10.0 LUNAR SURFACE

ARMSTRONG The postplanning checklist went as planned, and venting was initiated in the OX tank almost immediately — even before the point on the timeline called for it.

We ran the OX pressure down to the 40- to 50-psi range and opened the fuel vent and vented it down the same amount. We then closed it off after which time Houston became concerned with tank pressures and asked us to reopen it again, although at the time we were reading relatively low tank pressures. I think the OX built up slightly over 50 at the time, but they were apparently reading a higher value, and I assume perhaps that they had an error in their signal from that tank pressure. In any case, we opened both tanks after that and let them bleed down to about 15 psi, which was probably the stable condition of the vapor pressure in the tank at that point.

ALDRIN After touchdown, we got a GO for T-1 and then we proceeded to enter P68 and recorded the latitude and longitude and altitude. We then proceeded out of that and reset the stopbutton and entered P12 for T-2. At this point, I think that a little shuffling in the data

ALDRIN (CONT'D)

cards might prevent someone from making the same error that I did in loading the tape for ascent. On the data card, we've got the PDI pad, which is referred to somewhat during descent. It has PDI aborts on it with a NO PDI plus 12 abort on the right side. I think that the NO PDI plus 12 abort would be better placed on the back of this altitude card because, once you ignite, you're through with that NO PDI plus 12 abort and you ought to get it out of there. In its place, I think the T-2 abort pad should be on the data card because when I started to load P12 with NOUN 33 (the TIG for this T-2 abort, which is PDI plus 23), I loaded the TIG for the NO PDI plus 12 abort, and the ground caught me on it and said, "You loaded R-2 wrong." Instead of loading 10254 29, I loaded 10244 27. Now, the two are pretty close and they both say TIG NOUN 33. So, I think if we can get that one abort (NO PDI plus 12 abort) out of there and put the other one in its place, it'll save someone from coming up with the same sort of thing.

We got remote control back to ATTITUDE HOLD and AGS, OFF and then cycled the Parker valves again. After having seen the erroneous talkback indications, I was expecting

ALDRIN (CONT'D) that when I put the feeds to close they would indicate open momentarily. The crossfeed was cycled again to close. I turned the camera off and proceeded with the switch configuration. Cycling the CWEA circuit breaker did, in fact, turn off the descent Reg warning lights. We read the sine and cosine out of AGS (and I'm sure they copied that down) and went immediately into recording the AGS gyro coefficients. I'm sure that these were the same numbers that we finished up with, but it might be a good time to check. Then we went to cabin on the regulators and took our helmets and gloves off. Then we started in with the initial gravity alignment. I don't have the first NOUN 04 that we got. I didn't record that one, but it was fairly large. I've seen so many of them in simulation that I just can't recall what that number was.

ARMSTRONG I am sure that it was recorded on the ground.

ALDRIN After the recycle, it was 00001. We asked them about recycling and they said affirmative. Got a star-angle difference of 00015 and some torquing angles, which showed a fairly good change. I guess the pitch is the

ALDRIN (CONT'D)

one you're concerned with. That's about the Y-axis; that was 0.1. I don't know whether the sine of that agrees at all with the approximation of 0.1 that we got in the Sun check. We didn't torque those angles. The ideal was to get a gravity direction and then to do a two-star alignment and look at the torquing angles after the two-star check which would then give an indication as to what the drift had been since the last alignment. The initial gravity alignment, combined with the two-star alignment, would produce a new location of the landing site. Had we landed straight ahead, my intent was to use Rigel in the left detent number 6 and Capella in the right detent. The 13-degree yaw moved Capella out of the right-rear detent, but Rigel was in good shape there. That's the one I used first. I then selected Navi in number 4 detent, the right rear, and that wasn't particularly satisfactory. It was quite dim and it took a good bit longer than I had hoped to get the marks on that. I can't comment particularly on the star-angle difference other than it was a little disappointing in that it was 00009. Torquing angles we have recorded, and we did torque. The latitude and longitude — we'd have to listen to the guidance people as to just what

ALDRIN (CONT'D) that did to our possible touchdown point. It seemed to me, when we finished that, we were just about on schedule, maybe a little bit behind so we proceeded into the option 3 which was gravity plus one star; because Rigel had been so good, I used that one again. The gravity alignment seemed to be quite consistent. The first time we did the gravity alignment on option 3, it came up with 00000, our star-angle difference on the gravity plus one star, which indicates an error in that gravity measurement and star measurement was 00008. I know we had the torquing angle recorded on that also. The azimuth is very large — 0.2 degrees. We received a GO for T-3. In the vicinity of loading times for a T-2 abort, I noticed that the mission timer wasn't working. It was frozen; it just stopped.

ARMSTRONG No, it didn't just stop.

ALDRIN Yes, it had gone to 900 hours.

ARMSTRONG 900 and some hours. I couldn't correlate the minutes and the seconds with any particular previous event.

ALDRIN Yes. 903:34:47. I don't know what time that relates to. Obviously, the 9 digit changed. It might have stopped,

ALDRIN
(CONT'D)

but it was static at that point. We ran through the circuit breakers but couldn't seem to get it moving again. The ground suggested that we turn it off which we did, but when we turned it back on we got all nines. You could change the last digit with the digit sequencer. We turned it off for a while and turned it back on again and it worked after that. We gave them an E memory dump; got a new ascent pad or the CSI pad, for T-3. We then proceeded on with the option 3 alignment. Continuing through the checklist, looking at switch settings, and circuit breaker cards, we found ourselves 10 minutes to go and essentially up on the checklist. At that point, we had to start pressurizing the APS if we were going to launch, so we read through the remainder of the simulated countdown and decided that there wasn't any point in sticking with that timeline any further. So we terminated the simulated countdown and went to the initial powerdown sequence. We had discussed among ourselves the possibility of evaluating, during this first 2 hours, whether we wanted to go on with the rest period that was scheduled or to proceed with the EVA preparation. I think we had concluded before the end of the simulated powerdown that we would like to go ahead

ALDRIN (CONT'D) with the EVA and it was sometime in here that Neil called to ground and let them know that.

ARMSTRONG There were two factors that we thought might influence that decision. One was the spacecraft systems and any abnormalities that we might have that we'd want to work on, and the second was our adaptation to 1/6g and whether we thought more time in 1/6g before starting the EVA would be advantageous or disadvantageous at that point. Basically, my personal feeling was that the adaptation to 1/6g was very rapid and was very pleasant, easy to work in, and I thought at the time that we were ready to go right ahead into the surface work and recommended that.

ALDRIN Now, we estimated EVA at 8 o'clock. I think that was a little optimistic. The ground recognized that, because they said, "Do you mean beginning of PREP or beginning hatch opening?" And all during this time, we could tell that Mike was kept busy each pass, doing P22's trying to find where we were.

10.8 HORIZON, SIGHTING, APPEARANCE

ARMSTRONG The things that seem worthy of comment here are observations from the window prior to lunar surface work. We were in a relatively smooth area covered with craters varying from up to perhaps 100 feet in the near vicinity down to less than a foot, with density inversely proportional to the size of the crater. The smaller they were, the more there were of them. The ground mass was very fine silt, and there were a lot of rocks of all sizes, angularities, and types in the area. Our immediate area was relatively free of large rocks. Several hundred feet to our right there was a significant boulder field, an array of boulders, essentially, that had many boulders greater than 1 or 2 feet in size. We never were able to get into that area to look at those rocks in detail.

ALDRIN Distances are deceiving. When we looked at this fairly large boulder field off to the right, it didn't look very far away at all before we went out. Of course, once we got out, we wandered as far as seemed appropriate. Of course, we never came close to this particular field. What really impressed me was the difference in distances. After we were back in again looking out at the flag, the

ALDRIN (CONT'D) television, and the experiments, they looked as though they were right outside the window. In fact, on the surface, we had moved them a reasonable distance away.

So I think distance judgment is not too good on first setting down. The tendency is to think that things are a good bit closer than they actually are. This says they are probably a good bit larger than what we might have initially estimated.

10.10 COLORS AND SHADING OF LUNAR SURFACE FEATURES

ARMSTRONG Probably the most surprising thing to me, even though I guess we suspected a certain amount of this, was the light and color observations of the surface. The down-Sun area was extremely bright. It appeared to be a light tan in color, and you could see into the washout region reasonably well. Detail was obscured somewhat by the washout, but not badly. As you proceeded back toward cross-Sun, brightness diminished, and the color started to fade, and it began to be more gray. As we looked back as far as we could from the LM windows, the color on the surface was actually a darker gray. I'd say not completely without color, but most of the tan

ARMSTRONG (CONT'D) had disappeared as we got back into that area, and we were looking at relatively dark gray. In the shadow, it was very dark. We could see into the shadows, but it was difficult.

ALDRIN We could see very small gradations in color that were the result of very small topographical changes.

ARMSTRONG Of course, when we actually looked at the material, particularly the silt, up close it did, in fact, turn out to be sort of charcoal gray or the color of a graded lead pencil. When you're actually faced with trying to interpret this kind of color and that light reflectivity, it is amazing.

ALDRIN When illuminated, it did have a gray appearance, very light gray.

ARMSTRONG Wouldn't you say it is something like the color of that wall? It isn't very far away from what it looked like. Yet when you look at it close, it's a very peculiar phenomenon.

10.15 PREPARATION FOR EGRESS

ARMSTRONG Now, a preliminary comment has to do with the longer time that it took than during our simulations. It is

ARMSTRONG (CONT'D)

attributable to the fact that when you do simulations of EVA PREP you have a clean cockpit and you have all the things that you're going to use there in the cockpit with you and nothing else. In reality, you have a lot of checklists, data, food packages, stowage places filled with odds and ends, binoculars, stop watches, and assorted things, each of which you feel obliged to evaluate as to whether its stowage position is satisfactory for EVA and whether you might want to change anything from the preflight plans. For example, our mission timer was out, and we decided we had better leave one wristwatch inside in case it got damaged. We would have at least one working watch to back up the mission timer or to use in place of the mission timer, in case we could not get it going again.

All these items took a little bit of time, a little bit of discussion, which never showed up in any of our EVA PREP's on the ground, really accounted for the better part of an hour of additional time. Our view of EVA PREP was that we were not trying to meet a time schedule. We were just trying to do each item and do it right sequentially and not worry about the time. Well, the

ARMSTRONG (CONT'D) result was, a lot of additional time used there. I don't think that's wrong. I just think in future planning you are probably better off adding time for these kinds of things.

ALDRIN No matter how many times you run through an EVA PREP, to the best of the instructor's ability to put things in a logical sequence, when you're faced with doing these things, there is a natural tendency to deviate somewhat from the printed sequence that you have. It's a rather complex operation. Nobody writes a checklist to tell you in the morning when you get up all the sequences you go through to put your clothes on, brush your teeth, shave, and all that. If you had one setting there, you wouldn't follow it the same every day. You would make small deviations just based upon what seems appropriate at that time. It is a very difficult thing to build a checklist for.

ARMSTRONG We shouldn't imply that the EVA preparation checklist wasn't good and adequate. We did, in fact, follow it pretty much to the letter just the way we had done during training exercises. That is, the hook ups, and where we put the equipment, and the checks were done

ARMSTRONG (CONT'D) precisely as per our checklist. And it was very good. I don't have any complaints about that at all. It's these other little things that you don't think about and didn't consider that took more time than we thought.

There was one control on the PLSS that surprised us. I don't know if it was different from the trainers or the flight PLSS's at the time we were looking at them or not, but there was a press-to-test knob of some sort that neither one of us could correctly identify as to function. At this time, we aren't really quite sure what it does.

ALDRIN It was a thumb depress button that seemed to go in somewhere as if it was relieving some pressure from something. I can't remember ever having seen that before. It protruded out toward your back and looked as if it might come fairly close to riding on the back of the suit.

ARMSTRONG We both thought we knew the EMU very well and knew every function and how it operated. But it turned out we were wrong. It was something that we hadn't learned there,

ARMSTRONG (CONT'D) and if it had been there before, somehow it escaped us. It took a little time to discuss that, and we proceeded.

ALDRIN Mounting the 16-mm camera and the two universal brackets, one of the mirror mount and the other on the crash bar, went pretty much the way we had planned it to go. The two brackets with the enlarged knobs helped out tremendously in that I was able to tighten them down to a much greater degree than I had any of the training models. It gave me much greater confidence that the cameras would stay where I placed them and that there would be no problem with any camera banging into the window when we didn't want it to. The RCU camera brackets were difficult to tighten down. By tightening just as hard as we could, there was still a little bit of play in both of them. I think an improvement in that knob would be quite advantageous, so that it could be cinched down a little tighter. Perhaps the kind of knob that has edges that stick out so that you can get much higher torque on it would be a good thing to use.

ARMSTRONG I think all the remainder of the EVA PREP went as per checklist.

10.17 PLSS AND OPS PREPARATION AND DONNING

ALDRIN The heaters tested out. Both lights came on, pressures regulated at very close to 3.7. Then when it came time to unstow the hoses, the pressures had dropped down to just about zero.

ARMSTRONG Yes. They were below 25.

ALDRIN Overshoes went on quite easily. We put the antifog on as soon as we got the kit out instead of waiting until a little bit later. I think that maybe there were two things that brought that about. One was that we weren't really sure it was going to appear later in the checklist, and we wanted to make sure we had that. The other was, in training, we wanted to avoid as many activities as we could with the PLSS on our back because it was very uncomfortable doing any additional exercises in one g. We did find, however, that it was quite comfortable, even without the shoulder pads, to have the PLSS mounted on your back. The mass of it was not at all objectionable. It did require moving around methodically and very slowly to avoid banging into things — no getting around it. You just couldn't always tell what the back of the PLSS or the OPS might be in contact with at any particular time.

ARMSTRONG As was reported, we broke one circuit breaker with the PLSS and we depressed two others, one on each side, sometime during the operation with the PLSS on the back. So that's an area that we still need to improve on to be able to have confidence that the integrity of the LM itself won't be jeopardized by the operation with the PLSS on the back.

ALDRIN We had problems with this one particular electrical connector, the one that joins the RCU to the PLSS, ever since the first time we'd ever seen it.

ARMSTRONG It's about a 50-pin Bendix connector.

ALDRIN It's just very difficult to get the thing positioned properly so that the three pins on the outside, the three little protuberances, will engage in the ramp so that, when you then twist, it'll cinch on in. That must have taken at least 10 minutes. The problem was not with mine, but in hooking up Neil's. I can't say that there was that much difference in the many times that I tried it unsuccessfully and the one time it did go in correctly. It appeared to be squared away each time.

ARMSTRONG This is not because we didn't understand the problem. We had had trouble with that connector for 2 years or more. We'd always complained about it. It had never been redesigned, and it was usually ascribed to the fact that all the training models were old and gouged, and so on. But when we looked at the flight units during CCFF on the EMU, it turned out that they were still difficult. We accepted the fact that by being very careful with that connector we could, in fact, connect and disconnect it satisfactorily. We did that in the lab at the Cape. We had a little bit of difficulty with it there. When we got on the lunar surface, it was the same problem. It took us at least 10 minutes each to mate those connectors. It's the big electrical cable from the RCU to the PLSS. It attaches at the PLSS end. It's our recommendation that it's a sufficiently serious problem that we can't afford to jeopardize the success of an EVA on that connector. And that's right now what we're betting. It began to look like we never would get those connectors made on the surface. We just have to improve that.

ALDRIN Connecting up the straps went quite smoothly. The initial COMM check out on the audio panel and the various communications checks that we made in the FM mode all

ALDRIN (CONT'D) seemed to go quite well, until we started switching the PLSS modes. For a while, we ascribed some of the difficulty perhaps to the antenna being stowed. So we unstowed Neil's, and that didn't help immediately. A little later, it seemed to help out, but then we got back into about the same problem, so I stowed his antenna. There didn't seem to be any particular rhyme or reason to when we did appear to have good COMM and when we didn't.

ARMSTRONG It suffices to say that we never did understand what was required to enable good COMM while we were inside the cockpit, relaying through the PLSS's. We had it part of the time, and we didn't part of the time. We tried a lot of various options, and they just weren't universally successful. But we were able to have adequate COMM to enable us to continue. I think, once outside, we really didn't have any appreciable COMM problems at all. It seemed to work well.

10.20 DEPRESSURIZATION

ARMSTRONG This was one area of flight preparation that was never completely performed on the ground. In the chamber, the PLSS's were left on the engine cover and we never put them on our backs because of their weight, and the

ARMSTRONG (CONT'D)

possibility of jeopardizing the integrity of the LM. So the COMM was operated, and the connections were made, but the depressurization sequence with the PLSS's on the backs was never completed. The times when we actually operated the PLSS was done always in the chamber and never done with the LM systems operable.

So two things were new to us. One was that it took a very long time to depressurize the LM through the bacteria filter with the PLSS adding gases to the cockpit environment and the water boiler operation or something adding some cabin pressure. The second was that we weren't familiar with how long it would take to start a sublimator in this condition. It seemed to take a very long time to get through this sequence of getting the cabin pressure down to the point where we could open the hatch, getting the water turned on in the PLSS, getting the ice cake to form on the sublimator, and getting the water alarm flag to clear so that we could continue. It seemed like it took us about a half hour to get through this depressurization sequence. And it was one that we had never duplicated on the ground. Well, in retrospect, it all seemed to work okay, it was just that we weren't used to spending all that time standing around waiting.

10.21 OPENING OF HATCH

ALDRIN Well, there's a step verifying PGA pressure above 4.5, and decaying slowly. And it did that. It decayed slowly, and the cabin stayed at around 1 psi. We had to get that down before we could open the hatch, it appeared to me. We were just waiting there between those steps of PGA pressure and cabin pressure coming down, and opening the hatch. And we didn't really want to go and open the overhead hatch. We like to open only one of them, and leave the other one the way it's been. When the hatch was finally opened, it took an initial tug on it, and it appeared to bend. The whole hatch as it opened on the far side came toward me. As soon as it broke the seal, it appeared as though I could see some small particles rushing out. Then, of course, the hatch came open and gave us a more complete vacuum. Then we went to opening the water. It seems to me that, if there is that delay to get rid of the pressure, maybe one could go ahead and open up the water ahead of time before you actually get it down to the point where the hatch is open. Maybe that would compound the problem. Once the water window did clear, it seemed that the cooling was noticeable almost immediately.

10.22 FINAL SYSTEMS STATUS

ARMSTRONG The final system status was without problems.

10.23 LM EGRESS

ARMSTRONG I guess the most important thing here with respect to the egress through the hatch and the work on the ladder and the platform is that our simulation work in both the tank and in the airplane was a reasonably accurate simulation. They were adequate to learn to do the job and we didn't have any big surprises in that area. The things that we'd learned about body positioning, arching the back, clearances required, and one person helping another and so on worked just like the real case. There weren't any difficulties in movement through the hatch or with stability on the porch.

After getting onto the porch, I came back into the LM and went up around the Z-27 corner, made sure that was as expected and it was. I returned to the porch, got on the ladder, discarded our duffle bag with arm rest and OPS pallets, released the MESA without any difficulty, and descended the ladder just as expected. The first step was pretty high; 3 to 3 1/2 feet. So the initial test

ARMSTRONG (CONT'D) was to see if we would have any trouble getting back on the first step. There were no difficulties, so we proceeded with the planned activities. The work and effort required to go up and down the ladder and in through the hatch are not objectionable enough that they need be worried about. Going up the ladder and going through the hatch are not high-workload items. They are items that require some caution and practice. I had it a good bit easier than Buzz did because he had to go through the hatch and around the corner by himself.

ALDRIN Once I had my feet and posterior out the hatch, Neil was in good position, as good as I was to help me move out, by just observing the profile of the PLSS as it matched with the hatch opening.

ARMSTRONG The two-man operation is good because all the help that each man can give the other one is money in the bank.

ALDRIN I think the first man moving out has a little bit more difficulty because the second man has to be back behind the hatch and has to try to move it out of the way. So you have the tendency to be more over to your side away from the hatch and anything you are contacting was

ALDRIN (CONT'D) usually on your side, your edge of the lower part of the DSKY table.

ARMSTRONG There weren't any temperature effects noted in the egress or ladder. Nothing felt hot or cold or had any temperature effects at all that I was aware of.

ALDRIN The platform itself afforded a more-than-adequate position to transition from going out the hatch to getting on the ladder. The initial step is a little bit difficult to see. When I got to the first one, I was glad to have you tell me about where my feet were relative to that first step so that I didn't have to make a conscious effort to look around to the side or underneath. What I am getting at is that operations on the platform can be carried out without concern about losing your balance and falling off. There is plenty of area up there to stand on the step and do any manipulating that might be required. There are alternate ways of bringing things up, other than by the LEC. I think there is promise of being able to bring things up over the side; straight up, versus making use of the LEC. We didn't have the opportunity to exercise those.

ALDRIN (CONT'D) In gravity fields, I would have come up with something closer to one-tenth, just by judging the difference in weight and feel of things in the way the masses behaved one to six. In the behavior of objects, it gives you the impression that there is a much greater difference. In my maneuvering, there didn't seem to be anything like a factor of 6 difference. It would appear as though the gravity difference was much less. What I'm saying is that it seems the human can adapt himself to this quite easily. It also appears that objects can be handled easier in 1/6g than we had anticipated. In maneuvering the objects around, they do have a certain mass. When they get going in a direction, they will keep going that way. This was evidenced when the objects were coming in the hatch on the LEC; they were fairly easy to manage, but you had to take your time in handling them.

10.24 ADEQUACY OF HARDWARE AND PROCEDURES

ALDRIN The initial LEC operation of lowering the camera seemed to work fairly well. It appeared as though you might have been pulling on the wrong strap at first; however, we rectified that without any particular trouble.

ARMSTRONG Initially, I had a bit of difficulty. I was not trying to get the camera up or down at that point; I was trying to pull the slack out of the line and make both straps taut. For some reason or other, it was hung up, and I had some difficulty getting the slack out of the lines. Once having done that, it came down very nicely. Here we changed the flight plan somewhat and got the camera down before doing the contingency sample. I wanted to get that camera down and hooked up while I was over there in the shadow, because to do the contingency sample, I was going to have to stow the LEC and go over into the area out of the shadow. Since I wanted to do it on the right side where the camera was mounted, I was going to have to make a trip of about 10 or 15 feet before I started the contingency sample. That's the reason we changed the order.

The operation of the suit, in general, was very pleasant. There was very little hindrance to mobility, with the exception of going down to the surface to pick things up with your hands which was a very difficult thing to do. As far as walking around and getting from one place to another, the suit offered very little impediment to that kind of progress. It was, in general, a pleasant operation.

ARMSTRONG (CONT'D) Thermal loads in the suit were not bad at all; I ran on minimum flow almost the entire time. Buzz found a higher flow to be desirable. This was consistent with our individual preflight experience. I didn't notice any temperature thermal differences in and out of the shadow. There were significant light differences and visibility changes but no thermal differences. The only temperature problem I had (and Buzz didn't have this problem) was with the gloves. I did not wear inner gloves. I chose to go without the inner liners in the gloves, and my hands were a little warm and very wet all the time. They got very damp and clammy inside the gloves. I found that this problem degraded my ability to handle objects and to get firm grips on things.

ALDRIN I had cooler levels set on the diverter valve, because it just seemed to be comfortably pleasant that way. In retrospect, it appears that this leads toward a higher consumption of water. I wasn't fully aware that when you are on higher flow, you are going to be pumping more water overboard. It was not clear to me preflight that it did have that effect on your water consumption. I certainly could have operated at lower levels much sooner without

ALDRIN (CONT'D) overheating. In confirmation of Neil's findings, I didn't experience any hot or even warm spots in the suit. I didn't wear any inner gloves, either, in my desire to get a better feel through the gloves. During the donning, I did not have the wristlets on. I thought that the LCG extending down far enough into the wrist would be adequate. If I had to repeat this effort, I would put the wristlets on, because once I was in the gloves and I started moving them around, I did find that it was rubbing a small amount on the wrist. I thought that it might get to be more annoying than it actually turned out to be, but looking back, I would have preferred having those wristlets on.

10.25 ENVIRONMENTAL FAMILIARIZATION

ARMSTRONG With respect to work on the surface, the 1/6 gravity was, in general, a pleasant environment in which to work, and the adaptation to movement was not difficult. I felt it was quite natural. Buzz had the opportunity to look at more detailed aspects of it, a good bit more than I did, but, in general, we can say it was not difficult to work and accomplish tasks. I think certain exposure to 1/6g in training is worthwhile, but I don't

ARMSTRONG (CONT'D) think it needs to be pursued exhaustively in light of the ease of adaptation.

ALDRIN Moving around is very natural. Some attention must be paid to the mass that you have in the suit and also to the mass of the PLSS that is on your back. I think we anticipated this adequately, and the fact that we did have a sizable mass mounted to the rear was not detrimental to moving around.

10.26 WALKING

ARMSTRONG Buzz did more in that area than I did. I would say that balance was not difficult; however, I did some fairly high jumps and found that there was a tendency to tip over backward on a high jump. One time I came close to falling and decided that was enough of that.

ALDRIN There is no doubt that it was much easier to reach that neutral point by just leaning back slightly than it was leaning forward. I think the happy medium was to lean forward more than we did. It was more comfortable for us to stand erect than to lean forward to be at that absolute neutral point. The pogo tends to give you the impression that most of your moving around will be the

ALDRIN (CONT'D) result of toe pressures — that you will rock up on your toes and tend to push off. I did not really find this to be the case as much as I had anticipated. The 1/6g airplane is a very poor simulation of the lunar surface. There is excellent traction in the airplane, so you can't relate too much as to how the foot departs or what sort of resistance you need when you put your foot back down again. I didn't find that there was much of a slipping tendency on the surface in trying to put in sideways motions or stopping motions. It was quite natural as you began to apply a force to make a change in your momentum. I think you were able to tell just how much you could put in before you would approach any instability case. In general, it would take a couple of steps to make a good sideways change in motion and it would take two or three steps to come comfortably to a stable stationary position from a fairly rapid forward movement. To get a sustained pace evaluation, I would have had to have gone a good bit farther than I did. Before the flight, I felt that you might be able to sustain a fairly rapid pace comfortably. My impression now is that this was a little tiring on the legs. There was a rubbing in the suit somewhere in the knee joints and you had to keep

ALDRIN (CONT'D) moving the knees, even though they are very mobile in the suit. I felt that, as easy as things looked, a 1-mile trek was not going to be an easy thing. Just by having to move your muscles and your body in the suit, you would end up getting tired on any prolonged trek. Because the terrain varies a good bit relative to your ability to move over it, you always have to be alert to what is coming up next. On earth you only worry about one or two steps ahead; on the moon, you have to keep a good eye out four or five steps ahead. I think the one foot in front of another is a much better mode of locomotion than the more stilted kangaroo hop. You can do it, but it doesn't seem to offer any particular advantage. When your feet are on the surface, you can do fairly vigorous sideways movements such as leaning and swinging your arms without a tendency to bounce yourself up off the surface and lose your traction. This was one experiment that was suggested and I found that you do tend to remain well-rooted on the surface where you are, despite motions that you may have. I guess the best thing in carrying this further is to answer the questions that people may have about certain specifics.

ARMSTRONG I went the farthest. While Buzz was returning from the EASEP, I went back to a big crater behind us. It was a

ARMSTRONG (CONT'D) crater that I'd estimate to be 70 or 80 feet in diameter and 15 or 20 feet deep. I went back to take some pictures of that; it was between 200 and 300 feet from the LM. I ran there and ran back because I didn't want to spend much time doing that, but it was no trouble to make that kind of a trek - a couple of hundred feet or so. It just took a few minutes to lope back there, take those pictures, and then come back.

ALDRIN I don't think there is such a thing as running. It's a lope and it's very hard to just walk. You break into this lope very soon as you begin to speed up.

ARMSTRONG I can best describe a lope as having both feet off the ground at the same time, as opposed to walking where you have one foot on the ground at all times. In loping, you leave the ground with both feet and come down with one foot in a normal running fashion. It's not like an earth run here, because you are taking advantage of the low gravity.

ALDRIN The difference there is that in a run, you think in terms of moving your feet rapidly to move fast, and you can't

ALDRIN (CONT'D) move your feet any more rapidly than the next time you come in contact with the surface. In general, you have to wait for that to occur.

ARMSTRONG And you are waiting to come down. So the foot motion is actually fairly slow, but both feet are off the ground simultaneously. You can cover ground pretty well that way. It was fairly comfortable, but at the end of this trip, going out there and back, I was already feeling like I wanted to stop and rest a little. After about 500 feet of this loping with a 1-minute stop out there in the middle to take pictures, I was ready to slow down and rest. There were a lot of interesting areas within 500 feet or so to go and look at if we had had the time. It would have been interesting to take that time and go out and inspect them closely and get some pictures, but that was a luxury we didn't have.

ALDRIN There were so many of them; it is the sort of thing you just cannot anticipate before flight. You can plan to some degree when you are on the surface, but until you get out and look around, you can't make your final decision as to what you are really going to do. Inside, you are only looking at perhaps 60 percent of the available panorama.

ALDRIN (CONT'D) We were supposedly in a nondescript area, but there was far more to investigate than we could ever hope to cover. We didn't even scratch the surface.

ARMSTRONG I'll be interested in getting the pictures back and looking at them. I think you'll find that even though it is not a terribly rough area - it is basically a smooth area - operating around in any type of a vehicle is going to take some planning. The Moon has fairly steep slopes, deep holes, ridges, et cetera. I am sure that we can devise things that will do that, but it isn't going to be just any vehicle that will cover that kind of ground.

ALDRIN It will be interesting to see just how soon you depart from the walking-return concept. I don't think you can stretch that too far. I wouldn't guess as to what that distance is; you could give some reasonable distance you could return on foot, but it isn't miles. When you talk about miles, you are talking about being out of sight of the LM.

ARMSTRONG Another area that is not listed here is the stereo camera. I would like to make a couple of comments about that. The stereo camera worked fine. We had no problems with

ARMSTRONG (CONT'D) it; however, it was hard to operate. I found that the angle that I had to put my hand on the handle to pull it and the force that it took was excessive.

ALDRIN The squeezing of the trigger?

ARMSTRONG Yes. I found my hand getting tired very soon while taking pictures with that camera. It was wearing out my grip.

ALDRIN Would you say that the angle was too horizontal?

ARMSTRONG Yes.

ALDRIN You would like to have had it sloped down more towards you.

ARMSTRONG Yes. It was requiring the wrist to be cocked down.

ALDRIN The initial opening up or deploying of it went quite smoothly. The extension of the handle and the opening up of the case was quite well engineered. Separating the cover, taking it off, cutting the film, and removing the cassette also went quite smoothly. I think that the big area for reengineering might be just a change in the angle the handle comes out. We might have to add a hinge or something like that to it. What about the height of the handle? That would probably not be too bad.

ARMSTRONG I think that probably was reasonable. The other problem we had with the camera was that it was falling over all the time. I think this was the result of a little bit of difficulty in figuring out the local vertical.

ALDRIN Yes.

ARMSTRONG You'd set it down and think it was level, but apparently it wasn't, because the next time you looked it would be laying over on its side. Or you would bump it inadvertently while you were looking somewhere else and knock it over. I picked it up three different times off the surface and it's a major effort to get down to the surface to pick the thing up.

ALDRIN How'd you do that? By going down on the knee?

ARMSTRONG On one occasion I got it with the knee, one time I got it with the tongs, and the last time I had something else in my hand like a scoop or something that I could lean on and go down and get it.

In general, there were a lot of times that I wanted to get down closer to the surface for one reason or another. I wanted to get my hand down to the surface to pick up

ARMSTRONG (CONT'D) something. This was one thing that restricted us more than we'd like. We really didn't have complete clearance to go put our knees on the surface any time we wanted. We thought the suit was qualified to do that in an emergency, but it wasn't planned as a normal operation. We didn't let ourselves settle to our knees a lot of times to get our hand on the surface. Now I think that is one thing that should be done more on future flights. We should clear that suit so that you could go down to your knees, and we should work more on being able to do things on the surface with your hands. That will make our time a lot more productive, and we will be less concerned about little inadvertent things that happen.

ALDRIN Now we can say we have the confidence to know that we could get back up from the surface. You might have to put your hand down into all this. The thing that discouraged me was the powdery nature of the surface and the way that it adhered to everything. I didn't see any real need in getting down. I had no concern about doing it. But I agree. I think if we need something on the suit to qualify it to do this, then we ought to go ahead and do that. If it doesn't, if it just

ALDRIN (CONT'D) requires looking at the suits that we brought back and saying that they're qualified for kneeling, we ought to do that.

ARMSTRONG If you have a grip on something like a scoop, or a stick to hold on, then there's no problem at all in getting back up. You can go right down and just push on your hand and push yourself right back up. It was easy the time I did it with the scoop in my hand. That's one thing that we hadn't done a lot in our simulations, and it would be a help, I think. Let's go on with ingress.

10.35 PHOTOGRAPHY

ARMSTRONG Photography through the Hasselblads on the RCU mounts was satisfactory. I did have some trouble installing the camera on the RCU mount. The opening to the slot as you first put the tongue in the groove was binding a bit, and I always had difficulty getting it started. I'd never observed that problem on the ground, and I can't account for it.

ALDRIN I took the first panorama out in front without having the camera mounted on the RCU, and it did not appear to be unnatural to do so. It's much easier to operate with

ALDRIN (CONT'D) it mounted; however, I didn't find that the weight of the camera was as much a hindrance to operation as preflight simulations indicated it would be. There is no doubt that having the mount frees you to operate both hands on other tasks. The handle is adequate to perform the job of pointing the camera. I don't think we took as many inadvertent pictures as some preflight simulations would have indicated. It seems as though, in all the simulations where we picked up the camera, we always managed to take pictures. I don't think that was the case in this mission as much as we thought it was going to be. We'll know if a number of the pictures taken are pointed at odd angles.

10.36 SWC DEPLOYMENT

ALDRIN I found that the shaft extended and locked back into position very easily. It folded out, deployed, and unrolled. I was able to hook it in the bottom catch without any undue shifting around. In putting it in the ground, it went down about 4 or 5 inches. It wasn't quite as stable as I would have liked it to have been, but it was adequate to hold it in a vertical position. I could make the adjustments so that it was perpendicular

ALDRIN (CONT'D) to the Sun. The shadow that was cast by the solar wind aborted a good check in the fact that you did have it mounted perpendicular to the Sun. So I think we got a very high degree of cross-sectional coverage. When we get to surface penetrations, later, it's going to be quite evident that once you go past a depth of 4 or 5 inches, the ground gets quite hard. However, I didn't get much of a cue to this at this point while installing the solar wind experiment.

10.37 TELEVISION

ARMSTRONG The TV was operated as planned with no particular difficulties. The one thing that gave us more trouble than we expected was the TV cable; I kept getting my feet tangled up in it. It's a white cable and was easily observable for a while, but it soon picked up this black dust which blended it in with the terrain, and it seemed that I was forever getting my foot caught in it. Fortunately, Buzz was usually able to notice this and keep me untangled. Here was good justification for the two men helping each other. There was no question about that either; he was able to tell me which way to move my foot to keep out of trouble. We knew this might be a problem

ARMSTRONG (CONT'D) from our simulations, but there just was no way that we could avoid crossing back and forth across that cable. There was no camera location that could prevent a certain amount of traverse of this kind.

ALDRIN Neil initially pulled out about 20 feet of cable and then I pulled out the rest of it. It seemed to reach a stop; it seemed to have a certain amount of resistance, and I thought that was the end of the cable. However, when I pulled normal to the opening, I found that I could then extract the cable to the point where I saw the black and white marks on it. The cable, being wound around the mounting inside the MESA, developed a set in it so that when it was lying on the surface in 1/6g, it continued to have a spiral set to it which would leave it sticking up from the surface 3 or 4 inches. It would be advantageous if we could get rid of that some way.

ARMSTRONG Your foot is continually going underneath it as you walk, rather than over the top of it.

ALDRIN One time when Neil did get the cable wrapped around his foot, the cable very neatly wrapped itself over the top of the tab on the back of the boot. That created a

ALDRIN (CONT'D) problem in disentanglement. I don't know whether it's worth moving that tab or not.

10.38 BULK SAMPLE OPERATIONS

ARMSTRONG The bulk sample took longer than in the simulations because the area where the bulk sample was collected was significantly farther from the MESA table than the way we had done it in training. The MESA table was in deep shadow and collecting samples in that area was far less desirable than collecting them out there in the sunlight where we could see what we were doing. In addition, we were farther from the exhaust plume and the contamination of the propellants. So I made a number of trips back and forth out in the sunlight and then carried the samples back over to the scale where the sample bag was mounted. I probably made 20 trips back and forth from sunlight to shade. It took a lot longer, but by doing it that way, I was able to pick up both a hard rock and ground mass in almost every scoopful. I tried to choose various types of hard rocks out there so that, if we never got to the documented sample, at least we would have a variety of types of hard rock in the bulk sample.

ARMSTRONG (CONT'D) This was at the cost of probably double the amount of time that we normally would take for the bulk sample.

ALDRIN I want to inject a thought about spacecraft location in respect to lunar surface working location. Putting the area of the MESA in the shadow also put the cable in the shadow. The white cable, being covered with a little bit of this powdery stuff and being in the shadow, was very difficult to observe. Consideration should be given to keeping any cable or small object out in sunlight whenever possible. It leads one to think that if you're going to yaw one way or the other, it's preferable to put your working areas out into the sunlight.

ARMSTRONG We've discussed free-launch on a number of occasions and whether we wanted to yaw specifically for lighting at touchdown. There are obviously a lot of advantages, but I was very reluctant to do any fancy maneuvering on the first lunar touchdown for selected yaw for lighting considerations. I figured we'd just take what we got and we paid for that later, because we had a lot of operations in the shadow during EVA that would have been easier had we had better lighting.

ARMSTRONG (CONT'D) It's very easy to see in the shadows after you adapt for a little while. When you first come down the ladder, you're in the shadow. You can see everything perfectly; the LM, things on the ground. When you walk out into the sunlight and then back into the shadow, it takes a while to adapt.

ALDRIN In the first part of the shadow, when you first move from the sunlight into the shadow, when the Sun is still shining on the helmet as you traverse cross-Sun, you've got this reflection on your face. At this point, it's just about impossible to see anything in the shadow. As soon as you get your helmet into the shadow, you can begin to perceive things and to go through a dark-adaptation process. Continually moving back and forth from sunlight into shadow should be avoided because it's going to cost you some time in perception ability.

ARMSTRONG We'll start here with the flag installation. It went as planned except that the telescoping top rod could not be extended. Both Buzz and I operating together were unable to put enough force into extending the rod. It appeared to just be stuck and we gave up trying. So

ARMSTRONG (CONT'D) the flag was partially folded when we installed it on the flagstaff. I suspect that didn't show very much on television but our still photographs should show the result of that.

ALDRIN Neither of us individually could extend it. We thought maybe we could extend the rod by both pulling, but then we didn't want to exert too much force because if it ever gave way, we'd probably find ourselves off balance. I don't know how we'll ever find out what happened. I suspect this is just something that may in some way be due to thermal conditions or vacuum welding or something like that. It came out of its mount fairly easily. I thought we had a little bit of trouble with one of the pip pins there for a while. Generally, it was a straightforward job to dismantle it.

ARMSTRONG The flagstaff was pushed into the ground at a slight angle such that the c.g. of the overall unit would tend to be somewhat above the point at which the flagstaff was inserted in the lunar surface. That seemed to hold alright, but I noted later after getting back into the LM that the weight of the flag had rotated the entire unit about the

ARMSTRONG (CONT'D) flagpole axis such that the flag was no longer pointed in the same direction as it was originally. I suspect that the weight of the flagpole probably had shifted its position in the sand a little bit from the position where it had originally been installed.

ALDRIN How far would you estimate you got it into the ground?

ARMSTRONG Six to 8 inches was about as far as I could get it in.

ALDRIN It was fairly easy to get it down the first 4 or 5 inches.

ARMSTRONG It gets hard quickly.

10.39 LM INSPECTION

ALDRIN I don't think we noticed a thing that was abnormal. I guess the only thing that I made note of was the jet plume deflectors. The one on the right side as I was looking at the LM (which would make it the quad 1) appeared to be a bit more wrinkled than the one on quad 4. Of course, there's nothing to compare it with, because I'd never seen them before. As a matter of fact, the first time we really saw them was when we looked out of the command module and got a pretty good idea of their structure.

ARMSTRONG The only abnormality I noticed was (and it wasn't an abnormality) that the insulation had been thermally damaged and broken on the secondary struts of the forward leg.

ALDRIN This is true in the rear, also.

ARMSTRONG We didn't carefully check every secondary strut, but the primary struts didn't seem to be damaged.

ALDRIN Yes, in the foot passage, it didn't appear to have suffered hardly at all. There was a sooting or darkening or carboning; I don't know what you call it. At least, I feel it was a deposit rather than just a baking or singeing of the material.

ARMSTRONG We have some pictures of the struts.

ALDRIN The part that had been melted, separated, and rolled back or peeled back on the secondary strut appeared as though it was a much more flimsy design then any other thermal covering on there. I don't think there is anything significant in the fact that part of the thermal coating that was higher up had separated, whereas the material lower down had not. I didn't notice anything peculiar about the vents. There didn't seem to be anything at all deposited on the surface from any of the vents underneath or from the oxidizer fuel vent up above.

ARMSTRONG The most pronounced insulation damage was on the front plus Z strut. Its being in deep shadow obviated the possibility of getting a good closeup picture in that dark environment.

ALDRIN I think the best pictures we got were of the minus Z strut.

ARMSTRONG There was less damage than on the examples we looked at preflight. Just the very outer layers were penetrated.

ALDRIN From what I could see of the probes, they had just bent or broken at the upper attach point. I didn't observe that they had any other fractures in them. One of them on the minus Y strut was sticking almost straight up.

ALDRIN (CONT'D) It was pretty substantially the metal case on the outside of it, and there weren't any thermal effects noted on it at all. The inner thermal coating was trying to protect something that was relatively fragile, the flag itself; however, there was no sign of degradation on the flag. I don't remember seeing the minus Z probe. I don't know; maybe it was there.

ARMSTRONG I thought I remembered seeing all three probes. I think one was straight up and one had a V shape.

10.40 EASEP DEPLOYMENT

ALDRIN Taking the cover off the lanyard was very easy. It pulled away and didn't seem to have any thermal or blast effects on it.

ALDRIN Underneath the EASEP, the radar looked like it came through without any heat damage that I could tell. The lanyard underneath the thermal cover was in great shape. I didn't see any evidence of thermal effects. When it folded out, the doors went up even easier than the trainer. As the top door folded back, it didn't seem to fall into a detent and I tugged on it a couple of times. It looked like it was going to stay up there without any tendency to come back down again. In an effort to save some time, I elected to

deploy both packages manually; I pulled out the seismometer a few inches, disengaged the hook, disconnected it from the top, and slid it out. I was unable to toss the lanyard over the side door to keep it out of the way, so it did come down from the boom and had a tendency to get in the way. The package itself was quite easy to manage. I had my left hand on the handle and moved the right hand around to support the weight as it slid off the rails. It was disengaged quite easily from the boom at the pip pin. I had it down on the surface, and then to get ample maneuvering room to get the retroreflector down, I decided that I wanted to move the seismometer away. However, there happened to be a small crater right there, so I had to move it maybe 10 feet away and come back. Remember, it didn't seem to be a good place to set that seismometer down, other than right in front. It appeared to be in my way a little bit. In pulling out the laser package, I used the same technique, pulling out a few inches, then disconnecting the lanyard from the package itself, then pulling the string that was attached to the pip pin. In training sessions, I had pulled this one rather slowly and firmly and had a few problems with the pip pin binding. The recommendation was to give it a fairly good jerk. When I did this, the wire ring that attached the cord itself to the pip pin sprung open. Either it was a welded

joint that separated or thermal effects somehow weakened it; but it opened up and came loose from the pin. I was able to get the pin out by depressing the one side. Then by pushing it with my right hand and pushing it through, it came loose. Then I lowered it down to the surface and again it was quite easy to handle. The boom slid back in with no problem. I left the lanyards dangling out the bottom, pulled the retract lanyards, and the doors came back down and fitted together very nicely. The whole operation was quite smooth and I thought we got a little bit ahead in time in the deployment of these things. I picked up the two packages and we headed out to the minus Y strut looking for a relatively level area. Looking for level areas, I found it difficult in looking down at the surface and saying exactly what was level. I don't know what to attribute this to particularly. You don't have as good a horizon definition as on the earth. When you look out to the side, you've got a very flat area on the Moon. When you look out to the edges, you've got varying slopes. I think it's further compounded by the fact that with 1/6g, and a center of mass displaced considerably aft and up from where it normally is, your physical cues of supporting your weight are different. The result was that it was just a little bit difficult to tell what was level and what was sloping, either to one side or up or down.

ARMSTRONG You don't have as strong a gravity indication either, I don't think.

ALDRIN Yes. It doesn't have as firm an orientation. That pretty well covers the deployment out to the site. In going through the numbers of pulling the little lanyards, everything progressed as neat as can be. The handle deployed upward and rotated around, even though I wasn't able to see it fit into its slot. This is the maneuvering handle on the PSE. I might point out that the flight article was different in configuration than the training package, the difference being that you couldn't see when the handle was out and locked in its detent as well on the flight package as you could on the training package. Anyway, this worked out quite well. Orienting the package in azimuth was quite easy. The shadow of the gnomon stood out quite well in our session in the lab with the flight packages. We had had some concern as to just how well this shadow was going to stand out against this silver surface. However, all three of the pins in the gnomon were quite clear. I won't say they were a very crisp shadow, as there was a little bit of fuzziness to them, but it was quite easy to determine where the center of it was and get it orientated at the 45-degree mark. The big problem arose in trying to get the BB to settle down into the center of its little cup.

ALDRIN (CONT'D)

It seemed to want to find a home away from me at about 11 o'clock as I faced the package. I would try to push it down to get it to rotate around and it would move away from this position and start spinning around the outside. Try as I would to move it gradually away or push down on the package (away from where the bubble was) to get it to drift across, I was completely unsuccessful in getting the BB to find a home anywhere but along the perimeter. As I would bend down and look at this thing, it just appeared that this cup, instead of being concave, had somehow changed its shape and was convex. It didn't appear that there was any hope of the BB ever being anywhere but along the edge, so I visually tried to level it as best I could. As I indicated before, that wasn't too easy to do with any degree of confidence. Then I went to deploy the panels. One of the two retaining structures that should have fallen away when you right the package (both should fall down exposing the panels) failed. So I walked around the package and easily reached down with my finger and flicked it loose. It didn't require much force at all. When I deployed the panels, the left one came out and deployed completely; then following another pull on the lanyard, the right one deployed. There was a certain amount of rocking motion and dancing around on the surface as the two deployed panels flung themselves around before

ALDRIN (CONT'D) finally settling down. During the process of doing this, I believe two of the four corners came in contact with the surface and picked up a light coating of surface material. I'd say the triangle that was coated might have been 2 inches on one side and maybe 1 inch on the other — a very small triangle. So I don't think there was much degradation at all on the surfaces with that particular coating. I made one final inspection and, when I left it, the BB was still sitting on the edge. Neil came by with the camera to photograph it and he looked at it and found the BB was sitting right in the center of it. I have no explanation for that at all.

ARMSTRONG It would have been nice to have a big rock table to set those packages on, but there wasn't any. The area where they were placed was a ridge between some shallow craters. I think we have reasonably good pictures of those ridges. They have this same kind of soil consistency as the surrounding area. The packages were in essentially soft material which allowed us to jiggle them down and get them reasonably well set into the sand, but there is no knowing whether they will stay there for a long period of time or might slowly settle.

ALDRIN I think that they retained their present position pretty well. When I decided that I wanted to change the slope of the package one way or another, I found that I had difficulty in getting it to sink down a little more on one side. Even by scraping it back and forth, I couldn't seem to lower one edge as much as I would have liked to have.

ARMSTRONG There was no difficulty in the laser reflector installation. It worked as we expected.

10.41 DOCUMENTED SAMPLE COLLECTION

ALDRIN Let's discuss the documented sample. We were obviously running out of time at the end of the EASEP deployment. We had limited time to conduct the documented sample. A figure of 10 minutes was used. I thought we might actually progress in a formal excursion and get something started anyway. As the box was opened, we got the report that they wanted two core tubes and it looked like that was probably going to take most of the time. While I proceeded to that — because that's essentially a one-man operation — Neil went around the backside of the LM and picked up what rocks he could identify, getting as wide a variety as possible. In unpacking the box with the core tubes, I was quite careful to try to identify where the caps were. In some simulations, we had misplaced them or they had dropped to the surface.

ALDRIN (CONT'D) I do think we need a better way of identifying the various packages that have this packing material wrapped around them, so that at a glance you'd know what is inside a certain roll. In many cases, there is nothing in it. In other cases, it's got an environmental container in it, or it's got the caps to the core tubes. In putting the extension handle on the core tube, the first one went on fairly cleanly and locked into position with a fairly high degree of confidence that it was not going to come out. I won't say that there was complete certainty that they were not going to come apart. I then picked up the hammer, went out into the vicinity of where the solar wind experiment was, and drove the first core tube into the ground. I pushed it in about 3 or 4 inches and then started tapping it with the hammer. I found that wasn't doing much at all in the way of making it penetrate further. I started beating on it harder and harder and I managed to get it into the ground maybe 2 inches more. I found that when I would hit it as hard as I could and let my hand that was steadying the tube release it, the tube appeared as though it were going to fall over. It didn't stay where it had been pounded in. This made it even harder because you couldn't back off and really let it have it. I don't know if we have any way of measuring the exact force or impact that

ALDRIN (CONT'D)

was applied other than subjective. Maybe watching television would be some help. I was hammering it in about as hard as I felt I could safely do it. Unfortunately, we don't have any of the surfaces on the extension back to look at the impact. I was hitting it with the hammer to the point that I was putting significant dents in the top of it. I didn't find any resistance at all in retracting the core tube. It came up quite easily. On rotating it up to the inverted position to keep anything from coming out, I didn't find any tendency at all for the material to come out of the core tube. When I unscrewed the cutter, the surface seemed to separate again without any tendency for the material to flow or move. This meant that the consistency of this material, even though it looked to be about the same, was a good bit different. If I had some very close surface material and shifted it a little, it would tend to move from one side to the other. At the bottom of the core tube, I had the distinct impression—and it's just a descriptive phrase—that this was moist material. It was adhering or had the cohesive property that wet sand would have. Once it was separated from the cutter, there was no tendency at all for it to flake or to flow. I put the cap on, put it away, and then went to another area I would judge 10, maybe 15 feet away. I

ALDRIN (CONT'D) encountered about the same difficulty in driving the tube in. I imagine it went in about the same depth. It struck me that when I was removing this core tube from the extension handle, it was coming off. I had less confidence in initially putting the two together that they were going to stay together properly. When I was removing it, it appeared as though the end of the core tube that attaches to the extension handle had a tendency to come off. I had noted this earlier in some of the bench checks. When you screw the core tube in, if you aren't careful when you disengage it you're liable to disengage the cap on the other end. And the reason I'm belaboring this particular point is because I understand that one of the ends did come off. I guess I can't be sure that it did not come off at the time of disengaging. Perhaps it could have come off in the box, but I don't believe they found the other end. So the assumption is that when it was taken off the extension handle, the other end came off with it. It doesn't appear as though the material spread around inside the box because none could be found, so it must have adhered pretty well. Did we get photos of both those areas?

ARMSTRONG I did not get stereopairs. I got one photograph of the second one. Well the first one to a high degree of

ARMSTRONG (CONT'D) confidence was right in the area of the SRC. We can identify its location pretty well by the photograph. The solar wind disengaged from its staff quite easily. When it rolled up, it had a tendency to sneak off to the side and crinkle on the edges. I spent some 20 to 30 seconds unrolling it and trying to get it to go up a little smoother. I then remembered that they really didn't care about exact neatness. All they wanted was the material back because they were going to cut it up in many pieces anyway. So I bunched it together and it slid into its container fairly easily.

In regard to the SRC height, we couldn't tell, due to the insulation, just what it was; but we gave the height of our ladder above the ground. The photographs would fill in the story there.

ALDRIN It might be advisable to have some simple measuring device. It wouldn't take very much. Perhaps by the use of some marks you just make a judgment whether the distance between the 3 and the 4 is the same as between the 4 and the 5 or whatever the sequence might be.

10.42 SRC

ALDRIN The SRC's worked as planned. The only difficulty that I encountered was in closing the boxes. Opening the second one, I felt, required a little more force than I had anticipated in just lifting up the lever lock.

ARMSTRONG Closing the bulk sample box took a lot more strength than I had expected. It took just about everything I could do to close the document sample box. I was afraid I might have left the seal in the box. I don't think I did because, at the time, I thought I remembered clearly taking the seal off and throwing it away; but that's what it felt like. I inadvertently tried to close one with the seal in place at one time during training, and this was very much the same kind of situation. It took an inordinate amount of force. There's another difficulty in the fact that the gravity is so low that the box tends to slip around very easily. It feels very light; skids away from you. So, in addition to closing it, you have to hold it firmly down on the table. The table's not very rigid. It's quite flexible. So just holding the box securely enough in position to apply the high force on the sealing handles was some trouble.

QUESTION: Compare lunar versus Earth gravity.

ALDRIN Subjectively comparing the weight of the boxes (following removing them from the spacecraft on the carrier), I would say closer to one to ten — just judging the differences in weight and feel of things and the way the masses behaved. One to six gives you the impression there is a much greater difference than that. Now in your own maneuvering around, it doesn't seem to be anything like a factor of six in the ease in being able to do things. It would appear as though the gravity difference was much less. What I'm saying is that it looks like the human can adapt himself to this quite easily. It also appears as though the handling of objects is considerably easier in 1/6g, as we had anticipated. In maneuvering objects around, they do have a certain mass. When they get going in a direction, they will keep going that way as was evidenced when they were coming in the hatch on the LEC. They are fairly easy to manage, but you have to take your time in handling them.

10.44 LM INGRESS

ALDRIN Stability and balance: Well, the first step up to the bottom rung no doubt is a pretty good step, though Neil tells me he got up to the third one.

ARMSTRONG The third step.

ALDRIN The capability exists to do a good bit more in terms of a vertical jump than certainly the POGO leads you to believe. There's no way to evaluate that in the airplane. The big problem in the POGO was that it just didn't seem to be able to bring you down with enough to bear so that your inertia would carry you as far as it's able to with good leg extension.

ARMSTRONG The technique I used was one in which I did a deep knee bend with both legs and got my torso down absolutely as close to the foot pad as I could. I then sprang vertically up and guided myself with my hands by use of the handrails. That's how I got to the third step which I guess was easily 5 to 6 feet above the ground.

ALDRIN The rungs of the ladder were not in any way dangerously slippery. Material on the bottom of your boots tended to cause them to slide back and forth.

ARMSTRONG They were a little slippery.

ALDRIN I think we have already mentioned the adequacy of the platform for other operations, that is, alternate ways of bringing things up. The hatch moved inward very easily. As I faced the hatch, I moved the camera from its position on the right side of the floor, up onto the Z-27 bulkhead.

ALDRIN (CONT'D) I had very little difficulty, again using the same technique that Neil used. About half way in, make concerted effort to arch your back to keep the PLSS down by keeping your belly down against the floor. This affords you the least profile going in. There didn't seem to be any exertion at all associated with raising yourself up and transitioning to a point where you can bring your knees on inside the cockpit, and then moving from a kneeling to an upright position. It all seemed to work quite smoothly. When there is a large bulk attached to you, you have to be careful. Once you get inside, before you start to turn around, you must make adequate allowance for all this material behind you.

ARMSTRONG That was an interface problem. As a matter of caution, each person should be helping the other as much as possible. The first man in has the biggest problem, at least when he gets inside the cockpit. He has nobody to help him with clearance and I'm sure he must use a good bit of caution.

ALDRIN The LEC didn't seem to get in the way at all while I was getting in. We had the mirror available, but I don't think either of us found any particular use for it.

10.45 EQUIPMENT JETTISON

ARMSTRONG I don't racall any difficulties with that.

ALDRIN Well, this period was prolonged a bit to try to make as much use of the film remaining. I think we probably took more pictures than we should have in an effort to make sure that we covered each particular window as thoroughly as possible and with as wide a range of settings as we could before we proceeded to jettison the camera.

ARMSTRONG I think the equipment jettison went well and as planned.

ALDRIN We made an LiOH change at this point.

ARMSTRONG We included the canister as a separate jettisonable item at this point, which we had planned to do before the EVA.

ALDRIN We elected to leave the helmets on because at this point there was so much stuff rattling around inside the cabin that they would have added just one more bulky item. The primary canister change proceeded quite well to the point of inserting the new canister. I ran into a minor problem in getting it to rotate fully so that I could get the cover on. When it finally did seat itself in properly, I can't for sure identify what I did differently from the times when it didn't seem to rotate. That seemed to be what

ALDRIN (CONT'D) was stopping the cover from going on completely, the fact that when the canister was inserted I couldn't seem to rotate it as much as I thought it should have been rotated. However, the canister container behind the ascent engine removed very easily, and we were able to jettison it without any problems. We didn't have any problem; I didn't notice you had any difficulty giving the packages the heave-ho. I think each PLSS bounced once on the porch before it went on down.

ARMSTRONG Only one thing stayed on the porch. That was a small part of the left-hand-side storage container that did not make it off the porch onto the surface. That was the last item jettisoned. Concerning the LEC, I had neglected to lock one of the LEC hooks which normally wouldn't have caused any trouble. You would expect to proceed normally whether that was locked or not. However, for an unknown reason when I got the SRC about half way up, the Hasselblad pack just fell off. I can't account for that. I just took the pack on up and attached it, and ensured that it was locked when I put it on the SRC the second time. When it fell onto the surface, it was covered with surface material.

ALDRIN I'm sure there is a lot of inertia with any package like that and, with that low gravity, it tends to swing back

ALDRIN (CONT'D) and forth; and if there is some tendency to reach an unlocked position, it will.

ARMSTRONG There was no problem because the ladder was right there, so I just leaned over and down to the ground and picked it up. I had the ladder to hold on to and then I could push myself right back up to a standing position.

ALDRIN Did the film magazine hit the pad or drop right to the surface?

ARMSTRONG I think it hit the surface clear of the pad, on the right side, which would be the spacecraft's left. I wasn't worried about the contingency sample because that was inside a bag. If anything was going to catch fire, it was going to be my whole suit because it was just covered with that stuff.

10.46 POST-EVA CONFIGURATION

ARMSTRONG The post-EVA checklist went very well. It was well planned and we went precisely by the preplanned route with possibly a few exceptions. They went very well and probably took about the same or a little more time than we expected. Of course, the time period that we took while we were waiting for the canister before starting the repressurization was comparably long. We had to put an eat period in there as I remember and took a lot of pictures.

ALDRIN Well, there's no getting around it, it's another EVA PREP exercise. It's easier, but you still have to go through the same exercises such as pressure-integrity check, reading the cabin down, and configuring the ECS. I guess if you have two EVA's, it probably would be nicer to jettison your equipment at the beginning of the second one, rather than having to add another DEPRESS. I'm not sure how they're planning to do this.

ARMSTRONG There still was a full truckload of equipment inside that cockpit at the end of EVA. It's just a bunch of stuff, and I was glad that we were able to get rid of a lot of it and finish the jettison before we started our sleep period. With all that stuff in the cockpit, there's really no place left for people to relax.

10.50 UPDATES FOR LIFT-OFF

ALDRIN On P57 before lift-off, the Sun moved up in the field of view, as did all the rest of the stars. The Earth stayed the same. The Earth obscured the forward detent and the right detent. The Sun was now in the rear detent, and for some reason, it also obscured the left-rear detent, which was the one I was counting on using with Rigel. This was the one we had used before. I was quite surprised to discover this. The Sun was not within more than 15 degrees of the total field of view. It completely obscured the left-rear detent. It effectively left us two out of the six detents to pick stars from. Looking at those two detents, there weren't any stars near the center. The closer to the center of the detent you get the greater the accuracy is. The day before we had used Navi and it wasn't particularly bright. So I went back and now could use Capella, but it was fairly close to the edge of the field of view. So we did a gravity/one-star alignment and that first gravity alignment came up with 00010. VERB 32 gave us 00001. We used a sequence of marking that involved an onboard averaging of five successive cursive readings, followed by depressing the MARK button, and then five successive spiral readings that Neil would log down as I would read them off. Then he would

ALDRIN (CONT'D)

average these up and we would put them in. We'd use either spiral or cursive first, whichever appeared to be convenient.

I think this averaging technique worked out better than letting the computer do it, because it would have amounted to a considerable rotating of the spiral and cursive reticle field back and forth to make one spiral, then a cursive, then a spiral, and do a recycle. There is the option, however, to do one or the other. This was a REFSMMAT alignment. The torquing angles were fairly large, the star-angle difference was 00007 which preflight was the expected value of a two-star alignment. Torquing angles were very close to 0.7 in all three axes, which indicated that the platform did drift a fair amount during that time period. We then did the P22. I had hoped at that point to use the AGS to tell me where the command module was, but unfortunately we didn't update the AGS with the latest PGNS state vector so it wasn't giving us good range and range rate. I would recommend doing that, if anyone does a P22 in the future, because you can't use the PGNS to tell you what the range and range rate are. And you can't use the radar because it's not going to lock on until it gets to 400 miles. But the AGS gives

ALDRIN (CONT'D)

you very good indications as you are approaching that range. So we were a little misled and I thought we were still well out of range when we finally got the lockon.

You call up the program before the command module gets to 400 miles. It sits and waits; and, when it gets less than 400, it locks on automatically, and you see the signal strength grow and it starts to track. But it's in mode 2 so you don't see the needles doing anything; the cross-pointers move, indicating it's got rate drive going as it's trying to keep up with it. Because we didn't want to run the tape meter into the stops, we left it in ALTITUDE/ ALTITUDE RATE.

We really didn't have much of an indication that any good information was coming in, other than signal strength. I guess the ground got the data on the downlink. When it broke lock, I thought the command module was overhead and it had broken lock because of a maximum rate drive. The radar representative from RCA had indicated that the SPEC said it might break lock, but he didn't think it would as it went over the zenith. But, because of the AGS indications, I thought that was what had caused the break-lock. Evidently, it had gone out the front field of view. It broke lock just a short time after the time given us by

ALDRIN
(CONT'D)

the ground for the zenith passage. So I was fully expecting it to acquire again. I don't think we had our AGS configured and the ground was not as helpful as they might have been had we run this sort of thing previously in simulations and had a bit more training on it.

We started to do the P57 and realized that this would be too soon before lift-off. It seems to me we had a time period in which we were essentially standing by. We did an abbreviated RCS check. Because one of them was a cold-fire check, we got all the red flags coming on. We did an AGS calibration, got the ascent pad; then, at about 45 or 50 minutes before lift-off, we called up the P57 again.

We did a landing site option at the TIG of lift-off. The torquing angles between this alignment and the previous one were on the order of 0.09 degree maximum. The gravity alignment had an initial error of 0.00001 and on recycle had the same thing. I don't have logged down what the star-angle difference was, but it was - probably on the order of 7 to 9, somewhere in there. It wasn't anything that made me jump up and down. But again it was measuring the difference between gravity and a star and, of course, doesn't really indicate how well you know the star position

ALDRIN (CONT'D) or how well you measured that, because it's relative to how well the gravity was measured.

We had an update concerning the position to leave the radar for ascent. We were instructed by the ground not to turn the radar on during ascent and to leave it in SLEW.

I think we left the circuit breakers out. This was to keep from overloading the computer, in a similar way to what had happened during the previous day during descent. I think that's unfortunate that we do have to deprive ourselves of one additional check for insertion confirmation. There was one more venting of the descent tanks at insert — lift-off minus 30 minutes. I had the radar in SLEW and the circuit breakers off.

ARMSTRONG I'm quite sure they were off.

ALDRIN Well, I didn't want us to use the tape meter in PGNS. Now that would have given us altitude and altitude rate out of the PGNS, right? So they didn't want to burden down the PGNS with doing that. Here I have on the circuit breaker card, leaving both radar ciruit breakers open.

ALDRIN (CONT'D) We got the batteries on the line a little sooner because I think the ground thought that they might have cooled down a little bit more than their preflight information might have indicated. So we brought those on before TIG minus 30.

Another change — we lifted off with the updata link in VOICE BACKUP, brought the VHF ranging on at TIG minus 15, and pressurized the APS tanks. I guess it slipped my mind, perhaps Neil's too, that the Apollo 10 crew had noted that they saw very little decrease in the helium pressure. At first, it looked like we had about a 100-psi decrease in Tank 1 and zero decrease in Tank 2. That was probably the worst thing we could have seen because we figured that just one tank had pressurized. The ground was a little concerned about that. If they were not concerned, I wish that they had given us just a little bit more comforting thoughts at that particular time, because we hesitated at that point, at least I did, in doing some more of the switch configuration, waiting for a confirmation from them.

10.51 GENERAL LUNAR SURFACE FATIGUE

ARMSTRONG I wasn't tired at all. I worked real hard at a high workload right there near the conclusion when I was pulling the rock boxes up. We knew that was going to be hard,

ARMSTRONG (CONT'D) plus the fact that we were racing around a little bit towards the end, trying to get everything thrown into boxes and getting all the pieces put together. I expect my heart rate ran up pretty good right there, but I had a lot of energy and reserve at that point, because we had been sort of taking it easy all through the EVA. Everything was, with a few small exceptions, accomplished with a comfortable workload. We didn't have to work hard throughout the whole timeline, and I knew I could afford to race around there for 5 or 10 minutes without jeopardizing the operation at all. They called for a status check and I gave them one and we proceeded, but there wasn't a problem with respect to available energy and reserve.

ALDRIN I think the fact that you're well cooled off enables you to absorb a fair amount in an increase of activity before it manifests itself. The oxygen flow rate concerned me a little bit preflight because I found, in doing some fairly strenuous exercise in the thermal vacuum chamber, that the first indication I got was that there was not quite enough circulation of air or oxygen to breathe. It tended to get a little stuffy in the helmet.

ALDRIN (CONT'D) I think all of us who have been through this business know a good bit about the pace of activities following insertion, which is rather leisurely taken. However, you can get wrapped around the axle doing a lot of different things that aren't required — many of them are doing things just to say, "Yes" — you can add more and more solutions. Therefore, to carry out a minimum-rendezvous effort is not, as I would see it, a very tiring task to look forward to after descent and a prolonged EVA. I think we would have been fully capable of carrying out a lift-off and rendezvous.

ARMSTRONG We handled one.

ALDRIN You just are not going to get any sleep while you're waiting for it to be completed, but you're certainly not going to be completely bushed chasing yourself around the cockpit. With the automatic radar lift-off and rendezvous are fairly leisurely exercises. I guess I'd have more concern about Mike's ability to continue, because he's quite active moving back and forth and doing a lot of manual tasks with the sextant that we didn't have to do.

ARMSTRONG We cleaned up the cockpit and got things pretty well in shape. This took us a while and we had planned to sleep

ARMSTRONG (CONT'D) with our helmets and gloves on for a couple of reasons. One is that it's a lot quieter with your helmet and gloves on, and then we wouldn't have any mental concern about the ECS and so on having two loops working for us there.

ALDRIN We wouldn't be breathing all that dust.

ARMSTRONG That was another concern. Our cockpit was so dirty with soot, that we thought the suit loop would be a lot cleaner.

ALDRIN I guess the question is — Can you keep it cleaner? I guess you could keep it a little cleaner, but there are so many things going in and out that it's almost impossible to avoid getting a significant amount of lunar material in there.

ARMSTRONG A couple of comments with respect to going to sleep in the LM: One is that it's noisy, and two is that it's illuminated. We had the window shades up and light came through those window shades like crazy.

COLLINS Why didn't you pull the window shades?

ARMSTRONG We had them closed. A lot of light comes through the window shades. They're like negatives and a lot of light will shine through.

ALDRIN You can't see what's going on outside, but you can come quite close to it.

ARMSTRONG For example, you can see the horizon out there through the window shades. There's that much light that comes through. The next thing is that there are several warning lights that are very bright that can't be dimmed. The next thing is that there are all those radioactive illuminated display switches in there. Third, after I got into my sleep stage and all settled down, I realized that there was something else shining in my eye. It turned out to be that the Earth was shining through the AOT right into my eye. It was just like a light bulb. If I had thought of that ahead of time, we could have put the Sun filter on or something that would have cut the light out.

The next problem we had was temperature. We were very comfortable when we completed our activities and were bedded down. Buzz was on the floor and I was on the ascent engine cover. We were reasonably comfortable in terms of temperature. We had the water flowing and the suit loop running. We had to have the suit loop running because our helmets were closed. After a while, I started getting awfully cold, so I reached in front of the fan and turned the water temperature to full up, MAX increase.

ARMSTRONG (CONT'D) It still got colder and colder. Finally, Buzz suggested that we disconnect the water, which I did. I still got colder. Then I guess Buzz changed the temperature of the air flow in the suit.

ALDRIN Yes. We fell victims to a time constant. Once we noticed it going bad there wasn't anything we could do about it. In addition, because we were trying to minimize our activity and stay in some state of drowsiness, we didn't want to get up and start stirring around because it would be that much harder to get back to that same state again. So we tried to minimize our activity. We underestimated how much light was coming in through the windows. There must have been a significant amount of light and heat coming in and just being reflected off the surface. We had no feel for what gas-flow setting we should have had, because we'd been on the cooling all the time up to that point while moving around. I'm not sure that there's much control over that anyway. We finally disconnected the oxygen flow.

ARMSTRONG But that requires you take your helmet off, so that you can breathe when you turn the suit disconnects. This means that it gets noisy again, and all you hear is a glycol pump and stuff like that. This was a never-ending

ARMSTRONG (CONT'D) battle to obtain just a minimum level of sleeping conditions, and we never did it. Even if we would have, I'm not sure I would have gone to sleep.

ALDRIN I don't know who was on BIOMED at the time, but I feel that I did get a couple of hours of maybe mentally fitful drowsing. I'll have to say that I think that I had the better sleeping place. I found that it was relatively comfortable on the floor, either on my back with feet up against the side or with my knees bent. Also, I could roll over on one side or on the other. I had the two OPS's stacked up at the front of the hatch, so there was ample room on the floor for one. But there wasn't room for two.

To cut down on the light level, we're just going to have to do something with the window shades to make them more effective. I think sleeping with the helmet will keep the cooling down and is probably a good reasonable way to go as long as you're going to keep the suit on. Unless some change is made, we'd never even think about taking the suits off.

COLLINS Apollo 12 is planning to take their suits off. With the longer stay-time and a couple of EVA's, they're planning to take their suits off.

ALDRIN I think they ought to think a little more about it. I don't know what the temperature would be in there. I got the impression that it was a lot cooler outside the suit than it would have been inside. I don't feel that having the suit on in 1/6g is that much of a bother. It's fairly comfortable. You have your own little snug sleeping bag, unless you have some pressure point somewhere. Your head in the helmet assumes a very comfortable position. Even out of the helmet, you don't have to worry about what you're leaning against. Your head doesn't weigh that much, and will very comfortably pick just about any position. I just don't see the real need for taking the helmets off.

ARMSTRONG I didn't mind sleeping on the ascent-engine cover. I didn't find it that bad. I made a hammock out of a waste tether (which I attached to some of the structure hand-holds) to hold my feet up in the air and in the middle of the cockpit. This kept my feet up about level with or a little higher than my torso.

ALDRIN Well, you were back out of the mainstream of the light except for the windows in the AOT. I think we could fix that up and obtain a more horizontal position or the capability to roll from one side to the other. That's

ALDRIN (CONT'D) just something that has to be worked out. It wasn't satisfactory. If we had known then what we know now, we could have preconditioned the cabin a little bit better. We needed to start at a warmer level by turning the water off, thereby storing a small amount of heat.

ARMSTRONG That's just one of those areas that didn't occur to us. It clearly needs some more work.

10.53 LEC

ARMSTRONG The LEC worked as expected; however, I have a few comments worth noting. The primary one is that the LEC was a great attractor of lunar dust. It was impossible to operate the LEC without getting it on the ground some of the time. Whenever it touched the surface, it picked up a lot of the surface powder. As the LEC was operated, that powder was carried back up into the cabin. When the LEC went through the pulley, the lunar dust would shake off, and the part of the LEC that was coming down would rain powder on top of me, the MESA, and the SRC's so that we all looked like chimney sweeps. I was just covered with this powder, primarily as a result of dirt being thrown out by the LEC. This also tended to bind in the pulley. I felt like there was enough silt collecting in the pulley that

ARMSTRONG (CONT'D) it was actually binding. Fortunately, Buzz was able to help a great deal. He actually put the majority of the forces into pulling the boxes up from the top end, rather than me from the bottom end. I was standing at a very severe angle, which prevented me from using as much force as I had planned for pulling. The ground was too soft and my feet slipped easily. I was leaning over at approximately a 45-degree angle. I had one foot behind me so that if my foot slipped, I wouldn't fall down.

The surface was worse. I think the angle and so on were about the same, but I did not have the footing. I couldn't get the footing in this soft powder that you needed to do that job.

ALDRIN There are several points that tend to make footing more difficult. One is the powdery, graphite-like substance. When it comes in contact with rock, it makes the rock quite slippery. I checked this on a fairly smooth, sloped rock. It was quite easy to get this material on it, and the boot would slip fairly easily. That factor tends to make one more unstable. The second point is that the surface may look the same, but we found that in many areas (with just very small changes in the local surface topography) there

ALDRIN (CONT'D)

would be unexpected differences in the consistency and the softness of this top layer. For example, we might find in some areas where there was just a small slope that when we were on the edge of this slope, there would be little change in the thickness or depth at which we penetrated. In other places, we would find we had put our feet down and we would tend to depress this surface to a new location, as if there were a different depth of the more resistive subsurface. These two factors gave us a low confidence level in our balance and footing setups.

To keep the LEC coming smoothly on the inside and to have my pull on it in the appropriate direction so that it neither tangled up near the pulley end nor tended to move or slide the pulley as it went out the hatch, I found that I was completely unable to look out the window at the same time. It was a question of my looking at the LEC, talking to Neil, and hoping we were coordinated. It would be nice to work this over more and try to find some way to maintain visual contact back and forth. I didn't find that easy to do.