

DISCOVERY PROGRAM ORAL HISTORY PROJECT

EDITED ORAL HISTORY TRANSCRIPT

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NIEBUR: This interview is with Andy Cheng, who was the project scientist for the NEAR [Near Earth Asteroid Rendezvous] mission and a Co-I [investigator] on CONTOUR [Comet Nucleus TOUR] and MESSENGER [Mercury Surface, Space Environment, Geochemistry, and Ranging], as well. Today is Friday, July 31st, 2009, and we are in his office at the [Johns Hopkins University] Applied Physics Laboratory [APL] in Laurel, Maryland. My name is Susan Niebur and I'll be conducting the interview as part of the Discovery Mission History Project. Andy, thank you for agreeing to speak with me.

CHENG: It's a pleasure. Okay. Well, we just started talking about CONTOUR, which was our first successful Discovery mission proposal. You know, NEAR was not really proposed. And it's also our first experience with a PI [principal investigator] mission. NEAR was not a PI mission. And it was curious in many ways for that reason because NASA didn't really know how it was supposed to be run or how it would work out, and we were almost told to make up the rules as we went along. So, we were the first—lots of firsts—we were the first ones to get on the internet because that was 1992. NASA had no website at the time.

NIEBUR: I didn't remember that. Really?

CHENG: It's before your time, I know. They had no website. It was the beginning of the World Wide Web.

NIEBUR: Right, right.

CHENG: And so, it was NEAR that put up the first mission website. It looks primitive today, but it was the first one. And the AO [Announcement of Opportunity] for participating scientists, that was the first one also that the call went out over the web. We had to do it for them because there was nobody at NASA who knew how.

NIEBUR: Really? Wow.

CHENG: Well, there was only a couple of people in APL who knew how.

NIEBUR: Sure.

CHENG: It was all new.

NIEBUR: --Brand new.

CHENG: It was brand new. We were the first ones to have to deal with PDS [the Planetary Data System] because that was just starting up, also. There was a lot of resistance because a lot of the

people who were on our science team were Galileo people, Joe [Joseph] Veverka [principal investigator] for instance.

NIEBUR: Right.

CHENG: And this business of not allowing people to have proprietary data rights, that was an innovation.

NIEBUR: That was new then.

CHENG: That was new then. A lot of people didn't like it. That was one of my biggest problems, convincing people that NASA wasn't going to change its mind. We've got to do this. And they were saying no. So, also at that time, NASA had not decided how to procure future Discovery missions. Everyone agreed that the model followed by NEAR and [Mars] Pathfinder was not to be followed again because it was a curious situation where they were both directed missions.

NIEBUR: Right.

CHENG: But initially, NASA couldn't decide—well, one, wanted to direct it to APL and wasn't allowed to and that had to compete between APL and JPL [Jet Propulsion Laboratory, Pasadena, California]. And then, after that competition was determined, still wasn't allowed to award it. But that's NEAR. Okay.

NIEBUR: We won't talk much more about NEAR, but how did you get involved with NEAR? I don't know that story.

CHENG: That story—well, I was brought in by APL, Tom [Stamatios M.] Krimigis. Tom Krimigis was, as you know, the APL department head at the time and he was working with Wes [Wesley T.] Huntress, who was the AA [Associate Administrator for the Office of Space Science at NASA Headquarters] at the time. Although he may have been—

NIEBUR: He was DD [Division Director] first.

CHENG: He may have started out as DD. But certainly when the program started, he was the AA. They wanted to start NEAR, but one of the concerns was, okay, APL has to have a project scientist. Who would it be, right?

Now, at the time, I was the only person who had any involvement in planetary science. I was a COMPLEX [Committee on Planetary and Lunar Exploration] member already by then. It was in the mid '80s. And I had, at that time, my first encounter with the NEAR mission because there was an SWG [Science Working Group] report that was reviewed by COMPLEX in that period.

NIEBUR: Oh, so you had read it from that perspective. How interesting.

CHENG: Yeah. So, I was on COMPLEX. I heard about it. I said, yeah, it's a good mission. This is 1989 or something. We're talking about, okay, NASA wants to see it as a way to do small planetary missions. Which would be a good one? You know, I said, well, NEAR. NEAR. That's the one.

So, Tom Krimigis was the one who got me involved into the APL push to get a low-cost planetary mission line started. We were at the time proposing to follow the Explorer paradigm. You know, it's a small mission. It's fast. APL knows how to do these things. So, that's how I got involved and became project scientist.

NIEBUR: Wow.

CHENG: I was the only planetary scientist—not even a planetary scientist. My background was in space plasma physics. So, Tom has this—he was well known—I was a Galileo IDS [interdisciplinary scientist], also, on the magnetosphere side. So, people in the planetary community knew me, but as sort of one of the enemies because I was one of the particles and fields types [as opposed to one of the] imaging types on Voyager and on Galileo, which is what people remembered at the time, and I was fighting because the imaging people wanted to point the cameras and they wanted to turn the spacecraft and do things like that. Particles people wanted to spin the spacecraft.

NIEBUR: Right. There's different objectives.

CHENG: They have different objectives. They want to look at different things than the imaging team. So, here I am. They knew who I was. They figured they didn't really know me that well, but okay. That's how I got roped into NEAR.

At the time, my thing was interactions of the particles, with sputtering, with the surfaces, and with the atmospheres and so on. So, I at least had some contact with what you might call the core planetary scientists.

NIEBUR: Interesting. All right.

CHENG: You know, they had seen, they could—they knew some of what I was talking about, right? So, they talked to a lot of the other guys in the field. Plasma physics—what do you know about that stuff—you know, plasma waves. And so, they at least talked to me.

NIEBUR: But then, NEAR was a success.

CHENG: NEAR was a success.

NIEBUR: A big success, I think.

CHENG: Right, right.

NIEBUR: And that's documented all over the place [and in various books]. So, we won't go into that part of it, but tell me about CONTOUR.

CHENG: NASA decided AOs; NASA decided PI missions. CONTOUR was APL's first experience with a PI mission. We had an outside PI. That was Joe. Joe was a great guy. So, I naturally got involved from the [beginning] because again, Joe needed people here to talk to.

At the time, we had been doing NEAR. We had by then a few people here because they'd been hired to work on NEAR. Scott Murchie was one of them. Deborah Domingue was another. In the early days of CONTOUR, it may have been only Scott, and then there were some NEAR post-docs, but they weren't staff members. Scott was probably the only other one.

NIEBUR: Wow.

CHENG: Anyway, he's involved in CONTOUR as well. I'm the one who actually came up with the name CONTOUR.

NIEBUR: Oh, really?

CHENG: Yeah.

NIEBUR: Cool.

CHENG: Yeah.

NIEBUR: Very cool.

CHENG: Yeah. Oh, and we had Bob [Robert] Farquhar here at the time.

NIEBUR: Right.

CHENG: Farquhar was also a key player in getting NEAR and CONTOUR both because he came up with the trajectories. And to this day, I don't know when those trajectories were actually discovered, whether it was, you know, decades earlier. He just came in and had boxes and boxes of folders and things like that.

NIEBUR: Oh, interesting.

CHENG: So, I don't know when these trajectories were actually discovered, but a long time ago. Anyway, I've never known a time when Bob wasn't talking about something like the CONTOUR mission because that's always been his first love, you know, multiple flyby and comets.

NIEBUR: Right.

CHENG: So, that was CONTOUR. Of course, Joe's been a comet guy from way back. He was a student of [Fred] Whipple. So, CONTOUR was APL's first one. It was also at the time NASA was more focused on low cost than it is now. So, I suspect it won also because it was just a flyby mission, very simple payload and it was low cost, lower cost than—by a lot—than MESSENGER, for instance.

NIEBUR: Sure. That was like \$167 million. I mean, it was very low cost.

CHENG: Very low cost.

NIEBUR: It was amazing what was planned.

CHENG: Yes.

NIEBUR: So, how did the team get put together for that one?

CHENG: It was a PI mission. Joe did it.

NIEBUR: Joe picked it?

CHENG: Oh, yes.

NIEBUR: Now, did Joe pick the science team?

CHENG: Yes.

NIEBUR: And did he come down and—what kind of involvement—having not been involved in that side of things, I don't actually know how a team gets put together. So, did the lab propose certain project managers and things like?

CHENG: Oh, yes. Project managers and the engineering team, the lab puts together because for one, Joe doesn't know the people.

NIEBUR: Exactly. That's not his expertise.

CHENG: Not only that. He doesn't know who's available and who can do what, what needs to be done. So that was done more in the style of an old style mission. The implementing institution has to do that.

NIEBUR: But the science team Joe put together.

CHENG: Put together, absolutely, because we don't know that.

NIEBUR: But there were a lot of people from APL on the science team for both CONTOUR and MESSENGER.

CHENG: Well, MESSENGER was already later. It was much different. It was a few rounds later.

NIEBUR: Okay. Well, we'll just stick with CONTOUR then.

CHENG: Stick with CONTOUR.

NIEBUR: Okay.

CHENG: Yeah, CONTOUR was an earlier one. It was done more in the purest of what you might call the faster, better, cheaper with emphasis on faster and cheaper.

NIEBUR: So, in your perspective as a Co-I on that mission, I imagine was a little different than when you were a project scientist.

CHENG: There was much less of a role.

NIEBUR: What kind of involvement did you have during the formulation phase?

CHENG: Oh, we were sitting down with Joe. We were talking about, you know, it's discussions. We're deciding which instruments we wanted, what they had to do, what the mission was about. There were also questions about targets. CONTOUR was proposed a number of times.

NIEBUR: Right.

CHENG: And then, after we had the failure on CONTOUR, there was a new version of it proposed again. And we were actually punished on Discovery 12 because CONTOUR was one of our two missions that were category one. This actually came out and NASA decided not to select anyone. But that was because they couldn't see their way to selecting APL for that opportunity. So anyway, CONTOUR has an interesting history.

NIEBUR: These things are always difficult. And in fact, everyone has difficult moments because when you're given so much [meaning so little] money. And you have such a large project, nothing can be perfect.

CHENG: And in retrospect, I think, CONTOUR and MESSENGER both exposed limits of, I think, faster and cheaper, better. Once you get to a certain level of complexity, once the institution starts taking enough jobs that they have to actually bring in new people or that they have to get outside the—they have a core, a few people who always get asked to do everything within APL. And then, there are structural issues and there's cultural issues APL had to improve because [it had to act] less like the small entrepreneurial kind of outfit it was before and more like a NASA center. Arguably, we had gone too far because now we're just a small—APL as a space department is much bigger now than it was then.

NIEBUR: Oh, it's huge, yeah.

CHENG: Well, it's still tiny compared to JPL and Goddard, but it's huge compared to what it used to be.

NIEBUR: Right.

CHENG: So, it's gotten much bigger. It has taken on more quality process. You know, it's AS9100 certified now, you know? The whole lab is probably eventually going to be ISO9000 certified in a year or two, so things have changed. Anyway, CONTOUR was different. And I was just in a roundabout way trying to explain why my involvement with CONTOUR was less. The other reason was that we were trying to win other Discovery missions at the time.

NIEBUR: Sure. Of course. No, you're always at that.

CHENG: Yeah, we were trying to win another one.

NIEBUR: Okay. So, during development—and like I said, I'm just trying to get a picture. So, during development, the science team, even if you were co-located here at APL, clearly, that was an asset to the mission, right? Because you got to know what was going on more often.

CHENG: Right.

NIEBUR: Did you interact with the engineers much?

CHENG: Sure, sure, sure.

NIEBUR: Was it just because you were co-located or was that by design?

CHENG: It's by culture and by design.

NIEBUR: By culture.

CHENG: Yeah. No, sure, that's one of the things that makes APL a little different, I think. It is a smaller institution and people are—we just talk to each other. So, I think Scott Murchie—you should probably talk to Scott if you want to know about CONTOUR. He had more daily interactions with Joe and with the instrument team than I did. And partly, the reason was that I was also working two other missions, the Aladdin [proposal] and MESSENGER.

NIEBUR: Oh, boy.

CHENG: And Aladdin was another one of our Discovery mission concepts that never made it.

NIEBUR: Right.

CHENG: Got a little close. It got to step two a couple of times, and Carle [M.] Pieters is the PI, [but it] never quite made it. And then, MESSENGER.

NIEBUR: Which did make it.

CHENG: Which did make it.

NIEBUR: So, let's talk about MESSENGER. So, how did you get involved in that?

CHENG: It's the same kind of thing.

NIEBUR: Okay.

CHENG: People wanted to—

NIEBUR: Same group of people, because there seemed to be a lot of overlap on the science side, but I don't know about the engineering side?

CHENG: Engineering side, not so much; there's obviously more of those. But, yeah, it's a small number of people. It's true at every institution, small number of people tend to get asked to do anything. Headquarters is like that, too.

NIEBUR: You looked weary when you said that, but yes.

CHENG: And so, I was involved with all of those.

NIEBUR: Okay.

CHENG: Some were successful. Some were not. MESSENGER was also proposed many times. MESSENGER was subject also of actual program mission studies because it was a Mercury dual orbiter. It was a previous JPL study of a Mercury mission.

NIEBUR: I didn't realize it had heritage to that. Really?

CHENG: Yeah.

NIEBUR: Okay.

CHENG: You can go look it up. The last version of it that was studied as a strategic mission was Mercury Dual Orbiter.

NIEBUR: I've heard of it. I just didn't realize it was connected. But of course.

CHENG: Well, it's because there hadn't been a Mercury mission in forever and ever.

NIEBUR: Right.

CHENG: And so, it was studied. At that time, it costed at like a \$700 million mission.

NIEBUR: Wow.

CHENG: Wow. Yeah. So, MESSENGER was going to come in for half that or less actually and say it was a Discovery mission. I remember the first time I talked to Tom Krimigis—this was during the days of Mercury Orbiter—and said we ought to propose MESSENGER for Discovery—we proposed the Mercury Mission. We had MESSENGER then. We ought to propose a Mercury mission for Discovery. He was like, are you nuts? But, I mean, not too many years after that, he was involved.

NIEBUR: Wow. It's a big mission. It was always a big mission.

CHENG: Well, no, it wasn't. It was proposed in the days we had just won CONTOUR and we had been proposing Aladdin and MESSENGER, and both of those made it to step two.

NIEBUR: Right.

CHENG: And they were competing against each other and they both came out very well. And scuttlebutt has it—and Tom would never admit this—scuttlebutt has it that he was asked by Headquarters, okay, which one do you want?

NIEBUR: Wow. Wow.

CHENG: So, that's why we have MESSENGER.

NIEBUR: It's the amazing the things it comes down to.

CHENG: Yes.

NIEBUR: But, even back at selection Ed [Edward J.] Weiler, who was the selection official then as he is now, he made comments that this is a really big mission and it's great that we're getting in a Discovery box, so I think it's going to be a bit of a challenge.

CHENG: It was just a little bit outside, but it was only a little bit outside, but it was only a little bit.

NIEBUR: And it was the opportunity to propose. There wasn't a New Frontiers then, so it was a way of getting it into the system.

CHENG: Right, right, and to tick off another planet.

NIEBUR: Check.

CHENG: Check, yes.

NIEBUR: So, as a Co-I, anything about the proposal experience that particularly stands out to you?

CHENG: Being Co-I on a proposal is a lot better than being the PI. Or the project scientist.

NIEBUR: Really?

CHENG: Let me tell you—well, it's because, if you've written a review paper or anything like that, you would know. One person ends up doing the bulk of the work. It's the PI.

NIEBUR: Sure.

CHENG: That's just the way it is. Okay, his name or her name is going on the proposal. That's all there is to that, so that person ends up doing the lion's share of the writing. Now, there are good and bad PI experiences if you go around and talk to more people. We've had, I think, well, reasonably good luck. That's because we recruited our PIs. This is true for Sean [Solomon] for instance. Tom [Krimigis] and I sat down together and asked ourselves, who should be our PI. Okay. I don't know who the first to suggest it was. It was probably me. So, we recruited our PIs. I think Joe was probably also recruited by us. Carle was certainly recruited by us. I think JPL does that, too. They sit down and say they want to propose something. Okay, we need a PI.

NIEBUR: Sure.

CHENG: That's how they do it.

NIEBUR: Well, you've made some amazing picks. I mean, quality, quality people.

CHENG: There's not that many people out there, especially in the early days when the PI mission paradigm itself was just getting set up. You didn't want to screw up. You didn't want to have a problem. So, there's only a small number of people who were on the same—scientific qualifications are necessary, but that's not even the biggest part of it. It's knowing something about missions and seeing how they work with engineers and also how they handle Headquarters and how they handle the program [management], whatever. So, it's a whole variety of things. So anyway, we recruited those. Also, there was the feeling that nobody at APL for any of those was of sufficient stature or experience or whatever to be a PI.

NIEBUR: And with that kind of judgment, are you looking for a name?

CHENG: Step two.

NIEBUR: Experience? What makes a really good PI? The things you were listing were fascinating. Coming at it from an implementing organization perspective, part of what I'm doing is looking at it from this wide range of perspectives, but what makes a really good PI, from an APL type perspective?

CHENG: That's a good question.

NIEBUR: Not that you're speaking for APL, but from an implementing organization, what are you looking for in a PI?

CHENG: There's a number of different perspectives when you're choosing a PI. I guess one of the biggest considerations—well, I'll name this and they'll say, oh, he's your PI.

NIEBUR: Okay.

CHENG: So, that's number one, which is the cachet to help you win the mission. And then there's the consideration, “Okay, what if we win and we're actually stuck with this guy.” And all right, he better be able to work with the engineers, better know how to listen, better realize that, yes, you're in charge, but you're not really because they have to be able—PIs don't know everything and they need occasionally some—they have to know how to delegate. You know, these projects are so huge. It's the only thing that's going on and they can't get their fingers into everything.

NIEBUR: Exactly.

CHENG: There are PIs who try. There are PIs who almost can't stay out of things, and that's bad, because then decisions can't be made. There's just too many. You know, that's a serious problem, micromanaging of a PI. And then, there's PIs who can't get engaged, because they think that all we have to do is write the papers and show up in the news and say no, you can't change this or you can't change that. Okay. So, you've got all types. You know, PIs are people, too. So, you've got people not engaged enough, people engaged too much, people who won't listen, people who won't make decisions. So there's good news and bad. I mean, Headquarters has seen both.

NIEBUR: Absolutely, absolutely. You're not surprising me.

CHENG: We've had reasonable luck so far. And the other thing is that being a PI of a mission is different from being a PI of an instrument.

NIEBUR: Yes, it is, and I think that's something that's come a little late to some of the PIs. You need to have a bigger picture [outlook] and understand that you're representing and selling.

CHENG: You have to delegate more.

NIEBUR: Yes.

CHENG: Right. You can't make all the decisions about everything. You know, the instrument's a small effort, 10, 20, 30, even 30 million is starting to push it, but it's a small instrument, there's only going to be five or ten people working on it. So, it's a small group. That's a group that you could supervise day in, day out, do everything. Okay. That's fine. When you get to the point where it's a mission, and now there's hundreds of people working on it, you can't do that. It's just impossible.

NIEBUR: Right, right.

CHENG: You have a core group that you talk to, and then they have to manage.

NIEBUR: Exactly. Now, one interesting thing, you've been on both CONTOUR and MESSENGER. And one of them [the PIs] was located at Cornell [University, Ithaca, New York] and one of the PIs was located downtown. Did you find that the interactions with the PIs changed because of being close?

CHENG: Being close helps, of course. And Ithaca's not that far away. So, Joe can hop on a plane. He doesn't mind hopping in the plane at five in the morning, showing up a few hours later.

NIEBUR: Wow. Really?

CHENG: Yes, so that's what it takes?

NIEBUR: Yes.

CHENG: So I don't think location and distance are really an issue for CONTOUR. It's really more a matter of Joe was a faculty member and he was part of the time department chair. Also, he had students. He never stopped teaching, never took a sabbatical.

NIEBUR: Really?

CHENG: Yes. So, that was more of a problem, that he had other things. And so, there were times when he was inaccessible to us because of all the things he had to do. The same is true for Sean.

NIEBUR: Right.

CHENG: That's more of a problem actually than how far away they are.

NIEBUR: Interesting. And yet, that's going to be a fact of life unless you have a PI coming from a lab.

CHENG: And even then, they have other things to do, they have other things to do.

NIEBUR: Exactly.

CHENG: So that's actually another one of the big considerations. Is the PI willing to make the commitment? And one of the things I've been struck by is that, in many respects, the decision to be a PI is almost like a decision to campaign for a political office.

NIEBUR: [laughter]

CHENG: No, I'm serious. You have to drop your regular life if you're serious and you want to do it. You have to drop everything else and you have to take a big chance.

NIEBUR: Wow.

CHENG: If we win it, okay, fine, you've got a job for a few years. But, if you don't, time to go back to what you were doing before. So, it's a big risk. There's a big risk. If you don't make that commitment, take that risk—

NIEBUR: That's a really good point. And with so many really high-quality proposals, you're competing against 25, 30, 40 other proposals, depending on the year.

CHENG: It's a lot like running for political office. So yes, you have to be willing to make a big-time commitment, take a big risk for a long time.

NIEBUR: Being a Co-I is less of a commitment. You're able to do other things and you're not all consumed.

CHENG: You're not consumed, right. Your name goes on the proposal, your writing responsibilities—the amount of work you have to do is minimal. And if you win, that's very nice because—

NIEBUR: You get data first.

CHENG: Yes, and also, you get a lot of support typically for many years. So, you don't have to write so many proposals – nice.

NIEBUR: Yes, absolutely. Of course, you also end up with some of the risk when things go south. Now, MESSENGER had some hard times. And this was well before you went to Headquarters, so you were here the first times at least.

CHENG: Yes, we had cost problems.

NIEBUR: Right.

CHENG: It was underbid, and partly, again, it was a matter of not fully appreciating all of the, first, the complexities of the mission, and also the requirements that would be new requirements that we imposed on the program after faster, better, cheaper related problems.

NIEBUR: The NIAT [NASA Integrated Action Team report] requirements.

CHENG: The NIAT requirements, and so on like that. So yes, there was cost growth. There were things that were deferred, activities that were deferred, the science operations—operations were things that were deferred until after launch. And when you do that, of course, you end up paying more in the long term. Headquarters knows that, but anyway, that's what happened.

NIEBUR: So, how does that kind of back and forth—at that point in 2002, 2003, when the realizations were that MESSENGER was out of the box and perhaps underbid—I'm not making that judgment—

CHENG: No.

NIEBUR: But what happens here at the lab? I mean, how does that trickle down?

CHENG: How does that trickle down? Well, you recognize that you made mistakes. You have to find out what can you do. All right. So, obviously, you have to make the best of what you've got.

NIEBUR: Is there a morale issue?

CHENG: Oh, of course there was, yes. I'm sure people are unhappy.

NIEBUR: Does that affect the work?

CHENG: Does it affect the work? I mean, yes. People are unhappy, sure. It happens. You just have to deal with it.

NIEBUR: But is it an external issue or did it cause problems within the project? I'm not trying to create any. I'm just curious because I wasn't here.

CHENG: Sure, it created problems. It created friction, some unhappiness. There were personnel changes and things like that.

NIEBUR: Oh, that's right. You did have several series of personnel changes, didn't you?

CHENG: Yes. So, sure. It creates all these things. But these things come about because of the competitive pressures that you're put under because you know that if you bid a higher cost, you're less likely to be selected. So, you have a very strong incentive to convince yourself, yes, I can do it for that.

NIEBUR: Right.

CHENG: We can do it. We'll figure out a way. And if you don't promise enough, someone else will promise more and be selected.

NIEBUR: That certainly was the argument.

CHENG: That's what happened. And we fell victim to that as well as a lot of other people did. I mean, not as bad as some because I think a much worse example is out there.

NIEBUR: True, but they didn't have to live with what they proposed. I mean, you guys proposed big and had to live within your box for a long time.

CHENG: Right.

NIEBUR: Do you think it affected—now, you're here. You're at the engineering lab where it was all done. But you were also on the science team. So, did it also affect the science team?

CHENG: Not so much it seems.

NIEBUR: Not so much? Were they protected from that kind of ongoing thing?

CHENG: They were, yes.

NIEBUR: Okay. I'm always interested to see because I know Sean was there all the time.

CHENG: Sean was there.

NIEBUR: And I felt bad.

CHENG: Yes. Sean bore the brunt of it, but he was vocally unhappy with APL also for a fair amount of time. I think he feels a little better now. But, certainly back then, he didn't like the fact that he looked bad because of things that happened up here. So he made his displeasure very clear.

NIEBUR: Well, he runs a tight ship.

CHENG: Yes.

NIEBUR: I mean, from what I've seen from the outside, I've been very amazed at how quickly—for example skipping ahead to after launch on the science side—how quickly the science team has gotten out all these amazing science papers, from the flyby, from the second Venus flyby, from the first Mercury flyby. Just flotillas of papers.

CHENG: Yes.

NIEBUR: How do you do that so fast? We've not seen that on previous missions.

CHENG: He's just a good taskmaster.

NIEBUR: Yeah?

CHENG: Yes, sure. He runs it, as you said, that was one of his strengths as a manager. He really cares about that. He's engaged, he reads all the papers, he makes people submit drafts to him. He's just active, makes things happen. So, that's what a PI needs to do.

NIEBUR: Excellent.

CHENG: Yes. Discovery missions—those were our last ones, of course.

NIEBUR: Well, there's another opportunity coming about.

CHENG: Yes, that's right, there are, yes.

NIEBUR: I'm sure you're in full flux trying to—

CHENG: We are. But there's this low hanging fruit problem you've probably heard a lot about.

NIEBUR: I'm afraid so.

CHENG: It's serious, what wins, NASA's new way of doing business didn't last long. We're now back to what we used to call the old way of doing business. That's the new new. And as always, everyone's costs have gone up a lot.

NIEBUR: It's the risk cycle. When the risk tolerance went down, cost went up.

CHENG: Right. Cost went up. And now, the problem is the Discovery cost cap is so low that it's hard to find the [missions] we can do within that cost cap. The launch vehicle alone is a third of the cost cap. What are you going to do?

NIEBUR: Right. Of course, there are additions—

CHENG: —are close to that, somewhere between a third and a half of your cost cap just to get out into space. Okay, now what?

NIEBUR: Exactly.

CHENG: What can you do?

NIEBUR: Exactly.

CHENG: But, the ops cost, the way people have to do operations these days, if you take more than a few years to get out where you're going, that's also a huge cost. And some won't let you just run cheap operations anymore, either.

NIEBUR: Like the hibernation technique?

CHENG: Yes. You propose that kind of thing and you run the risk of not being selected just because people think it's too risky. But the combination of you've got to do short missions, you've got a big part of your cost going off by the way of your launch vehicle, it's hard to do anything. It's a serious problem due to the fact that things like MESSENGER if we have to do it again—well, MESSENGER didn't quite fit even before. But nothing like that is even remotely possible now with—Dawn also didn't quite fit. They might be able to do it in New Frontiers' cost cap—maybe.

NIEBUR: Well, we really have New Frontiers. I mean, that's a step. At least there's a place for a bigger box.

CHENG: There isn't any more money in it and the opportunities are very few.

NIEBUR: Right, right. And the only way to raise the cost cap for Discovery is to make the opportunities even fewer and further between, which is a difficult problem.

CHENG: Yes.

NIEBUR: Very difficult.

CHENG: And is NASA actually willing to take more risk? I don't know.

NIEBUR: We'll have to see. I'm convinced we will be able to one day. I don't know that it's today.

CHENG: Yes, until the next big failure, that's right, and then you'll swing back.

NIEBUR: Yes, it's tough. Okay. Well, thank you, Andy. I really appreciate this. This has been wonderful.

CHENG: Good.

[End of interview]