HARNEY COUNTY HISTORY PROJECT

AV-Oral History #205 - Side B

Subject: Survey Desert Trail

Place: Diamond Craters

Date: May 1980

Interviewer: Pauline Braymen

BOB IVY: ... processes are just ...

PAULINE BRAYMEN: That's all right, no one will ...

BOB: Essentially what we're doing is, it's just basic trigonometry. You know in basic trig, if you know this distance, and you know what this distance is, and you know what this angle is ---

PAULINE: Uh huh.

BOB: --- by definition we know what this angle is, it's a right angle. We're sitting at this point here with a tripod, where Scott's looking. He's looking down at one of those targets down here. Okay, so what he's doing on a vertical angle is he is measuring this angle, and then we'll have, we have a laser unit that we will set up here, and shoot to a reflector here, and that will give us this distance. Knowing this angle, this distance, and this angle, we can compute exactly what this distance here is then.

PAULINE: Uh huh.

BOB: Okay, that gives us our rectified distance from this point, to any of these other targets out here, so we have distances. Now, this will be an aerial view looking down here. Here is the Diamond Craters area to be mapped, for example. We'll say that we have oh, co-points here, a point here in the center, another point over here, another point here. That's just for example. Okay, so he's sitting here, what he is doing now, he looks over at this point and he sets this at zero degrees, then he turns and he looks at this thing here, and he measures the degrees there.

PAULINE: Uh huh.

BOB: And he does the same thing for each of these, measures all of these angles. So --- and then we also set up here and we shoot a distance so that we know this angle and this distance.

PAULINE: Uh huh.

BOB: And then it's the same basic tri --- trigonometry. He'll go to each one of these points and repeat it. So from this point he'll measure this angle, this angle, this angle, and this one here.

PAULINE: Uh huh.

BOB: By doing this, we can ultimately compute it then, knowing the distances and the angles in elevation as well as across. We can come up with very accurate readings of exactly what the rectified distance is from this point to this point, this point to this point, etc.

ELLEN BENEDICT: All of that information is fed into the computer.

PAULINE: Uh huh.

BOB: But through a whole series of computations that we have so that we can come out with that. Now what we do is we have Diamond Craters area here. We've got these points --- I'll draw them somewhat --- somewhere here. Now we send an airplane --- oh, did you see the panels, those white ---

PAULINE: Uh huh, uh huh.

BOB: --- 90 degrees angle things here. Okay. They're on all of these points that can be seen on the photography. We'll send a plane, we'll fly exact lines like this, and they photograph. Now the photographs that they do overlap by 33 and 1/3 percent --- by 66 percent. This way, remember the old stereo movies, the 3-D movies?

PAULINE: Uh huh.

BOB: Okay, those were shot the same way. From --- just like your eyes do, with one eye, you can't see perspective.

PAULINE: Uh huh.

BOB: But with both eyes focusing; you can get an idea what your perspective is here. When we have these photographs overlapped this way, this area right in here we can view in stereo, see it in three dimensions. By looking at --- oh let's say a hill, hill, if you're looking at it from here, you see this type of a view. The other photograph is taken from here, and you see this view.

PAULINE: Uh huh.

BOB: Okay. By doing that it's just like your eyes, you can see this in three dimension.

PAULINE: Uh huh.

BOB: What we do is in a big --- it's called a plotter, it's a big instrument where we're looking at these photos projected, but essentially what we do is we can put a dot, up at this point ... one of these points in here will be at --- at least one of them will be a USGS coordinate. They've already established exactly what the altitude is.

PAULINE: Uh huh.

BOB: We also know exactly what that state plane coordinate is. Where it fits on the grid surface of the whole world is laid out in.

PAULINE: Uh huh.

BOB: Okay, that would be this point here. So if we know this is 4,000 feet and we're going to map this, let's say in 20 foot contours, so we want to, we want to map it at these points here. So that when you look down on your map, and you see this, you've seen these ---

PAULINE: Uh huh, okay.

BOB: --- contour maps like this. Okay, that is what we're coming up with as a final product. We do this back in the office optically by putting a dot; it's just an optical dot on this point here, set the instrument at 4,000 feet. Then we just crank it to, let's say 3,800 -- - 3,980 feet, and we have this little free-floating dot out here, and we just move it down until it touches the ground. When it touches the ground, which would be here, we just trace it around, just keeping it, what it looks like sitting right on the ground the whole time.

PAULINE: Huh.

BOB: That is how we actually draw the maps. And I probably, it's getting way ahead of myself --- I'm not keeping myself very logical here. Ah --- back to the photographs. The airplane flies normally north to south, he'll fly here and photograph all of these. On the photographs, the actual photographs will extend like this, and these will overlap on the side as well. But these angled panels that you see will show up on the photographs. Now we'll call this one Badger.

PAULINE: Uh huh.

BOB: Okay. By doing this we know what all the coordinates for Badger --- to here, we know what that angle is from this triangulation that he is doing here. So looking down on it, on the photographs, we can see all of these points. We now have what the elevation is on each one of these, what the exact distance is from that one to that one, and from this one to this one. So we can get it all in exact perspective in scale. And then by computations in the computer we can plot where each one of these little points is. And from that it causes the whole system to be perfectly flat so that we can get these exact distances. We can draw these contours, you know, between the different things and we know that from this point to this point it's 3.6 miles.

PAULINE: Uh huh.

BOB: In scale, if we're doing an inch to a mile, it would be 3.6 inches. And then we can draw all these things; it will be exactly scaled, and very accurate. Accurate to, oh within a couple of centimeters at 20 miles.

PAULINE: That's pretty accurate.

BOB: This one --- what he is using there is called a theodolite. It's calibrated into degrees, minutes, and seconds. That is accurate to one-half of a second of a degree of arc. Now if you have got 360 degrees, and so a second of arc, because there is 360 degrees in a circle, 60 seconds --- or 60 minutes to a degree, and 60 seconds to a minute.

PAULINE: Uh huh.

BOB: And this is a --- it's called a one second theodolite, and it takes quite a bit of concentration. He focuses on one of the panels out there, the targets, and then he reads in the site of the scope, he'll probably have you look through it ---

PAULINE: Uh huh.

BOB: --- and you can see the numbers. And you can read how many degrees he has traveled from the last target.

PAULINE: Uh huh.

BOB: Anyway, he'll do that for all of these out here. Then he'll turn a little switch on and he can do it the vertical degrees.

PAULINE: Uh huh.

BOB: And he does that individually on a target. He sets it on a horizontal, and that's zero, then he measures down or up ---

PAULINE: Until he hits, until he hits ground level ---

BOB: --- oh, it's not ground level; it's actually the target. You see all of these targets are built exactly the same size. Now you noticed the targets ---

PAULINE: Yeah.

BOB: --- look like this. Okay. What he measures looks, where is this bar right here.

PAULINE: Uh huh.

BOB: We know what this distance --- this is exactly 36 inches.

PAULINE: Uh huh.

BOB: Anyway, so we know that this is sitting on ground level. We have driven a piece of rebar into the ground, flush with the ground, stamped it with a number of that point.

PAULINE: Uh huh.

BOB: So we know exactly from that point to here, that's 36 inches.

PAULINE: Uh huh.

BOB: So he does his measurement to this, and then in computations we adjust --- to 36.

PAULINE: To 36.

BOB: But each one of them is exactly the same.

PAULINE: Uh huh.

BOB: And that's how he gets the elevation, or the vertical angle, vertical distance. And he does this with a horizontal distance. Ah --- we also measure the height of the center of that instrument to the ground, over the pin. There is a pin and a target on this point too.

PAULINE: Uh huh.

BOB: And so we have the height of the optics from there to the ground, and also the height of the target from here, and that can all be adjusted down.

PAULINE: Uh huh.

BOB: That gives us all of our angles. The other instrument that we have, we'll set up and show you, it's what they call an EDM, an electronic distance-measuring device. What it does, it works on a laser, a laser beam to a reflector, and so we shoot a beam of light to this reflector, and it's bounced back and read in this instrument of how long it takes this beam to come back.

PAULINE: Okay. Now I couldn't, I couldn't quite understand what the laser did. Say that again now, because I get it but ---

BOB: Essentially all this is, there is --- I'll show you, when you look at this instrument it looks like it's sitting inside of a housing. This is where the light comes out, and this is where it receives the light back. It shoots it to a reflector, and in this reflector there are 45-degree front surface mirrors. So no matter whether you look at it straight on, or off to an angle, the light comes back exactly the way it took off.

PAULINE: Uh huh, uh huh.

BOB: And so it will shoot a beam of light to this reflector, which will then shoot it, back. Now even if it is laser, because of the atmosphere it spreads, the light spreads a little bit.

PAULINE: Uh huh.

BOB: It doesn't really go straight like a pencil that only works in a vacuum. But it will come back and it will, the light will reflect back here. This instrument is a marvel; it's state of the art now. It will measure, what it actually measures is the light waves, the amplitude. How long it takes for it to get back and where this wave is on there, by doing that it's --- I think that's accurate down to 3 decimal places.

PAULINE: That's fantastic.

BOB: We have another unit that we didn't bring here that we use for very long distances that works on a microwave principle.

PAULINE: Uh huh.

BOB: And it is accurate to plus or minus 2 and 1/2 centimeters at a distance of 30 miles. This is about --- that is the most accurate type of mapping that can be done at this point.

PAULINE: Uh huh.

BOB: There is more sophisticated mapping done, but it is --- the mapping is not done on the earth.

PAULINE: Yeah.

BOB: They're using a little more sophisticated stuff for mapping the moon and things, but --- it's not feasible for here.

PAULINE: Uh huh. Time-wise, in looking at doing it this way, and doing it using the old transit and chain method, what --- how long is it going to take you to map this?

BOB: This project, we should, hopefully we'll have this wrapped up by Friday afternoon.

PAULINE: And you've been working since ---

BOB: Since a week ago Monday, so it will be exactly 2 weeks.

PAULINE: Uh huh.

BOB: But we work Saturday, and we have been working 12, 13-hour days.

PAULINE: Uh huh.

BOB: A lot of it depends on the heat. Once --- you know, when you look across and it's really hot, and you get the heat waves, you can't --- and it's so temperamental, it's not so temperamental, but it's such magnification that it magnifies the heat waves and you just can't see the targets.

PAULINE: Uh huh.

BOB: But it will take us 2 weeks to do this, and then maybe another 2 weeks for a man in the office to actually draw this up, actual time, the map to be completed. I would imagine it would probably take, oh, if you ran one crew like we got a 3-man crew here, which is unusual, normally we have a 2-man crew, and then 2 people from the districts to help, it couldn't be done as accurately with the transit. But even to do it with a transit in dragging a chain, I would imagine it would probably take 5 months of a 4-man crew, working 6 days a week.

PAULINE: Uh huh.

BOB: Eight hours a day to do it, at least. And the difference in cost is phenomenal. And although the equipment is rather expensive, it pays for itself in just about --- well one season.

PAULINE: Uh huh.

BOB: We can have all this stuff; it pays for itself tremendously. ...

PAULINE: I need to know the spelling of that first, the one he's using now.

BOB: T H E O D O L I T E.

PAULINE: Theodolite.

BOB: Theodolite.

PAULINE: This measures angles.

BOB: Uh huh.

PAULINE: The other was ---

BOB: An electronic distance-measuring device. They're known as EDM's, just EDM. And this one works on a laser principle.

PAULINE: Uh huh. Okay. I always wondered how they got those contours. You know you look at geologic survey map and I wondered how they figured out ---

BOB: What it actually is --- the plane that flies over uses a camera, something like a --- well the negative that it takes is 10 inches wide, it's a 10 x 10 negative. And these negatives are actually produced into a positive, like a slide, put into a stereo plotter.

PAULINE: Uh huh. And they overlap?

BOB: Uh huh. They overlap. When we, we do is we --- they then have --- this is some very sophisticated equipment, I really love playing with it. Anyway, it projects an image down onto a little disk that you're looking at. Now since it is all done optically we can introduce anything, we can introduce a dot, an optical dot in there. So we introduce this optical dot and it looks like it's floating. It looks like a little UFO. You can just move it around by a series of gears and things, until it sits right down on the ground. And you can see, you can actually make it look like it goes into the ground. Anyway you sit, and it sits right on the ground on a known elevation. This is not a known elevation but the other one that we did, a couple of those, that are benchmarks ---

PAULINE: Uh huh.

BOB: --- that are already established with a known elevation is. You set that dot right on there, and then you just move it over until it's off --- it's floating again. And you just crank it down to --- like in this case --- what are we doing these in now, 2 foot and 5-foot contours?

ELLEN: You better ask Scott.

BOB: Yeah. I know one of them is going to be a 2-foot contour.

ELLEN: Right.

BOB: But a normal --- we do the maps in 20 foot, in 20-foot contour intervals. But essentially we just move that dot down to the next elevation that we want to draw a contour ---

PAULINE: And you know how far you've dropped it, and so you now how far ---

BOB: Yeah, that's all calibrated in the instrument. You drop it down, let's say 20 feet to the next interval that we want to draw a contour on, then you set it down there on the ground, and then as you're looking at it in stereo you just move it around, you trace around the side of the mountain looking straight down on it.

PAULINE: Uh huh.

BOB: And keeping it always in focus, and sitting on the ground.

PAULINE: Uh huh.

BOB: And that is how they draw those squiggly ---

PAULINE: And they're absolutely accurate. That's fascinating.

BOB: It is --- it's funny, Ed this morning said, "You didn't tell me this was going to be hard work."

PAULINE: (Laughter)

BOB: People in the office they see us go out in the field and we come back with suntans.

PAULINE: Yeah.

BOB: And they think, boy you've just been out having a field day doing nothing at all, you know. And they don't see us getting up at four in the morning so that we can get out here at dawn.

PAULINE: You don't get much of a sun tan at four, do you?

BOB: No. And they don't see Scott --- by the end of the day you almost have to lead him back to the truck by the hand.

PAULINE: Yeah, yeah.

BOB: Because he is almost blind from looking through that instrument. And like yesterday afternoon, sitting up on top of the ridge, by the time he came down his hands were so cold from the wind ---

ELLEN: It was so cold yesterday.

BOB: Yeah. And of course, then by the time we get back to the office, you know, we're warmed up and ---

PAULINE: You're warmed up.

BOB: --- and cleaned up and everything, and they think boy, you've just been out there for a two week vacation. They don't, by the time we've --- as Ellen and John have done, climbed the same blasted mountain, up to the top about six times to turn the target, or ---

ELLEN: Opened the same damn gate six times in four hours ---

PAULINE: I can just see now, you know, if the wind blows that down, if John's sky wire slips or something, why back over there to ---

ELLEN: Right.

BOB: Now we'll just come to a stop. But sometimes we have to start from this point all over again. If we have to, for example, abandon this, let's say it's a --- real bad rain storm came up and lightning and all this other stuff, and we had to tear it down, and then when we set it up again we have to start all over from scratch ---

PAULINE: Uh huh.

BOB: --- from this point. Because it's continuous readings with it set up.

PAULINE: Because then that would be the difference in the temperature and the heat waves and all, all makes an effect. So that if you read one today, and then read tomorrow you wouldn't get an accurate reading.

ELLEN: Now that's another point, he sets in his laser both temperature and barometric pressure.

BOB: And as that changes, it changes, it affects the readings, the accuracy of the readings.

PAULINE: Well I can see then why it's important that he goes ahead and finishes a set before he stops.

BOB: They drill ---

SCOTT SMITH: ... so they can put a fence in that, holes through a telephone cable.

ELLEN: Well that's good.

SCOTT: Uh huh.

BOB: Scott's been doing this for about 17 years, this type of work. And he's, well as it is, he's the only one in Oregon and Washington for the federal government, well for the Bureau of Land Management, that's doing this kind of work.

PAULINE: Scott Smith.

BOB: Smith.

ELLEN: Of Newberg.

PAULINE: And you said he'd been doing this 17 years?

BOB: Yes, 17 years he's been doing this.

ELLEN: Surveying of some type.

BOB: Surveying of some type. He started out, you know, driving the rig for other surveyors, and he's now --- we do not have an official department of photo-grammetry, although he is considered, well he is, he is the only one doing this photo-gram metric work.

PAULINE: Okay, that's another word, I better get another pen; I probably grabbed the only two ones that were all leaked out. How do you spell photogram metric?

BOB: Ah ---

PAULINE: How do you pronounce it?

BOB: We'll do photo-grammetry first.

PAULINE: Photo-grammetry, okay.

BOB: P H O T O --- P H O T O, yes, G R A M M E T --- there's your first. Your photo-grammet --- R Y would be photo-grammetry.

PAULINE: Okay.

ELLEN: So that's what he actually is.

BOB: His official title ---

ELLEN: Okay ---

BOB: --- I believe is cartographic technician, I believe. You'll have to check with him. We don't go much by titles. But in effect he is really a photo-grammetist, or a fancier word they are using now is geodesist. I don't even understand what that means.

PAULINE: I'm not going to ask you how to spell that though ---

BOB: Geodesist ---

PAULINE: Geodesist ---

BOB: Geodesist --- there is no T in there. Geodesist --- something like that.

PAULINE: Yeah.

BOB: He'll know a little better than that.

PAULINE: And your name is Bob?

BOB: Uh huh, Ivy. I V Y.

PAULINE: Where are you from?

BOB: Ah, Portland. Sellwood.

ELLEN: Portland.

BOB: I'm one block from the city limits. (Laughter)

ELLEN: What are you officially?

BOB: A cartographic technician.

ELLEN: And what are you otherwise?

BOB: I'm a photographer.

ELLEN: Okay.

PAULINE: And you are on the BLM staff?

BOB: Uh huh.

PAULINE: Both of you?

BOB: All three of us.

PAULINE: Yeah

ELLEN: From Portland, the state office.

BOB: And the third fellow, I don't even know where Ed is --- he's hiding behind the rocks.

ELLEN: He's recording.

BOB: Okay, it's Ed ---

ELLEN: --- ward, his name ---

BOB: Edward, yeah, Zigoy. Z I G O Y --- O Y. Z I G O Y, Zigoy.

PAULINE: Well, that's not as hard as it sounds.

BOB: He's from Aloha.

ELLEN: That's a suburb of Portland.

PAULINE: Okay, I'm going to have to get ---

ELLEN: No, that's not ---

BOB: O H A, Aloha.

ELLEN: I think ---

BOB: A L O H A. But it's Portland.

PAULINE: Yeah, okay.

BOB: We're all from the Oregon State Office of Bureau of Land Management.

PAULINE: Okay.

BOB: And he's also a cartographic technician.

ELLEN: And does he have a specialty, or --- as yet?

BOB: Not as yet. Well, ah ---

JOHN HANF: Computers.

BOB: Not really, he ah --- this is Ed's first field trip in the photo-grammetry department, and this is probably my last field trip in it.

PAULINE: Uh huh.

BOB: Because I have taken over the photographic department. But he, you know, at his point that's --- we're all cartographic technicians.

ELLEN: And then there is John over there.

PAULINE: Yeah, I don't want to forget John. (Laughter)

BOB: Hanf.

ELLEN: H A N F.

BOB: That's H A N F.

ELLEN: Spell it John.

JOHN: Well, you spelled it.

PAULINE: Well, do it again.

JOHN: H A N F.

PAULINE: H A N F. I think I'll call him Doug. (Laughter)

ELLEN: Now, what are you?

JOHN: Range technician.

ELLEN: Other than general flunkie.

BOB: Gofer.

ELLEN: Yeah, Gofer.

BOB: Go for this target, go for that target.

PAULINE: You're on a temporary appointment. Where are you from?

JOHN: Eastern Washington, tri-cities.

ELLEN: But he is currently out of the Burns District.

PAULINE: While we're getting titles, Ellen, you've got a new one now this summer with your new job here.

ELLEN: Yeah, I was just wondering what --- (Laughter) Okay. I guess the official title is Environmental Biologist, which equals coordinator for Diamond Craters.

BOB: Ah, here comes Mr. Smith.

ELLEN: And I would appreciate it if you would mention my academic institution.

PAULINE: Portland State, and University ---

ELLEN: And Pacific University.

BOB: Other door, other side.

ELLEN: Because it's dual. This one is going to run until June 15th, and the Pacific University one is going to start maybe as of right now. It's, they're overlapping. What you

--- if you put it here, I hold an adjunct appointment with both of those. And I realize the Oregonian has a big prejudice over using a doctor for a female, but ---

PAULINE: But --- I'll dictate it that way.

ELLEN: Right.

PAULINE: Actually I may come closer to getting away with it than Connie will ---

ELLEN: It irks me no end thought when ---

PAULINE: I'll dictate it to the typist and she'll type it, and the northwest editor will be too busy to worry about it.

ELLEN: Well it annoys me no end though when they do an article like Connie's last summer when they said, it was fine to start with, they said Dr. Ellen Benedict, and Dr. Bruce Nolf, and then they went on and said, Mrs. Benedict and Dr. Nolf.

PAULINE: Dr. Nolf ---

ELLEN: And that was really ---

PAULINE: I ---

ELLEN: Actually they said Nolf, and Mrs. Benedict. And that's not; professionally it's not correct.

PAULINE: No, I'd rather see them just drop the title all together, and go ---

ELLEN: Well see they have this hang-up about using just the last name of a female. But that is, it's perfectly correct.

PAULINE: I think it's --- I see it changing. It's, I see it slipping by some of the editors sometimes.

ELLEN: Right.

PAULINE: I'll just go with it. Like I said, if the editor has a real busy day that day he'll never, never catch it.

ELLEN: I think the other thing I was told was that they don't like to use doctor for a PhD.

They only want to do it for a medical doctor, and that made me even more irritated. (Laughter) How are your eyes?

SCOTT SMITH: Pretty good. I don't know what happened over there, everything went clear out of level and I got a big break in my reading so I quit.

ELLEN: Was that on the butte we were just on?

SCOTT: Oh, no, the targets all look good.

ELLEN: Oh.

SCOTT: Just that the ground is so unstable --- it ---

ELLEN: You can see the heat waves rolling right down on the ground.

SCOTT: Uh huh.

PAULINE: Yeah. Well Bob gave me kind of a capsule lesson here. I think I understand what's going on. I'm going to pretend that I do anyway. And ---

ELLEN: You might show her the map that --- okay ---

PAULINE: You've been working at surveying for about 17 years?

SCOTT: Well all of that wasn't surveying. I started out as a scriber, and then transferred to the Service Center in Portland, and started going on field trips, kind of in Bob's position. And we went all over Arizona, Nevada, New Mexico, and did surveys similar to this. Mostly it was hunting section corners and doing photo I.D. from aerial photography.

PAULINE: Uh huh.

SCOTT: And then I transferred to Alaska when the Service Center fell apart. And I was aerial photographer up there for about five years. Then I transferred back down here into this position.

PAULINE: Uh huh. About how long have they been using this equipment with the laser and the computers and ---

SCOTT: Well, quite awhile. The equipment we've got is fairly new. But they've been

using lasers for what, 10 years I suppose. I don't know, maybe 15. They use microwave quite a bit also. Our
--- the extreme long-range instruments that we have are DM-20's. Ah --- they're electro tapes, aren't they?

BOB: Uh huh. M-20's, electro ---

SCOTT: The M-20 electro tape. And those we use, those will shoot up to 30 miles. But they're quite heavy, and each instrument weighs what, about 30 pounds?

BOB: At least.

SCOTT: Yeah, about 30 pounds a piece, and it takes two instruments, one on each end. Whereas the equipment we've got here, it's quite light and all we use at the other end is a reflector. We'll show you what those look like.

PAULINE: How far is it from this point back to the target where we just came from?

ELLEN: It's hard to tell.

SCOTT: Eight miles.

BOB: That's --- we got the map there.

SCOTT: Oh.

PAULINE: This is, this is Badger?

ELLEN: No, this is Square ---

SCOTT: Square Butte.

ELLEN: Square Butte.

SCOTT: It's about 5 miles.

BOB: Pretty good.

PAULINE: Well I feel pretty good judging distance in this country. It's not always easy.

SCOTT: Now see what we've done here is we've shot distances ...

PAULINE: Uh huh.

SCOTT: So what we do is we measure the angles, that's what I'm doing out here, this is the point we're on right now. And what I'm doing is just similar to what I've done on these other points. I set up right on the point, and then I measure the angles to these targets, both horizontally and vertically.

PAULINE: Okay, I understand the horizontal part, I'm not sure I understand the vertical part. That has to do with the elevation.

SCOTT: Right.

PAULINE: Okay.

SCOTT: Let's say that we've got a point here. Okay, now we've got a point out here someplace. We're looking down into the valley, so those points out there are lower than we are. So what we do is we shoot the distance directly between the two points. Okay, we measure that. And then what I do is, I measure the angle between horizontal.

PAULINE: Okay.

SCOTT: Okay, then I measure this angle right in here.

PAULINE: Okay.

SCOTT: And then we correct that, the distance to the horizontal.

PAULINE: Okay ---

SCOTT: So that we know the precise distance between these points.

BOB: Huh?

ELLEN: And that's actually measuring this, ah, handles the curvature of the earth, does it?

SCOTT: Oh yeah, we take that, all that into our calculations.

PAULINE: So that when ---

SCOTT: Also the refractions, and so on. We shoot, now we shoot a vertical angle from both places. See we shoot a vertical in here also, from this point back.

PAULINE: Does that --- does it double check, or will these equal?

SCOTT: Not quite.

PAULINE: Not quite.

SCOTT: Not quite. This is to take the refraction error out from the atmosphere. And our measurement distance is right across here, see.

PAULINE: Uh huh. So that by the time you put this on the map then it's going to be like you said, accurate down to the ---

SCOTT: Yeah, right.

PAULINE: --- finest degree ...

SCOTT: What we're doing is --- we hold well within second order. And there are three orders of accuracy. Now the stuff we're working from, the geological survey put in, and they did, they put this net in for the seven and a half minute quads which we've got right there. And they are a third order accuracy. Here's a point here on Rattlesnake. And this point that we're on right now is a GS point.

PAULINE: Uh huh.

SCOTT: And you ought to come out and take a look. It's just a drill hole in the top of a rock.

PAULINE: Okay.

SCOTT: And then what we do is extend their control. Let me start from the beginning. First of all, what we're going to do, we're going to map the Craters area here.

ELLEN: Bob shut it --- it's letting --- thank you.

SCOTT: Let me fold it ---

...

SCOTT: The objective of the whole thing is to map the Craters area. Okay?

PAULINE: Uh huh.

SCOTT: The whole, the whole thing. Now we're gong to use 1 to 24,000-scale photography. Now I don't know how much detail you want me to go into here. I mean I get back up, clear into cameras and all this.

PAULINE: Well ---

SCOTT: But let's just start from that. Okay.

PAULINE: Well, let's just get the general picture.

SCOTT: Okay. We're going to map this at 5-foot contour intervals. Okay. Now I don't want to get into plotters either. Uh --- okay, in order to do that with the instrumentation that we have, we're going to fly three flight lines of photography, that's what these lines are right here. Okay. This is the line that the airplane flies along, taking exposures as he goes along.

PAULINE: Uh huh.

SCOTT: Okay. We have end lap, each photo overlaps the other one about 60 percent. And we also have side lap between here, and we got about a 30 percent side lap in here, so that these photos will overlap 30 percent. Okay. Now to control the photography so that we can --- so that it can be put into a plotter, to compile the maps and draw these contour lines that you see here, we have to come up with a series of points. We're going to get ...

MAN: Bob ---

SCOTT: Okay, well let's just take the Craters area here roughly; you're going to fly the three flight lines of photography.

ELLEN: Ed --- come sit in the front.

SCOTT: Okay, now each one of these is a strip of photography, like this, that's one photo.

PAULINE: Uh huh.

SCOTT: Okay then the next one then, I'll offset them here slightly. The next one then will set in here like this, with a 60 percent overlap.

PAULINE: Uh huh.

SCOTT: And this is called a stereo model. Now this is what they use to set in a plotter to compile these maps. Have you ever seen a, stereo photography?

PAULINE: No, but I have a good idea now what, Bob explained sort of, it puts it into a 3-D so that you can make your calculations through ---

SCOTT: Right. Now in the plotter they set this up so that, and create this three dimensional image. Okay. They can do that with any photography.

PAULINE: Uh huh.

SCOTT: But they have to tie it to a point on the ground so that they can correct that three-dimensional model. This area right in here, okay, is floating. They create it ---

PAULINE: Uh huh.

SCOTT: --- and then it's there. It might be here, it might be here. Okay, let's say that this is it here. Okay, now what we have to do is come up with a series of points around that model that have coordinate values on them ---

PAULINE: Uh huh.

SCOTT: --- and also elevations, so that we can take this thing and correct it to the ground.

PAULINE: Uh huh.

SCOTT: Okay. Okay, that's what we are doing now. We're putting in the control, now we have a series of exposures here, we'll put one photo in there like that, okay. And then we'll have another photo sitting in there like this, and another one over here. These are three photos from the three different flight lines. Okay, we have a 30 percent end lap, I mean side lap in here. Okay, in this side lap area, when they put this into the computer ---

well first of all they take an individual exposure. Okay, one photo out of this thing, so we've got one photo here. They put it on what's called a comparator, and they measure --- now in each one of these there are tick marks on the sides all the way around, like this. These are standard in the camera, and they're projected right on the film at the time the exposure is taken.

PAULINE: Uh huh.

SCOTT: Okay. Then they measure from these relative stable positions two points out on the photo. Okay, now when they tie these together they put a series of points in between these. And now let's just draw in --- well, let's do this. In here is also a series of points. There is a series of points across here, and across here like this. These are approximate photo centers. These are tie points. Then we have another strip of photography over here, and these tie points are transferred to that model over here, or they're setting right out in the middle of this 30 percent sideline.

PAULINE: Un huh.

SCOTT: Make sense?

PAULINE: Uh huh.

SCOTT: Okay. So what we need to put this into the plotter is a coordinate value on these points. Now they can take any three strips of photography and tie them together this way, as long as they are about the same scale, and have the proper overlap. Now what we want to do is put control out here on the ground that will show up on the photography that we know a coordinate value for.

PAULINE: Uh huh.

SCOTT: Okay. So that's what we're doing here. This point here is in that 30 percent side lap area, see. This one over here is very close, and it's in there.

PAULINE: Uh huh.

SCOTT: Actually this point is over in here. So we've got a point in there, and then outside of here we have another point, over here we have another point. So what we're doing is putting control in here, here, here, and here. And then the same thing on the south end, and some points in the middle.

PAULINE: Uh huh.

SCOTT: Okay, when we put this into the computer, they tie these all together physically with the points on the photography. Out here they'll punch a --- they'll take a drill and --- okay, it's called a pug-marker, and it's a microscopic drill that they drill holes in the emulsion of these photos. Okay, and then they transfer that precise location to the next one. And out here they'll use a white area, an ant den, a rock, or a sagebrush, or something that they can identify for sure, on not only the stereo model, but the adjacent stereo model as well.

PAULINE: Uh huh.

SCOTT: Okay. So then we've got exact positions punched on all of these photos. Okay, we put these into the computer, and we tie them all together by --- see when we end up after --- let's say that this photo right here is going to have nine points on it. Its got the three points here that are the transfer photo centers, from this photo down here, and this photo up here. Okay, so we got a 60 percent end lap, so we have between every other photo we also have a 20 percent end lap.

PAULINE: Uh huh.

SCOTT: Okay. Now --- okay, once we come up with this, these are all tied together, we pull out a photo, and this is it here, we'll have nine points on it. Okay. These points again are photo centers, roughly photo centers, transferred back and forth all the way up that flight line.

PAULINE: Uh huh.

SCOTT: These points are tie points. See this photo, this other photo is going to set right in here like this. So what we're doing with these points here is tying these two photos together.

PAULINE: Uh huh.

SCOTT: Okay, then these points are transferred over to the next flight line. So you have the same line of points on this next fly line over here. Okay, this point is transferred right over here, and ... Okay, pretty crude, but ... Okay, so these two points are the same image right here.

PAULINE: Uh huh.

SCOTT: Okay, now we take this back to this photo again here, then we put it in the comparator and we measure the relative distance, plate coordinates they call it, from these points around here, over to each one of these. So we have an X and a Y value for each one of these. We're reading from this side over, and from the top down. So we come up with a plate coordinate. So many microns over here, so many microns down here to that point. That's the data that's fed into the computer.

PAULINE: Uh huh.

SCOTT: Then the computer runs up this flight line and forms what they call a strip. And that's all it is, is a strip of this photography, all tied together mathematically. Okay. Then they do the same thing with this strip, and the same thing with this strip. And then they put them together into what they call a block.

PAULINE: Uh huh.

SCOTT: Then they adjust all of those, any little errors, any errors you've got from punching the holes, you know, it's all done by people, so there is, there is little errors all through that. Okay. Tie all those together so everything fits, but they have a block of photography setting here, all tied together.

PAULINE: Uh huh.

SCOTT: But they don't know for sure where it is, okay ---

PAULINE: Uh huh.

SCOTT: --- in relation to the ground. So then we plug in the coordinate values for each one of these points.

PAULINE: Uh huh.

SCOTT: And then the computer takes those, see these are on here also, they are a little panel like you've seen over there. I don't know whether you've seen one yet, have you?

PAULINE: No, I haven't seen it yet, but we'll ---

SCOTT: It's a white V on the ground, is what I use. Okay, we know the exact coordinate of that, and it shows up on any photography that is taken of it. In this case, this one right up here is going to be on this strip, and this strip. Okay, the block has that point out there. We assign a coordinate value to it, and then the computer goes back and readjusts this whole block to fit those points.

PAULINE: Uh huh. And then as Bob explained then you can trace around your mountains and get the exact contour from that ---

SCOTT: Right, right. From this data, once this is all corrected. And then everyone of these points is given an X, Y, and Z value, so we know so many feet north, so many feet west, and so many feet vertically. Okay, every one of these has got that on there. Then when you set this in the computer, I mean in the plotter, and --- okay, then you got to draw a manuscript. Okay, the thing we're going to draw the map on.

PAULINE: Uh huh.

SCOTT: Okay. We'll go along and we say that this whole map right here is represented here. On this map is going to be a strip of points plotted through coordinates all the way down here. So we take this and put it in the plotter, set up this model, and then adjust it to this area right here. Once it is adjusted then they just draw the contours in. Does that make any sense to you?

PAULINE: Yeah, it does, surprisingly enough. When you started I thought, I don't know whether my mind would accept that or not, but yeah. That's ---

SCOTT: So what we're doing out here now is putting in these points, we come out and we put a panel on the ground and we set up in the center of that panel, and then we survey out. And all we're doing here is just surveying to achieve a coordinate value for that point.

PAULINE: Uh huh. And when --- now you're going to have contours at 5 feet you said?

SCOTT: Uh huh. Five feet all over the entire Craters area. And then we have two areas that we're going to put in 2-foot contours. And that's these two right here. Now the district, what they do, is send in a request stating that they want such and such. Okay, in this case they wanted a 5-foot of the entire area, and 2 foot of these two areas. And what we do is, we talk back and forth and kind of coax them along so that they get what they're after. They say that they have a certain job to do on the ground, and then we kind of suggest what contour intervals and what they need, what's ...

PAULINE: What will work for them. Is this, is this the ---

ELLEN: Yeah.

PAULINE: The Cinder Pit here?

ELLEN: See, the Cinder Pit is right here.

PAULINE: Uh huh.

ELLEN: Let's see if we can --- that's the Lava Pit Crater right there.

PAULINE: Yeah, okay.

ELLEN: Okay. So you don't need to publicize it, but this is the cave area that we showed you last July.

PAULINE: That's why you want the 2 foot --- okay.

ELLEN: And then this is the Central Craters Complex.

PAULINE: Is this a cave area also?

ELLEN: No, it's a very complex geologic area.

PAULINE: I'll just say there are two areas, very complex geological areas ---

ELLEN: Well, maybe you shouldn't ---

PAULINE: Even say that?

ELLEN: Yeah, you can say that, yeah, let me think about that a second.

SCOTT: I wonder if --- what we can do is --- when she makes a draft of this, call me up and read it to me over the phone, and maybe ---

ELLEN: That would be a good idea.

SCOTT: --- maybe I can suggest additional information, or whatever.

PAULINE: Right. Okay. I think under the circumstances ---

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