NASA Symposium: Risk and Exploration

9.29.04,10 am - 12 pm - Why We Explore

John Grunsfeld: All right. Welcome back to Session 4. Hopefully, we can just continue with the dialogue. I know there were a few more people that had questions or comments. In the back?

Question: I'm Sandra Kauffman. I'm from Goddard. I kind of mentioned to you what I wanted to say but I want to repeat it again.

I think we're missing some basic thing here. The question is, why we explore, and we are not really answering that question. We're talking about the risks and, yes, that is very important, but the people out there need to understand why it is that we're doing what we're doing and what they are getting in return. They like to understand why we are risking the people, but what are they getting back?

In the DOD world they understand why we are risking our soldiers and why we are sending people to war and whatever, but in the NASA world they do not understand why are we sending astronauts. And they see pretty pictures of the stars and stuff, but what is it that they are getting back in return as taxpayers? And we need to really send a clear message to them. And it's not PAO stuff. It depends on each and every one of us to do that.

Just a little story. I was in National Night Out in my neighborhood a couple of years ago and I was talking to my neighbor, a nice little old lady. And I am the Deputy Project Manager for the GOES-R Satellite. And she was asking me what I did for a living and I told her about the weather satellites and all this and all that. And she just looked at me with this puzzled look on her face and she said, "Why do we need weather satellites when we have the Weather Channel?" You know, that's what we have to deal with, you know, the perceptions out there. Yes, the risks are there but they need to understand, okay, we are risking but what are we getting back? So, I just wanted to say that.

John Grunsfeld: That's a great comment. Natalie, why don't you take that?

Nathalie Cabrol: Actually, I would like to add on that comment because this is the feeling that -- and probably translating better what these guys were saying yesterday. What is the gold? Not the goal, but the gold, you know? Five hundred years ago, Magellan's leaving and he brings back clothes and he brings back riches. What are the riches that we can show to the people today?

And there are many. And we are good at it at NASA but we are not good at telling people. You know, from the moon walks people today are going to ski. They have good -- what we call the moon boots, medication, better things that we do in space to the health of people, what the expeditions in the sky, in the sea, or

on the land are bringing. We have that, but we are not translating enough to the public. And I think this is where we need to do an effort.

John Grunsfeld: Steve?

Steve Dick: Following up on that -- I'm Steve Dick, the NASA historian -- on Friday we're launching a series called "Why We Explore." And I think this will address some of that. And it's not Public Affairs, it's historically nuanced and historically based. And by the way, this is the 46th anniversary of NASA on Friday, October 1st. And the first one will deal with why we explore in the sense that you need to be a creative society. And I'll go back and talk about Ming China, which was mentioned by Jack the other day. That's a .gov Web site. And it'll be a once-a-month, "Why We Explore," a different essay.

Nathalie Cabrol: I will wrap up quickly. But, you know, why do we explore? I think within us it's just because we think that somewhere on the other side of the hills as you were putting it, it must be better or something is better than that what we have now. Otherwise, we wouldn't be doing it. And it's true that maybe the other side of the hill has nothing particular by what we learn along the way is bringing a lot of good to society, etc. So we need to emphasize this really, really hard.

John Grunsfeld: And again, it comes down to both personal and institutional and as a nation. Certainly in the President's vision he said, "The purpose of this is to advance U.S. scientific, economic, and security." And it's through a broad range of things. As you say, along the journey you learn a lot of things that improve our life here on planet Earth.

But it's also the higher purpose. You know, we're trying to understand where we came from. Why is there a universe? And in the process of very basic research like that is where we learn the really valuable things, like quantum mechanics that leads to lasers, that it would be a long time before you'd do that with just subsistence farming. So, these types of things are very important.

I also have something that often ends up resulting in controversial discussions, but I have a statement that I think is true. I can't prove it, but it's, “single-planet species don't survive”.

Question: Dave Leckrone, Hubble Space telescope and NASA Engineering and Safety Center. I guess we're all ganging up on you because several of us must have made the same comment to you. So, I want to start out by thanking you for stimulating this conference, which has been absolutely fascinating [Laughter].

What fascinated me most in hearing all the speakers and the discussion and seeing the film last night about Ernest Shackleton and the Endurance expedition

was this business of what compels us to explore and take these risks in the first place, instead of just adopting the fetal position in our lives.

And I have my own ideas. I actually wrote it all down and I'm going to exchange this for my pin later. But it sort of goes to what was said just a moment ago, and I think Scott Hubbard mentioned this on the first day. We explore because we have no choice. It's an evolutionary imperative. Our species became what it became because it explored. What was over the next hill was either a threat or a source of sustenance. And if there wasn't anything there then you had to go to the next hill yet to check that one out. And I think this is built into our DNA.

Poor Ernest Shackleton was so obsessed with exploring he couldn't even really articulate why he kept going back to the Antarctic. He just had to do it. And I think at least some of us, if not all of us, within the species have it built into our DNA. And I think corollaries to this are all having to do with survival -- acquisition of knowledge, commerce, education, creating a national identity, finding not only individual self-fulfillment but group fulfillment. And I think every one of those relates, going way back perhaps, to our need to survive as a species. And maybe we can't survive as a one-planet species.

John Grunsfeld: I agree with that absolutely. You know, we try and raise it to a higher plane but ultimately it is, I believe, hardwired into us to do this. But as well, our evolution has taken us to be a species which is a thinking species, sometimes rational species. And so it's also provided us the ability to question what we do. And that's where this becomes a little bit messy because we say, "Well, is it worth the risk?" And that comes back to where we are.

And if anybody doubts that we have a survival imperative to explore, just look at the situation we're in with science, technology, engineering, and mathematics in this country and where that may lead to eventually -- because technology is the key to economic prosperity, which is the key to security, which is the key to freedom. And I believe that exploration is linked to our ability to stimulate people to directly and indirectly get a good education and make use of that productively.

Male Voice: I'm just going to build on some of these other things that people have been commenting on. And in particular, I want to play devil's advocate to some of the spin-off comments that have been made.

I agree that this is very important, and some of the discoveries have been fantastic. But really -- and this builds on your comment earlier -- I think that there's one question that NASA needs to be accountable to, or one big question, and that's quite simply, are we pushing the frontier? Are we pushing the frontiers of science, technology, and exploration in a way that no one else can -- no individual, no company, no university -- in a way that only NASA can? And that's the thing that we constantly have to be asking ourselves. And I think this conference is part of getting at that issue.

Jim Garvin: Well, thanks, John. I think there's one comment notwithstanding the spin-offs and everything. I mean, we can all play the game as, Dave, you said so well about, this is an investment choice. It's part of our DNA. But I think it also bears witness to trying to generate metrics and look at what the impacts have been. And we do that perhaps ineffectively, as you've said, Nathalie. But they are not transparent, they are major. And if you ask some of the technology leaders, exploration has begotten these catalytical effects.

So without it the question that you raised, John, is the one I think this group needs to raise. How fast would we have progressed in different areas? I mean, maybe Darwinian progression -- you know, seeking optimization whenever we can -- is not the game at foot, and natural selection in technology doesn't work. I don't know. That's a great thing to debate. You know, maybe in Steve's group on the history can.

But I'm still struck by questions that when we ask people in other sectors of society -- IT being a good example -- in remote sensing of this planet, the benefits, while maybe not tangible in terms of dollars in your pocket, are there. We would not have microcomputing with fault tolerance, ever. There would have been no imperative, except perhaps a very narrowly-defined security interest area -- which is important, of course -- without this exploration imperative. And we demonstrated that.

So I think we need to do better at defining those metrics. I mean, yes, the textbook metric I think is an important one that most people seem to forget. I like to think that all the textbooks have been rewritten in the last 20 years in many of the areas of astronomy, physics, planetary science, and even this place of our own planet.

But anyway, I think that's the -- it's the amplifier on technology progress in areas that aren't the ones that have instant economic gain. That's what we should be doing, and that follows on what you said so well. That's NASA's unique role as a government agency. Otherwise, it would be private. Thanks.

Question: I'm Becky Ramsey, NASA Headquarters. Recently we did -- or we had someone do a study for us. And while it was a very interesting study, I won't go into the whole thing. But one of the stats that struck me is that a majority of the people we talked to said that they like NASA. They don't have a clue what we're doing, but they like us. And I think we cannot lose sight of the fact that we're not the only ones who want to go. It's not confined to the people in this room or the people who attended this conference.

I walked over to the little lobby bar last night. I was sitting there watching the baseball game, and I got into a conversation with the bartender and some of the

servers. They said, "Are you with the NASA group?" "Yeah." "That's so cool!" [laughter] You know, they don't know what we do but they like us!

And we have to build on that personal connection. We are their representatives. Until Burt Rutan starts charging five bucks for a trip into space, most of the people out there are not going to get to go. We have a responsibility to be their representatives and to do what they can't do yet. I mean, we talk about the spin-offs. They don't really care about the spin-offs. Yes, they're important. Yes, the benefits that we make everybody's lives better. But they don't know about that, you know? We tell them, but they don't read our cool little magazine. They don't know the weather satellites from the Weather Channel. They don't care that much about that. They like it because it's cool, because they want to go. And I think we can't lose sight of the fact that that's why exploration is important to everyone else.

John Grunsfeld: I absolutely agree. In fact, in other studies we've found that the NASA logo -- the meatball -- is likely the number one brand recognition. There may be a couple others that are close but…

The other thing we found out is that when we were working on our renewed vision of discovery we found out that most people assumed we were already doing all these things. You know, when we'd say, "Well, what do you think about having a renewed trip to go beyond low Earth orbit to the Moon and Mars?" Folks would say, "Well, isn't that what you're doing?" [laughter] And we'd say, "Yes, that's what we're doing!" And we have to communicate that a lot better.

Mel Averner: That's not true. We're not going to Mars and Moon. We are attempting to do that, but it's not our mission yet. And if we say, "Yes, we're going," people will go away saying, "Great! Great! You're going!" Okay, you got my drift.

John Grunsfeld: I wish Steve Squyres were here right now. I think he would argue with you. He has two of his children on Mars right now. I don't know. Jim, do you want to comment just a little bit about our program, what some of the next steps are that are already in place?

Jim Garvin: Yeah. Well, I think maybe Steve would do it better but if you don't think we're exploring now, maybe we don't communicate that well. But I think -- two Rovers 270 days on another world wandering at 300% beyond expected lifetime is a new demonstration of that. Cassini alone is exploring at the highest order.

Mel Averner: I'd like to respond.

Jim Garvin: But, let me finish. I mean, I can go on and on with the legacy of how we explore. It's just that right now a lot of people perhaps in the public sector --

and I can't speak for them because I'm a geek and work for NASA -- but when I talk to them at hockey games and things where they don't always care what we do, they're stunned by what we're doing and how we're exploring. And how we've learned to go from people on the surface of the moon as our agents of exploration being our representatives to machines being those agents. And we're doing that so many different ways. We're so diversified. In fact, if you ask corporate America and many of my colleagues there, they're stunned. "You're doing all that, with that portfolio? You're nuts!"

Mel Averner: I'd like to get back to the bar last night. Becky, was that your name, doing what I would have done -- drinking at the bar? Suppose you were to go back to the bar and talk to those people and say, "Well, we are exploring. We have two robots on Mars doing terrific scientific things." Would they say, "Wow, that is great, but when are we going?"

John Grunsfeld: Absolutely, I agree. But just to give you the counter-argument -- and I don't know what the current number is but there have been 13 billion hits on the NASA Web site of which three-quarters . . . [audience laughter] -- yeah?

Male Voice: [off-mic] That's a false number. It's not 13 billion people.

John Grunsfeld: No, no. I didn't say it was 13 billion.

Male Voice: I know, but that's the impression that it leaves.

Jim Garvin: But there are well over 100 million unique IP addresses, maybe 250 million total. It's all around the world, predominantly the U.S., but all around the world. And, you know, you could argue about the numbers but it is so much greater than any other Web site that it's phenomenal. There is interest there, and there's interest specifically because, I believe, that what we've done is we've put two human eyeballs on the surface of Mars. So people see what the Rovers see and they think, "This is kind of what I would see when I get to go." Or when we send people, this is what they will see. And we want to do that.

Question: I'm Nancy Ann Budden, Naval Post-Graduate School and Lunar Planetary Institute in Houston. I want to build on some comments that were made by Joe Fuller and others about getting the word out, and on some communications issues that Jim brought up. I joined Johnson Space Center's Exploration Office in '88 and I worked with a lot of you, Chris and Dale, on human exploration issues, was the part we were doing at Johnson and this was about the time that Bush 41 came out with his announcement that we were going back to the moon and on to Mars.

One of the things that we neglected to do over the next 12 years really was put into place a communications plan. We all had great ideas. We had a lot of meetings. And now we have another opportunity with Bush 43 coming out with a

much more reasonable, cost-rational plan and vision. And one thing I think we really need to do is put together a communications strategic plan, like a mission, and have a schedule and a budget and have somebody own that. Whether it's PAO through NASA Headquarters or whether it's an industry/NASA/university team. But we need to have a plan for that, that actually has someone own it, someone that's going to pay for it, and understand who are the advocates that we need to build? Obviously, there are communities we need to get to within NASA, of course. We need to get to the Hill. But we need to do it in an integrated planned way with someone thinking about, okay -- who are the first people we need to get to and when and why and how do we integrate this message? I nominate Keith Cowing to put together the message [laughter]. And, John, I think everyone would love for you to run the communications strategy idea since you're getting asked to do a lot of other things this morning and since you have a lot of spare time!

Anyway, I would like to see someone own that and put together a message that people agree with and actually stand behind, and make sure that it is consistent with our Commander in Chief's vision of the future for space exploration.

John Grunsfled: That is absolutely a great comment. We've received that comment quite a lot, so we've actually heard that message and we've acted on it. Part of the transformation was to create a communications group, and we've linked the legislative and the public affairs and our external relations into one team so that we can help craft it. We were at the bar as well last night, talking about a budget, specifically, or an increased budget, line items and management for public affairs as well. That that's crucial, that we have to treat that as something that's very high-priority. But in the transformation, we've combined all of those for exactly the reason that you mentioned. Thank you.

Question: David Gast; I'm the other student here for the school. The thing that I think everyone here is touching on and building on some of the things that have just been said is, it is about communicating to the public. I think everyone in this room and most of the people watching NASA TV already know, kind of, the reasons that we wan to go out there, what we hope to accomplish, where we hope to go, and understand the risks that are inherent to doing that. With this communication message, what we have to do is say to everyone else, the people that aren't in this room and aren't watching NASA TV, "This is where we want to go and this is why we want to go there. And, you know what? It's dangerous. Very likely, things are going to crash. Maybe people are going to die. But the people that are putting themselves on the line for that understand that and accept those risks for themselves. And believe that the goal of what we're trying to accomplish is worth that risk." So, I think it's all these things.

We have to communicate the risk, yes, coupled with why we think the risks are worth taking. We can't just say, "We're going to do these great things, we're going to go to Mars, go to the Moon, and it will all be safe and happy and fun."

Neither can we say, "It's dangerous to travel through space." We have to say all these things at the same time.

I was talking to a couple people -- sorts of things, you know, maybe it's a PSA of an astronaut saying, "This is why I love doing what I do and this is the danger I face." Maybe it's a program that follows a space shuttle crew from, you've been selected for part of this crew, all the way through your training, all the dangers we face, all the way through the mission to returning home. And not just a pretty, happy, “Oh, we're going to space, isn't this fun?" But these are all the things that went wrong on the mission! And these are all the dangers that we faced and overcame, and all the things that could have happened and fortunately didn't. And why, you know.

We talk about, the American people won't accept that something went wrong that we could have avoided. There's always one more thing we could have avoided had someone happened to think of it, had someone happened to see it. And I think they're willing to accept that if we're doing the best we can with what we have, there's always dangers there. And they're willing to accept that, again, if we communicate that to them in advance. Like I said, the people here all understand that. We need to take what we've talked about here and present that to American people.

John Grunsfeld: I think it's T.K. Mattingly who told us, "Success always has failure as its predecessor." He was more eloquent.

Question: Keith Cowing: Thank you, Nancy, for the nomination. When you hear what I have to say, you may withdraw it. To the point of web traffic -- and you're right, I do websites for a living -- citing web numbers is so 1997, so Pathfinder. [laughter] Google does that traffic before lunch on Sunday. It's great to hear these numbers, but I could go write something in my room right now. Drudge Report would pick it up and have a million hits by tonight. Big deal. The numbers are important. A lot of people are looking at [NASA’s websites]. But we need to move on to other metrics. When a nine-year-old girl raises her hand at a Presidential visit and asks about space -- things like that -- then you know. When the late-night shows make different jokes about space -- I mean, Jim Garvin's done yeoman's duty, going on Letterman and so forth -- but when you start to see this consciousness percolating up in other places … These numbers can be very deceiving. Anybody can generate hits. You've just got to look for other metrics. You've got to have a new metric every month. Just some advice from somebody who does this for a living.

Male Voice: Where did my voice go? This sort of follows your point, Keith. But when the NASA crews come into the small town in Lander, Wyoming and go on courses, they often stay after and talk to our kids. And when those kids leave the room, they're changed. And following on your point, I believe, it's not about communicating to the public, it's about changing the public.

Keith Cowing: As the Administrator of NASA loves to say – it is this Jesuit thing he has: "one conversion at a time". It works. [laughter] It's self propagating if you do it right.

John Grunsfeld: I should say that every time an astronaut leaves the school, they're changed as well.

Question: Bill Clancy at NASA Ames. One concept I found very useful that we haven't talked a lot about here that I found very useful as it relates to the public and also inside is the word sustainability. To me that's the most important word, I think, that's in our current vision. And I found it very useful to the shift from thinking about particular missions to the program. So rather than just talking about mission risk, we have program risk. And we're talking about building competence and the ability to go places and so on.

I first understood this, I think, with Mars Polar Lander, where we didn't have the telemetry that we needed to give us the information for building the redesign that we needed. I think your example this morning is a beautiful example, as well, of the investment that one can make to build tools that will give us a competence that we know we want to have part of our tool kit. So, I think when we're articulating to ourselves what's our priority and our objective, it's the clear objective, maybe dates, and the sense of challenge. But it's all about sustainability, and we make decisions because we need to be here tomorrow. We're not going to climb Everest today because just getting to Everest today is not our goal. We want to be able to climb again tomorrow.

John Grunsfeld: Anyone else? David.

David Halpern: Thank you, John. I'd like to make a comment not so much on the risk, but to related to the word called "SCA." And one of the things we've learned -- some of us knew before, but some others learned -- that 96% of space needs to be explored and 96% of the ocean needs to be explored. One has zero pressure and one has a very large pressure on the bottom. And then the question comes that the ocean definitely is a place to explore, for two reasons. One is the creation of new knowledge, which is the same as what you're talking about for outer space. But inner space also has a well-recognized thing of creation of wealth. I mean, a number of activities have always gone on in the ocean -- and I don't mean just transportation but subsurface as well -- and new ones are coming along, like genomics, oceanography, things like that.

So, then comes the question. In the new, transformed NASA, the challenge, now, would be to make use of the fact that both oceans -- or inner space -- requires the same type of dedication and the same type of methodologies as are being used in exploration of outer space and it's something that the new NASA might want to consider. And it's actually well-poised for that because all of the

science now is in the Science Mission Directorate. Rather than in two different stovepipes, it's all in one. It's a comment, not a question.

Jim Garvin: I'm really grateful for you for saying that because my new job at NASA, with the many hats, is in fact to try to integrate the inner and outer space exploration in this new vision. Now, that's an NP complete type of challenge, in the vernacular of computing. So I'm looking, as is Ghassem Asrar and John, we're all looking for the connections. Because I think the point with a vision, with an objective, with some of these good points about program thinking which we've had in EOS for Earth science, we've had in the Mars program, we hope to have throughout our program -- the shuttle program -- is an aspect of risk that I think is the one that right now strangleholds a lot of us. And that is risk of our own interpersonal management structures to get the job done.

And that, perhaps, is the genesis of the transformation, to get around some of those things. But, you know, when organizations grow old they become well-rooted in certain directions. And breaking roots, it's like taking a root off a redwood out there. I mean, it's going to stay three hundred feet tall, so you don't want to have it fall over. You want to have it move. And other than slime molds, most large plants don't move. So -- well, slime molds are fungus -- so anyway --

[Laughter]

I digress. But I think that's the challenge. The ocean is an exploration frontier that will teach us about high-pressure environments and knowledge and all that, and some shared technologies could be trialed there in the name of science and exploration to good end. And, you know, it's rather ironic to me that a large fraction of the ocean exists at 100-bar pressure, which is the average surface pressure of the planet Venus. And, you know, lots of living stuff there. Interesting to think about.

John Grunsfeld: Thanks, Jim. We'll take one more.

Question: George Tahue from NASA headquarters. Listening to some of the comments here, an analogy is coming to my mind. If you're familiar with the paleontologist Stephen Jay Gould and his description of evolution as punctuated evolution, sort of taking a take off of Darwin's. And I think NASA is, as a government agency, we are going through an evolution and we will continue to do so. Where we're going with this is going to take a very long time, but there are certain points where there will be punctuations that make great changes in very short amounts of time. And I think Apollo, that era, was one of those points. We may go through slower periods of time where we go through those changes. But here we're at another point where we may be at another one of those punctuations. And this new transformation that we're looking at isn't just rearranging the deck chairs. And it's something that we have to take internally

and not just focus only on, why didn't the public understand what we're doing and how can we make them understand? It's something that we have to do over this long period of time, even internally.

When we had our transformation and the office of Earth Science and the office of Space Science came together, I was listening to some of the Earth Science guys and saying, "Wow, you do that? That's cool!" Same reaction at the bar. So, I'd like to charge all of us to try to take a lot of this internally and focus on those goals. Another key thing we've heard here is to focus on the target. Stay on target. Protect and understand our planet. Search for life. Understand the limits of it, and recognize that humans and robots are the tools to do those goals. It's not just, "get us there." It's not just, "get the robots there." Focus on those goals. We'll have these punctuated evolutions where we have a grand, maybe, target that we're looking for. And in between, we'll have this balance that we keep going forward in trying to get that message to the public to understand that we as an agency have a role as a public function in our society. So, those are my thoughts.

Question: I'm John Gaff from the Glenn Research Center. I think the agency, while it does wonderful things and I've been in it a long time, does not recognize by our society as critical to the survival to society. Nobody questions why you've got the State Department, nobody questions why you've got the Treasury, and nobody questions why you've got the Defense Department, or Agriculture, even. But for some reason, we have been unable, in my opinion, to transfer the knowledge that we are able to acquire for the future to being something critical for the survival of the economic success of the nation. And for the long-term viability of the nation.

Somehow, we need to start some mechanism -- and maybe it's in the education programs, these outreach things -- where we get more institutionalized as a recognized long-term investment. Until that happens, we're always going to be at the margin, we're going to be at less than half a percent of the budget, and we're not going to be able to compete for the other critical needs of, what’s in it for me, with the society. Thank you.

John Grunsfeld: I think that's a very good comment. I would like to point out that we're in relatively tough economic times right now, yet NASA is the only agency that's basically gotten an increase in its budget.

Male Voice: Did it get one?

John Grunsfeld: Well, in the request, in the request. And even in the appropriations meetings, we've fared better than virtually all discretionary agencies. I think the issue is: We're still a discretionary agency.

Male Voice: I'd like to kind of second that and say two things. You guys are in a really tough position, almost a harder position than you were in the Apollo era, because Apollo was something we all thought we needed to do. You guys are in the very, very hard position of deciding what we should do. We don't necessarily need to do anything, it doesn't look like. There's not an immediate and obvious need. But you guys can do lots of different things. I'd like to tack onto Dr. Halpern and Dr. Garvin's comments, in that one of the -- I think you guys recognized this but I'm not sure that the rest of the population does -- one of the amazing things about the way NASA is exploring the new frontiers in space and the way that ocean science explores our frontiers here on Earth is that for the first time, I think, in human history, you've got the conservationist, the naturalist, the scientist, and the greedy capitalist wound up, in many cases, in one mind, in one human being. And you've got an organization that's already looking to protect resources that we can't even exploit yet or use yet.

I mean, does that seem strange to anybody else? That's new, folks! I mean, I think even more so than technologies, you guys can share lessons learned and organizational experience based on, okay, how do we commercialize this thing and how do we get benefit out of it as a people without destroying it for ourselves and our posterity? And perhaps that could be part of your public outreach program, because for instance, look at the market for the Toyota Prius cars. It's huge! They're back-ordered, I don't know how long. Eight months back-ordered on the cars! You know? The public gives a darn about that kind of thing and you guys do it every day. It's innate. It's part of your nature. That's important. So -- I don't know if there's any comments there?

Male Voice: Coupled with that and again, talking about expanding the vision and explaining the risk, is the vision we want to put out there is not just we want to go back to the Moon and learn how to go to Mars. But I think it's a bigger vision than that. It's partially this and partially the thing that he's talking about. It's we need to present both, this is the next step on which we are currently embarking, but also, this is a vision for the future that we hope to achieve by taking these steps. And that vision doesn't have to be perfect. It doesn't have to be exactly what we're going to arrive at. But it has to be a goal beyond just, you know, as great as the goal was to put a man on the Moon and bring him back to Earth. Why? Now why are we doing that?

And we've talked a lot about that, but I think that needs to be part of what would go out to the public, and what NASA thinks about internally, and each of us thinks about internally in ourselves as what is our long-term pictured goal that all these things are steps forward? And that goes towards exploring the seas as well. You know, all these explorations are not just a, I want to go to the bottom of the Marianas Trench. It's, I want to find out more about the Earth. I want to discover more about us as a species. I want to maybe discover things that will save our species or our nation or whatever at some point in the future. So, just, that needs to be a part under consideration as well.

John Grunsfeld: Okay, well, I think we're up to the end here. I just want to give all of you a big spasibo bolshoi -- thank you very much -- for participating in this. I know I've learned a lot. I think we've all had a lot of good dialog. I got a few too many action items, but. . .

[Laughter]

John Grunsfeld: But they're very important ones and we will take that forward, back to NASA, and for those of us here from NASA, I hope you take that all out. I really want to encourage you again, though, as you leave here, regard this as the start of a dialogue. There's no question that this is one we'll talk about sustaining. I think this dialog will be sustained probably for all of human history as we push our frontiers, as we move out.

I'd like to bring Scott Hubbard, the Director of the Ames Research Center, to give us some closing comments.

[Applause]

Scott Hubbard: Thanks! And as somebody said, we discovered that John has an incredible sense of humor. My job mainly right now is to roll the credits and thank a whole bunch of people who made this all happen. Before I do that though, I'd like to take the prerogative of the chair here and just make a few additional comments from things that I'd written down in the last couple of days as well as some pre-thinking. One is the incredible speed with which we are moving ahead in space exploration. Now that sounds perhaps silly on the surface of it, but think for a moment. In the first 50 years of aviation, a million aircraft were built, most of them used multiple times. In the first 50 years of space exploration, there have been exactly 4500 launches total worldwide.

The difference, the gap, between where we are in commercial aviation today and where we are in space exploration is huge. The fact that Burt Rutan and his group can be so successful today is built on investments that were made, in some cases decades ago, by the government. Now where does this lead us? This leads us to establishing a viable space exploration industry eventually, that there will be a trailing edge of exploitation for people who can make a business case and make money out of not only communication satellites, but other types of space travel.

The two analogies that are already there are the railroads, and as I said, commercial aviation. The railroads, they've got the right of way, Union Pacific, Southern Pacific came together, drove that nail out there in Utah. Aviation, the government invested in mail routes. And eventually, this form of investment and technology and subsidies led to multi-billion dollar industries. I think we are just on the verge of being able to see something like this come out in space

exploration beyond something like the commercial satellite industry. And I think it's going to be an absolutely fascinating journey over the next 10 years or so -- maybe it's 5 years, we'll see -- as this plays out.

The second major point was to reinforce the false dichotomy of human versus robots. The only thing that will happen is the ratio will change over time. And at some point, a human being, I'm looking at Chris McKay here, will be the tool of choice for exploring the moon, and particularly exploring Mars. If we can put him in a little box, I'm sure he would go with the MPL and 09.

So where do we go with this dialogue? I agree completely with what John said, with what many of you said. This can't be a one-of-a-kind. I think the public will come along if we tell our story well, but we need professional help. Some people say we're beyond help, we need treatment.

[Laughter]

But if we can talk about the risk of not exploring, the risk of losing our imagination, and maybe, ultimately, a second home for humanity, I think that we have some compelling things in addition to the kind of spin-offs that may come from what Nathalie Cabrol found by exploring these lakes, that your blood oxygenation goes up, your heartbeat goes down. What does that mean? What does that mean for the biomedical community?

There are a lot of things in there, but telling the big future story I think is something we haven't done and we need to do. And we saw some storytellers here in the last few days who just grabbed us. In giving a lot of talks, there's the pin-drop moment, and we hit the pin-drop moment in those places were everybody was just absolutely transfixed by the story.

So, where can we go with this dialogue? One thing is that taking risks can prepare you for the future. Often in ways you didn't even think of. I'm going to give you one or two examples from my own experience, which has been largely taking programmatic and technical risk. In 1975, very little was known about repairing neutron damage in gamma ray detectors. So, I conducted at Lawrence Laboratory a bunch of experiments with a 72-Curie plutonium-beryllium source. Now if you consider that your smoke detector is picocuries, you get some idea of how hot this was.

So, we went through the safety procedures. I signed up to the risks. Twenty-five years later at the age of 50 or so, I had dual cataracts in both eyes, which was a possible outcome of doing that. But today, Bill Boynton with that same detector orbiting Mars, figuring out where all the water-ice is, is able to repair his detector because of what we learned doing those experiments almost 30 years ago about how you heat the detector and get rid of the neutron damage. You never know

what kind of a risk and what kind of information is going to prepare you for the future.

In a similar fashion, in April of 1990, I went in front of the headquarters folks and proposed the ridiculous mission using a Delta-2 and a single probe, and a cruise stage going to Mars and landing, of all things, using an airbag. The risk there was ridiculed and being laughed out of the room, which almost happened. Fortunately, Jim Martin, the legendary leader of the Viking mission, thought there was something to it. And 14 years later, we have now used that technology three times successfully.

So, what I'm building up to is the analogy of setting up the Astrobiology Institute in 1998. We took a risk -- and Keith Cowing was part of this -- in bringing together an interdisciplinary group of physicists, biologists, mathematicians, astronomers, who never talked to each other. Or if they do, the intersection is only at one point. And saying let's all think from our disparate point of view about a much broader series of questions, like where do we come from, are we alone in the universe, where are we going?

Out of that came a field today, and you've heard references to it, of more than 1,000 scientists worldwide who are engaged in this in everyday research and view it. This interdisciplinary work, the interaction, the action is at the intersections, as being where we're headed for research in the future. So I would say today, the group that has participated the last two and a half days at this has been at a seminal, similar event of bringing together communities that have perhaps not communicated as much as they should -- robotic, human, risk-evaluators, decision-makers -- and so what we need to do to keep this moving is have the dialogue, perhaps we have a road map, we certainly need a distillation of lessons learned from this, and I would be willing to bet that we're going to ultimately have, if John takes his action items here, thousands of people, maybe tens of thousands of people, who are engaged in doing the kind of work that we got started here over the last two days.

So with that, let me roll the credits and first of all thank the idea men -- John Grunsfeld, Keith Cowing, the people that had some of the initial concepts for this. Let me thank the Naval Post Graduate School, Admiral Dunn, and particularly Chris Walla for hosting us in this incredible venue. It's just been delightful being here. At NASA headquarters, Bob Jacobs -- where is Bob? There's Bob back there. He was the lead at headquarters for pulling this together. Trish Pengra -- is Trish still here somewhere? Ah, there she is, hiding in the back. Al Feinberg. And the inestimable Tony Stewart of NASA TV, the man…

[Applause]

Scott Hubbard: When Tony gives you these, you know that everything's going to work out right. The group from Ames, from my own center, Rho Christianson,

Danny Thompson, event coordinators. Where's Rho and Danny, are they in here? They're probably outside trying to fix things.

Male Voice: They're having beer!

Scott Hubbard: We owe them that and much more. Victoria Steiner and Ed Schilling, public affairs. There's Victoria, thank you. The video crew -- I won't go through all the names. There are many, many people staffing the cameras here, but I do want to mention Jim Taylor and the planners collaborative, Mark Shaddock and Spotlight Productions, Donovan Gates, Donovan Gates Production, and Michael Ditertay and his staff on this 30-person television crew. And out of this will come, I'm sure, an outstanding DVD.

Then there are a couple of other people from Ames that I want to mention -- Mike Maloney and Kathleen Burton of public affairs, who were part of the advance group getting all this together. There's Kathleen Burton back there. Then finally, a contributor, I'm looking at him right now -- one of the real concept, idea, content contributors to this, who through some personal diversity, has managed to stay focused on making this entire thing very successful, Mel Averner. Mel, thank you.

[Applause]

Scott Hubbard: Then finally, our moderators -- Miles O'Brien of CNN, Chris McKay, Dave Halpern, and again, John Grunsfeld, NASA headquarters.

[Applause]

Scott Hubbard: So finally to wrap it up completely, we want to thank all of you who have spent the last two and a half days with us, and of course -- and I've sent you the men for whom this is named, the honorable Sean O'Keefe, the NASA administrator. So let's give Sean a hand, even if he's not here.

[Applause]

[End of recorded material]