DISCOVERY PROGRAM ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

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NIEBUR: This interview is with Peter Bedini, MESSENGER project manager. MESSENGER stands for the Mercury Surface Space Environment Geochemistry and Ranging Mission. We are in his office at the Applied Physics Laboratory in Columbia, Maryland, and today is July 9th, 2009. I'm Susan Niebur and I'll be doing the interview.

Peter, normally, we sign a release form, and this release form says that the audio recording will be made during our interview here. It will be transcribed and you'll get an opportunity to review the transcription, make any corrections, changes, deletions that you feel are necessary for the integrity of the interview. A copy of the audio recording and the transcript will be placed in the NASA archives at the conclusion of this project.

I was hoping you could start by telling me a little bit about your background. You said you were involved with MESSENGER years before you became project manager.

BEDINI: Yes. I worked at the University of Maryland in the Space Physics Group building particle and field instruments for many years with Dr. George [M.] Gloeckler. In 1997, after the ACE

[Advanced Composition Explorer][1] mission launched, George began collaborating with the University of Michigan and invited me to continue working with him out there, and I did so.

I worked at Michigan for two and a half years, and during that time collaborated with the Applied Physics Lab on their MESSENGER proposal around 1998, I believe it was, to add a Fast Imaging Plasma Spectrometer [FIPS] to the Energetic Particle and Plasma Spectrometer [EPPS] instrument, which we did. So, that was my first involvement with MESSENGER. I left soon after, before that instrument was built, and, many years later, I became the deputy project manager in January of 2007 and succeeded Dave [David G.] Grant as project manager in September of '07.

NIEBUR: Great. So, you were involved with ACE, as well, before that?

BEDINI: Yes, we had two instruments on ACE - the SWICS [Solar Wind Ion Composition Spectrometer] and SWIMS [Solar Wind Ion Mass Spectrometer] instruments, that George Gloeckler built.

NIEBUR: Excellent, excellent. I have some background with ACE, too, so, it's exciting to hear. Okay, great. So, when you became deputy project manager, what were you doing just before that?

BEDINI: Before that, I was the project manager of the CRISM [Compact Reconnaissance Imaging Spectrometer for Mars] instrument on the Mars Reconnaissance Orbiter. I also for a year was deputy project manager for integration and test on the New Horizons mission to Pluto. And I was

[1] NASA's ACE collects and analyzes particles of solar, interplanetary, interstellar and galactic origins. The data contributes to our understanding of the Sun, its interaction with Earth, and the evolution of the solar system.

also the project manager—different times, not all at the same time—of our effort to become certified here in the department as AS9100.

NIEBUR: So, you had project management experience on both the instrument and the spacecraft level?

BEDINI: Yes, it was minimal on the spacecraft level. I was one of two deputies focused on certain parts of their testing.

NIEBUR: So, you became deputy project manager on MESSENGER, then. Were you doing anything else at the lab [APL] at that point, or did that become quickly a full time job?

BEDINI: When I first started as deputy project manager, I was working on CRISM and I ramped down CRISM to be full time on MESSENGER.

NIEBUR: So, you'd been away from the project for a while. Had things changed?

BEDINI: With MESSENGER?

NIEBUR: Yes.

BEDINI: Yes, a very long time. Well, yes, its design changed from what we proposed and it was built and worked. And, I was aware—the department is small enough that you keep abreast of what's going on with the other major projects just by walking through the hall. So, I was certainly aware of MESSENGER, some of its progress, and that it had been launched and how things were going. I knew some of the issues from—a lot of the people working on MESSENGER were working on MRO [Mars Reconnaissance Orbiter] or other things I've worked on. And so, I knew some of the low-level issues that were challenging the project at the time.

NIEBUR: And you came on as deputy, of course, to Dave Grant, which probably gave you a quick ramp up as to what was going on.

BEDINI: Yes.

NIEBUR: I see your offices are very close.

BEDINI: Yes, they put us in suites like this. Dave, of course, has been at the lab for 50 years now. We just had a little celebration. The wealth of understanding and experience that he has is wonderful. He wanted me specifically to deal with helping the science operations effort, whereas he was still taking the lead on most of the spacecraft and mission operations and navigation stuff at first. And that was very good for me to grow because I learned more about the mission design and nav being his apprentice, so to speak.

As far as the science, I actually have a masters in science, space science and have worked with space scientists and engineers for a long time. And so, I was actually pretty well suited to help him manage that science operations development. In an ideal world, the development of the Science Operations Center [SOC] is done before you launch. MESSENGER has a very long 6.6

year cruise until it gets to its final destination of orbiting Mercury. So, we had the time available to continue development in the cruise. We also had programmatic issues before launch that made it necessary to continue the development in cruise. So, we are still now developing capabilities with science operations that ideally would have been done earlier, but we're actually low risk doing them now because we still have a fair amount of time.

NIEBUR: Do you have a SOC set up?

BEDINI: We have a SOC set up over in Montpelier III building. We have used it, but it's not in use all the time. Right now, we're in a relatively quiet period of cruise where we have tracks every three days or so. We're doing a lot. This mission is extremely complicated and busy and we have six gravity assist flybys and six deep space maneuvers and lots of other activities.

But the SOC is really full of people and buzzing during our flybys. So, we've had two of those so far, and that's when it's really been used most.

NIEBUR: And for the first Venus flyby, were you still the deputy or had you become the project manager? It was October.

BEDINI: I wasn't on project until January of '07.

NIEBUR: Oh, January of '07. I'm sorry.

BEDINI: So, in October of '06 was the first Venus.

NIEBUR: Of course, not much happened then. But, you were there; you were deputy project manager during the second Venus flyby.

BEDINI: The second Venus flyby is the first time we turned all the payload instruments on and recorded data and had to orchestrate all the measurements of what actually had—although we have 7 instruments, we have technically 13 elements of the science investigation that have to be balanced when you're flying by a planet. So, we developed a command sequence to do that, and that was where we were cutting our teeth on what the process would be to develop that, and it worked very well. A couple instruments had issues that they needed to address. But, for the most part, all instruments worked and the flyby from a mission design point of view was very accurate, which is always a good thing. The first Venus flyby was not as accurate as all the ones we've done since then. So, we're only learning and getting better, I think.

NIEBUR: Sure. I think every team does, absolutely. So, during the flyby, there was a lot of activity, both scientific and engineering in terms of getting things right. Can you describe a little bit about what the atmosphere was like?

BEDINI: Most of the activity is in preparation for the flyby. So, these instrument teams all have to say what they want to do, and then we have to deconflict and analyze the opportunities to be sure that the spacecraft can do the high priority measurements of each instrument. This requires a lot of attitude control and pointing changes as we speed by the planet at a very close distance. And so, there's engagement by the science team and the mission ops team to put together all the commands that need to be done to control the systems and the spacecraft and the instruments during the flyby.

Mission design and navigation are busy early on trying to figure out exactly where our endpoint is such that we continue—the highest priority for all of our flybys is to get the gravity assist we need to continue on orbit and to continue on track and get on into orbit. So, in a way, everything else is gravy. At least that's the project management point of view. We were able to exercise the payload and learn how we need to do that in the future.

The science team then got really busy again after the flyby when the data came down, and, of course, is looking at this brave new world of images and other spectra. So, then things quiet down for a little bit. There's a deep space maneuver after every gravity assist, and that's as critical as the gravity assist for continuing on track for orbit. But there's no real science involved then for the deep space maneuvers, and so it's sort of a smaller version of the gravity assist.

NIEBUR: We tend not to hear about them as much, I think, but I don't know if that's true on the project management side.

BEDINI: Yes. Well, you don't get the pictures back and you don't get the exciting data back from the deep space maneuvers. But, when you're burning this large velocity adjust engine, even if it's just three seconds, it's a very nervous time because you're going to be sure it burns at the right time for the right duration at the right level, and you have very little data right away to tell you whether it is. You get a Doppler track only, and then after you get telemetry again later, you realize how well or poorly you did.

NIEBUR: Right.

BEDINI: So, in a way, those are more nervous times for me than a flyby, because in a flyby, you're cruising. You've set it. You've aimed there. You're sort of done. It's going to go by, and you don't have a lot of activity on the spacecraft to get it to go by the planet.

NIEBUR: Okay. To follow up on something you said about the instruments, I know this isn't exactly related, but you said the science team had to decide what the highest priority science was. Were you aware of how that happened? I mean, the science team, do they all—did every instrument say, well, this is our top priority, and then some subset decide or do they decide all together or was it Sean [C. Solomon]? There are a number of different ways to do that. It's kind of interesting.

BEDINI: Well, the science team was told that they had to put together what they wanted to do for the Venus, the second Venus flyby. And then, we had, I believe we called it a preliminary design review for the flyby where we presented the priorities of the flyby, starting of course with getting the gravity assist. And see, the Mercury ones are a little different, because with the Mercury flybys, we're actually getting data that addresses the high level requirements of the mission, whereas Venus was more of a practice, but also very good scientific data came out of it.

But, in any event, the project science office put together the measurements that the teams wanted to do. And actually, usually, all of it can be accommodated, but there are times when, if the MASCS [Mercury Atmospheric and Surface Composition Spectrometer] instrument wants to turn and do something at a certain point, and that means that the MAG [Magnetometer] instrument can't do what it wants to do, then there has to be some conflict resolution, and where, ultimately, Sean is the one who decides what they'll do.

That came up in this current planning for the third flyby of Mercury where a decision had to be made. Often, the resolution is simply that the MAG test is done a little later and they get 95 percent of what they wanted instead of 100 percent, because otherwise, if MASCS didn't do what they were doing, they wouldn't get any of it.

NIEBUR: Right.

BEDINI: So, there's actually a very good rapport among the science team members on how to get everything done.

NIEBUR: That's great to see.

BEDINI: The science teams are broken into four discipline groups, each with a lead. So, when Sean needs to get consensus from the science team, he polls those discipline group leads. And then, if there's still a conflict to resolve, he resolves it.

NIEBUR: That's a smart way to do it. This is a big team. How big is the operations team now that you guys have been in flight for five years?

BEDINI: We're currently running at about 15 full time equivalents. It's more than 15 people. There are very few people that are working full time on this mission. APL is a matrix organization, so most people work on more than one project.

NIEBUR: Right.

BEDINI: But, it's roughly 15 full time equivalents for the mission ops and roughly 17 for the science operations, depending how you define it.

NIEBUR: And so, the major job now is to make sure that the flybys go well and to get ready for MOI [Mercury Orbit Insertion], or is there a lot of day to day?

BEDINI: Well, what I see, and I often get up and talk in front of the science team and try to remind them that the biggest risk we have right now is not being ready to get all the data that we need in orbit. The engineering team and the mission design and nav team have proven experience with doing the deep space maneuvers and flybys such that, they still have to be well prepared, but I can sort of follow that and be confident that they're doing what they need to do.

The thing that's new is going to be having two flybys a day. Once we get into orbit, we will be having two Mercury flybys a day. Looking at all the energy and effort it has taken to plan, execute and analyze data from a single flyby, and I'm imagining this happening twice a day, obviously, we have to automate. We also have to be prepared with very robust contingency plans.

NIEBUR: Right.

BEDINI: So, do you want me to talk about how we're planning for orbit?

NIEBUR: Please do.

BEDINI: We are planning all observations by all elements of the science payload for an entire year, and we lay it out; we call it the baseline plan. In an ideal world, if DSN [Deep Space Network] tracks didn't change and if nothing breaks and there's no change at all, then in an ideal world, you'd just start running that and you'd run it all the way through.

But, we know that we're going to be missing DSN tracks or they're going to move for some reason or we're going to have to—we've missed an observation because of some—perhaps an error in a command or something like that. So, we have to be prepared to redo this baseline plan routinely during the year of orbital observations. So, at any one time, we will be preparing week-long command loads. And roughly, every month, what we're going to do is this data validation to be sure that the data we got down on the ground is the data we wanted to get to achieve the science. And if for any reason, it isn't and there's a gap, then we rerun the baseline plan from that point to the end of the mission and try to fill in the observations that we've missed into opportunities that are in this plan.

We also have opportunities that are sort of placeholders for targeted observations, meaning there are a lot of targets we now know after two flybys we want to target with our MASCS and MDIS instruments in particular, but there will be more assuredly that we find and don't know about yet. So, we have capability to throw those into the plan and then rerun this baseline. It automatically analyzes opportunities and comes up with schedules. It has the DSN tracks in there and it's based on a science planning tool called SciBox [Autonomous Science Planning System] that was developed here and used on Cassini, MRO, and other missions. This is the first time that's being used to coordinate the measurements of a full payload of seven instruments.

NIEBUR: Wow. That's fantastic that you have that kind of a tool.

BEDINI: It's quite impressive and it's new, but it's been tested. It spits out what are called SASFs [spacecraft activity sequence files], which are the files that with a little modification end up creating the commands that are radiated to the spacecraft. We can actually shoot out the command files for that whole year and run it by the mission ops people through their testing, and they can see whether there are problems with it or verify, and we've done that already. We haven't used commands generated by SciBox for any of the flybys. They have been manually created because we have the time to do it, and also, SciBox is still—it's not premature, but it was in development.

So, that's the approach for the year, and that's the risk that I talk about with the science team is the focus. The process we follow in orbit to break off a few weeks of this plan and bring that to the near term science planning people who prepare the weekly command loads. Meanwhile, the advanced science planning people rerun the baseline and make sure everything fits in. These are things that we have to practice and be sure that we're ready. And that's where these, I call them rehearsals, but they are day in the life [DITL] and week in the life [WITL] tests that we're doing. WITL 2 is starting Friday, tomorrow. These are essential to get the whole science teams, those that will be involved in the week-to-week operations, to understand what they'll need to be doing routinely for a year, an Earth year of observations.

So, we started with DITL, day in the life, and WITLs are a week in the life and we might go to FIDLs if we have to go to fortnights. I don't know.

NIEBUR: So, they really are going through a rehearsal, I mean, not a rehearsal, but going through an understanding what it's going to be like.

BEDINI: These first two are just going through not real time what are the processes, who's doing what, and they come up with a scenario. Okay, if EPS wants to change something, how do they put in that request, who okays it, when does it go to the advanced science planning people, and then how is the command load built? They do it slowly over weeks. Now, the next one after this, the third week in the life test will be more of a real time test. In other words, in any particular week, there'll be several command loads being worked. One will be being written. One will be being tested by different people. So, that coordination starts. We'll have half a dozen or more of these.

I worked on MRO, and the orbital readiness tests that were done were essential. That was a shorter cruise, of course, but actually trying to do it in real time is when you learn that you either can't handle it or you can handle it and you make changes. So, that's what we're doing, and it seems like we have the luxury of time because we have over a year and a half before we're in orbit, but I see it as being just enough time to get all this done.

NIEBUR: So, does it seem very close to you?

BEDINI: It seems closer than you would think.

NIEBUR: Yes?

BEDINI: 2011 still sounds far away if you just say it. But, if I look at what—we have a third flyby in September. We have a deep space maneuver in November. And then, we have the year of 2010 basically to be prepared for orbit.

I think we're on track. We're making great progress. We have people like Brian [J.] Anderson, the deputy project scientist, who has stepped up to lead this effort of coming up to the orbital baseline plan.

NIEBUR: Oh, good.

BEDINI: And he's doing a superb job, and his team. It's a very good, very talented team working together.

NIEBUR: Excellent. Well, I can't wait to hear more. I've been very impressed with how much MESSENGER has accomplished even during the flybys. You know with science not being the priority, they're still putting out a lot of science. They're putting out actual papers, which is something that is really, as you know, very important.

BEDINI: I kept repeating the mantra before the first flyby that the priority was just getting the gravity assist. But, boy, were we all thrilled with it. The payload worked almost flawlessly. The accuracy of the flyby was tremendous, and the spectacular images coming back from 125 miles from the surface are just wonderful.

NIEBUR: You're gesturing to an amazing poster here of MESSENGER.

BEDINI: That was the first picture that came down from approach on the first flyby.

NIEBUR: It's beautiful. That picture of Mercury is absolutely beautiful. It's interesting to hear you say that as the project manager. Have you found that the engineering side of the house and of the team is also excited that not only it's working, but we're going to Mercury, that we haven't been there in a long time?

BEDINI: One of my jobs is to make sure that everybody down to the littlest detail and smallest contributor to this project understands that that contribution is part of the success.

NIEBUR: Good.

BEDINI: I've been in places where that effort wasn't always taken to share it. And so, I know I could do better with it, but I do try to make sure that everybody understands. Typically at APL, the engineers, the scientists and the managers work much closer together than at many other institutions. So you will just see a scientist over in an engineer's office and they're working together to make sure they understand what's going on. A lot of that excitement of this kind of data return does go through just because of the way that people collaborate.

NIEBUR: Excellent. Have you seen that then feed forward into how they work together in the crunch, like in a flyby?

BEDINI: Yes. And I have to be honest - there are certainly times when there are personality conflicts and the stress gets to people. But, the fact that they're getting together and closely working together and not just sort of saying, this is my table and that's his responsibility. That's the kind of stuff that makes for a successful team: recognizing what your capabilities are, how you fit in and the fact that what you do is contributing and what other people do all work together for one unified goal.

NIEBUR: Were there any other keys that you found to be very useful in terms of helping the team work together, both the science and the engineering side?

BEDINI: Well, the standard sort of leadership things. To be sure that there's open and free communication, be sure that everybody's contribution is recognized as an important part of what's going on. The more people feel part of this, then the more open they're going to be to taking direction or working with others and understanding what people on the other side of the interface are doing. And of course, handing out free MESSENGER pins helps a lot; we have t-shirts and things like that.

NIEBUR: Excellent. It's all about team building.

BEDINI: Yes.

NIEBUR: Well, that's really good. Well, Peter, thank you for spending time with me today.

BEDINI: Quite welcome.

NIEBUR: I appreciate it very much and it wouldn't be complete without you, so thank you.

BEDINI: You're welcome.

[End of interview]