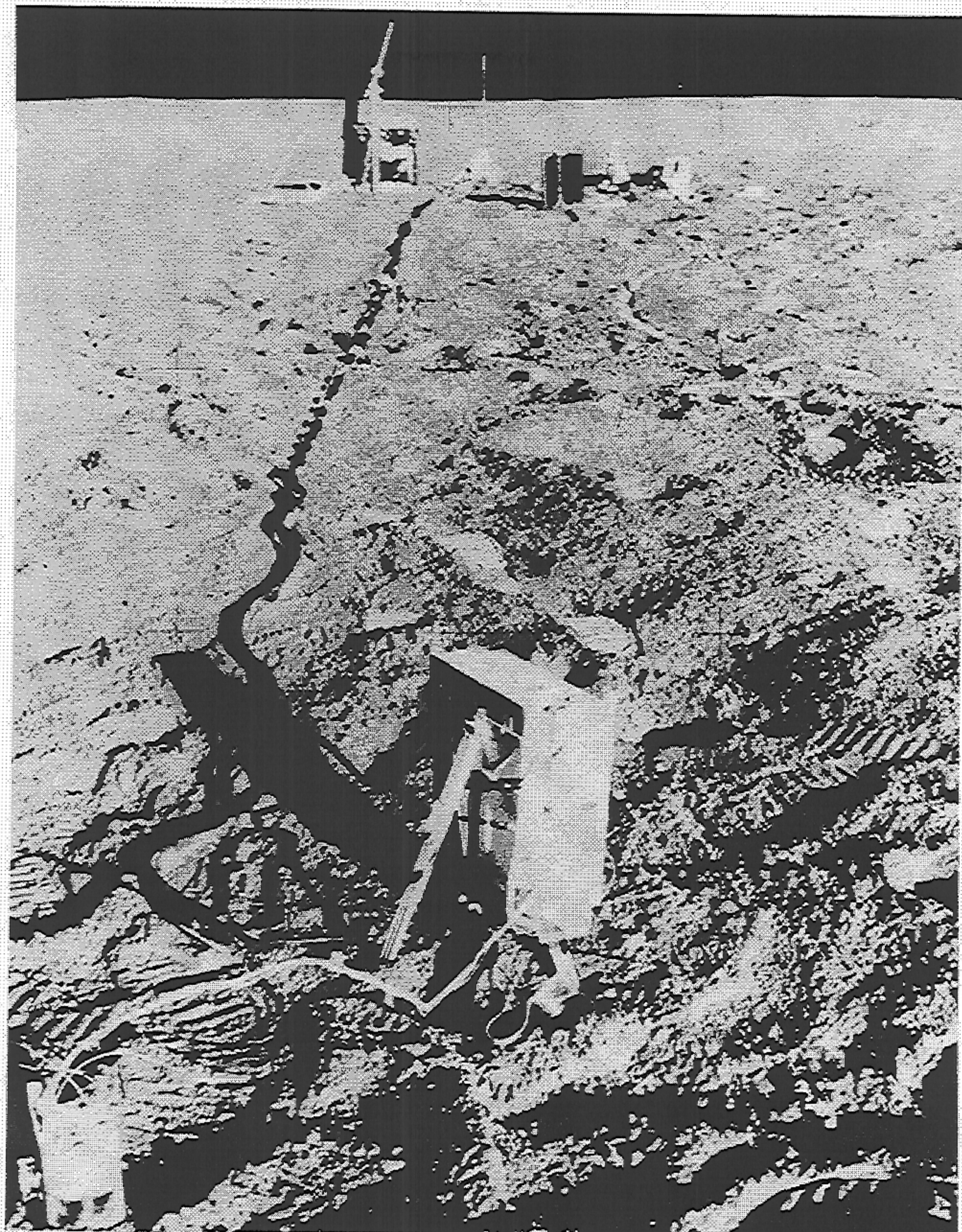

FIGURE 19.—Apollo 14 ALSEP. Individual items are readily identified by comparison with the sketches included in this guidebook.

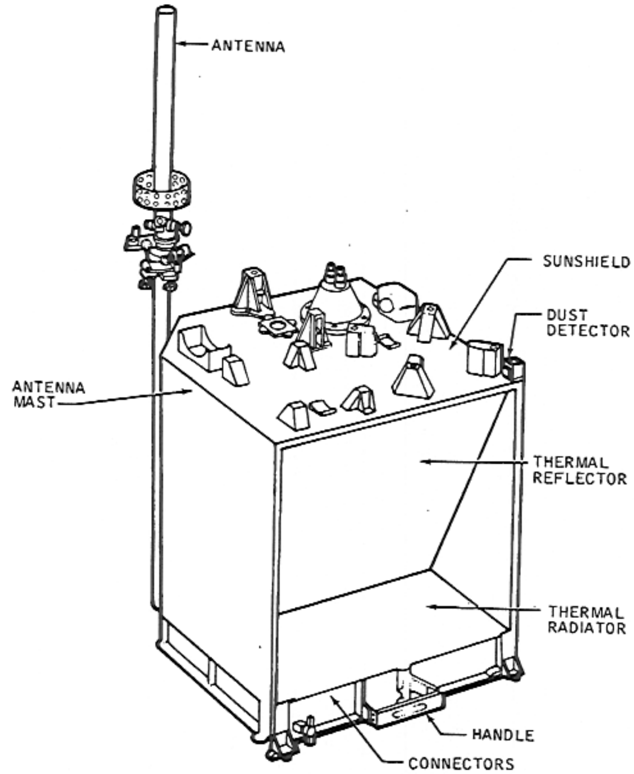

FIGURE 20.—The ALSEP central station. This equipment is connected electrically to each of the other ALSEP experiments. It is a maze of electronics that accepts the electrical signals from various experiments and converts them into a form suitable for transmission by radio back to the Earth. The pole-like feature on top of the central station is a high-gain antenna. It is pointed towards the Earth. Commands may be sent from the Earth to the central station to accomplish various electronic tasks.

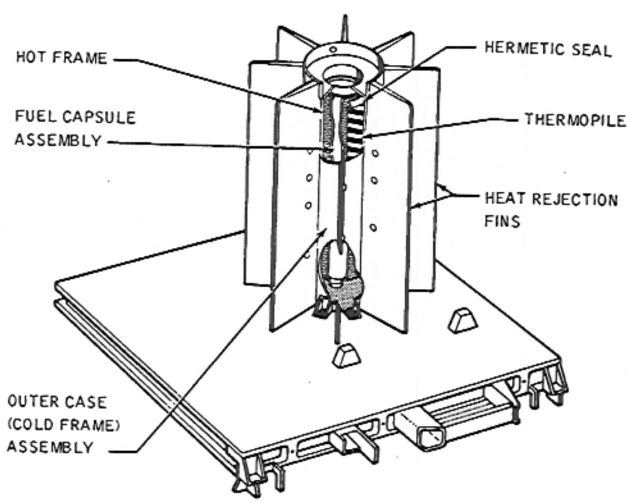

FIGURE 21.—Radioisotope Thermal Generator. This equipment provides all of the power used by the ALSEP. It furnishes continuously about 70 watts.

by one of the astronauts to a depth of about 10 feet by means of the drill sketched in figure 22. After each hole is drilled, temperature sensors (platinum resistance thermometers) are placed at several points in the lower parts of the holes and several thermocouples (for measuring temperatures with lower precision) are placed in the upper portions of the holes. See figure 23. The thermal properties of the rocks will be measured by the equipment that is placed in the hole, they will also be measured on samples that are returned to the Earth.

Because the temperature of the rock is disturbed by the drilling process, the various measurements for heat flow will be taken at regular intervals over several months. As the residual heat left around the hole from drilling dissipates with time, the temperatures measured in the experiment will approach equilibrium.

The great importance of the HFE derives from the fact that knowledge of the amount of heat flowing from the interior of the Moon will be used

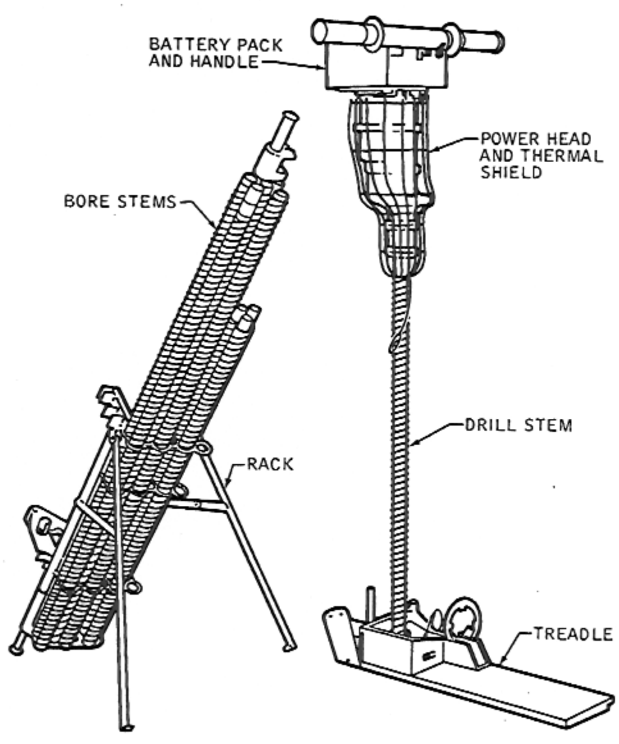

FIGURE 22.—Lunar Surface Drill. This drill will be used to drill holes on the Moon to a depth of about 10 feet. It is electrically powered and operates from batteries. The treadle is used to steady the drill stem and to deflect cuttings from striking the astronaut. Two holes are used for the heat flow experiment and a third one is used to obtain samples for study back on Earth.