

Admiral Steidle: Now I have the opportunity to introduce – and I'm very excited about this – our guest speaker for this afternoon. This is just outstanding. Let me show you something first of all. Could you put that on the camera for me please? If you haven't read this – get the glare off it – this is the Wired December section, turn to page 187 and start reading about exploration and some of the things we need to do. This is the man that wrote that afternoon and the man who'll be speaking with us today.

Mr. Jim Cameron was born in Ontario and grew up in Niagara Falls. He studied physics at Bolton College. Setting his sights on a film career in 1978, he parlayed an original 30-second short film into a full-time position at New World Pictures, ultimately writing and directing *The Terminator*. He has since served as writer, producer, director, and/or editor on such films as *Rambo: First Blood 2*, *Aliens*, *The Abyss*, *Point Break*, *Terminator 2: Judgment Day*, *True Lies*, *Titanic*, and the television effort *Dark Angel*. Just fantastic. In 1995, Jim Cameron made 12 dives to the *Titanic* in preparation for his feature film. His desire to bring that experience to audiences around the world motivated him to turn to documentary filmmaking. And the development of a 3-D reality camera system with his brother Michael. They designed and built underwater housings that allowed the camera to be taken to depths of 20,000 feet with two remotely operated vehicles. The expedition was the subject of his 3-D IMAX film, *Ghosts of the Abyss*. In May of 2002, he guided his cameras inside the wreck of the *Bismarck*. Jim Cameron has made a total of 38 dives in submersibles. His most recent expedition to hydro-thermal vents is the subject of the recently released IMAX film *Aliens of the Deep*. Let me just put a few of my notes up here and double-check a few things. From film.com: "A fascinating large-format 3-D documentary, *Aliens* is another sturdy production from Cameron and a thought-provoking look at life on other planets." From the New York Times: "This 48 minute film is a visual adventure worthy of that much degraded adjective, awesome." Ladies and gentlemen, I'm really proud and happy to introduce, and thank you for being here, sir, James Cameron.

JC: Thank you very much and thank you Admiral Steidle for that great intro. This is such a watershed moment in exploration that it's really thrilling to be here and I was very honored to be asked by Admiral Steidle to attend and speak. It actually had the force of command, but I would have come anyway. Well, the Wired magazine issue is interesting and right after it came out I had the opportunity to meet Burt Rutan, and as I walked up to him he said, "Here I thought you were just another Hollywood puke and it turns out you're a real explorer." Well, I'm not exactly sure what a Hollywood puke can tell a room full of practicing experts about space exploration, but I'm going to give this a whirl.

I don't do space for a living like you folks do, but please keep in mind that I love space exploration with all my heart. I have since I was a kid and I'm tremendously excited about what's happening right now, not only here, but throughout NASA and throughout the space community and the potential for the future. I'll give you my perceptions about where we've been, where we are, and what I think we need to do. Two days ago, I mean two years ago today was a grim day for all of us in the space community and so we're keenly aware of how the Columbia tragedy has the power to remind us of the price of our dreams. It brought us as a nation to a fork in the road. Back previously when the Challenger exploded we confronted the nightmare we always feared but had, up until then, had always averted. Then as we regrouped and we went back to flight, we believed we'd made the shuttle systems safer and that what was broken was fixed. But after Columbia, the message finally sunk in: this will always be dangerous. No matter how vigilant we are, spaceflight will always come with risk. The loss of Columbia

precipitated a reevaluation of our national goals in space and of the very raison d'être of the human spaceflight program. Now, NASA rose to the challenge of dealing with the tragedy in exemplary fashion thanks to Mr. O'Keefe, and the agency worked toward a safe and sustainable return to flight. But the nation still faced a decision. Should we continue to risk our astronauts on space flight in low earth orbit, which will always carry risks, or should we stand down, step away from the challenge, step away from the dream of human exploration? Should we let the robots do it?

I've had the privilege to sit on the NASA Advisory Council for the last 2 years. My first meeting was three weeks after the deaths of the Columbia crew. Over the next year I watched through that window of the NAC as the agency wrestled not only with the return to flight, but an overall crisis of faith. How can we assign meaning to this tragedy if we don't know the greater meaning of what we're doing and where we're going? Out of those dark days came a new vision of exploration, a new definition of purpose for the agency. Now two years later we stand at the cusp of a new history of exploration. The best minds in the space community are gathered here right now to map a course to the future. Crisis of faith has passed. The American people have said resoundingly, "Don't turn back, go forward. We want this." I don't think it's an exaggeration to say that those little rovers up on Mars helped keep the dream alive through a dark hour. It was kept alive by the knowledge that our human consciousness was out there on another planet in the form of our robotic avatars, figuring out the secrets of that world, paving the way for the day when human footprints will follow those wheeled tracks in the dust. So I'd like to shout out a personal congratulations to Steve Squires and the MER rover team for their truly astounding accomplishment. The mysteries of that alien world beckoned to all of us and got 11 billion hits to the NASA website during the Spirit and Opportunity missions. Today which are testimony to the fascination we collectively have with the unknown, most of those hits are from people who don't understand science. They care and follow along nonetheless. Their imaginations are captivated by the romance of exploration. All the workshops, the focus groups, the polls, the endless media blather in the wake of Columbia revealed one major theme: exploration is what NASA should be doing, and human exploration is very much a part of that. Of course, this had the force of good news and bad news since all of NASA's space flight plans in the indefinite future were geared toward LEO assembly and science activities, not true exploration beyond LEO.

People of all cultures were stunned by the greatest gift the Apollo program gave us: an image of the whole earth from beyond LEO for the first time. A blue oasis of life in a black void. It sobered and united us all, if only for one brief moment. The last time human beings crossed space to a destination was the Apollo 17 mission in 1972. At that time we were 11 years into the mission of manned space flight. The 32 years since then, no human being has seen with their own eyes the earth as that beautiful, solitary blue sphere, and just as a reality check, no woman has ever seen it.

After Columbia we found ourselves at an existential crossroads. Everything done in space until then was in reaction to something. When the Russians launched Sputnik and then Gagarin, we were challenged to keep up with them. In an effort to leapfrog out in front to take the symbolic high ground, Kennedy pointed us toward the moon, which was not as much about science and exploration as it was a cheap political strategy. After Apollo, the burden of cost sunk in and the mantra became reusability and the shuttle era was born, not out of an arching set of goals but in response to the sticker shock of Apollo. But the shuttle needed some place to shuttle to, so the ISS was born, not so

much out of an urgent science need, but in reaction to the momentum of the program preceding it. Shuttle and ISS then formed a kind of closed-loop ecosystem for self-justification. You needed ISS to give shuttle a destination, and you needed shuttle to build the ISS, but we weren't going anywhere. None of these technologies and none which were in the planning queue at the time had the capability to take humans outside of LEO, and that's pretty much where we were when the whole program came into question with the loss of Columbia. It became clear that, in order to survive, the space program needed to evolve. It needed to return to its roots in going where none had gone before. It needed to have a set of goals which were not determined by the momentum of the program to date or the specifics of what we could do next, but by a long-range vision of the future. And so the new Vision for exploration, the nation's vision, was born, and it's been lauded for putting us back on track. For the first time we can talk seriously about sending humans to Mars. Now we have goals. They're spelled out in black and white. We're refocusing the shuttle only on ISS and then retiring it as soon as possible. We're focusing the ISS science goals on enabling long-duration space flight beyond LEO and we'll be sending humans back to the moon in preparation for missions to Mars. And we'll be doing it in an affordable and sustainable way. Pretty clear, and pretty damn logical.

If there wasn't an overwhelming cheer of support about this from the public, it was probably because they thought this was a restatement of the obvious and not something revolutionary. But we in the space community – notice how I slip myself in – know how revolutionary this all is. We have an unprecedented opportunity right now to define the future of the human race in space and we so desperately need not to blow it. So now we stand at a second crossroads. Having defined the goals, we now have to figure out how to accomplish them. What do rockets burn for fuel? Money. Where does the money come from? Comes from people, working people with mortgages and kids who need braces. Why do they give the money? Because they share the dream. So if you want to look at it that way, rockets really run on dreams. As the designer of the Brooklyn Bridge, Johann Roebling, said about his creation, "No one will be able to look at it and not feel prouder to be a man." That's exactly how I felt at the age of 15, staring at the TV with tears in my eyes as Neil Armstrong and Buzz Aldrin hopped off the LEM foot pad onto the lunar dust. I was proud to be a human being. Anybody who's ever felt the thunder slamming into their chest as they watched the space shuttle rise on its column of fire into the heavens has felt it. I had tears streaming down my face the first time I saw a launch, to see that thing fly and know the millions of man and woman hours it took, the complexity of the machine itself, the complexity of the human and machines systems that back it up, and see all of that working so perfectly, in perfect harmony, to see such awesome energies tamed for human good. And to know that there were men and women in there, riding into the sky at the apex of their collective will, riding on the power of dreams, made me proud to be a human being.

All of the famines and the war and the greed and the brutality and the Jerry Springers and our stupidities and our failings paled before that image. A friend of mine, Bob Zubrin, said "A grand work of reason is not a simple object of utility, but a celebration of the human spirit." The conquest of space is perhaps the grandest work of reason, and therefore the ultimate celebration of the human spirit. If we're ever going to outdistance our failings, if we're ever going to evolve further, if we're ever going to do all of these things, we're going to have to embrace our higher selves. Men and women need to go out there. They need to stand on an alien rock-strewn plain or float midway between worlds and the black void and say, "I'm not afraid of the dark. I'm not afraid of that which

I don't know and don't understand. I embrace it, I walk in its beauty and unfathomable mystery." But there are some serious obstacles to this dream we need to address.

One major hurdle is our collective perception of risk. I've met a lot of astronauts and they're pretty smart people. They know that riding the pointy end of a rocket, screaming through the atmosphere at 20 times the speed of a rifle bullet propelled by a sustained explosion is dangerous. They get it. They've assessed the risk and they've decided that their dream, not just for themselves but for the entire human race, is worth that risk. The problem is not the individual players' perception of risk, it's the team owners' perception of risk. Look at this from the perspective of government. They're going to hazard the criticism of taxpayers to accomplish a feat which will demonstrate this nation's technical and moral superiority. But if you build all this stuff and you send it out there and you fail, you've wasted the money. So from that perspective, talking about going is actually far superior to actually going. To send humans to Mars requires a reexamination of our culture of risk aversion and our culture of blame assessment. Managing the public's perception of risk assessment must be a critical part of going forward. They must buy into the risk, and to do that they must be reminded that exploration is a fundamentally different activity than almost anything else in human experience. Only by having the public understand and support our exploration goals will they be achievable. Otherwise, the dream will die with the first budget overage or first setback. The public support must be loud enough and sustained enough that the mind of the politician in that fear-based processing algorithm that fear of going becomes less than the fear of not going. This can only come from the ground up. A top-down presidential mandate may have set us down this new path and hallelujah, it's long overdue, but to get this thing to the goal line it's going to have to be driven by a bottom-up ground swell, and how do we generate that groundswell? Well just as so much energy is currently going to designing systems and spacecraft, energy must be allocated to addressing the public as a paying partner. Certain critical messages need to be conveyed convincingly. 1) This is affordable. 2) This exploration vision will benefit you directly. 3) This is your space program. You are a participant.

Let's go back to the first point, affordability. This is of subjective value and the cost is always going to be judged relative to the rewards. I think a good starting point right now is to tell people it's not going to cost them more than they're presently paying. The problem is that so far I haven't seen the media spend the time to look at the projected NASA budgets and see how the funding wedges for human exploration emerge out of the declining allocations for shuttle and ISS as these two programs retire. This message needs to be gotten out there and gotten out there clearly. I also have seen media sources quoting obsolete estimates of how much missions to Mars programs would cost based on the old SEI studies. This tends to invite ridicule and make the whole thing seem like a non-starter. But enabling technologies that have emerged in the last decade or so, like ISRU, aero capture, inflatable habs, and so on have radically slashed these estimates and advanced computer design tools, advances in materials sciences, the competitive participation of private entrepreneurs, international partnerships, these can all significantly reduce projected costs.

So we need to remind the media the numbers they're using are incorrect. This is an area where the romance of the challenge works against us. The idea for us of sending humans to Mars is appealing for the very same reason it seems like a challenge. So the very reason it inflames our imaginations works against us when we try to tell people it's affordable, so this is going to require a lot of work on NASA's part, on the collective part

of the space community, not only to get the message out that this is doable and within the current scale of spending, but to figure out the best paradigm for doing it cost-effectively. NASA must also work to create a fiscal credibility in the minds of the public. A rigorous set of budgeting tools and prevention against overruns must be put in place. If the public senses the kind of slippage we've seen in the past, there will be a disincentive for them to want to play. As I said, cost will always be perceived subjectively. Now one metric is cost against reward. Another metric is cost relative to pressing needs in other areas. The classic line – I hear it over and over – why are we spending so much in space when we need to solve our problems here on earth? Now no one in this room shares that view, but we have to be aware that this is a reality. The problem with solving all our problems here on Earth is that we could still be saying that a thousand years from now. We're never going to reach some utopian plateau where everything is solved and we can look around us for worlds to conquer as some hobby. We live better, more luxuriously and longer than at any other time in human history. Vasco da Gama, Magellan, and Cook were leaving behind shores wracked by so much injustice and disease by several orders of magnitude than current explorers, but they went. And their societies benefited. Our problems must be solved, but not at the expense of exploration. Now see, I think that not spreading ourselves out in the solar system now, when we have the capability to do so, is one of the problems we have to be solving right here on earth. Now, some are willing to sacrifice exploration in order to solve our problems here, but they're not willing to sacrifice luxury to do either. Americans spend \$50B with a B on gambling every year. That's enough for a pretty good start on a humans to Mars program. If it was up to Bob Zubrin, you'd have \$10B and change.

Exploration is not a luxury. It defines us as a civilization. The real key to solving problems like disease and education, so on, is to have a robust economy, and a vigorous space program has historically contributed to that, which leads to the second point: how will exploration of space benefit me, Joe Public? What's in it for me?

Exploration directly or indirectly benefits every member of society. It adds to our technological basis and our body of knowledge, which continues to reassure our economic supremacy. Everybody talks about the cost of going, but what about the cost of not going? Where would our economy be if the space race of 60s had not happened? If there hadn't been the need for more complex computing to calculate those trajectories on the fly? All the guys were out there circling the Moon in titanium cans. And where will be in 20 years if we don't do something that captures the public imagination, which inspires kids to give a damn about science and engineering again? Every dollar spent on the space program goes directly into the economy in the form of jobs for Americans, it's not getting launched into space. But indirectly, the boost to our economic global stature is incalculable as new technologies developed for space research and development continue to give us competitive edge. This core technical excellence must be preserved at all costs. Sure, defense projects also perform this role, but I'd like to think that our plowshares can be as powerful as our swords. You know, in the historical perspective, the seafaring nations of Europe grew mighty from the wealth returned from the discovery and settlement of the new world. Those societies who stayed home languished, those who embraced the unknown prospered. Seen broadly, we're a species which owes its current success to exploration. Exploration generates opportunities which lead to economic strength, and exploration yields situational awareness which creates survival options. It contributes directly to our survival, not by giving us a second home if we screw this one up – I think that's kind of a lame argument – but by giving us interplanetary technical capability which will allow us to police and secure our own

backyard, the solar system. It might possibly give us the means to deliver ourselves from destruction in this cosmic shooting gallery.

Now right now if we discovered a comet nucleus or an asteroid on impact course with Earth, we could do exactly what the dinosaurs did, and we could stare upward with a dumb look on our faces. We need to evolve beyond the dinosaurs. And maybe the ultimate goal of the great Darwinian engine churning away on this planet since the days of heavy bombardment was to evolve beyond the role of helpless victim. We're not going to do it sitting here. The hardest argument to make quantitatively but one with which most people tend to agree with viscerally is what I call the inspirational dividend. Space exploration will yield an inspirational dividend whose impact on our self image, our morale, our confidence, our economic and geopolitical stature is immeasurable. Our children are raised in a world without true heroes. They're led to believe that heroism consists of throwing a football the furthest, getting the most hang time during a slam dunk, selling the most movie tickets with your looks and charm. But this isn't heroism, and these are not valid tests of our mettle as an intelligent race. Young kids need something to dream about, something to measure their value system against. Going to Mars is not a luxury we can't afford, it's a necessity we can't afford to be without. We need this challenge to bring us together, to all feel a part of something, to have heroes again, which leads to point 3.

This is your space program. You are a participant. The public wants and should have ownership. They want to be included, they want empowerment, participation. In the Apollo days, NASA's public affairs office of keeping the ravenous press at bay. In recent decades the roles have reversed and it's harder for NASA now to get into the public eye. I've been asked lots of times by folks at all levels of NASA, what can we do better to reach out to the public? Well, two things. One, tell the story better. Two, have a better story to tell. Now for the first time in a while, we have a better story to tell, so the job just got a whole lot easier. Now the story of the ISS can be told in terms that mean something to the public. It's the place where we're gonna go to figure out how to live and work for long duration in space so we can go to Mars and further out in the solar system. And it's going to make sense to them. That story couldn't officially be told before. And until the research goals were refocused under the Vision, it wasn't really true. Now we can talk about the challenges of sustainable mission architectures for Moon and Mars, and we can tell the story of actually really no kidding planning to send people to Mars, not some vaporous someday, but when these other specific and defined tasks are completed. That's big. But telling the story better in the meantime is also critical. How do you sustain interest over the next decade while all this groundwork is laid? NASA and the space community needs to find better ways to involve the public through education and media. We need to think of one of its key products as the story, not just the science and technology. Telling the story involves putting a premium on the images, both in capturing them and getting them out there. It means embracing the concept that human exploration of space is a story of people, not of agencies and systems. We need to take a cue from the tawdry world of reality TV and make our characters interesting. Astronauts and the many who support them on the ground need to be free to be seen human beings with hopes and fears, people who make mistakes, who have dreams, who work hard and care about what they do – dimensional, living, breathing people. Only by seeing the passion of those who practice space exploration can the average person feel the sense of participation and excitement. There are six billion of us here on the ground who are not gonna get to go and a handful of us who will. Those who go become the avatars for the rest, the eyes and ears, the hearts and spirits for the rest of humanity. On

my recent ocean expeditions I brought along a number of young scientists, and in the IMAX film which resulted from the expeditions it's the heart and passion of these young researchers which conveys the importance of the task of doing science, and not the actual content of the information. Audiences are responding remarkably well to what is basically a science documentary, because they see people on the screen who care about what they're doing. The key to telling the story of humans in space is humans. People. This is how we communicate as a species. We perceive events through the experience of others.

To aid in the task of telling the story, NASA also needs to allocate resources for better imaging and better live streaming of those images. The images are your most important product. It's already getting better. I'm actually lucky enough to be a co investigator on the proposal for the mastcam, which was selected for the 09 Mars lander. The team will be developing a stereoscopic high definition camera with zoom lenses and motion video capability. It will literally capture the first moving images on another planet. As a movie maker, I think that's pretty cool. Now, there are good science and engineering justifications for having these images, but to the public, seeing our machines moving and working on another planet will have tremendous impact. This is a great example of telling the story better, and when we set foot on the planet with our eyes fixed on the moon and beyond, we'll be telling the greatest story of the 21st century. And when the first man or woman creates those historic footprints, every human being will stand vicariously in those boots at that moment. We will all at one be uplifted and ennobled. We will be energized by the exhilaration of accomplishment. We will be energized by the greatest accomplishment of all. In an age when the horizons have grown near, when the lands of mystery are as close as the Discovery Channel and the Travel Channel and all the wilderness is conquered, the human soul is starved for challenge. Only our outbound quests can satisfy this hunger. Which is a very real hunger. It is at once spirit, psychological, and emotional as well as intellectual.

I have a little boy, one year old, his name's Quinn, and he's a natural explorer. He's a fearless climber. He boldly toddles where no toddler has gone before. He learns from his falls and he picks himself up and it doesn't stop him. This is the true soul of the human animal. We understand inherently in ourselves that we need to push outward. So what are we waiting for? Let's go! Thank you.

Admiral Steidle: I only have a few words for that: inspiring, exciting, outstanding, and that much-degraded adjective I used before, awesome. Well, thank you sir. Thank you for being here. You've certainly set the course. It's time for us to execute the plan together. I declare the conference over, it's time to get to work! Thank you.