



Figure 60-January 1969 field exercise at Cinder Lake Crater Field with MOLAB/MGL and Explorer vehicle for the National Geographic Society; (a) MOLAB and suited test subject on Explorer at Cinder Lake Crater Field for January 1969 exercise. Explorer vehicle had magnetometer boom attached; USGS photo P741, F16960PR



Figure 60-(b) Explorer vehicle negotiating a crater in the Crater Field; USGS photo P741, F16924CPR



Figure 60-(c) Explorer in bottom of large crater; General view of Cinder Lake Crater Field with Explorer for scale; USGS photo P741, F16946c.

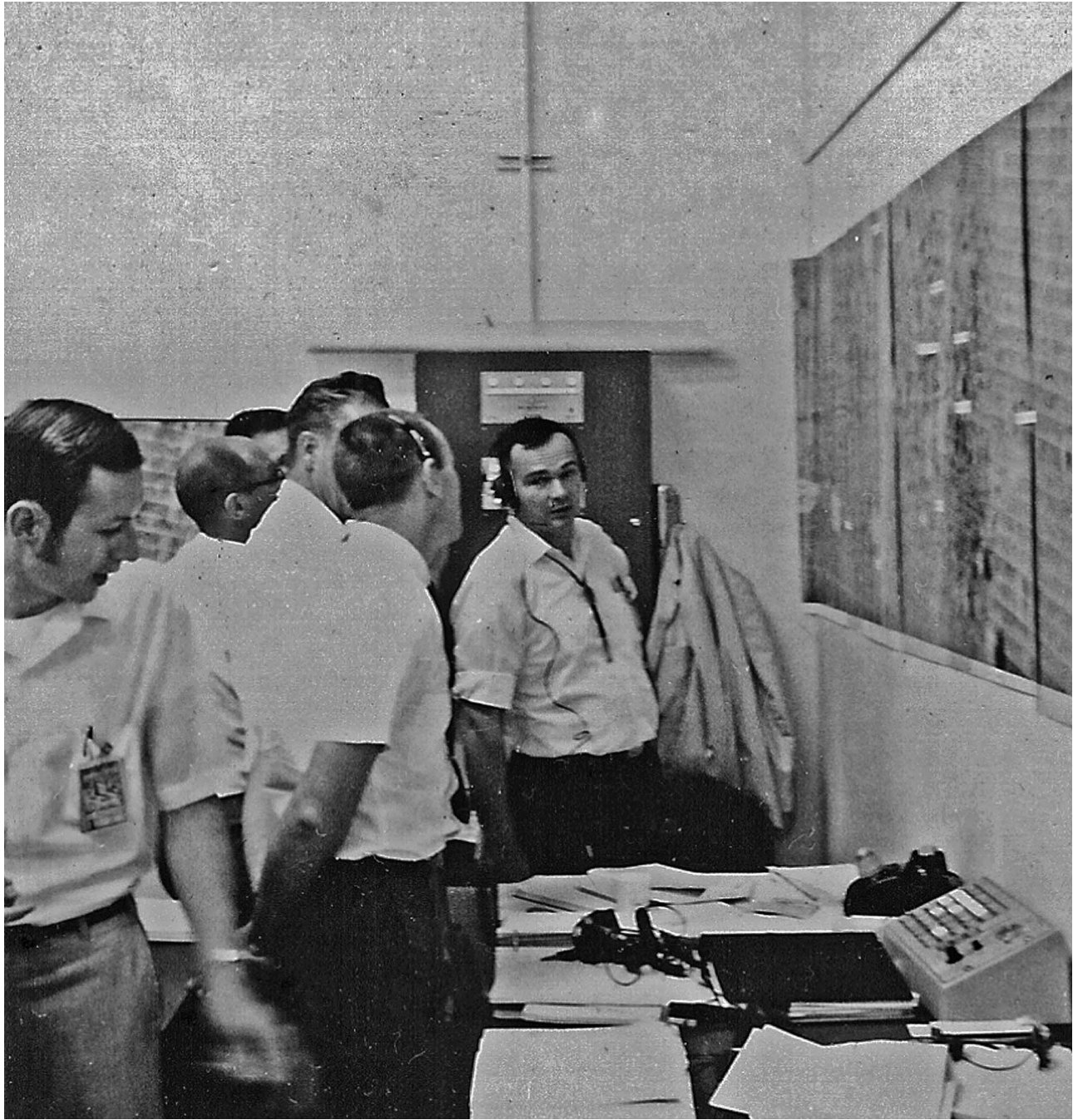


Figure 61-Members of the Apollo 11 Lunar Geology Experiment (LGE) Team from Flagstaff, Arizona in the Science Operations Room (SOR) at Mission Control in Houston, Texas during the historic Apollo 11 Moon landing on 20 July 1969; (a) Gene Shoemaker (Principal Investigator) discussing the landing site with several unidentified personnel from Flight Control; USGS photo P942, F17035



Figure 61-(b) Dave Dahlem (standing by blackboard), Bob Sutton (white shirt seated in back), Ray Batson(right back row) and several other persons, unidentified; USGS photo P942, F17031



Figure 61-(c) the SOR filled with USGS LGE Team members during the Apollo 11 landing; back row (l to r) Bob Sutton (seated) Red Bailey standing at backboard, Dave Dahlem (white shirt sitting on table in front of Bailey), Gordon Swann (bending over table on right); front row, Ray Batson (center seated with head set); photo source unknown



Figure 61-(d) (l-r): Dave Schleicher, Gerald Schaber (by screen), Dave Dahlem (seated) and Red Bailey (standing at right)



Figure 61-(e) LGE Team member Gerald Schaber standing at his landing site plot board in the SOR; photo source unknown. Shown on Schaber's plot table is a schematic representation of the LM vertical plan, with concentric and radial grids representing distance from the LM landing point. A television camera mounted over top of the map plot board allowed Flight Director Gene Kranz and the other flight operations personnel in the Mission Control room (directly across the hall from the SOR) to bring up Schaber's display wherever he desired and project it on any of six or so 10 X 10 foot screens in the front of the Mission Control Room.



Figure 62-CBS Television coverage of the Apollo 11 lunar landing (20-21 July 1969) at the Center of Astrogeology in Flagstaff, in addition to other sites around Flagstaff (a) CBS Television vans parked behind the Center of Astrogeology building on McMillan Mesa; USGS photo P858PR, F76969PR

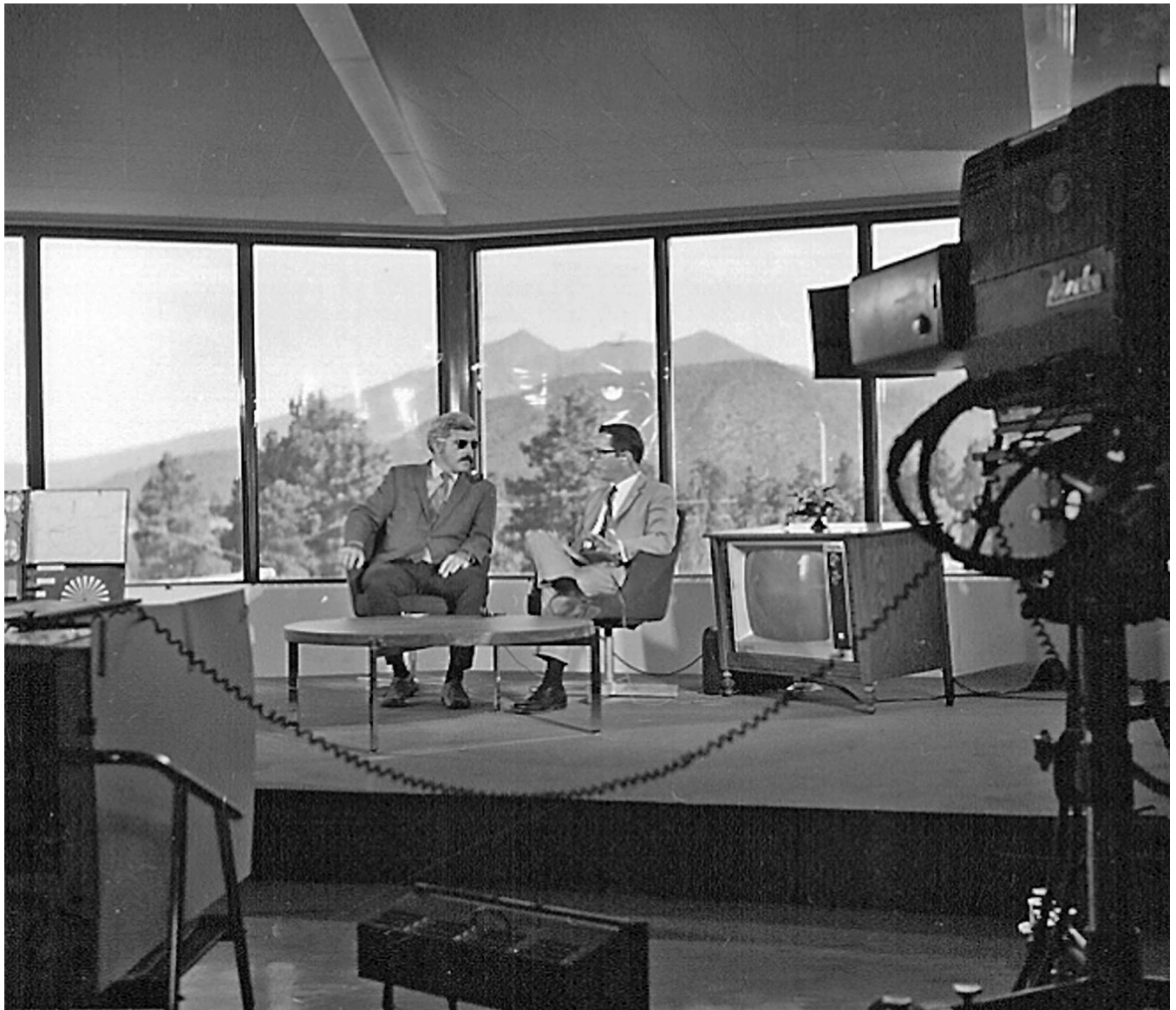


Figure 62-(b) Jack McCauley (left) talking with CBS anchor George Herman in foyer of the Center of Astrogeology headquarters on McMillan Mesa in Flagstaff; USGS photo P862PR, F769236



Figure 62-(c) Jack McCauley and George Herman in Foyer of Center of Astrogeology Headquarters; USGS photo P860PR, F769173PR



Figure 62-(d) Thor Karlstrom (left) and George Herman; USGS photo P860PR, F769174PR



Figure 62-(e) (l-to r) Terry Offield, Jack McCauley, Elliot Morris, George Herman (CBS) Howard Pohn, and David Roddy in Branch Chief's office in Center of Astrogeology headquarters building; USGS photo P860PR, F769186PR



Figure 62-(f) (l-to-r) Jack McCauley, Thor Karlstrom (standing), Bob Regan CBS assistant (unidentified) and Al Chidester in Branch Chief's office during Apollo 11 mission; USGS photo P860PR, FF769188PR



Figure 62-(g) (back l-to-r) Thor Karlstrom, Bob Regan (seated), Jim Lovelace (middle back), and George Ulrich.
Nearest seated person not identified; USGS photo P860PR, F769131PR



Figure 62-(h) CBS camera crews at Cinder Lake Crater Field for live broadcasts during Apollo 11 mission; USGS photo P858PR, F76974PR



Figure 62-(i) MGL vehicle with CBS camera crew on top; USGS photo P858PR, F76976

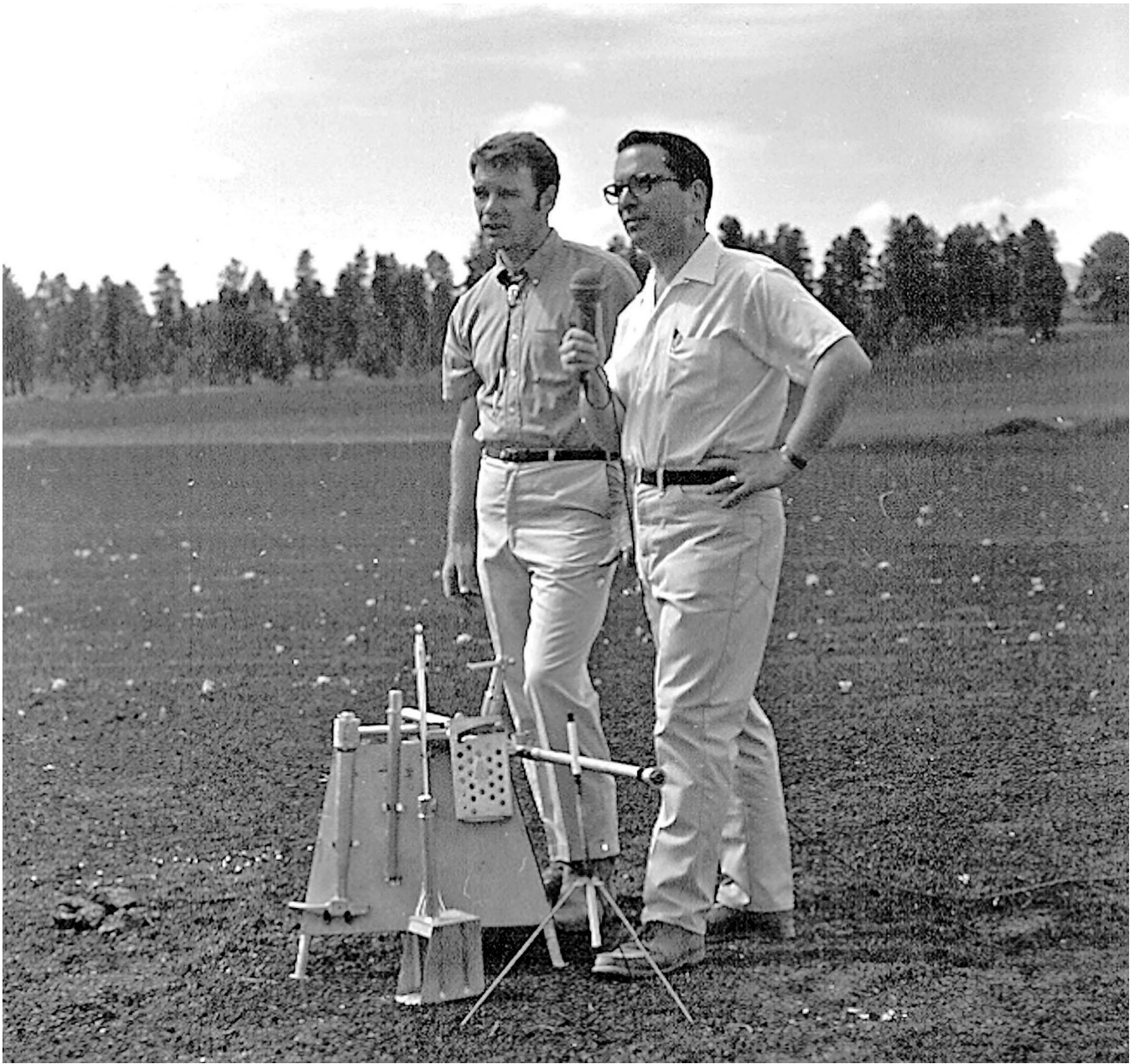


Figure 62-(j) Tim Hait being interviewed by CBS anchor George Herman (probably prior to Apollo 11) in Cinder Lake Crater Field near Flagstaff. Apollo lunar tool carried on ground; USGS photo P858PR, F76987PR

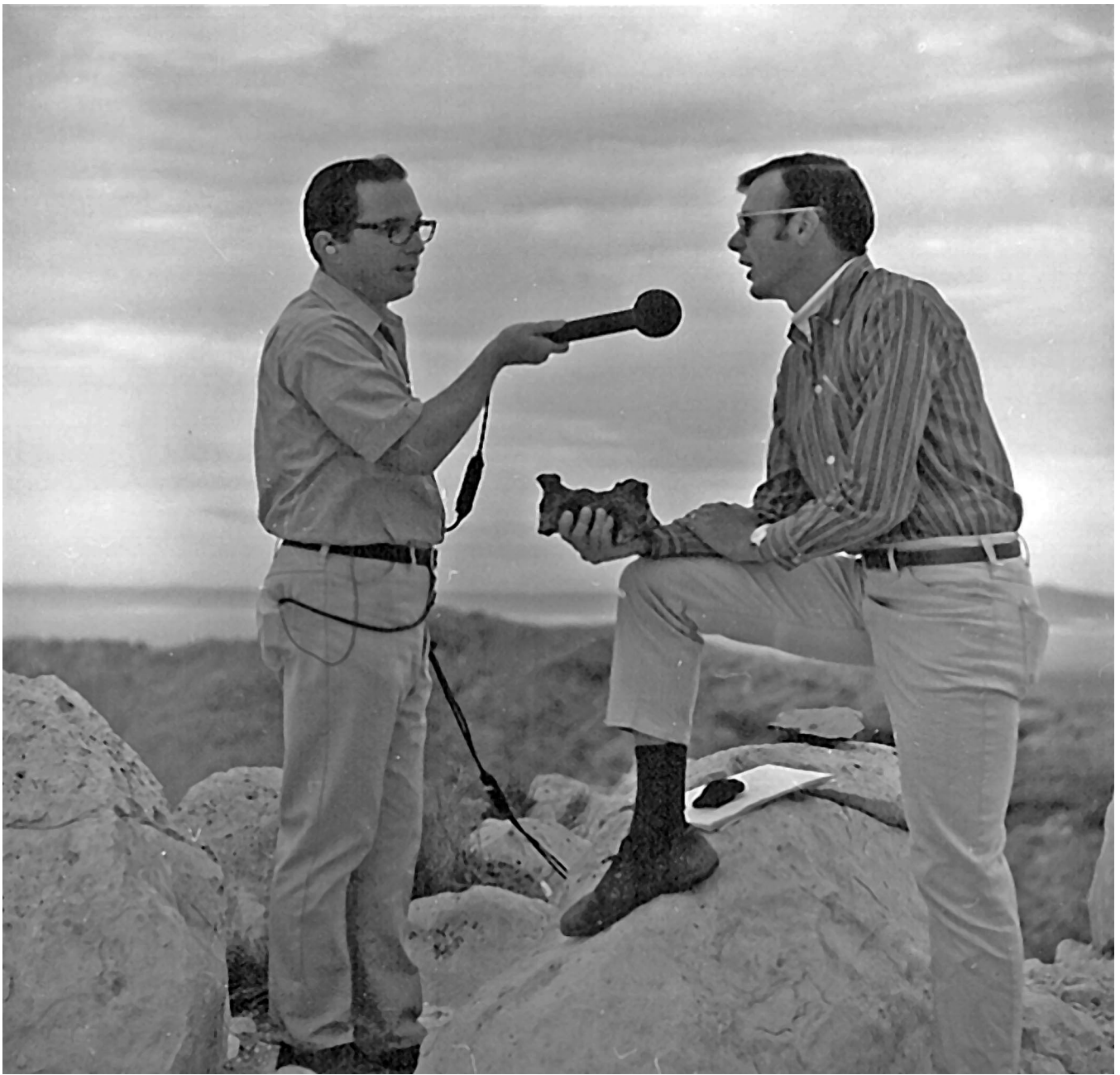


Figure 62-(k) David Roddy (right) being interviewed by George Herman of CBS at Meteor Crater during the Apollo 11 mission; USGS photo P862PR, F769225



Figure 62-(1) Dave Roddy with George Herman of CBS being filmed at rim of Meteor Crater; USGS photo P862PR, F769221



Figure 62-(m) television microwave relay towers set up behind the Center of Astrogeology headquarters building on McMillan Mesa for live TV broadcasts during Apollo 11; USGS photo P858PR, F76979.

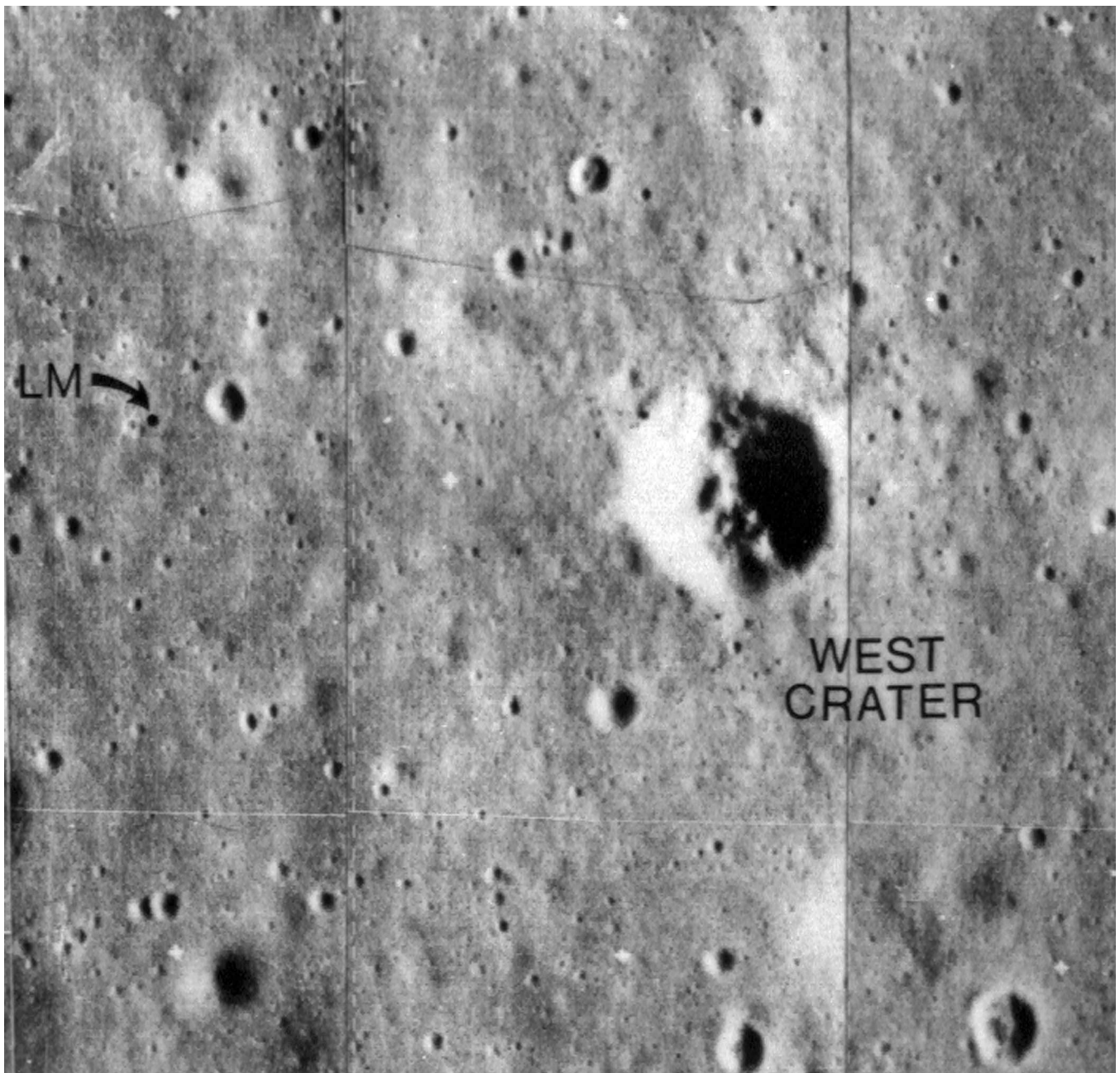


Figure 63-Lunar Orbiter photo showing location of Apollo 11 LM landing site, and nearby West crater; USGS photo P854a, F2702.

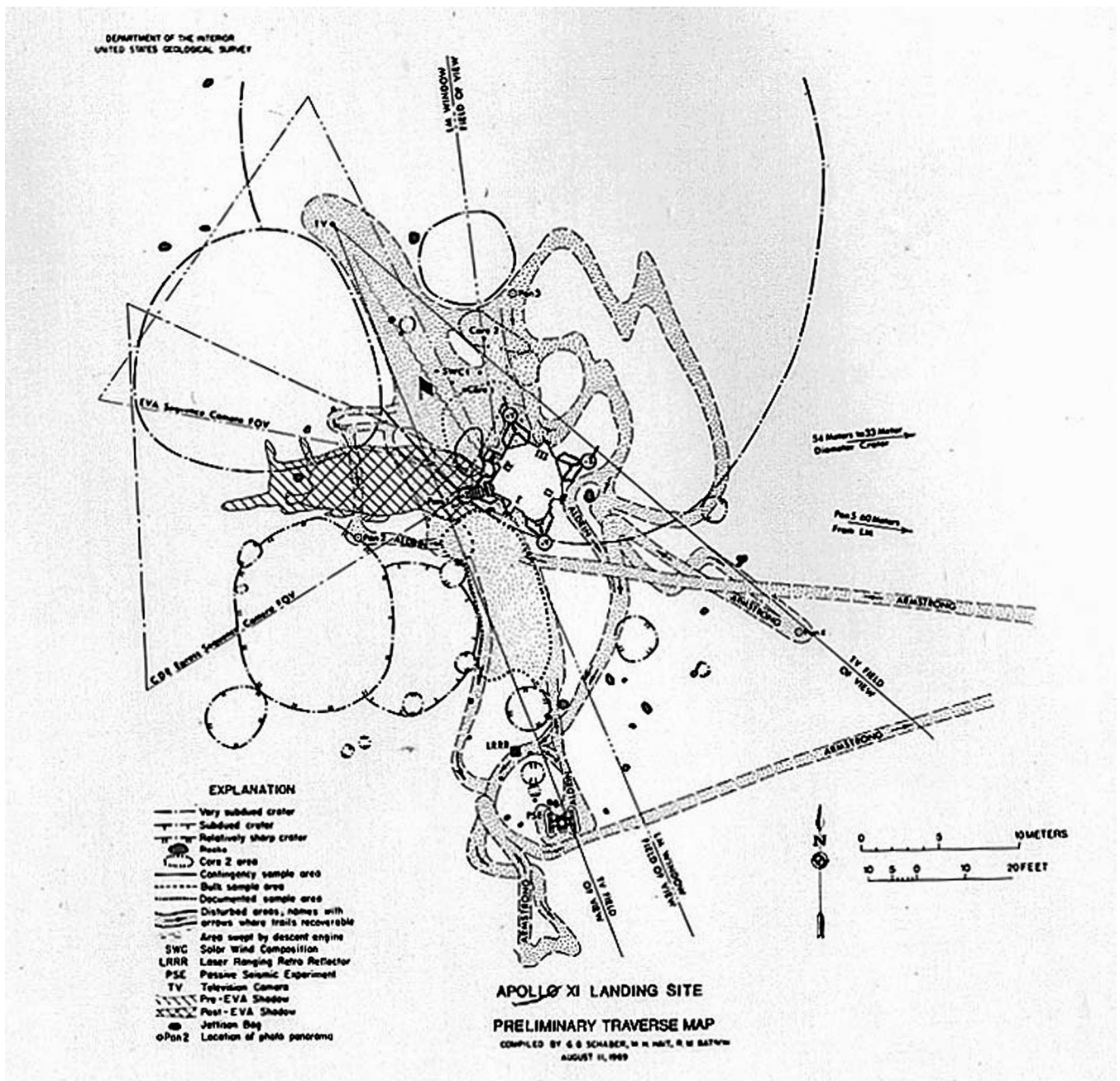


Figure 64-Apollo 11 Landing Site Map compiled by G. Schaber, R. Batson, and T. Hait, August 1969 that was presented to President Richard Nixon; USGS photograph P854c, F27042.

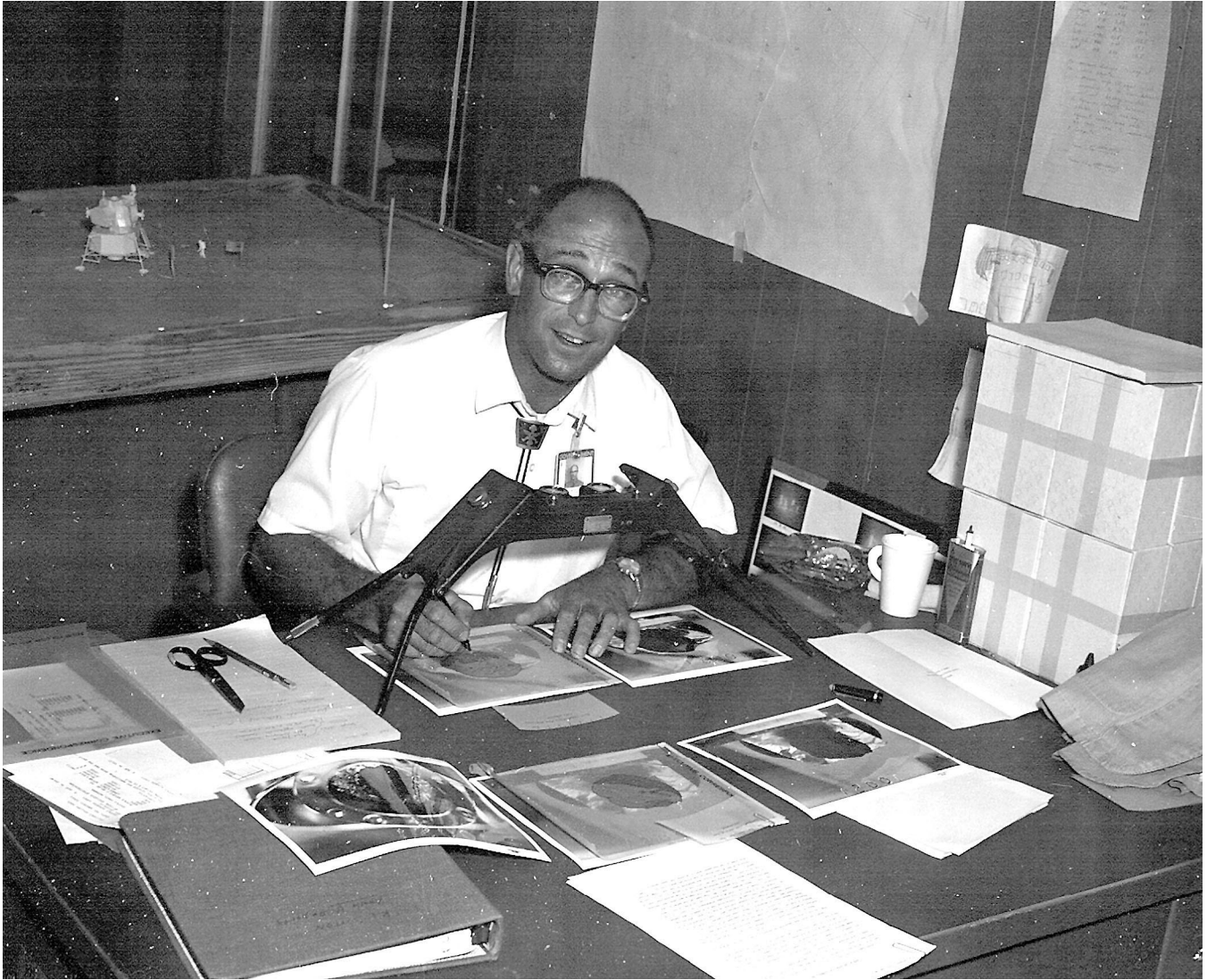


Figure 65-LGE Team members working on the Apollo 11 45-Day Mission Report in the experimenters trailer complex located at the back of the MSC campus in Houston following Apollo 11 July-August 1969); (a) Bob Sutton; USGS photo P954a, F27013

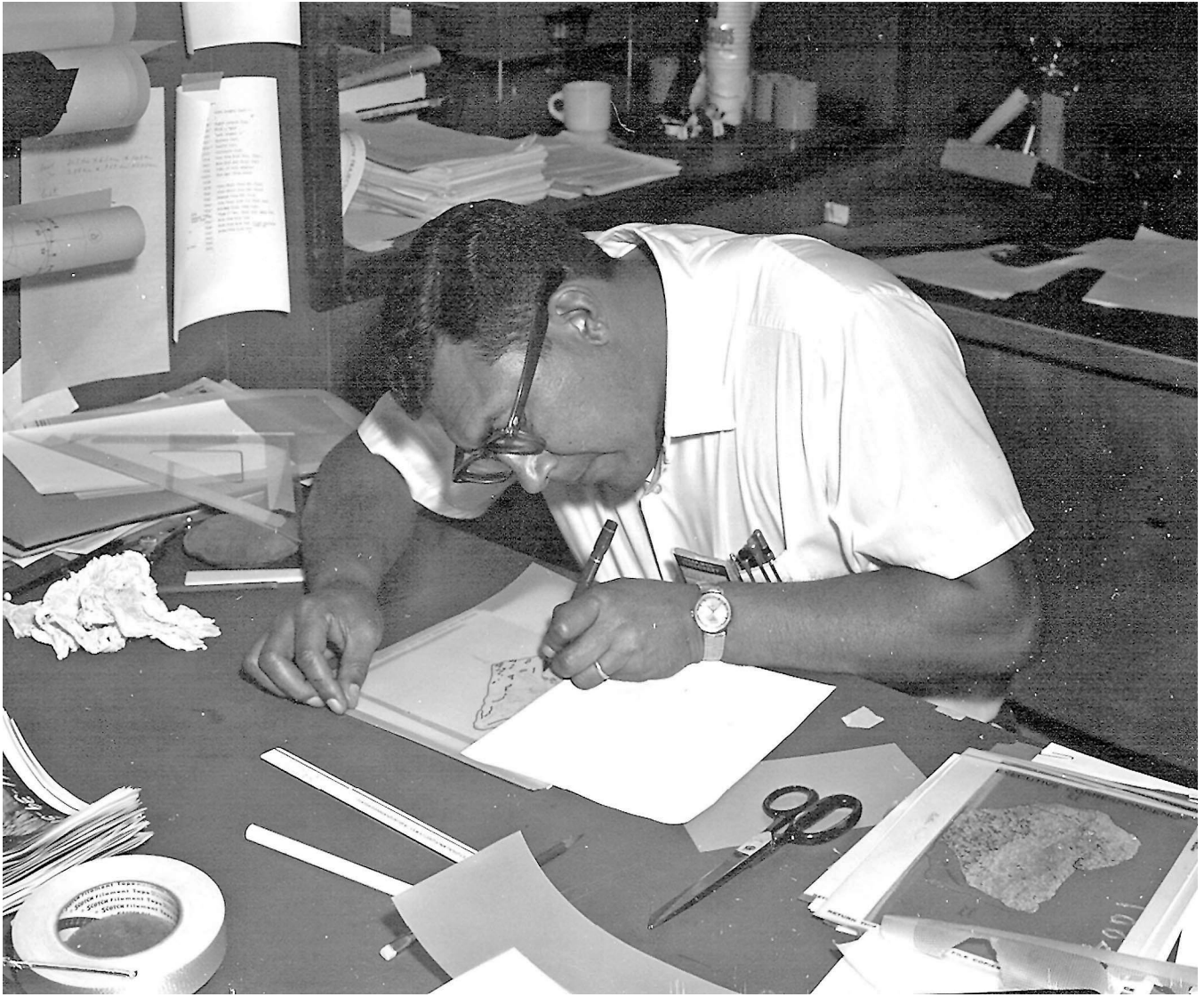


Figure 65-(b) Ray Sabala (draftsman); USGS photograph P954a F27011



Figure 65-(c) Gerald Schaber; USGS photo P954a, F27012.

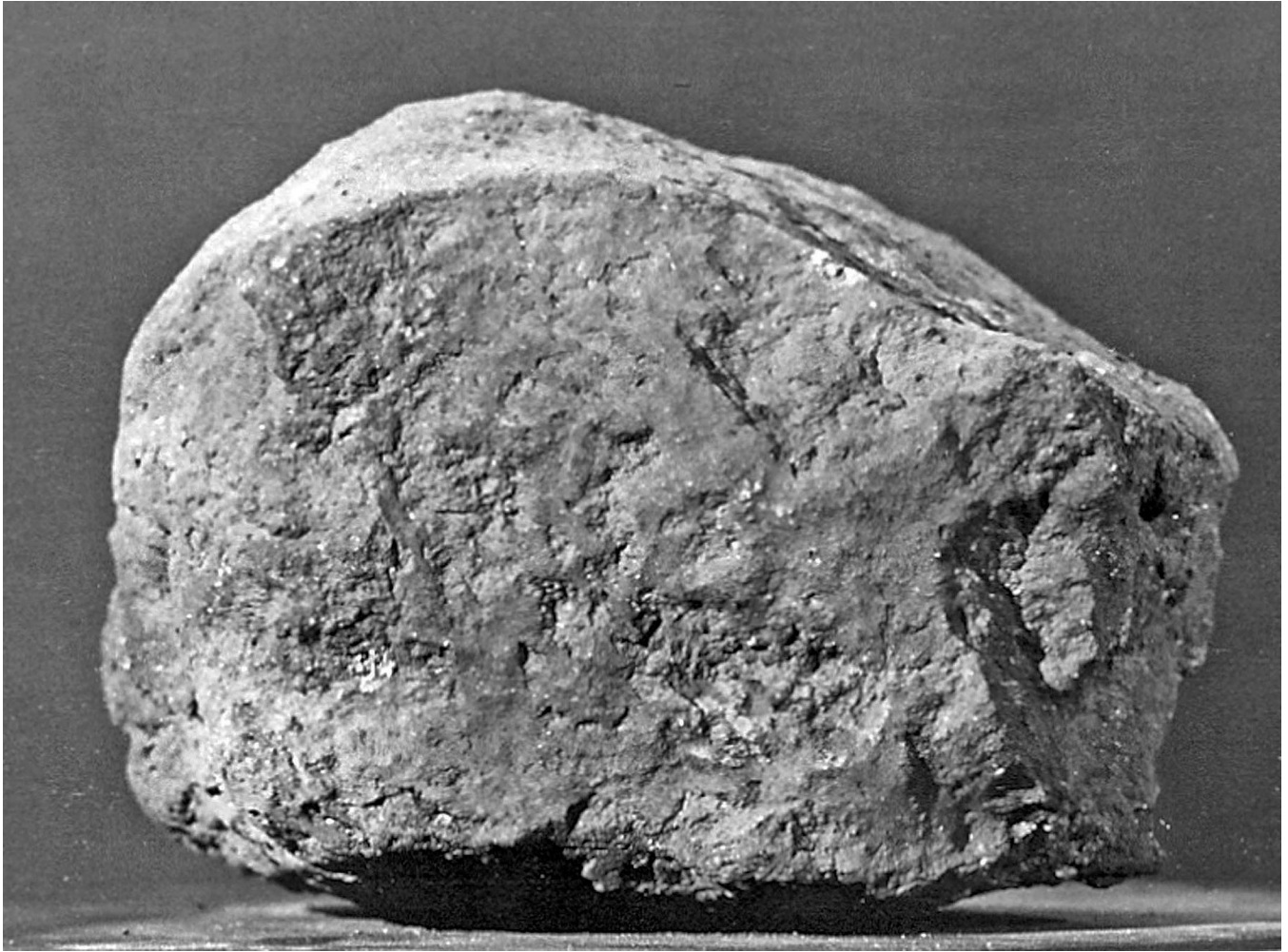


Figure 66-Lunar Receiving Laboratory (MSC/Houston) mug shot of Apollo 11 rock 10046 that was used to count impact craters down to micron size; USGS photograph P954a F2704.



Figure 67-Field testing (29-30 September 1969) in the Cinder Lake Crater Field of two Lunar Roving Vehicle (LRV) concept vehicles built by Bendix Aerospace Corporation and Grumman Aerospace: (a) Astronaut Harrison "Jack" Schmitt and an unidentified right seat passenger driving the Bendix LRV concept vehicle; USGS photo P916c, F116929

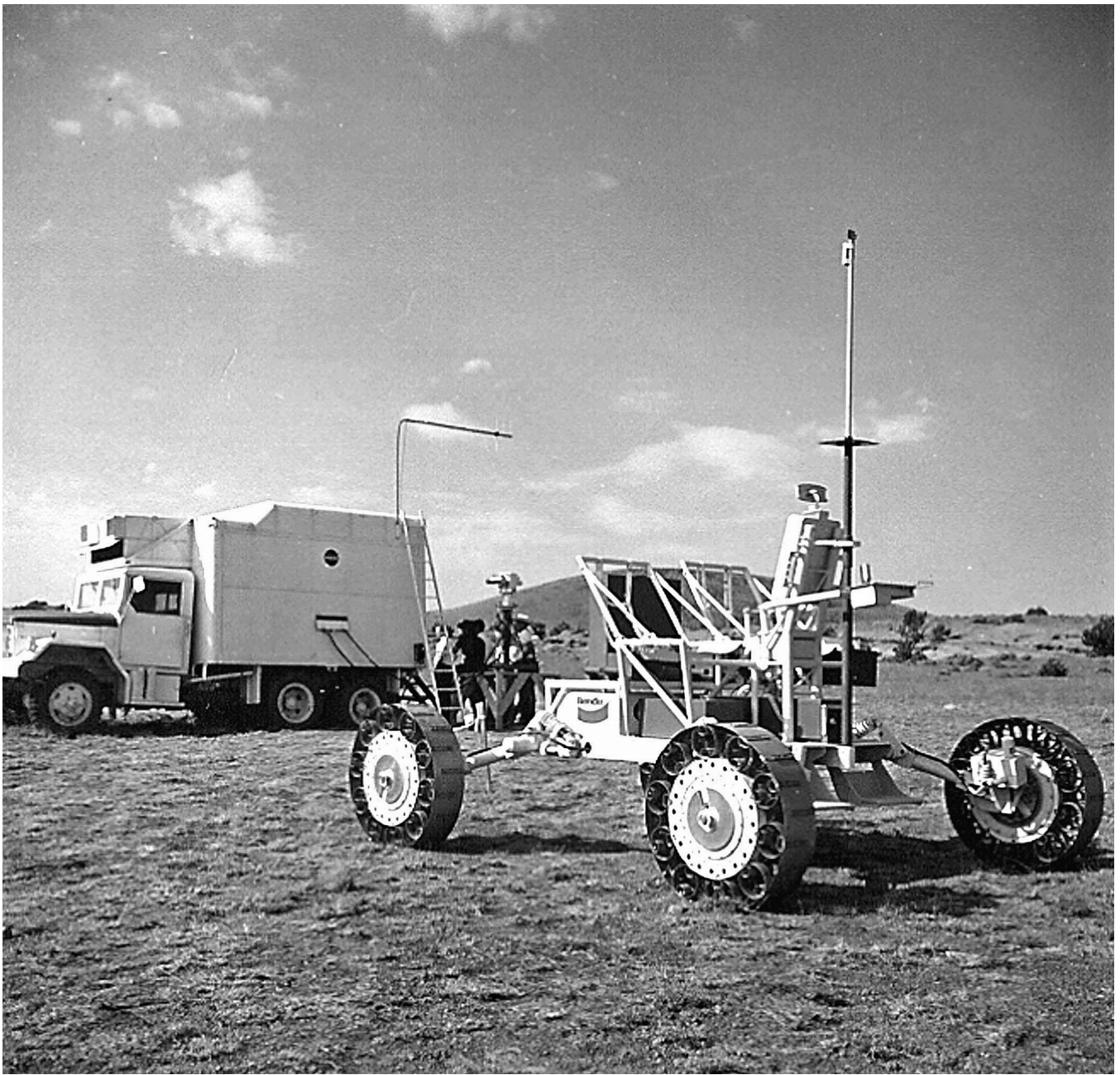


Figure 67-(b) black and white photo of the Bendix LRV concept vehicle; test-support van in background; USGS photo P899, F106953

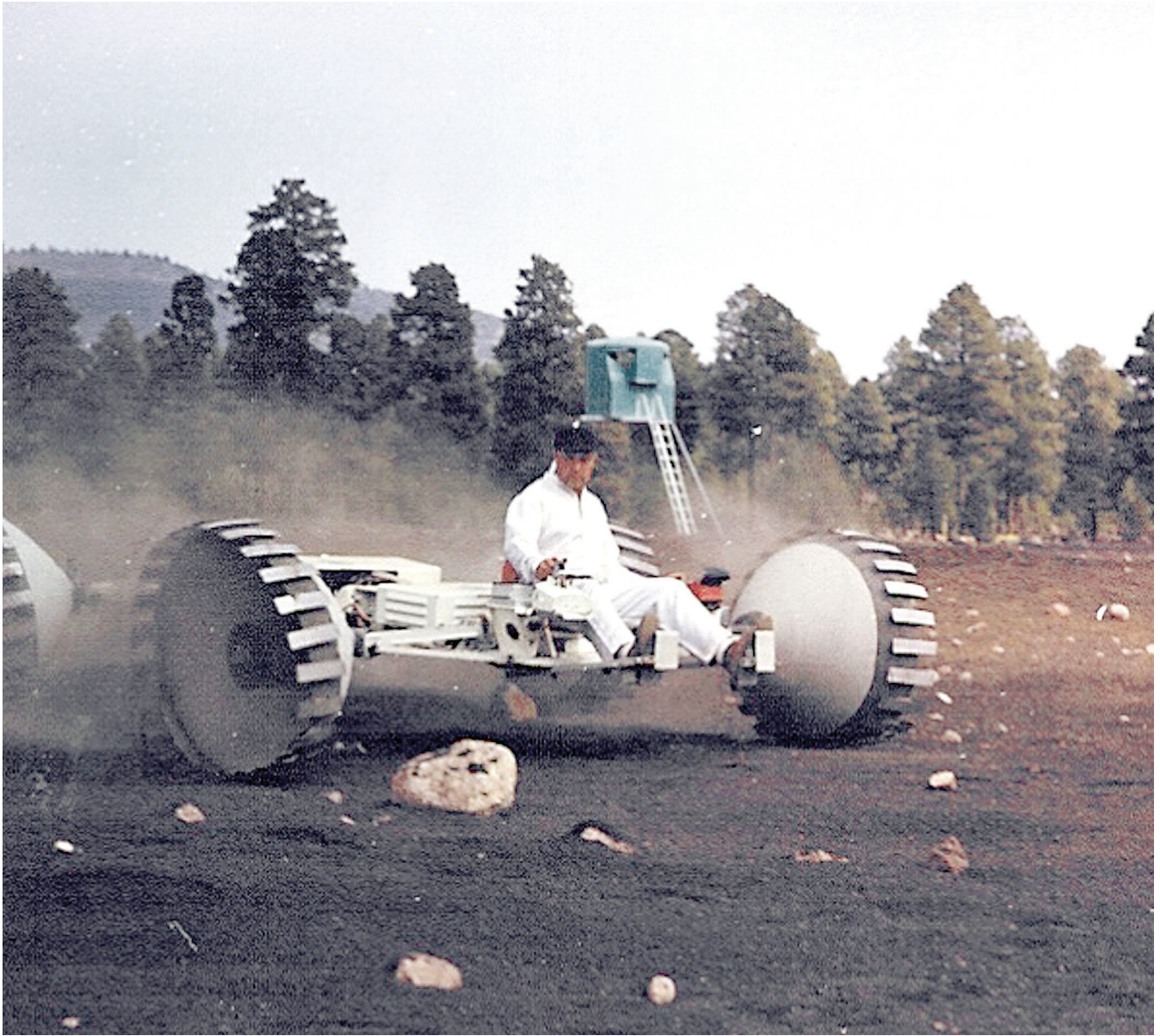


Figure 67-(c) Grumman LRV concept vehicle with Grumman engineer driving (?); USGS photo P916c, F116943

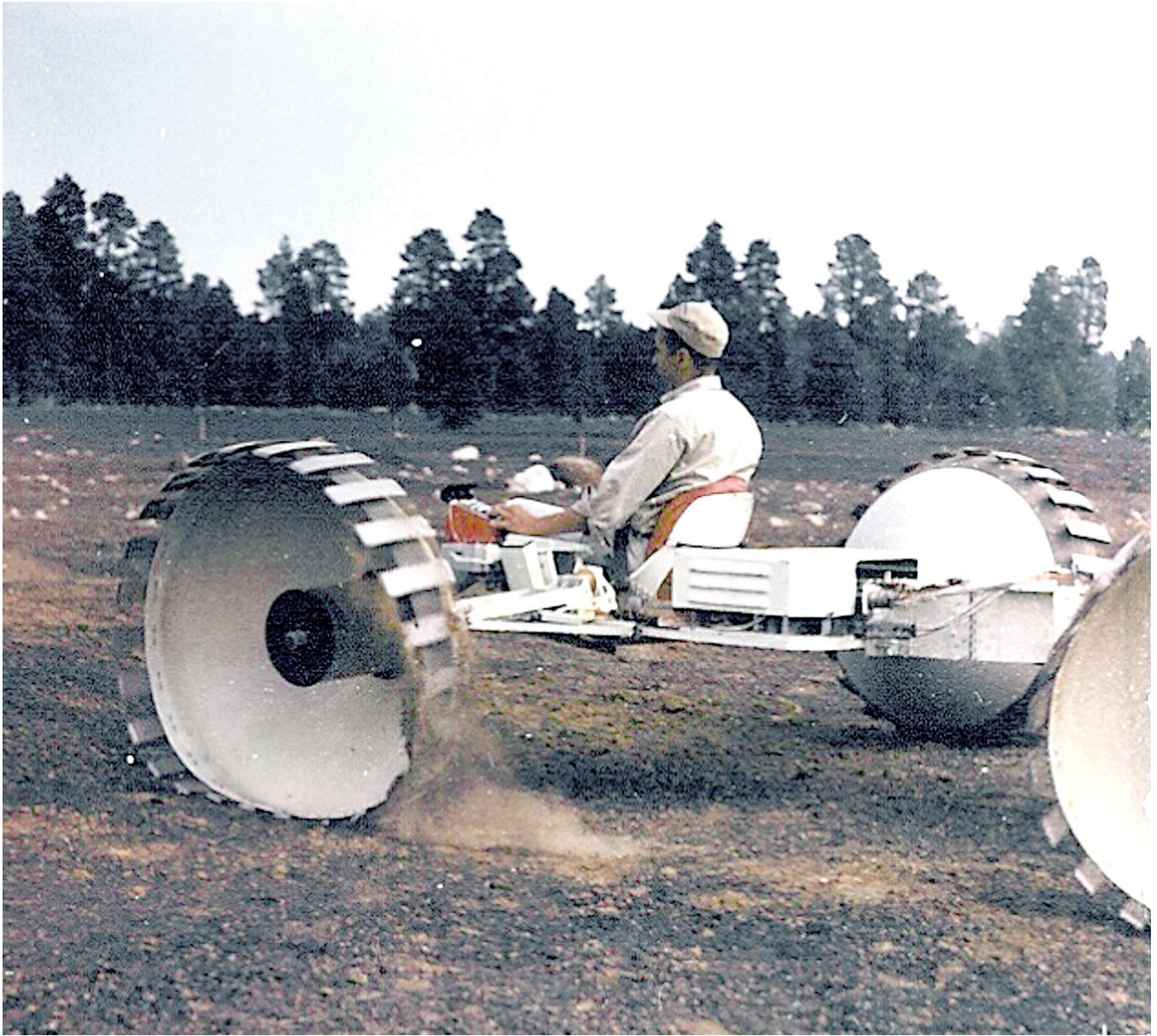


Figure 67-(d) Jack Schmitt getting the “feel” of the Grumman LRV concept vehicle; USGS photo P916c, F116939



Figure 67-(e) Gordon Swann giving briefing to attendees at LRV demonstration and testing at Cinder Lake Crater Field; USGS photo P899, F106962.



Figure 68-Apollo 12 astronauts Alan Bean (left) and Charles Conrad at the Center of Astrogeology Headquarters in Flagstaff, Arizona on 9-10 October 1969 for a briefing prior to their final geology training exercise at the nearby Cinder Lake Crater Field before their trip to the Moon the following month (November 1969); NASA photo S-69-54560.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER

Presents this

CERTIFICATE OF APPRECIATION

to

U.S. Geological Survey

For outstanding contributions to the Apollo Program. The geological training and lunar mapping services provided to the Apollo astronauts were in large measure responsible for the successful accomplishment of the scientific objectives of the world's first manned lunar landing mission in July 1969.



Signed and sealed at Houston, Texas
this month of October
Nineteen hundred and sixty-nine

Robert R. Gillett

DIRECTOR, MSC

Figure 69-NASA Certificate of Appreciation to the U.S. Geological Survey presented in October 1969 following the historic Apollo 11 lunar landing; USGS photo packet P1075c.

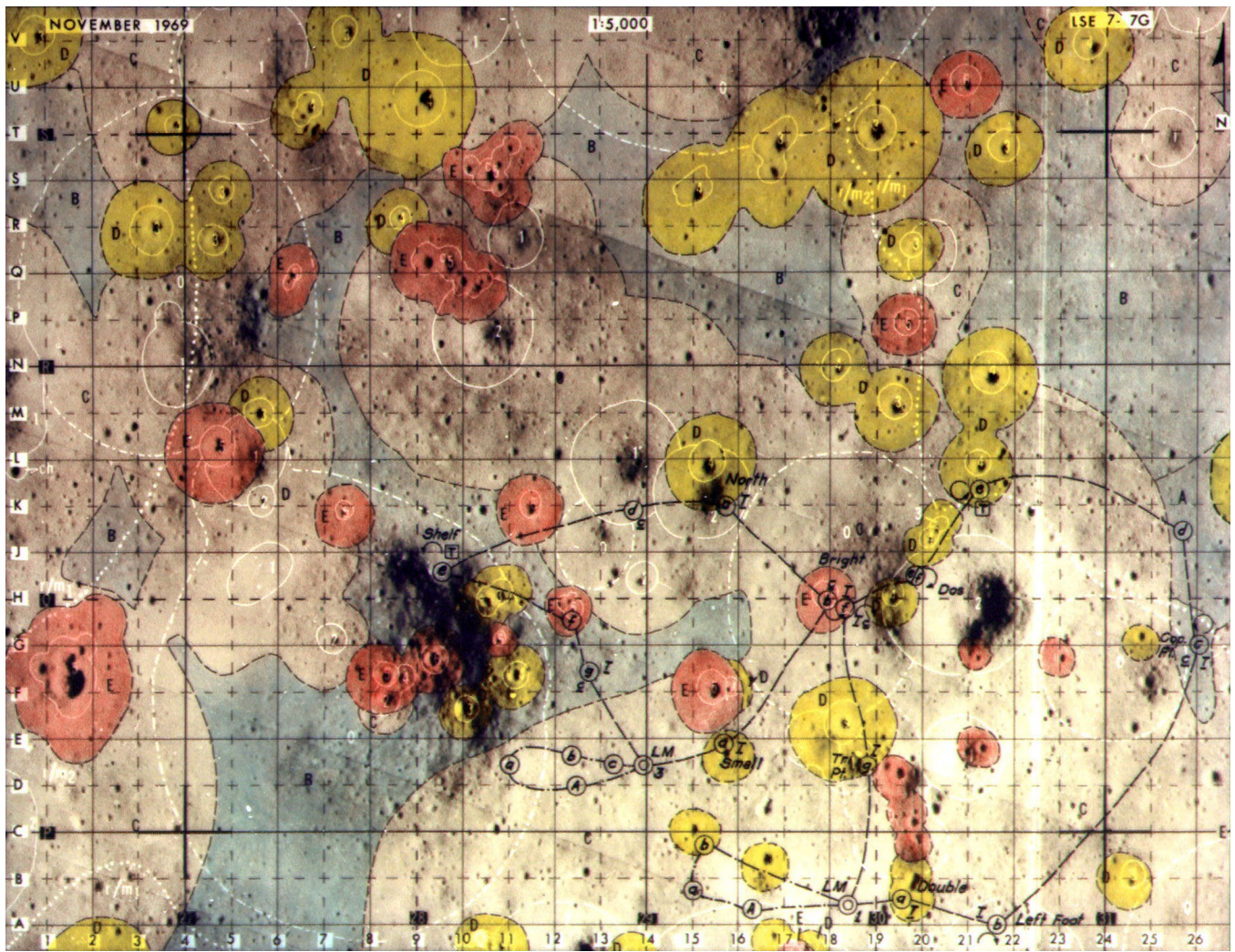


Figure 70-(a, b) Examples of two color Apollo 12 traverse maps from the Apollo 12 Lunar Data package hand-colored at the Kennedy Space Center a few days before the mission by personnel (Ray Sabala and James Vandivier) from the Center of Astrogeology (Flagstaff) at the request of the Apollo 12 crew (Conrad and Bean). USGS photos (a) P941c, F17024

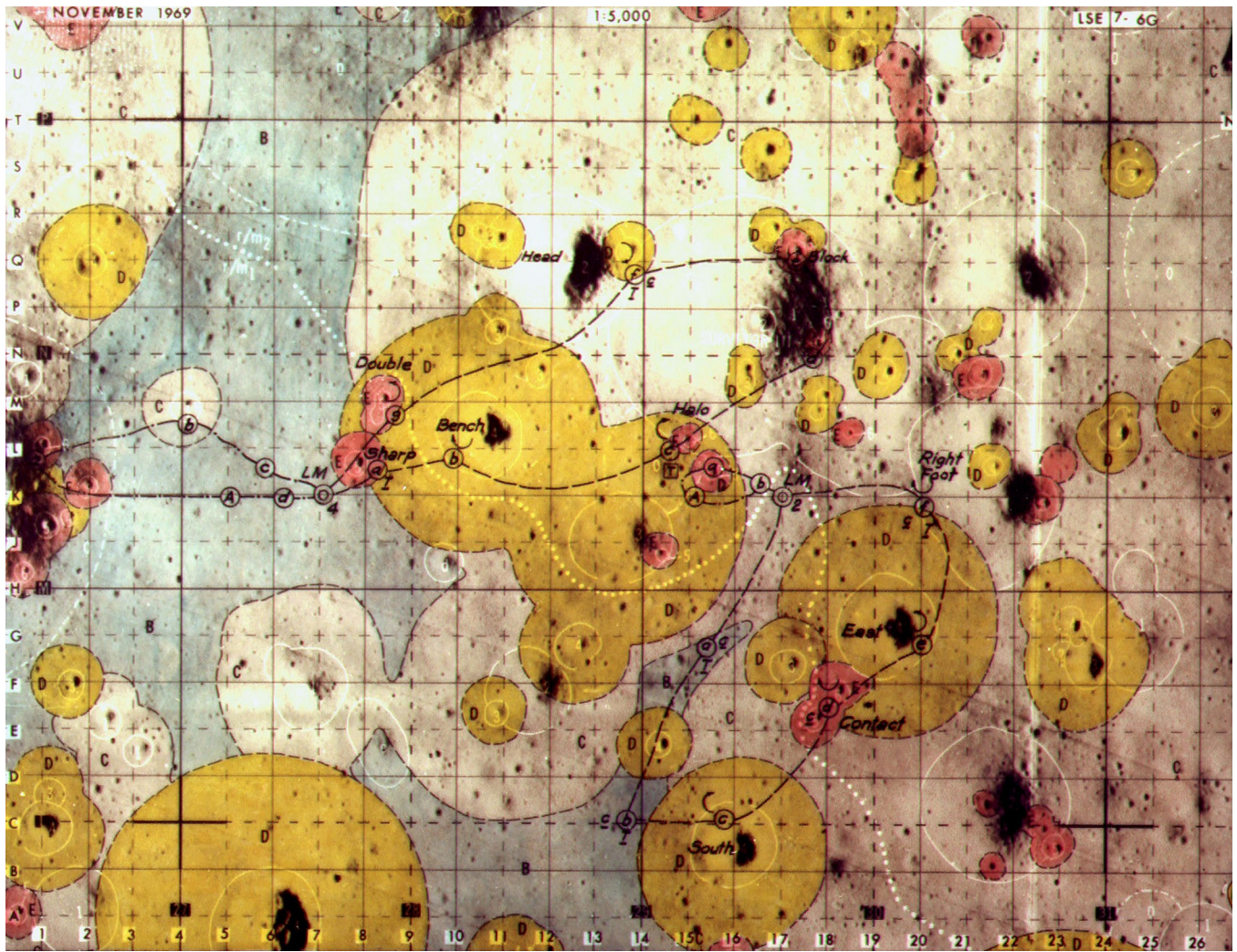


Figure 70-(b) P941c, F17023c).

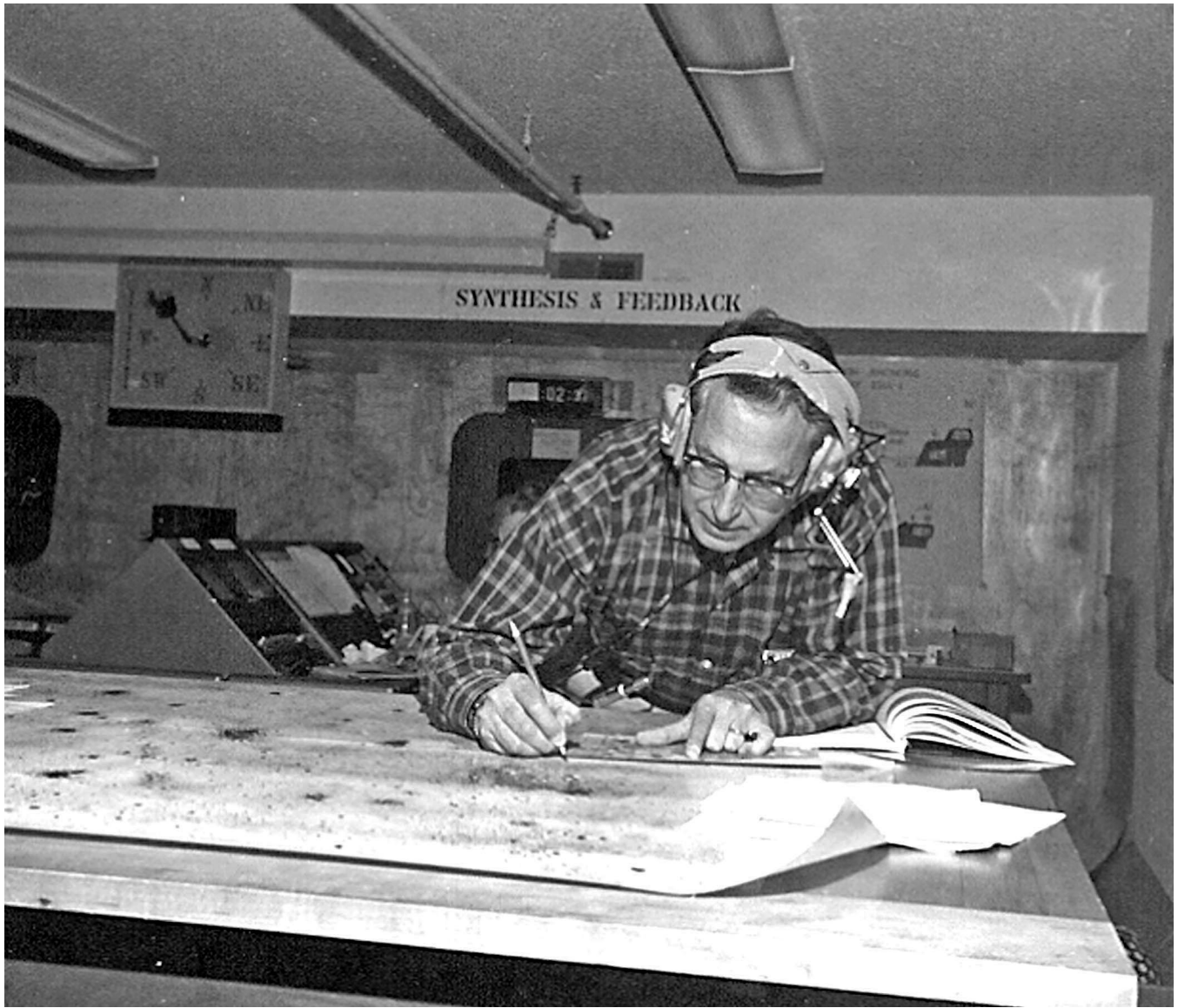


Figure 71-Branch of Astrogeology personnel manning the ADF facility at 2720 N. Fourth Street in east Flagstaff during the Apollo 12 mission (November 1969); (a) Al Chidester checking out landing site maps; USGS photo P929, F169132



Figure 71-(b) (l-to-r), Al Chidester, Ivo Lucchitta, and John M'Gonigle; USGS photo P929, F1169136

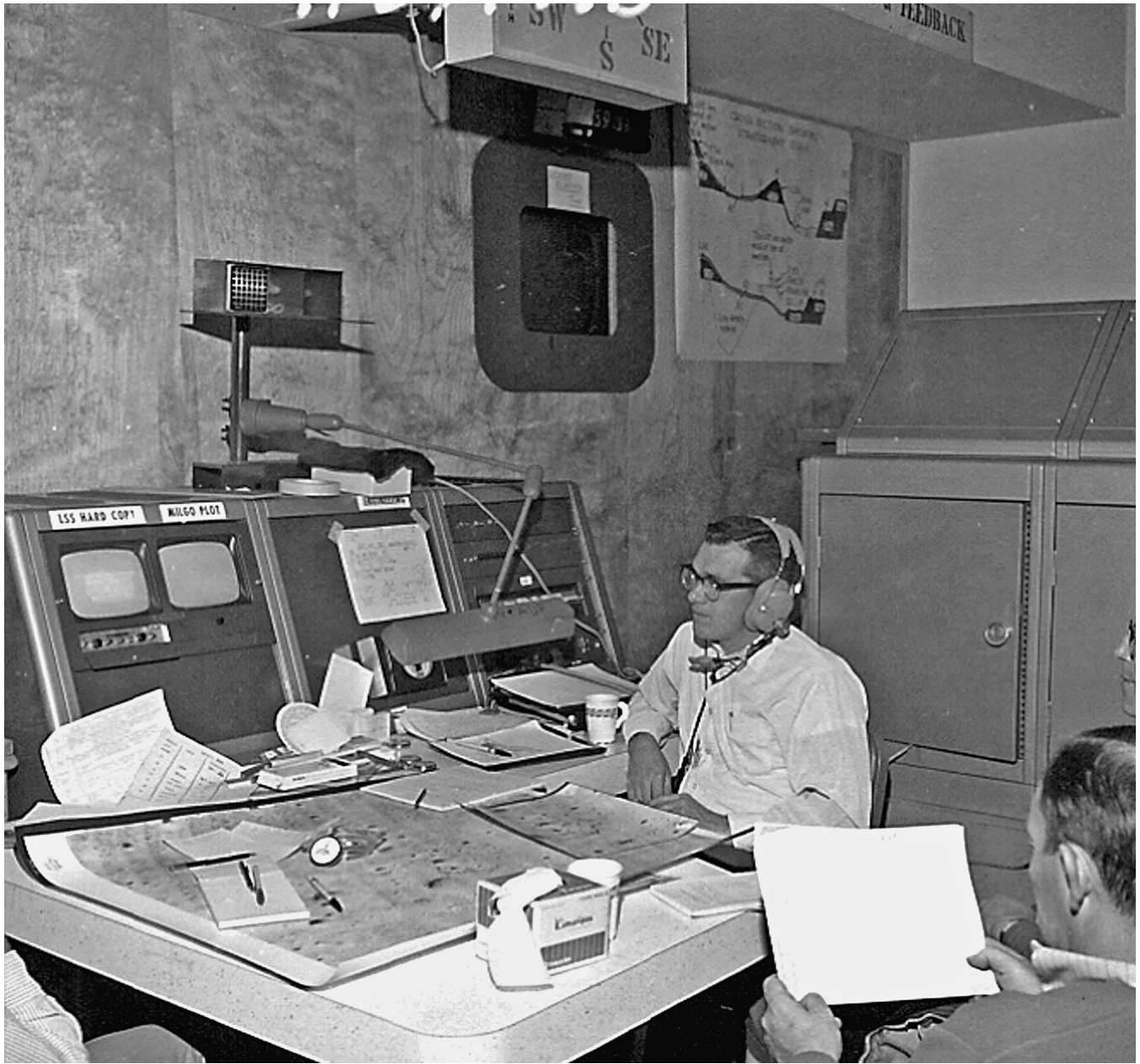


Figure 71-(c) George Ulrich and unidentified person; USGS photo P929, F169125



Figure 71-(d) Thor Karlstrom; USGS photo P929 F1169134

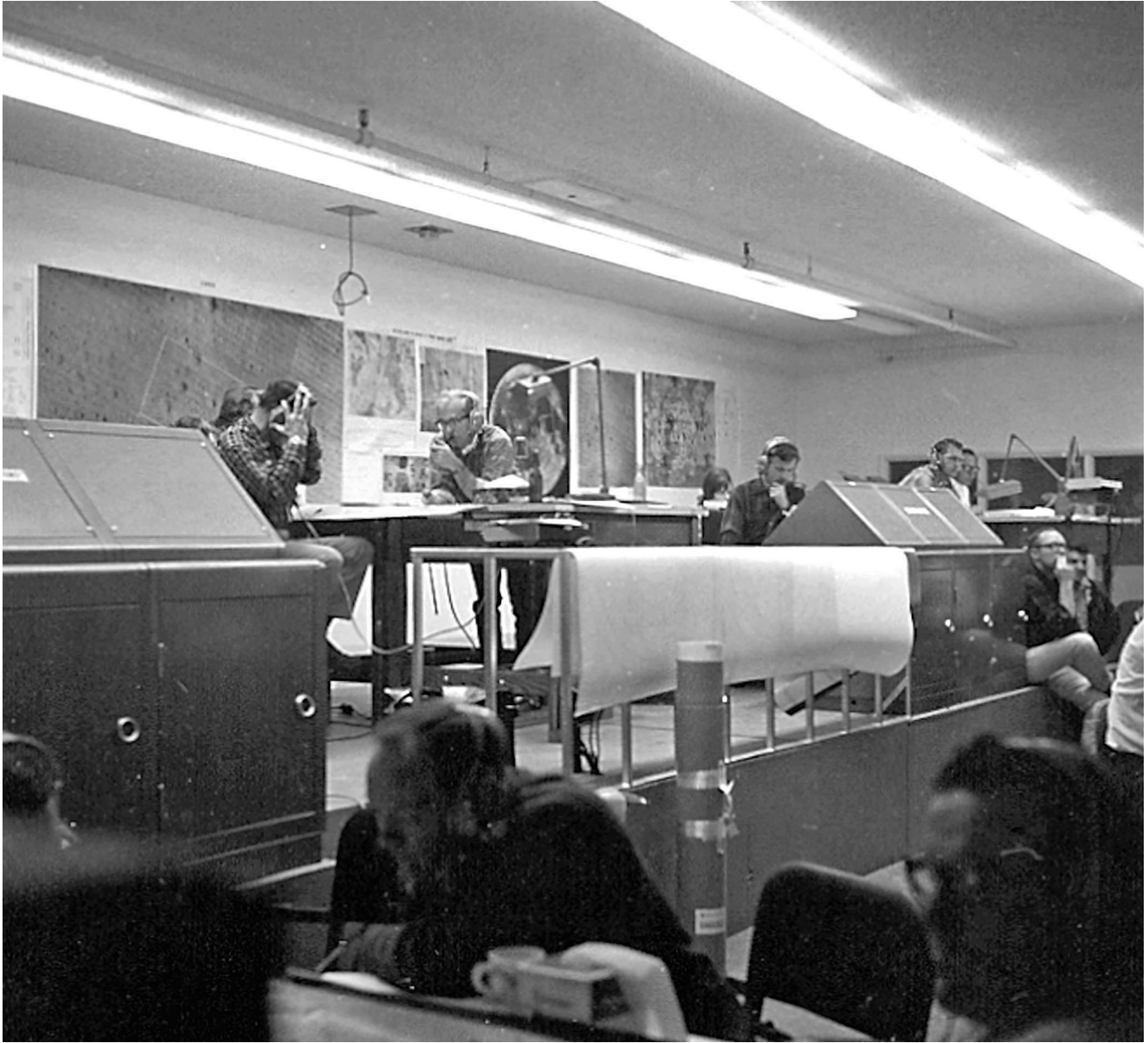


Figure 71-(e) overview of the interior of the large data recording and analysis room at the CRDA on Fourth Street during Apollo 12 mission (see a); USGS photo P929, F11669143.

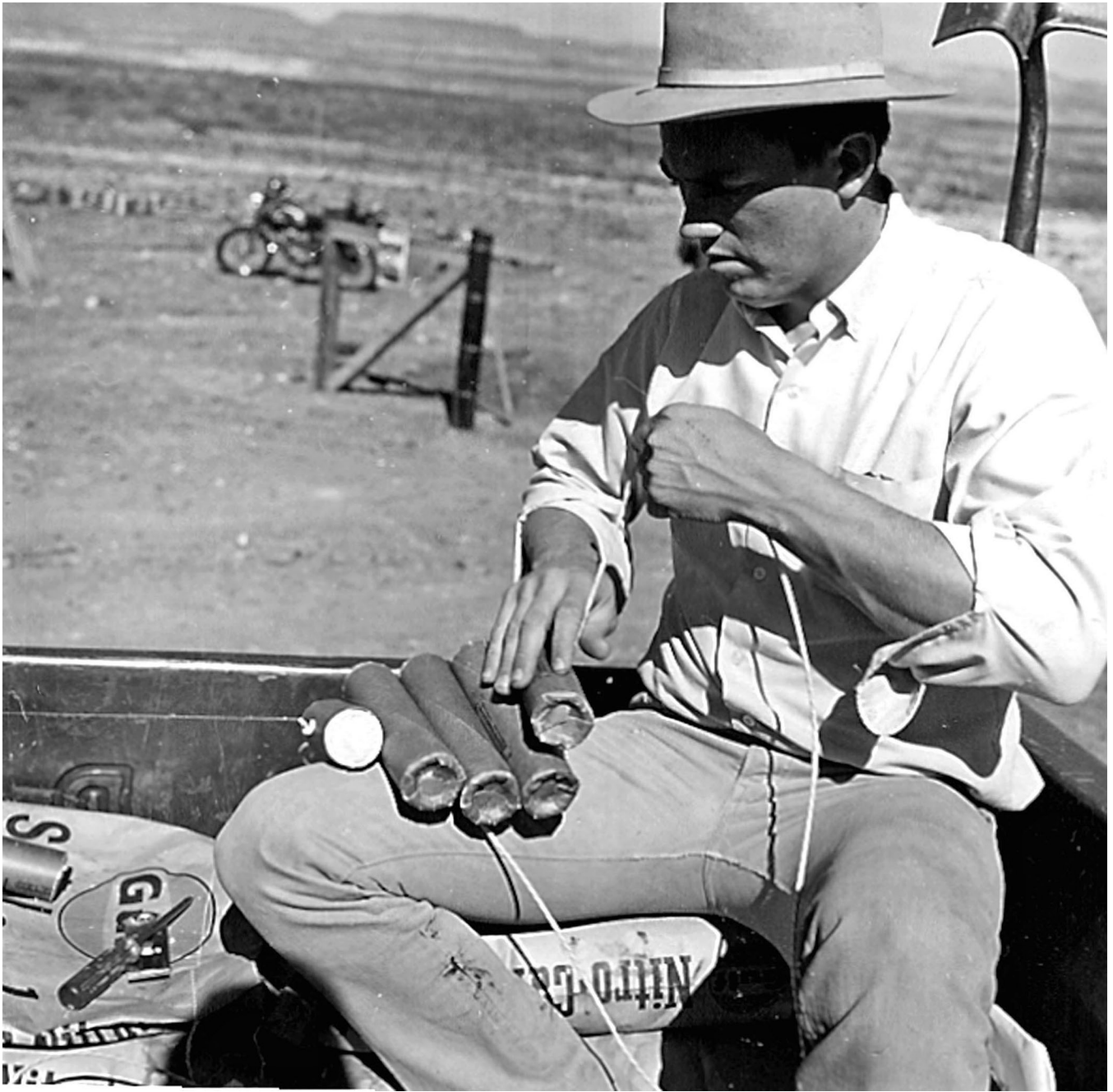


Figure 72-Construction of the Black Canyon Crater Field in Verde Valley, Arizona (south of Flagstaff) on 24-26 February 1970; (a) USGS geologist Bob Philpott preparing sticks of dynamite; USGS photo P965, F27096

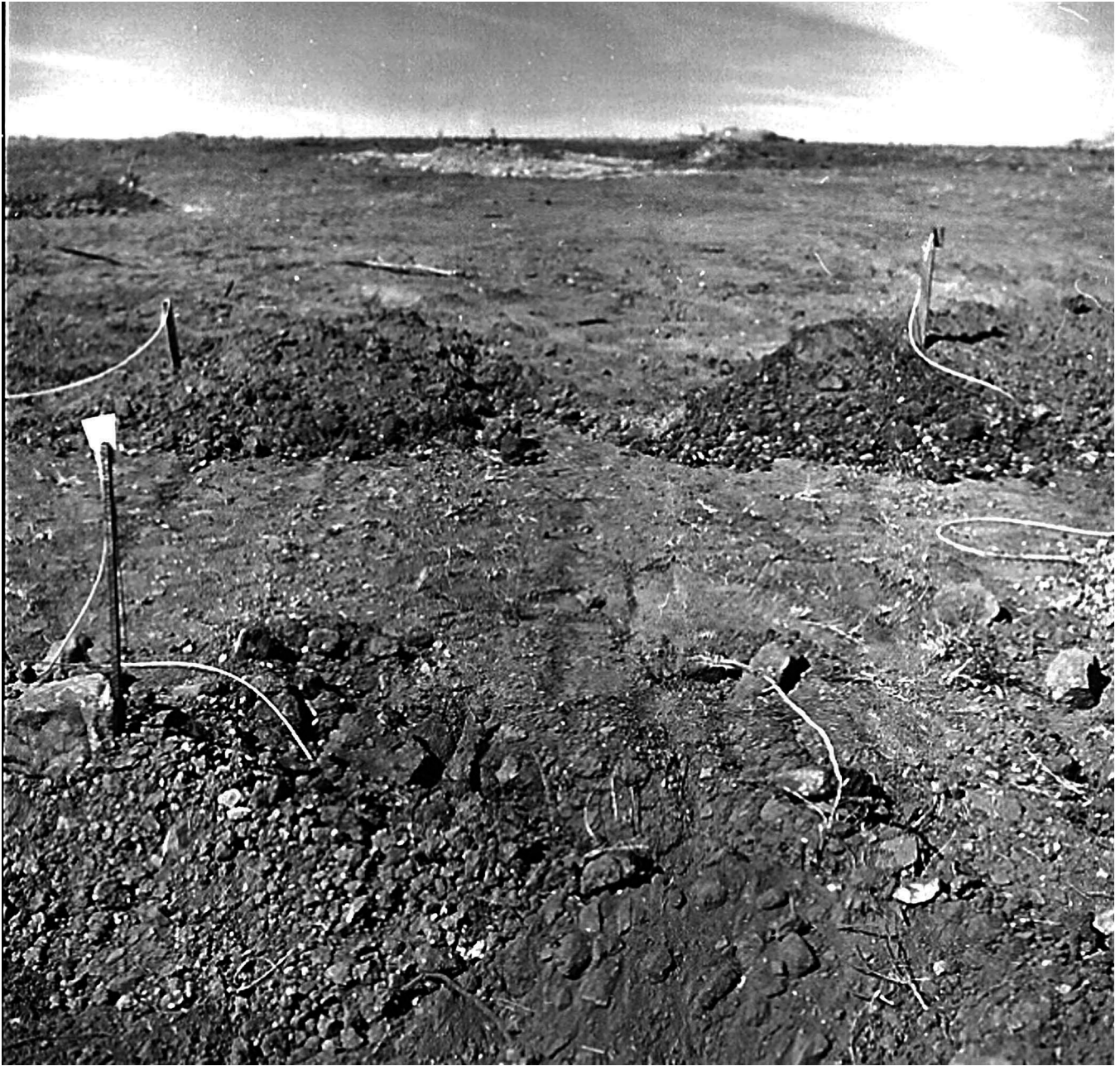
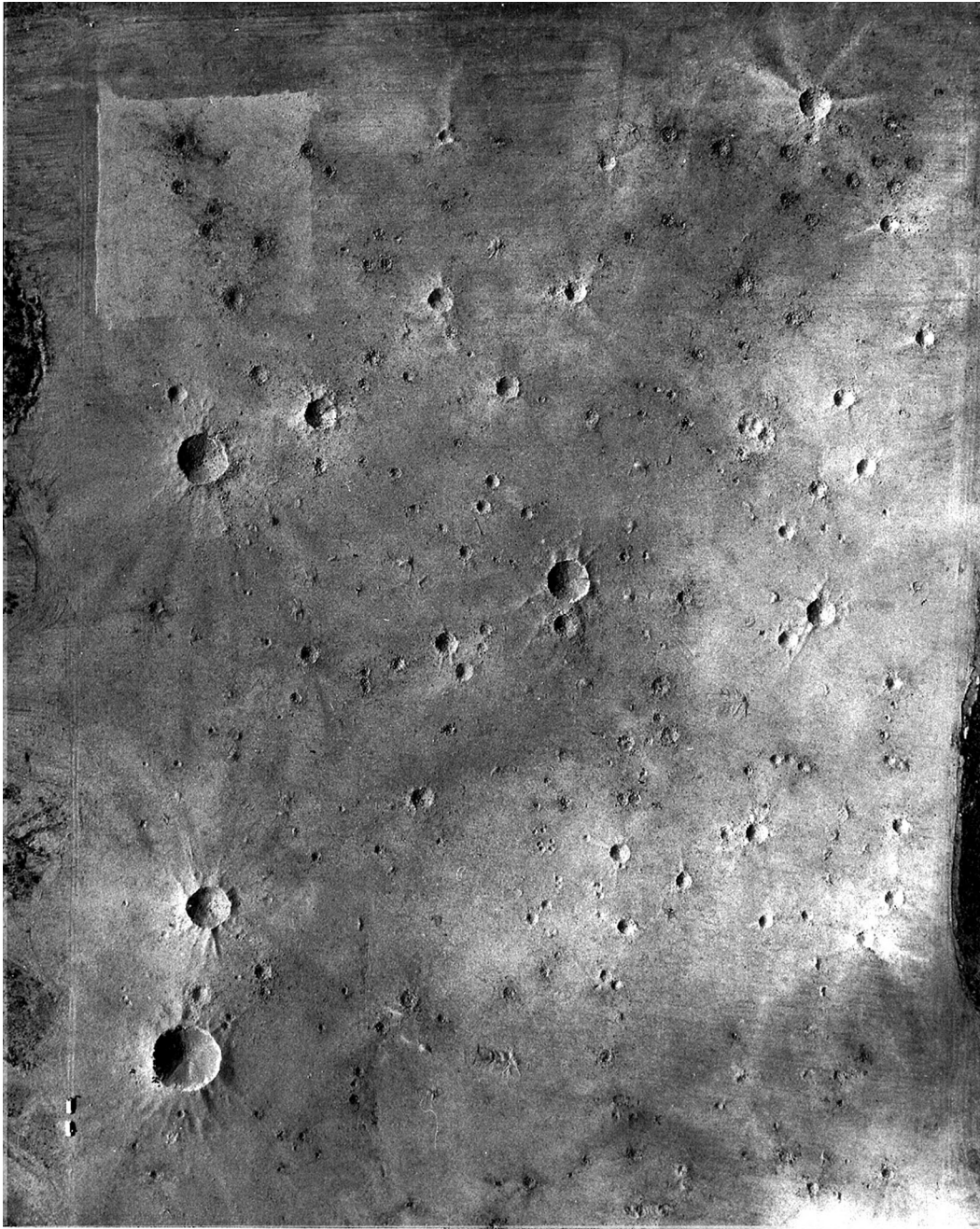


Figure 72-(b) buried charges connected with Primacord prior to final tie off and final shot; USGS photo P965, F27098PR



Figure 72-(c) firing of shot two sequence (out of three) of 52 craters; USGS photo P978, F270185PR



2/11/70 Tucson Post Office

Figure 72-(d) aerial view of the Black Canyon Crater Field after shooting; photo courtesy of Red Bailey.



Figure 73-Apollo 13 field test at the Black Canyon Crater Field, Verde Valley, Arizona on 15-16 March 1970; (a) Professor Lee Silver (Caltech and USGS-back to camera) talking to Apollo 13 astronauts Jim Lovell (left) and Fred Haise; Red Bailey and Walt Roeder in background; P991, F370140PR

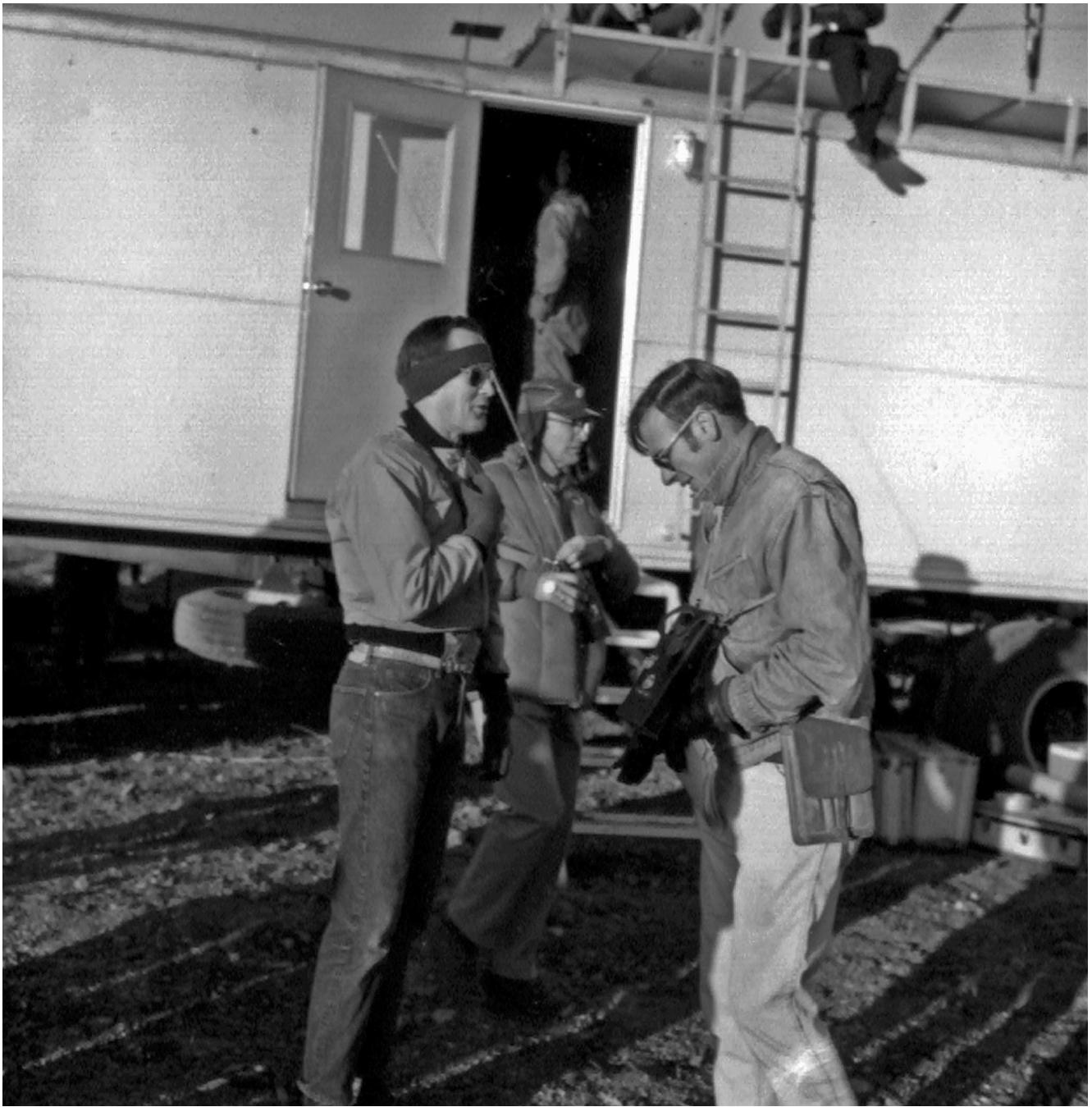


Figure 73-(b) Charles Duke (left) and Dave Roddy (USGS Flagstaff) chatting during break in traverse exercises; USGS photo P991, F370157PR



Figure 73-(c) Charles Duke (left) and John Young (backup Apollo 13 LMP and CDR) with tool carrier; Dave Roddy (right side) taking notes on the crew's progress and efficiency; USGS photo P991, F370164PR.



Figure 74-Marshall Spaceflight Center's 6-wheel Amphicat, all-terrain vehicle used in support of their Astrionics Laboratory during a test of a navigational system at Merriam Crater (northeast of Flagstaff, Arizona) on 19, 23-24 March 1970; (a) Amphicat vehicle with its trailer containing a portable generator and other equipment; USGS photo P998, F370233



Figure 74-(b) side view of Amphicat vehicle without trailer; USGS photo P998, F370241



Figure 74-(c) close up of navigational instrumentation and X-Y plotting board; USGS photo P998, F370237

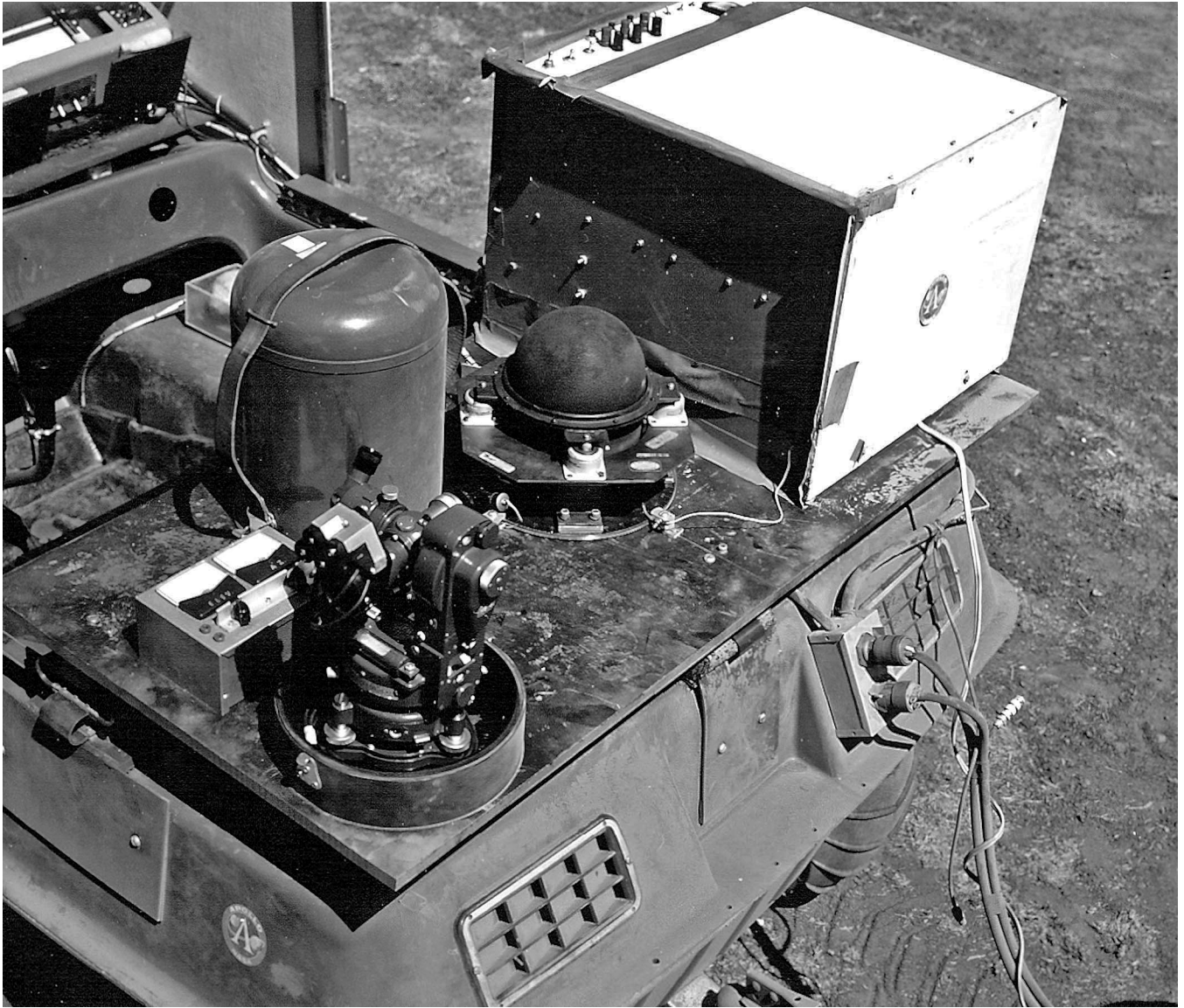


Figure 74-(d) details of gyrocompass and other navigation-system components; USGS photo P998, F370238.



Figure 75-Several phases in the construction of the “Grover” simulated LRV vehicle at the Branch of Surface Planetary Exploration’s vehicle shop at 1720 East Street in the Sunnyside area of east Flagstaff, Arizona; (a) garage facility at 1720 East Street as it appeared in May 2002; photo by G. Schaber



Figure 75-(b)-Putty Mills grinding a part for the Grover; USGS photo P1012 F470107



Figure 75-(c) Putty Mills (welding face mask)) and Dick Wisner welding a part for Grover; USGS photo P1012 F470111



Figure 75-(d) Bill Tinnin (left) and Dick Wiser working on one of the wheel assemblies for Grover; USGS photo P1012 F470106



Figure 75-(e) Grover at the framing stage with batteries for electric wheel motors installed; USGS photo P1012a, F-470112



Figure 75-(f) Grover with seat framing and additional structures added; USGS photo P1012c F470130



Figure 75-(g) East Street (1720 East Street) facility in East Flagstaff with MGL, Explorer and Grover vehicles all in front; also present (to right) is the canvas version of Astrogeology's simulated Apollo LM ascent stage shelter used during field tests; USGS photo P1041, F7702



Figure 76-David Roddy briefing Apollo 15 Commander David Scott and others on the rim viewing platform below the museum at Meteor Crater during a 4-5 June 1970 Apollo 15 trip to the crater; photo, US Atomic Energy Commission.

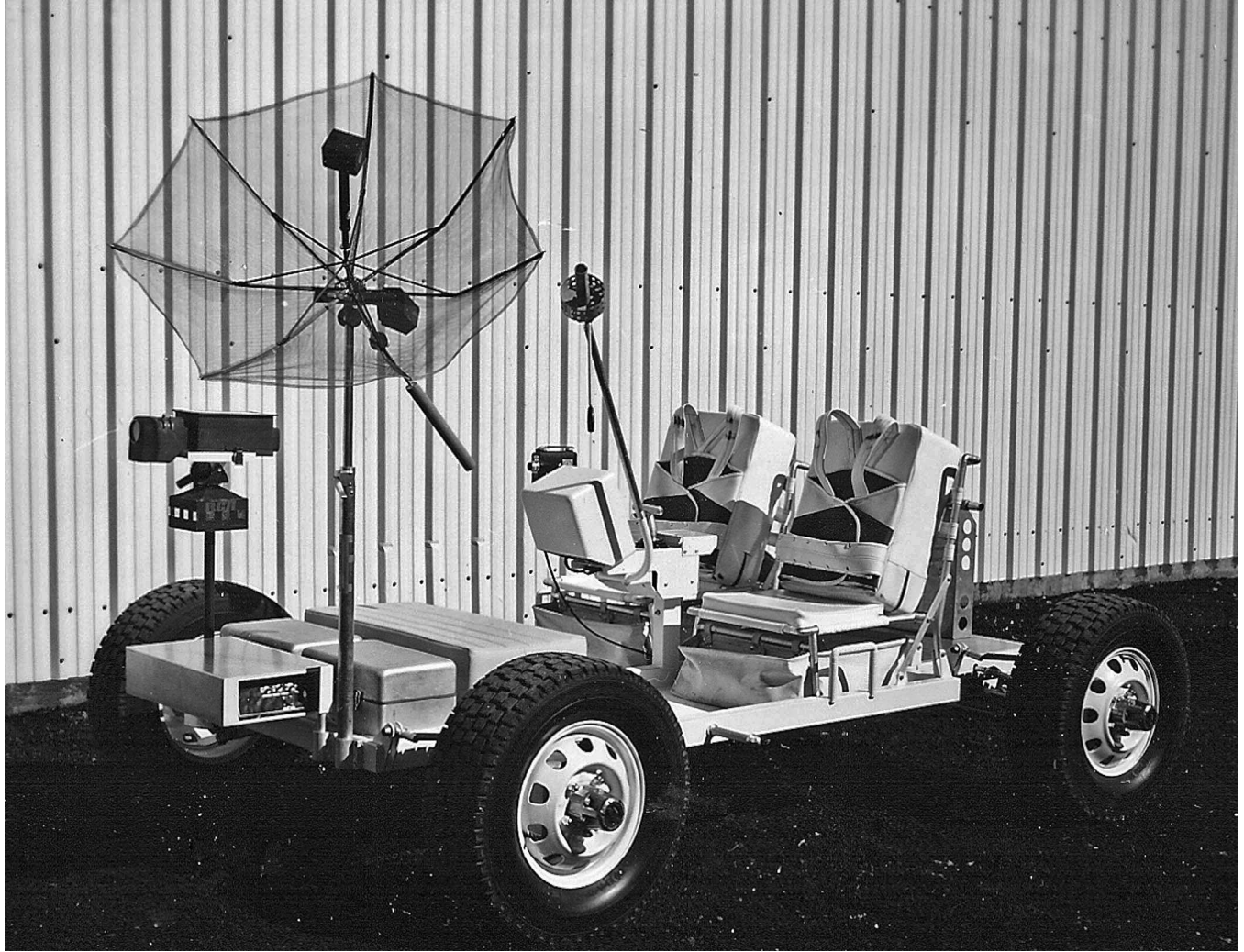


Figure 77-(a) completed Grover LRV field vehicle (late April 1970) at the Branch of Surface Planetary Exploration's Vehicle Field Support facility where it was constructed; left front view; USGS photo P1012f, F470155



Figure 77-(b) completed Grover in right rear view at East Street facility; USGS photo



Figure 77-(c) left side view of completed Grover in front of East Street facility; “Explorer” (Astrogeology’s earlier LRV simulator) shown to right of building; USGS photo (1970)

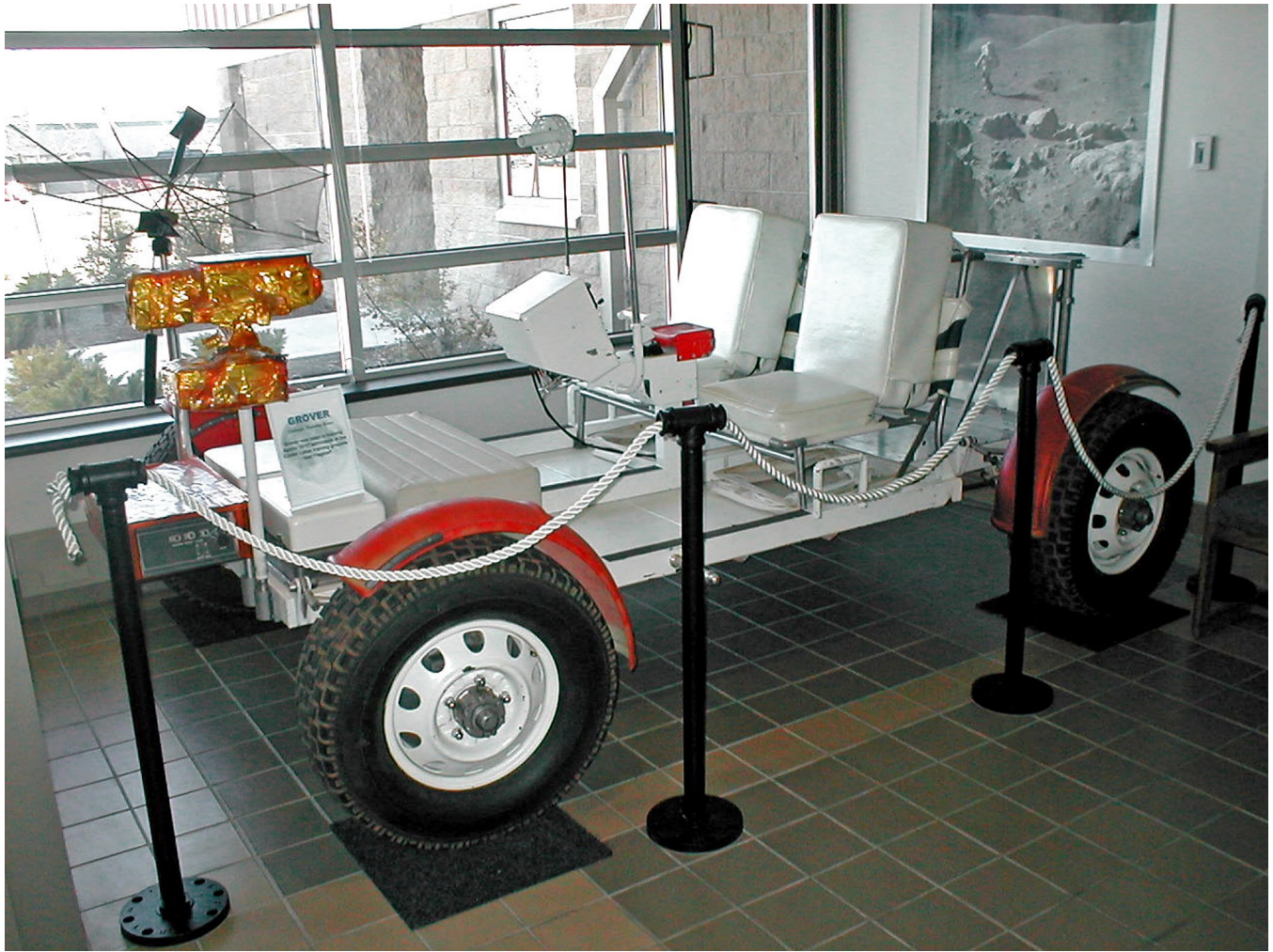


Figure 77-(d) Grover in its current location on display in the Foyer of the new Shoemaker Building constructed at the USGS Flagstaff Field Center, and dedicated 26 September 2002.



Figure 78-The Apollo 16 prime and backup crews were the first to check out the newly-completed Grover vehicle on 2 September 1970 at the Branch of Surface Planetary Exploration's Field Test Support facility on East Street in East Flagstaff, Arizona; (a) (l to r) in background: John Young, Bill Tinnin, and Putty Mills (hand on Grover's console); Charles Duke (sunglasses), Fred Horz (MSC/NASA), unidentified, Anthony "Tony" England. Sitting on Grover is Fred Haise (left) and Gerald Carr (right); USGS photo F97044



Figure 78-(b) Putty Mills (left) describing steering on Grover to Apollo LM Pilot Charles Duke (behind Putty Mills), two unidentified persons (center and right center) and Apollo 16 Commander John Young (on right); USGS photo



Figure 78-(c) Putty Mills (light shirt) showing power supply for electric motors that drive wheel to Charles Duke; USGS photo



Figure 78-(d) Charles Duke (left) and John Young (behind console) testing out Grover; USGS photo

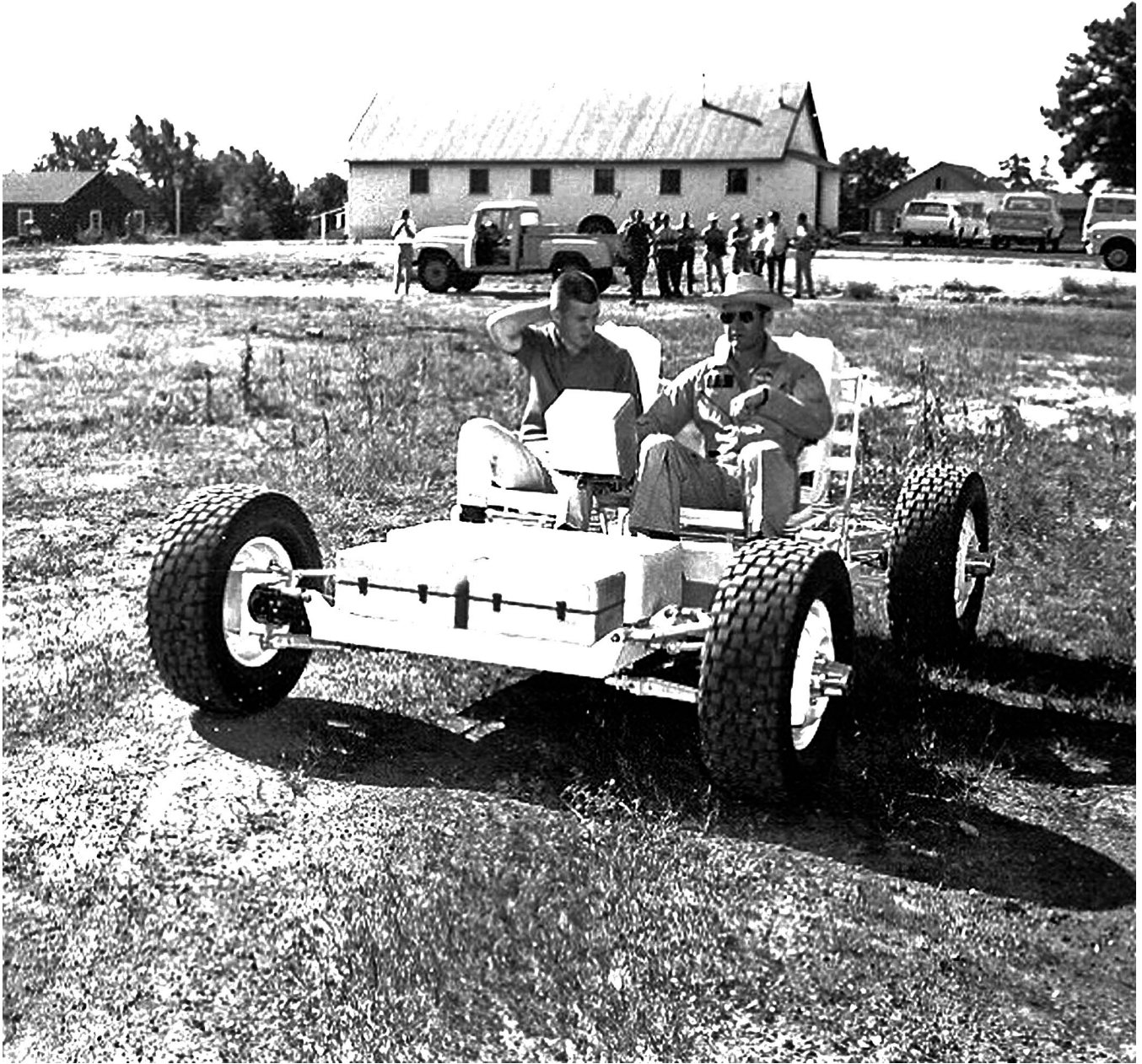


Figure 78-(e) Astronauts Tony England (left) and Fred Haise checking out Grover; USGS photo F97056.



Figure 79-The 360-degree FOV Hycon Camera was tested on Grover at Merriam Crater northeast of Flagstaff in September 1970, supported in the field by personnel of the USGS' SPE Branch in Flagstaff; (a) Hycon camera mounted on the rear deck of Grover; USGS photo



Figure 79-(b) color photograph of Grover at Merriam Crater during test of Hycon Camera system. Putty Mills driving Grover; USGS photo P1087a, F970130c

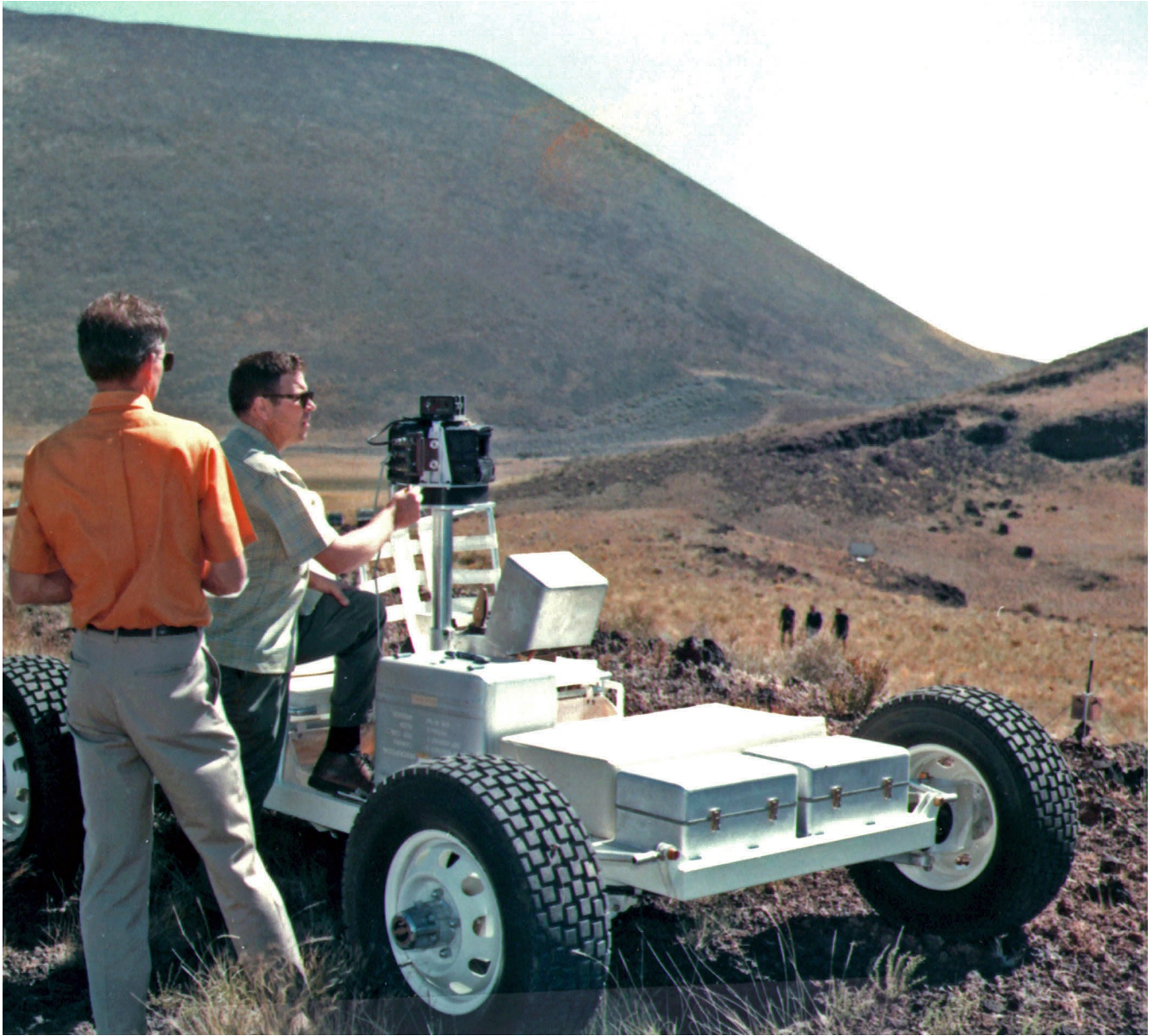


Figure 79-(c) color photograph of Grover at Merriam Crater with Putty Mills (colored shirt) and unidentified person; USGS photo P1087a, F970125c

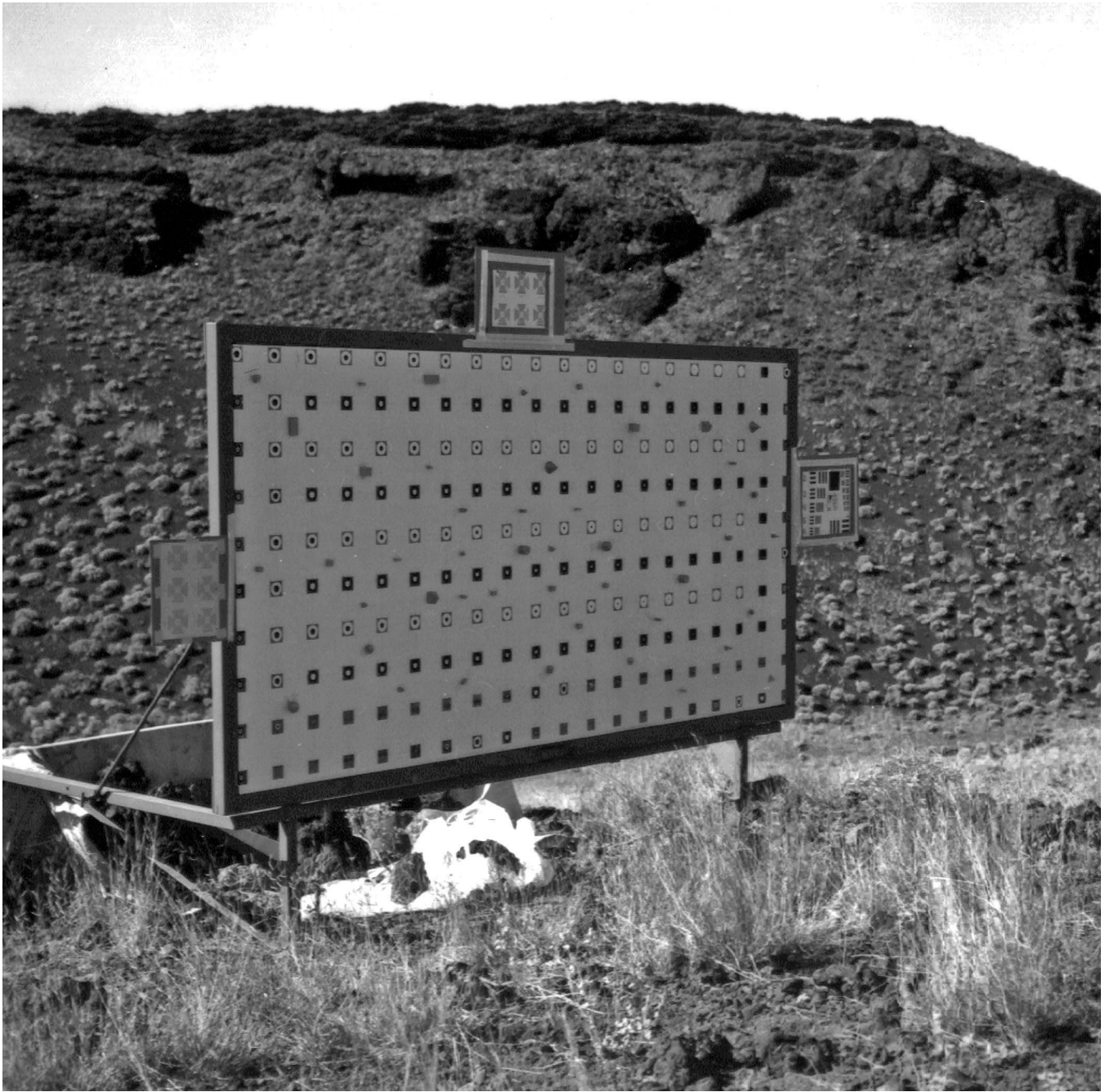


Figure 79-(d) photo-calibration test panel set up during test of Hycon Camera during test; USGS photo P1086b F970115



Figure 79-(e) additional participants and on-lookers supporting in field during Hycon Camera exercise at Merriam Crater; l to r are Jim McCord, unidentified, George Ulrich, Jim Crossan, Ray Jordan, Bill Tinnin, Frank Shafer, two unidentified persons, and Bud Dahl ; USGS photo P1086a F97096.