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EVIDENCE

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Chair

The Honourable Michael Chong

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● (0905)

[*English*]

The Chair (Hon. Michael Chong (Wellington—Halton Hills, CPC)): I call the meeting to order.

Welcome, members of the committee and witnesses, to the 15th meeting of the Standing Committee on Industry, Science and Technology this May 11, 2010. We're here pursuant to Standing Order 108(2) to meet with a delegation of astronauts from the Expedition mission.

In front of us today we have two representatives from the Canadian Space Agency, Mr. MacLean and Mr. Thirsk. From the Japanese Space Agency we have Mr. Wakata. From the European Space Agency we have Mr. De Winne.

Welcome to all of you. I understand you have an opening presentation. Why don't you begin with your opening presentation? Then we'll go to questions and comments from members of this committee.

Dr. Steve MacLean (President, Canadian Space Agency): Thank you very much.

We welcome the opportunity to speak to you today at this committee. I'm going to speak for 60 seconds because we have a presentation that I think you'll be very interested in.

Canada has had a banner year this year. Bob Thirsk started his mission earlier in the year and flew with space station commander Frank De Winne. That was the first time we had six individuals up in the international space station, and it was the first time that all five partners that had been put on the international space station flew at the same time, so this mission, more than any other mission, represented a crossroads in human space flight.

The presentation is a story line of what happened. It's the adventure of what these two crew members did over the last six months. Bob and Frank flew on one Soyuz, and Koichi Wakata was there when they arrived, having come up on the shuttle. The three of them are now going to give you a presentation and tell you their story of flying for six months in space.

Dr. Robert Thirsk (Astronaut, Canadian Space Agency): Mr. Chong and members of the standing committee, it is really exciting for us to be here today and share with you our adventure.

The era of human space flight in Canada is now 25 years old. In that period of time eight Canadians, including Marc Garneau, have flown in space on 15 different flights.

Mr. Mike Wallace (Burlington, CPC): He still is.

Voices: Oh, oh!

Mr. Marc Garneau (Westmount—Ville-Marie, Lib.): At least I know what space is.

Dr. Robert Thirsk: Sorry about that, gentlemen. This is going to be a good morning.

The point is that what Canada has done over those 25 years is increase our roles and responsibilities in human space flight, and I also think our international credibility among our partners as well. When we first flew, we flew as payload specialists back in 1984, and then we progressed to mission specialists, and then to flight engineers.

We've enlarged our scope of skills as well. Initially we were operating payloads or experiment packages and then systems on board spacecraft. Then more recently we've been operating the Canadarm on the shuttle, the Canadarm2 on the international space station, and other robotics as well. Steve is a good example of that. Also we're now doing EVAs, or spacewalks, as well, so I think it's true to say that the training Canadian astronauts receive is almost equivalent to that of our international partners, including the cosmonauts in Russia and NASA astronauts. Our competencies are equivalent as well.

I'll let my colleagues speak, but I think we are regarded as reliable partners and team members.

Speaking of team members, let me introduce my team members to you in a little bit more detail. Frank De Winne is from Belgium. He represents the European Space Agency. Prior to becoming an ESA astronaut, Frank was a military test pilot. He flew F-16s. He bailed out of an F-16. He also was a squadron commander.

Frank has flown once before on a Soyuz mission to the international space station about five, six, or seven years ago. As Steve mentioned, Frank was also the commander on board our Expedition 21.

Koichi Wakata, from the Japanese Space Agency, has been a Japanese astronaut since 1992, and has flown on two shuttle flights and also a long-duration space flight. Koichi is my role model. When I think of something that we in the astronaut core call expeditionary behaviour, Koichi demonstrates self-management, self-care, team-work, group living, and leadership. Koichi is a role model for all of us. He plays on another playing field than we do, so he's an excellent person to fly with.

Expedition 20/21 was a first for Canada in certain respects. In one respect, as Steve mentioned, it was the first time we had a long-duration space flight. This was Canada's first long duration flight. We've had several shuttle flights before, 14 of them. Long-duration space flight is different. It has an impact on the individual, it has an impact on the individual's family, and it has an impact on the support team on the ground. It's not a sprint; it's a marathon or a Tour de France. It's a different way of thinking. It's a new skill and a competency that Canada has.

Last year was also the first time that we had two Canadians in space. My friend and colleague Julie Payette joined me in July. She came up on the shuttle and did a marvellous job operating all three robotic arms on board the station, including the shuttle, and brought me a lot of pride.

Then a few months later the first Canadian space flight participant, Guy Laliberté, the founder of Cirque du Soleil, joined us in orbit as well.

I'd ask Frank to say a few words about some of the international firsts associated with Expedition 20/21.

● (0910)

Mr. Frank De Winne (Astronaut, European Space Agency): First of all, thank you very much, also from my side, for inviting us here today.

Of course one of the big things was that we upgraded the international space station from a three-person crew at the start of our mission to a six-person crew. The international space station is now so big that it takes about two-and-a-half to three people to maintain the space station. If you want to do science and technology research on the space station, you need these extra persons.

This happened with our crew. We went from three to six, which meant that we did more than 1,000 hours of science and more than 100 experiments throughout our mission. This was unprecedented. This is now ongoing with the six-person crew on board the ISS.

Another first that we had during our mission is the HTV, the new Japanese cargo vehicle. You need to supply all those people with goods, but also with experiments and new things to do. The Japanese cargo vehicle flew for the first time.

If we talk about the international space station, what we mean is that it's really international. The HTV was a Japanese vehicle, but it was captured with the Canadian robot arm in space. The arm was operated by an American astronaut, Nicole Stott, our colleague. The HTV and the station were under my command. Bob was the safety officer and had oversight of the entire operation. The command of the space station at that moment was under Russian Gennady Padalka.

All those control centres on the ground and all those teams and all those engineers on the ground also worked together to make this one single mission, the HTV mission, a success.

The international space station is really international, and we show every single day that it works and that people from around the globe can work together.

Dr. Koichi Wakata (Astronaut, Japanese Space Agency): It's my great honour to be here. I started to work as an astronaut candidate back in 1992. I was in the same class with, I was very honoured to be able to be in the astronaut corps with, Dr. Marc Garneau and Chris Hadfield. He was already an established astronaut at that time, and I was a baby. My colleagues even gave me a remove-before-flight pacifier.

Voices: Oh, oh!

Dr. Koichi Wakata: Since then I have had an opportunity to fly three times in space. On every flight I had an opportunity to fly the Canadarm, the space shuttle's robotic arm; the space station robotic arm; and Dextre, the Dexterous Manipulator of the Canadian contribution. Those are wonderful assets in space.

Frank talked about the Japanese cargo ship called the HTV. Not only the HTV is international; for the assembly of the international space station, we have five partners, and 15 countries are cooperating. We have Russian modules, U.S. modules, the European laboratory Columbus, and the Japanese Kibo laboratory modules and HTV vehicle. Without the contribution of the Canadian robotics technology, we would not have been able to assemble the large complex of the international space station.

You have to be proud of the accomplishment of this technology. I was very lucky to be able to work with the Canadian astronauts, who are very talented; Steve taught me a lot of good robotics techniques. There are not only astronauts, but also engineers and mission controllers in Saint-Hubert, as well as many companies here in Canada near Toronto. I was very fortunate to be part of this.

Today we will show the video of our mission, and we'll be happy to answer any questions that you might have.

● (0915)

Mr. Frank De Winne: Here you see the logos of all the partner agencies that are participating in this mission and a beautiful picture of the station we flew to, the ISS, which was of course the core of our logos for Expedition 20 and 21. We started as Expedition 20, and then later on, when part of the crew was changed, we progressed into Expedition 21. Six stars and both logos signify the upgrade from the ISS from a three-person crew to a six-person crew.

Dr. Koichi Wakata: We had two human space transportation systems that are now in use for the international space station. One is the Russian Soyuz vehicle, and the other one is the U.S. space shuttle. Bob and Frank, together with Roman Romanenko from Russia, went up on the Soyuz, and I went up on the space shuttle mission.

This is before the strapping in, and this is just before the launch of STS-127 with Julie Payette on board. Nicole Stott was the robotic Canadarm2 operator to capture the Japanese HTV vehicle. Those launches were wonderful.

I have been only on the Soyuz. Maybe Bob can mention the differences between those two vehicles.

Dr. Robert Thirsk: I have had the opportunity to fly on both now. The Soyuz vehicle, even though it looks somewhat ancient, is a very smooth trip to space. The only exception would be the staging, when one rocket stage is finished its propellant and the next one kicks in. That's when you get jolted around.

Dr. Koichi Wakata: This is before the rendezvous. It's amazing to see this gigantic scientific platform floating in a low Earth orbit.

This is the Soyuz spacecraft just docked. Bob came into the space station, and Commander Gennady Padalka and I were all greeting them.

Dr. Robert Thirsk: It's an incredible feeling when you get aboard the station. It seems surreal. It looks similar to the trainers that we trained with in Houston and other countries, but in another perspective, it looks like something out of a Salvador Dali painting.

We had several crews visit us; we had three shuttle flights visit us altogether, and one Soyuz flight as well. Every time we opened up the hatches, it was nice to see our friends.

Mr. Frank De Winne: Here you see an EVA operation ongoing on the Russian segment. For the first time in seven or eight years, we had a new module coming, also on the Russian segment, so the Russian segment is now also going to get into full swing. We did a lot of EVAs as well from the shuttle, when the shuttle crew was there preparing the station for utilization up to the year 2020. The station is now almost finalized, but we will now start utilizing it for the next 10 years. Because of that, we need a lot of spares on the outside of the space station.

Dr. Robert Thirsk: Part of doing an EVA is the necessity to breathe pure oxygen, which denitrogenates our bloodstreams so that we can avoid getting the bends. This is our good friend Nicole Stott going out the airlock on her first EVA. I helped operate the Canadarm2 here, transporting Nicole and the payload from the station over to the cargo bay of the shuttle.

Mr. Frank De Winne: You open up the hatch and the people come back in. The space walk takes about six to seven hours, but in total it's about eight to nine hours that they are in the suits without being able to scratch their noses, for example. It's quite interesting when people come back into the hatch.

Here we see some robotic operations.

Dr. Koichi Wakata: This is the assembly of the Japanese Kibo module. There were three shuttle missions, and this is the final assembly of the Japanese Kibo module. We used the Canadarm2 to take it out from the shuttle's cargo bay and install it onto the Japanese laboratory. After that, we moved each payload to the Japanese platform using the Canadarm as well as the Japanese arm.

Mr. Frank De Winne: Here we see the HTV vehicle. This is the Japanese cargo vehicle we talked about. Shortly you will see here on the right-hand bottom side the Canadarm being operated by Nicole, who is grabbing this vehicle in mid-space, quite a complex operation. Again, everything—all the control teams, all the people—worked flawlessly on this operation.

Dr. Robert Thirsk: The HTV vehicle is unique. It has a central unpressurized segment, which contained another pallet inside. I used the Canadarm2 to extract the pallet, which contained a couple more experiments, and then moved it over towards the back porch on the Japanese lab and handed it off to Frank, who was operating the Japanese arm, for installation of the payloads on the lab.

Inside the pressurized portion of the cargo vehicle were five or six tonnes of food, water, clothing, new experiments, and spare parts, which we transferred aboard.

● (0920)

Mr. Frank De Winne: Here is another big moment for Europe and for myself: the arrival of another shuttle with an MPLM and with another European astronaut on board, Christer Fuglesang. Bob was very happy that Julie was on one of the shuttle missions and that there were two Canadians in space. This time, here on the right, you'll see Christer Fuglesang; we were two Europeans in space, and it was, of course, a very good moment for Europe.

Dr. Robert Thirsk: We transport a lot of cargo when the MPLM or the HTV arrives. This is a new treadmill that arrived and required installation. Legs are useless for locomotion in space. They just float in the breeze behind us, so we use them for transporting cargo instead.

Mr. Frank De Winne: Here we see the Russian vehicle approaching. In Russia they have progress ships, about four per year, that supply the space station with goods. The Russian cargo vehicles normally dock automatically, but here you see Max ready on the controls to take over if something goes wrong and do a manual rendezvous and docking.

Here is the Russian module that we talked about before, the MRM multipurpose research module that arrived at the space station. It's always very nice to have Russian vehicles arrive and open the hatch; they have late access on the ground, and the Russians are very kind in putting some fresh fruits and onions or things like that into their vehicles. Whenever we open it up, we get this smell of fresh goods, and it is very nice.

Dr. Robert Thirsk: The primary reason for building the space station in the first place was to do world-class medical science and material science. This is one of the medical experiments studying osteoporosis and involves six mice.

This is an experiment from York University in Toronto. It's an attempt to figure out how the brain adapts to weightlessness, and in particular how we perceive orientation in a weightless environment.

Mr. Frank De Winne: Here some experiments are being done in the microscience glove box. It's a box that we use so we can work inside with materials that are toxic or dangerous to us. Here we see some echo scan equipment.

Astronauts need to be versatile. I was trained as an engineer and a military pilot. Nevertheless, I was trained in my astronaut career to do echo scans, for example. I did scans on Bob, and that was quite interesting for me to do.

Dr. Koichi Wakata: This is a 3-D space experiment that we're conducting in the European Columbus module. We tried to find out how microgravity affects our ability to judge distance in zero gravity.

Here Nicole Stott is working on the phlebotomy for the medical science experiment. We collect the samples of blood and other things and store them in the refrigerator in the Japanese module and return them on the shuttle or Soyuz.

Here Bob is working on the exercise device. We have a variety of exercise devices, including a cycle ergometer.

This is an experiment in the U.S. laboratory module. It's called SPHERES. We checked the software and algorithm for the formation flight of satellites. We tried combinations of two satellites and three satellites for this experiment.

Dr. Robert Thirsk: We welcomed a new laboratory rack in our increment, the fluids integrated rack, for doing fluid physics in space. Space is an incredible place to do research because it is an environment where there's no sedimentation, no convection, no diffusion, and no buoyancy.

We also do quite a bit of plant biology from Russia, Japan, and Canada. One day we expect to incorporate plants into the life support systems for the vehicles that go to Mars. Through the process of photosynthesis, plants produce oxygen, scrub carbon dioxide out of the air, and clean up our wastewater, so learning how to grow plants in space—such as lettuce, as shown here by Roman—is very important.

We also had an experiment from the University of New Brunswick in Fredericton. These are willow trees from New Brunswick that we flew up, trying to understand why reaction wood forms. Reaction wood makes poor lumber, so we're trying to improve lumber production in New Brunswick.

Koichi mentioned stowage of urine and blood samples. This is where we stow it, in a -80 degrees Celsius freezer.

Mr. Frank De Winne: This is the new treadmill that we are installing in the U.S. segment. As you can see, we're working together. Teamwork, of course, is one of the primary things in space, but we also have fun, so after the installation we were demonstrating how we could all run together.

Dr. Koichi Wakata: Here I was working on the advanced resistance exercise device. We were scheduled for about two hours of aerobic activities as far as this muscle-strengthening exercise was concerned. It's very important to have this exercise so that we can maintain our health, including our bone density, by running on a treadmill or riding on the bicycle machine.

Nicole Stott is now in the Russian service module.

This is the previous treadmill machine. We exercised for about an hour on this machine and then did the same amount on the resistance exercise device.

As you know, we had to constrain our bodies so that we didn't float. It's easy to do push-ups in zero gravity, as you can see.

Voices: Oh, oh!

● (0925)

Mr. Frank De Winne: This picture, of course, shows the result of all our exercising. We did two hours of sports every single day.

Dr. Robert Thirsk: I'll give you the quick tour of the station. It's a huge facility, 85 metres long now, about the same volume as a large passenger jet.

This is the Japanese lab. I have the Canadian flag up for doing an education downlink event. This is the Columbus module. It's an incredible laboratory facility for doing plant, animal, and human biology, and also for materials processing.

Mr. Frank De Winne: Here we are flying through node 1. As you can see, while we are flying on a tour, there are a lot of smiling faces. Bob was smiling as usual. You saw him smiling when he came into the space station when we opened up the hatch. Bob stopped smiling when we closed the hatch and came back to ground. Bob was really my hero on the station for the entire six months. It was a pleasure to work with him.

Here we are flying through the PMA. All of our pantry items are here.

Again, as you see, there are lots of smiling faces. We had a lot of hard work, and we worked very hard on the space station, but we also had a lot of fun doing it. We had an excellent team, and I think the key to the success of our team was that we were happy working together and really happy to be there.

Dr. Koichi Wakata: It's very easy to transport from one place to another. You just push, and then your body floats very easily, but once you start to spin, it's very difficult to stop, because you need to hold on to two places to stop the spin.

Transporting a big, heavy payload is very easy. Max is now going backwards inside the service module.

This is the window of the Japanese Kibo module. There are lot of windows in the space station. The Russian modules have windows and the Japanese module has two windows. It's always breathtaking to view this beautiful planet Earth.

Mr. Frank De Winne: We do Earth observations for two reasons: first of all, it's psychological support for the crew to be able to look at our beautiful planet and to see where our families are. They're not so far away.

On the other hand, we do a lot of Earth observations as scientific activities, photographing specific ground sites over the years that the space station has flown. Of course, we hope to see the changes in nature over the 10, 20, and 30 years that we will operate the space station.

Here we see a beautiful picture of Paris with the Champs-Elysées. Here's a very similar city, but in another part of the world. It's Medina, in Saudi Arabia.

Dr. Robert Thirsk: This is the astronaut training centre in Houston, the Johnson Space Center. If I had a laser pointer, I could show you where I live.

Here are the Grand Cayman Islands.

Mr. Frank De Winne: The coral reefs are some of the most beautiful things to watch from space. All of the shades of blue you see in the ocean are incredible.

Dr. Robert Thirsk: You see some sad things as well. This is an oil field fire. We saw other evidence of human destruction in the environment, which is sad, but also, as Frank mentioned, of scientific importance.

Dr. Koichi Wakata: We've seen Dubai, and a great deal of artificial construction all over the world.

We also captured a hurricane and observed some volcanic activities on the Kuril Islands north of Japan.

Mr. Frank De Winne: Here you see some other daily activities on board because, of course, we also lived there for six months. We worked, but we also lived there for six months.

Roman is not so happy here with Jeff doing his haircut, because he is from the air force and Jeff is from the army. They don't go together very well. Jeff prefers to cut the last hair himself to make sure he's completely tidy.

This is what your crewmates turn into after six months of working together.

Voices: Oh, oh!

Mr. Frank De Winne: Food was very important. We took all of our meals together. We had morning, midday, and evening meals with six around the table. If the space shuttle was there as it is right now, you would see 13 people around the table.

Some have mastered eating in space better than others. Tim is demonstrating here how you should do it with a bubble of water.

We cannot underestimate all of these psychological aspects, such as food or good company, on board the station.

● (0930)

Dr. Robert Thirsk: Those of us from Canada and the United States explained what Halloween was to our Russian and European crewmates. If you can remember that, keep the mental image in your mind. I'll tell you a story about it later. It's quite funny.

Mr. Frank De Winne: The photo shows Tim demonstrating, to those who didn't believe it, that Spiderman does exist.

This was an important moment for Europe. It's the moment that I was given command of the international space station. It was important for Europe, but I think it was an even more important moment for the international partnership, because it showed this cooperation really works, even for smaller partners such as Europe, Canada, and Japan. We now had the capability to command this facility in orbit and take on all the responsibilities that the bigger partners have. It's really a very good example of international cooperation at the highest level.

Dr. Robert Thirsk: The only sad moments were when we had to say goodbye to crewmates. The photo shows a green tag on Nicole's back that says she was transfer item number 914. We're transferring over to the shuttle. Frank De Winne and I were preparing to go home.

We undocked from the station. As opposed to the launch, which takes two days to arrive at the station, after undocking from the station, we were on the ground within three and a half hours.

It was an incredible ride. It was better than any E ticket ride at Disney World.

Dr. Koichi Wakata: The photo shows the Japanese module from one of the Soyuz spacecraft. I believe the picture was taken by a shuttle after undocking.

After undocking, we usually go 360 degrees around the space station, and we then take a lot of pictures of the international space station.

Mr. Frank De Winne: Of course, it's always a sad moment to leave the space station. We worked there for six months. We really enjoyed it. We enjoyed our crew mates. It was really a great time.

On the other hand, of course, we were also very happy to go back to our families, whom we'd missed for six months. It was even harder for them than for us, because we were there and had our work. They supported us not only through the six-month mission but through the preparation as well, which required travel all over the world. I trained for four years for this mission. Afterwards, it was six months spent in space. A lot of thanks go to our families, because without them we would not have been able to do this.

Dr. Robert Thirsk: That's our family movie.

The Chair: Thank you very much. It's very impressive.

Perhaps one day you will also be members of Parliament, sitting around this table, as Mr. Garneau is.

Before I open the floor to members of the committee, I want to ask you one question: how many kilometres above the Earth does the international space station orbit?

Dr. Robert Thirsk: It's typically 350 kilometres. As you can imagine, there's a vacuum in space, but it is a very rarified environment up there. There is some drag that affects the station and it slowly creeps down over time. Every once in a while, we need to boost the station back up. The usual target is 350 kilometres.

Let me segue and tell you that I think, in addition to being scientific and technical role models, Canadian astronauts should be role models for physical fitness. About 25% of young Canadians are overweight or obese. We had a challenge called “get fit for space” associated with this expedition. We encouraged young Canadians and senior Canadians to walk, run, or cycle the 350 kilometres to the space station over that six-month period of time. We had 40,000 people participate. It was gratifying.

The Chair: Thank you very much. That's a good initiative to know about.

Do members of the committee have questions for our guests?

Go ahead, Mr. Garneau.

Mr. Marc Garneau: No, I think I'll just listen.

The Chair: Do you have a comment, Mr. Rota?

Mr. Anthony Rota (Nipissing—Timiskaming, Lib.): I'll make a few quick comments and maybe ask a few questions.

I feel like a 10-year-old boy. I remember back in 1969 when Apollo 11 went up. Perhaps I'm dating myself a little, but I'm thrilled. It's great to have you here. As well, I want to assure you that your loss of Mr. Garneau is definitely our gain. We're very pleased to have him.

One of the other comments I want to make is this. It was nice to hear about the cooperation that goes on. When I look at Canada, I see a lot of different nations coming to one place. Basically, the best of the world is concentrated here. What happens up in space is basically a projection of what happens in Canada. It was nice to hear about the cooperation and what was going on.

You talked about the numerous types of projects that are commonly funded or take place. How do the projects that are funded through the Canadian Space Agency through the grants and contribution programs align with the government's science and technology strategy? I'm looking for some type of an alignment that would explain it to people. Not everybody sees the value in this. Perhaps you can highlight that alignment.

● (0935)

Dr. Steve MacLean: One of the driving features of everything we do at the Canadian Space Agency is doing is to try to align it with the science and technology strategy.

If you look at all the exploration work we're involved in with respect to robotics, we are the ones who are putting the station together, as Koichi said, but it's the spinoff from that, and the excitement from it, that make us a player at the table internationally. I think that contributes to nation building. It inspires the next generation to go into science and technology, so in addition to the role we play on the international space station, we also have a major part in contributing to the next generation.

That's just on the robotics side. If you go to the utilization of the space station, we are working in five or six different areas within science, so we're aligned with the other government departments that are involved. For example, they mentioned the project at York University, which is a neurological project. In some cases these projects have support from Health Canada. Maybe there is support from Agriculture and Agri-Food Canada, as you heard about with the willow trees that are being grown there to try to understand the growth of reaction wood. We have a myriad of important experiments.

In Health Canada there are areas that are identified as important, areas where we can make a contribution. Those areas are the cardiovascular system, the neurological system, and the immune system. Across 100 shuttle flights, I think there have been 70 flights that had cancer experiments on them, and that's because cells interact differently once they're in zero gravity.

The answer is that we try to align everything so that it meets criteria that maps into the S and T strategy.

A voice: Mr. Rota graduated from the University of Calgary.

Dr. Robert Thirsk: The University of Calgary and MDA, the company that manufactured all the Canadian robotics on the space station, have teamed up with the faculty of medicine there and created something called neuroArm. NeuroArm is a neurosurgical robotic tool—not experimental, but operational—that uses the control algorithms and the vision system from the Canadarm to perform surgery on human brains. The reason they do that is that a robot can hold a precise tool at a precise location in the brain a lot better than even the steadiest neurosurgeon's hand, so I think medicine has probably benefited the most from our space investment.

Dr. Steve MacLean: The thing that needs to be worked on, just to be frank, is that the CSA has about one-third of the total budget that's spent on space in Canada. DND has almost one-third, and the other third is split between Environment Canada, NRCan, Agriculture and Agri-Food Canada, and the Department of Fisheries and Oceans. It's still not enough money—I'll be honest about that—compared to other agencies, but it's a tribute to the leadership that was at the CSA before that for the amount of money we have, we have done relatively well.

One thing we need to improve is the alignment between those agencies. According to the Canadian Space Agency Act, that rests with the Canadian Space Agency. Since I came on board as president, this has been something I've worked really hard on: getting the other government departments to have their wheels all spinning in the same direction so as to make the Canadian space program even more vibrant.

What we need is a better and more efficient use of the total amount of funds so that we do a better mapping of the S and T strategy.

Mr. Anthony Rota: Thank you. It's important to make that connection because people often don't see the connection that happens on a day-to-day basis. They just see people up in space, floating around and having a good time, but work is actually being done, and it's good to make that connection for the average person out there.

I'm going to go back to that nine-year-old in 1969 and I'm going to ask you a question and I'm not sure it relates to the government strategy. But you have experience in space, you've been up there, and there is talk of a manned mission to Mars. Do you have any thoughts to share on what some of the challenges could be that will face us as we prepare for that and when do you see that happening and how do you see that working out?

Dr. Robert Thirsk: I'm guessing I'm the same age as you, because I can remember that day in 1969 when I watched Neil Armstrong and Buzz Aldrin walk on the moon.

It's very true that the Apollo astronauts inspired me in the way my education path and my career have gone. Back in 1969 Canada didn't have an astronaut program, but that interest in space was a dream that rested in the back of my brain, so one day when Canada was ready to have an astronaut program, because of my interest and capabilities in science and technology, I was a reasonable candidate to pursue.

We had three strategic objectives with this first Canadian expedition. One was exploration, the second was innovation, and the third was education. In the same way that the Apollo astronauts inspired me when I was young, we want to be an inspiration to the next generation of Canadians.

Canada is a country that was founded to a large extent on exploration by La Vérendrye, Champlain, Sir Alexander Mackenzie, Simon Fraser, and David Thompson. Our country has benefited from their work. Today all the geological frontiers have been explored. The new frontiers are science, technology, medicine, and space.

We want to encourage young Canadians to dream dreams but also to realize that dreams don't come true by wishing on a star. Dreams come true by passion, devotion, support from family members, and education. Education equalizes the playing field and gives us all those opportunities. I have four university degrees. They're required if I'm going to pursue my dream.

I mentioned the “get fit for space” program. We had several other educational projects that didn't just inform young people about space science and the need to pursue education; they engaged them as well.

Hopefully that's the answer to your question.

● (0940)

Dr. Steve MacLean: Let me show you where exploration is; I think that's an important point to get across, especially to this committee.

Five countries are partners in the international space station. There are 14, maybe 15, countries that have actually produced a major piece that has gone up and been assembled on the international space station, and there are 80 countries that use the data. This aspect of international cooperation on the most complex technical project ever is perhaps the best thing we are doing. We can show the youth of today that it's possible, when you work together, to do something that is technically quite phenomenal.

In terms of exploration, these countries have gotten together and strategized about where we should go and what we should do next. They have written a document; Canada played a lead role in writing this document, as did the other four major partners, about what we should do next. Should we go to the moon, should we visit asteroids, should we go to Mars, should we make use of the Lagrangian points? These are the stationary points between the Earth and the moon that are very good places to put astronomical equipment. That strategy has been written and agreed to.

China has already made their strategy. About 10 years ago they said that they would, first, get into space; second, put a human into space; third, put two humans into space; fourth, have a space station up there. They said they would do all that in 10 years. I think you would probably agree that if we didn't laugh at them, we smiled gently, because we did not believe that was possible.

Well, they have executed that plan exactly as they planned to do. Their space station isn't a space station like this one here—it's simply two different vehicles put together, and it is a somewhat different environment—but their future plans have them going to the moon and going to Mars. Russia has a similar strategy. The question is, what are the Americans going to do?

The Americans just had the White House commission that Obama set up, chaired by Norm Augustine. Each of the partners went down and testified. I represented Canada and testified there.

They were very interested in knowing the efficiencies that would be required to keep the partnership that's on the international space station and then head out to the other parts of the solar system. They wanted to know what Canada would do. This was all discussion. It was not decision, but discussion. What would Canada do?

The approach we took was that if the US decides to go to the moon, this is what we will do. If the US decides to go to Mars, this is what we will do. This is because we are a small player and can't direct the show, if you like.

I think that was a very diplomatic approach to take. The option that is coming forth with Obama is to perhaps not go to the moon. They are leaning away from going to the moon and they're deciding to go to asteroids and Lagrangian points as they go toward the planet Mars.

The information you have seen in the media recently about the Obama speech that was made down at the Kennedy Space Center in April is not correct. They basically said exploration is cancelled, etc. That was not true. What they did was to cancel the crew vehicle, because they had design issues with the crew vehicle. They cancelled the small rocket that was going to launch that small crew vehicle because there were design issues, and at this stage in the program they didn't want those design issues.

Given the fact that there were those design issues, the policy people around Obama said that if they go to Mars, they should do it with new technology. Space has always driven innovative technology to the next step, so they should do it with new technology. Obama's last budget froze all spending in the government and cut most discretionary funding, but he added $6 billion more to the NASA budget to go after those new technologies, the idea being to get them to Mars sooner.

That is the truth about what they are trying to do.

● (0945)

The Chair: Thank you, Dr. MacLean. Thank you, Mr. Rota.

Go ahead, Mr. Cardin.

[*Translation*]

The floor is yours.

Mr. Serge Cardin (Sherbrooke, BQ): Thank you, Mr. chair.

Good morning, gentlemen, and thank you for having welcomed us in your universe. It was extremely interesting. I know I frequently have my head in the clouds but I have not yet reached the moon. In any case, when I started writing down my questions, you were already on Mars.

Is it more of a challenge today, this dream of humanity since the beginning of time?Sometimes, the first explorers who came here got lost but, in the end, they always found something. There are things to be discovered. Is it more a challenge of pure exploration or is there some kind of necessity to go further, in the future?

Mr. Frank De Winne: It is both, I believe.

First, there is of course the challenge of going further. I always say that a society that stops exploring is a society that stops progressing. If we want to progress as a society, we must try to go further. We do that with technology, with science, but it is more than that. It is a matter of nation-building, of inspiring youth, of educating. A program of exploration is also something that allows society to rise to another level. So, it is a challenge.

Secondly, I also believe that in some distant future—I do not know when— some of our resources on Earth will not be sufficient anymore. Many other resources might be available on the moon, on asteroids, on Mars and perhaps in places yet to be discovered. We know that every time man discovers d new lands, new places, it gives us new things. It gave us things that were not expected or that were unknown. When Christopher Columbus tried to go around the world to find a new route to India, he discovered the something that radically changed our world, and I believe the same thing will happen if we continue exploring.

So, I believe it is a challenge but it will also become a necessity in the future. I agree with Steve about what we are currently doing in the US. Indeed, with our current technology, it would be very difficult to explore and harvest all the benefits of that exploration. We could perhaps consider that only as being a challenge. However, to really harvest all the benefits, I believe that we need new technologies and that we need to do things differently. I think that what President Obama has decided in the US is very important.

At the same time, Europe is also thinking about what it should do, what it could bring to this program of exploration. In Europe, they are aware that, first, space exploration is a matter of politics and of international cooperation and, second, if we do not continue to explore, the Chinese, the Russians and the Americans will do it. Many countries around the world will continue exploring.

One of the major concerns in Europe is to find a way to get everyone involved, everyone on Earth, not only the current partners which will probably continue exploring, but also the Chinese, the Indians, the Brazilians and even the Africans, who are all interested. The trick is making all those countries share a common vision, a vision of peace, a desire, as Steve mentioned, to achieve something together that will be an example for youth and for everyone on this planet. We have to find a way to build this program, and what role Europe can play in this process.

The current debate about this in Europe is very important, now that the European Union, with the new treaty signed last December, has its own role to play and its own competencies in space exploration. Even though we may not be as significant a partner, nor have as many leaders, or have the same means as the Americans or the Russians, I believe it is important for Europe—and for Canada too, I think—to contribute in sharing its values through programs of space exploration. You did that in Canada by affirming your values of diplomacy, your values of openness, your desire to get the best from all peoples. You also do that very well through space exploration. That is what Europe wants to do in the future.

● (0950)

Mr. Serge Cardin: You said something important about exploitation, or rather exploration— both words sound the same... You talked about answering some needs by going further to find new things. That is why international cooperation is required. Let us think about what happened in the past. I do not want to talk about philosophy of history but we may think of the wars fought because of our exploration and exploitation of resources on this planet. Of course, we should not to do that again, it should not become our objective. As a matter of fact, if it becomes our objective, it will mean that we feel we are beginning to lack resources. Considering the way we use the resources on Earth, our planet may start looking like a dried fruit a few decades from now. So, we would have to find resources elsewhere. That is why space exploration should be based on world cooperation. Let us not repeat elsewhere the wars of the past.

Many of the things you talked about have been done. Research has been carried out, things have been discovered and are being used today on Earth. One of the things you referred to is of special interest to me, your training program. You said that our population is more and more overweight, which has led you to set up a special training program. It is probably not something resembling the 5BX program developed for fighter pilots. Are those programs offered?

Mr. Steve MacLean: Let me answer this question. What you say about exploration is interesting. We could talk about this the whole day long. There are huge technical challenges. Inviting a country like China also raises significant challenges, one of them being to convince older world governments to do that at the same time. Also, as Frank stated, I believe it is very important to have an innovative vision of what should be done. Take the example of Russia which has been doing the same thing for 50 years. It is doing exactly the same thing today as in 1951. It is not an example of technology innovation.

All this deserves serious thinking. If we use the same technology as today, such as the shuttle and the Soyuz vehicles, we will only explore Mars. However, if we improve our technology, there will be benefits in many sectors. Over 20 years, in Canada, we have had a rate of return of 8 to 12% each year on our investment in exploration. I wanted to say that before answering your other question.

What I found interesting in the program developed by Bob—it must be said that *Get fit for Space* was his idea—is that most people who got involved were seniors, people 55 and over.

There is a link with what we did in the 60s with the Governor General Awards, bronze, silver and gold. However, we did not care who would be first or second. We only wanted to get people involved, not to promote competition through rankings. We wanted to ensure that all the seniors who wanted to participate would be able to do so. Even my 85-year old aunt was proud to tell me she finished her walk to the space station.

I believe we can do much in Canada in this field. it is something that is important to us.

● (0955)

The Chair: Thank you, Mr. McLean.

Mr. Serge Cardin: I had the “killer question”.

The Chair: You have another question?

Mrs. Carole Lavallée (Saint-Bruno—Saint-Hubert, BQ): He does not get it. It is a Quebec joke.

The Chair: All right.

Mr. Serge Cardin: It is from the TV show *Tout le monde en parle*. This is my killer question: did it cost $32 million to Guy Laliberté?

Mr. Steve MacLean: More like $35 million.

Mr. Serge Cardin: All right. Did you get a T4 for that?

Mr. Steve MacLean: Let me take 60 seconds to talk about Guy Laliberté. It was a difficult decision for me. Were we going to support such a mission, considering we were using taxpayers' monies, or should we step back and let him do his own show? I decided we were going to support him but without spending a lot of money. We would support him with our people. We would make sure that he received proper training. That is what we did because our space station is a fantastic asset and, if someone makes a mistake, we might lose all that we have accomplished. So, we provided training to Guy, at a higher level than to other tourists.

[*English*]

We called him a “private space explorer”, not a tourist, to try to encourage him to understand the role he was playing.

Guy has a past. I don't know if it's true or not, but he definitely has a reputation. However, I will tell you that from the moment I met him, he had a capacity for memory, he could focus on what was important, and he got along incredibly well with the entire crew.

He had a mission with respect to one job. I think you have to say he was successful at that. The media calculated that he received $865 million worth of advertising for his One Drop campaign; that will make a difference over time, so I tip my hat to what he did.

The other space tourists did not accomplish as much as he was able to accomplish. It was a joy to participate with him on that mission. Over the six months I met him and worked with him and knew him. It was an amazing partnership for the Canadian Space Agency and, basically, Cirque du Soleil.

The Chair: Thank you very much, Dr. MacLean.

Go ahead, Mr. Van Kesteren.

Mr. Dave Van Kesteren (Chatham-Kent—Essex, CPC): Thank you, Mr. Chairman, and thank you all for coming. This is incredible.

I think a lot of the questions have been exhausted as far as the direction I want to go, but the one thing that really stands out is the camaraderie that you've accomplished. I think we all agree on the importance of nations' working together. What an incredible opportunity this is to advance our causes.

There's an ancient proverb that says “people perish for lack of vision”. I think sometimes we can be moved away from that if we all have a common vision, and space definitely is one of these visions.

You've touched on a number of possibilities: we may go to Mars, we may go to an asteroid, or we may go beyond that. Has there been any movement towards a collective vision within the European Union, the United States, Japan, and Canada? Have we included other countries? You talked a little bit about China. China seems to have its own goals, but has there been an attempt to bring China into that sphere, and India or Brazil as well?

Those are the obvious ones, but I think about nations such as Turkey or, I suppose, any nation in the entire world, and I want to say, “Listen, we want you to become part of this. Here's how you can contribute. Here are possibly some of the benefits for you”.

In Canada we've had a number of astronauts go up. There's an opportunity for other countries. Is there such a movement? If so, how far along are you, and what are your plans?

● (1000)

Dr. Steve MacLean: I think I'll let Koichi start and I'll comment.

Dr. Koichi Wakata: Actually, this discussion has been going on. For example, Japan is at this time the only country participating in the international space station from Asia. Each year we have the Asia-Pacific Regional Space Agency Forum. We have Canadian representatives, U.S. representatives, representatives from Russia, Kazakhstan, China, and so on. Many countries are participating. We talk about the utilization of the space station.

Among those five core partners of the international space station, this is not officially discussed, but on a bilateral level we have been discussing utilization with other countries. Japan is trying to open up these opportunities to utilize the Japanese Kibo module.

As Steve said, we expanded it. More than 80 countries are utilizing the data that we gained from the international space station. I think this is the direction we are headed, and we are already proceeding in this.

Mr. Frank De Winne: I want to reiterate that the European Union now has competence in space. As a result of that, we had a first meeting in Prague last year, trying to debate what Europe should do in space exploration. It was decided that there would be a follow-up conference this year on October 21 in Brussels. The political level has given us a number of tasks concerning what we should debate at that conference.

One of the questions the European Space Agency asked us to explore with the European member states is the possibility of establishing a worldwide forum at the political level to debate the questions of space exploration. Again, this was a question asked; there is no decision yet, but I think that in Europe, at least, there is a will to establish such a forum so that every nation around the world can have its voice in this big program.

Of course, it will take a long time. Cooperation is not easy. Let's face it: if you are the sole decision-maker and you can decide everything on your own and you have the funds to do so, it's a lot easier than to have to sit around the table with 25 nations that all want to have their voices and their shares, but I think the benefits, in the long term, are really incredible, so I hope we will debate this question on October 21 this year in Brussels. I hope we will have a positive answer and can establish such a worldwide forum at the political level to discuss space exploration on a global level.

Dr. Steve MacLean: It was the same with the White House commission. The first series of testimonies were related to the technology and the vision and the direction that we should perhaps take. Three months later I was called back to testify again, and the entire day was spent on how to involve China. Given that China is a spacefaring nation on its own—they have 40,000 people in their mission control, which is more than any other nation—how do we work together, and what role does Canada want to play if we go in that direction? So there certainly is a lot of discussion and a lot of will at the highest level to do this kind of thing.

On the other hand, things are changing in space. We've been talking about exploration of asteroids and Mars, but also, just ten years ago, the resolution from satellites was about 30 metres. Today our RADARSAT-2 has a resolution of one metre. Optical satellites have a resolution of half a metre. Right now there are 70 Earth observation satellites orbiting the Earth. In ten years there will be about 300. It will really change how we do business, and I think Canada needs to stay at the forefront of this.

Take agriculture, for example. By using data from four different satellites—and we've done this with projects in P.E.I. and Saskatchewan—we can improve crop yields by 35% to 80%. Given that 13% of the GDP of this country is agriculture, that's $2 billion per year, even if you did it only at 10%. The challenge is to convince all farmers to use these assets, but the assets are there. There's a crossroads on what space can do for Earth and there's a crossroads on where we can go with respect to applications.

At the last space meeting, which was held in Korea—the next one is in Czechoslovakia—there were 72 countries involved. Just a few years ago, there were half that number. The number of emerging space nations is huge. Brazil is starting, and India is doubling its budget over the next two or three years, and t's because of this improvement in the quality of the data that we can provide for the benefit of Earth.

It's very important for us to take advantage of this emergence of the use of space. If there's one phrase I would like you to remember from a meeting such as this, it's that space should be an essential element of government infrastructure. If we do that, it will take us into the future. I talked to Gerry Ritz about all of this, and he became quite excited. When we departed, he shook my hand and said, “You know, Steve, this will take Canada's farming into the future. We need to do this kind of thing.”

However, there is a bureaucratic environment in Ottawa. There is a tremendous amount of support to do it, but to get it done in a timely fashion so that we can compete against the other nations is our challenge.

● (1005)

Mr. Dave Van Kesteren: You have segued into my next question. I was talking to one of my colleagues who did an agricultural visit and a study. They went to Saskatchewan and they were telling me precisely of a farmer who used that technology. The results are astounding. The implications, as you said, are just phenomenal.

You've already raised this, but I want you to add to it. I remember that when the space program first was launched in the U.S., we all had these little Texas Instruments calculators and we marveled at them. That was a direct result of the space flights to the moon.

You've talked about agriculture and you've talked about a number of other things. Are there other space program benefits that have really profound impact on this planet that you haven't mentioned but would like to talk about?

Dr. Steve MacLean: What I said earlier was that in the face of government priorities, space should be an essential element of government infrastructure. This is the one sentence that is very important to get everybody to remember.

If I take each government department, say Agriculture and Agri-Food, I can find a resonating example. I had dinner with Claire Dansereau yesterday, the deputy minister of Fisheries and Oceans, and I can find one resonating example for her. As for Environment Canada, it's clear what I feel the resonating example is with Environment Canada.

I'll be frank. There are a lot of talking heads on TV talking about climate change. I have been involved in climate change since the 1980s. I used to fly over the pole making measurements of ozone. I think it's very important for space to bring the data to the leadership of the country so that the leadership has the right data on which to make policy decisions about climate change. We are positioned to do that. It does require investment, though.

I told myself I wouldn't do this, but I'm going to do it. Our budget is 40% of what it was in 1996, yet we're still effective. I'm not going to do this again, but it takes investment to do this. We are effective in the sense that with our partners here, we have the best optical equipment to measure climate change in the world.

Mr. Dave Van Kesteren: Are we not using that equipment at this point?

Dr. Steve MacLean: We have a satellite up there right now that has the best optical instrument in the world. It is making those measurements, but we need to make it operational and put more of them up there.

I can talk about just this for an hour.

Dr. Robert Thirsk: Can I talk about medicine and telehealth? I have a medical background, so I'm rather biased.

I talked about the neuroArm a few minutes ago. One of the things that the ground team needs to do is provide health care for astronauts in orbit. We're isolated in orbit. If we have a medical problem, you have to think very carefully about whether you're going to return that individual to the ground or allow the person to continue in orbit. We like to continue the mission if at all possible. Therefore we have some in situ medical capability on board the station and we have some training ourselves. We are able to deal with the usual types of problems and also with serious problems, such as cardiac dysrhythmias.

A lot of the techniques we have developed have spun off to Earth-based applications. A lot of the telemetry equipment in ICUs, the intensive care units, came from our space program, from wireless technology and from miniaturization technology as well.

One of the problems that Canada has is trying to attract young graduate doctors to remote communities or to northern Canada. One of the reasons is that they don't feel technologically supported up there. A lot of the technologies that we have developed—the ultrasound technology, the telehealth technology, consultations with specialists at tertiary care centres—we're developing in concert with the people on Earth. Canada is a country that really needs telehealth, and we're working well that way. In our program, there's spin-off and spin-in. Some day we're going to go to Mars and we're going to be performing surgery on astronauts on Mars. The kind of laparoscopic, keyhole surgery that we will develop for those procedures can be performed in northern Canada and hopefully will attract young doctors who graduate in Canada away from the big cities and up into the small centres in Canada's north.

● (1010)

The Chair: Thank you, Dr. Thirsk.

Dr. MacLean, before we go to Mr. Masse, you touched on the science of climate change. I assume this is an area in which you are knowledgeable. There's been a lot of recent debate in Canada about the veracity of the science behind climate change. I was wondering what your views are on the science of climate change.

Dr. Steve MacLean: This is a very difficult question to answer in a sound bite. It really requires a long discussion.

I was up north just this summer, in the far north. We're planning to put up a ground station quite far up north, and I was up there for the first time. I think the conditions speak for themselves.

Whether we call it climate change or not, I'm not going to go there, but there are changes taking place. The north is melting. Areas that were frozen in by August, that being the end of summer, are no longer frozen in. The *Louis S. St-Laurent* is up there, and it often doesn't meet any ice. There's a Students on Ice program that we took pictures of when we were in orbit—we took pictures of their ship—and there was no ice around them.

I flew in 1992. On my first mission, I was on an equatorial flight, so I could see all the glaciers between +28 and -28 degrees. My second mission took me up to space station latitudes, which are much higher. There was clearly less ice—by memory, not by measurement—on all the mountains, and I flew in the same month in those two years, but 14 years apart. There are changes taking place.

I disagree, though, that it's a disaster. I disagree with people who get on TV and say that it's a disaster. To me, it's an opportunity. If the entire Greenland ice sheet melts and flows into the ocean, will the ocean level rise? Yes, it will rise, and it will rise by the numbers the scientists say, but our models are not very good.

One of the reasons we're pushing a PolarSat mission for the next budget, which you guys will see as we move through the budget cycle, is that it can measure climate characteristics in the far north from a distance.

Now, Europe has many satellites that fly at low altitude and measure climate change, but they just get pieces of it. We're taking one out to a geosynchronous orbit, and we're going to try to get the whole story. By improving the data over the north, we improve the data that come in over the south, and we improve the models. We therefore improve our predicting capability on climate change. It's there that I think the different countries of the world should invest. Canada should be part of that. In fact, the UN has done a gap analysis, and the second most important satellite the UN would like the world to fly is one Canada could contribute to.

There has been no commitment on this. It's a discussion. The idea is to get this data, get climate change measured, get it into the models, and then give the answers to the leadership of the nation so that they can make the right policy decisions.

The Chair: Thank you very much. I appreciate that.

We'll go to Mr. Masse.

Mr. Brian Masse (Windsor West, NDP): Thank you, Mr. Chair, and thank you for being here to brief the committee on the very important work that is happening here.

I'm a little bit shocked, though. I don't know how the elimination of species could be described as anything but a disaster. That's something that I find actually rather shocking, because that is the end result that is taking place, whether we call it climate change or something else. We are witnessing a global shift; plants, animals, and the human race are going to be in a different shift than they were before. I'll leave it at that for now.

I want to follow up on your earlier commentary, though. With regard to the main estimates, the Space Agency requested $390 million from this government and received $110 million. What's the difference in the work that is being done because of the gap between those numbers? What is not getting done because of the fact that you're about $300 million short?

● (1015)

Dr. Steve MacLean: When I came on board, I was mandated to come up with a plan with respect to where this country should go with respect to space.

We are in a tough fiscal environment right now. In Budget 2009 we received $110 million. The purpose of that money is to bridge the gap between the exploration we have done since 1986, when our robotics developments were mandated by the Government of Canada, and when we calculated the next major decision would be made about exploration. so that $110 million was for robotics.

The next large element in the plan is the RADARSAT constellation mission, which is a series of three missions that will make measurements that will contribute to our sovereignty, safety, and security and contribute to fisheries and oceans, part of the agriculture and agrifood issue. That's one satellite of the four we need to do that.

For that system, $397 million was funded in Budget 2010, and we were asked to get $100 million more out of our own existing resources to support that particular system. That was the five-year cost of the program. The actual cost of that satellite system will be about $897 million.

The next major project that I think we should invest in is a PolarSat constellation. This is a series of two satellites that will bring broadband to every Canadian in the north. We don't have that right now. Anik F2 works well to 60 degrees latitude and works intermittently up to about 70, so we need to change that. Our idea there is if that you build the proper infrastructure, the development of our north will take place faster.

The second purpose of that satellite system is weather. There is no weather satellite over the north right now. You get weather swaths. Europe has weather satellites that fly at low altitude, but they only give you pieces of the data. There is no NOAA-type satellite that sits way over the equator and takes it. We have weather information up to about 55 degrees. We don't have it in the north, so this weather satellite will contribute to the World Meteorological Organization and improve all the models I was telling you about.

Then we have climate change. Climate change is important to the Canadian Space Agency. I just referred to the accuracy of the talking heads; there is a difference. It is an important file. It is a priority for the country, but we have to do it accurately. We can't be held hostage by somebody who is threatening us with stuff that's not true. That's all I'm saying; I'm not saying it's not an issue. The third portion of the PolarSat is that particular capability to give us better measurements about what is really happening with climate change.

Mr. Brian Masse: You mentioned that the Obama administration is advancing around $6 billion toward that. Ironically, that is the implementation number for the HST. It is choices.

I would like to know why, in your perspective, no one has gone back to the moon. It's been trumped as a significant achievement for mankind, of course, but Obama is looking more to Mars, and so forth. Why has no one else gone back to the moon? Is there no significant value, aside from just the optics of it, or is there more of a desire to get to Mars, thinking there could be some benefits there?

I think what you did was important. You really touched on some very practical elements when we were talking about the different gaps here. People don't realize that. If you're walking around the grocery store and talking to people, why should we go into space? You've got some very practical things that make a lot of sense, things that people tie to their daily lives.

Why Mars versus the moon?

Dr. Steve MacLean: This is a difficult question to answer. Let me show you where the data are on the moon right now.

From the Canadian perspective, the answer is simple. We don't have such a large lunar community; we do have a large academic Martian community. From a Canadian perspective, my decision-making is easy in this area. If you were to ask me what we recommend, then I can easily let the moon go to the side because of that.

From a world perspective, it's a little different. In the Aitken Basin on the south pole of the moon, they feel there is a lake there now. It's frozen. It's subterranean a little bit. It's 965 kilometres across. They are also learning interesting things about the regolith on the moon, so there are technical and scientific reasons for going. If we go to the moon, it will allow us to test all our equipment, because it's only three days away. If we go to the moon first, we really improve the survival chances of the first crew going to Mars. There's a discussion and debate around that.

Now, let's go and look at Mars. What do we have on Mars? Mars has an atmosphere. Mars has a climate system. Mars used to have oceans on it. Those oceans have evaporated. It is possible—and it's a discussion and a debate, so I'm not giving you an answer—that if we go to Mars first, we will learn more about our own Earth.

I mentioned to you the optical instrument that we're flying in orbit now and that the UN would like us to fly more. We can fly that around Mars. We will learn the characteristics around the planet Mars and understand what's going on and use those data to improve what might happen to the Earth.

Mars has a magnetic field. The moon does not have a magnetic field of any significance. Therefore, studying what's called the electron outflow off the atmosphere of Mars is something that's very important to do because it's different than what it is.... There's a dynamic interchange across the atmosphere in space that we measure. It's different over the atmosphere of Mars compared to what it is on Earth. It's important for us to make these kinds of measurements so that we can understand our own planet better.

From a Canadian point of view, if I were able to convince the leadership to spend *x* millions of dollars, going to an asteroid is something that we could do, because the delta-v—that's the delta velocity—to get to an asteroid is small. For us to develop something that remotely lands on the surface of Mars is too expensive for the amount of money that the Canadian government would be willing to put up.

There are a whole series of different rationales about why you would do one relative to the other. Sometimes the moon would win. Internationally, sometimes the moon appears to be smarter and sometimes Mars appears to be smarter. From a Canadian perspective, Mars and the asteroids would be a smarter decision in order to drive innovation in this country as well.

● (1020)

Mr. Brian Masse: Very good.

I have one last quick question. There's something I think my constituents, and maybe others, would want to know, and you're under oath here: is space food actually good?

Some voices: Oh, Oh!

Mr. Brian Masse: We see it packaged and marketed, but I want to know if it's actually good. I'm not buying it, but people would like to know.

Dr. Steve MacLean: Bob, I'll let you go, but I'll start.

The stomach shuts down when you first get to orbit. All your systems shut down a little bit, so the HCl that's secreting out of the inner lining of your stomach to digest your food doesn't quite work the way it did before you left. Because of that, the best thing to take when you first get up there—not everybody agrees with this, and it's somewhat anecdotal—is shrimp cocktail with as much horseradish as you can take. If you take that, it kickstarts your stomach into action.

I will tell you that the shrimp cocktail tastes very good when you first get on orbit, but the consistency of the shrimp is like cardboard, so there's a balance.

Mr. Brian Masse: You'd do well at the receptions in Ottawa.

Some voices: Oh, oh!

The Chair: Thank you, Mr. Masse.

Go ahead, Mr. McTeague.

Hon. Dan McTeague (Pickering—Scarborough East, Lib.): As a segue to that, as we walked in, Brian had the wonderful question as to how astronauts served dinner in space, and Mike Lake and Mike Wallace both yelled, “On a flying saucer”.

Gentlemen, thank you for being here. Like so many others, we grew up in the shadow of the greatness of astronauts and wanting to be astronauts. Some of us didn't quite arrive at that level. We wound up being members of Parliament, which we think is a very noble pursuit, and of course Mr. Garneau has proven that for us. He is not here right now, but he has.

I'm interested in the statement by President Obama and your interaction with the space station as it relates to near-Earth asteroids. I want a better description of what we're talking about here and what the real intent is. I take it there are a number of asteroids within reach of our planet that can be attained either by shuttle or by other forms of rockets. Is the intention, as is my understanding, to land somebody on an asteroid for the purposes of exploitation of product or understanding asteroids?

Perhaps any of you could answer this question. I'm very fascinated with the idea.

● (1025)

Dr. Steve MacLean: I'm trying to remember the number, but I think 3,800 asteroids are catalogued between the orbits of Mars and Jupiter. Some of them are one-third to one-half the size of our moon; others go all the way down to something the size of a football field in elliptical diameter. Every day they are finding more of these asteroids.

One of the reasons for going onto an asteroid—I'll get esoteric for just one second—is that sometimes they can put you into transfer orbit to somewhere else. There's an orbit taking place, so you match your orbit to when it's going to be in this section and land on the asteroid. Then you can head off to another location in space that allows you to observe a different section of space or look at things that are a bit different.

Why there are so many asteroids is something that is not well understood. Just as there are theories about the origins of the moon, there are theories about the origins of the asteroids, but they're not entirely well understood.

It is important from a scientific point of view to get there. We can do it robotically as well as by having humans go, and we already have gone. The Japanese have gone to an asteroid. The Americans have gone to a comet, which is an agglomeration of dirty rock and ice. It's not the same as an asteroid. An asteroid in theory was once a planetary body, just like the Earth or Mars.

The idea of going to an asteroid is to understand our world beyond low Earth orbit. We do not have a good understanding of this part of space. One of the reasons we fly at 300 or 400 kilometres, as Bob mentioned earlier, is that there is an atmosphere at that altitude. It's almost a vacuum, but there are single atoms and single electrons out there. There isn't an oxygen molecule, but there are oxygen atoms. Here in our space there are 10 to the power of 23. Out in space there are somewhere between 10 to the 10th or 10 to the sixth, depending on your altitude. That gives drag, as Bob said, but it also protects us from the ionizing radiation.

It's important for us to get outside the protective environment of the Earth and see if we can operate beyond that. We have that issue with our geosynchronous satellites that go up to the altitude of 36,000 kilometres. They need to have electronics that are hardened to radiation relative to the ones that are lower.

Your final point was on whether it's really exploitation. That's a tough question to answer because of the costs associated with returning that kind of thing.

Hon. Dan McTeague: Excuse me. Is there any calculation on the possibility of any of these asteroids becoming dangerous in their proximity to Earth?

Dr. Steve MacLean: Yes, there's one—in fact, the one they're going to go to, which I feel is coincidence. It is Apophis. It has a keyhole that will be between the Earth and the moon in 2036. Don't quote me on the year. As it comes around, if it hits that keyhole.... The keyhole is an area in space defined by the orbit it takes to hit it on the next cycle. Apophis has been identified at the UN as the one that we know about that has the closest chance of doing that. I will say, though, that the error bandwidth on those calculations is quite high.

Hon. Dan McTeague: I'm going to an area that you may not want to talk about, but I'm quite interested in it, as I think are all parliamentarians.

Is it correct to say that your budget has not increased substantively or in any way, shape, or form since 1999? In other words, the budget you were originally given, notwithstanding your requests, has not been changed to meet even the value of the 1999 Canadian dollar in real terms—

● (1030)

Dr. Steve MacLean: Right. I can give you the data; giving you my opinion is where it gets a little dangerous for me, but here are the data, and this is just CSA's budget. In 1997, our budget was $496 million. When we were promulgated as an agency we were given a budget of $300 million. I was sitting in the back row in those days, and the concept was that the Canadian Space Agency would be given a budget of about $300 million and then a series of major crown projects that would add up to $600 million or $700 million.

I think the leadership with the CSA at that time did a good job to get the agreement that they'd have a base budget of $300 million and then a project budget of $300 million to $500 million.

Of course the project budget never materialized. As well, our base budget has gone like this—downward. Our budget this year was $358 million, and that includes some money from the stimulus program. That's why it's a little higher than the $300 million. With the strategic review, it's predicted to be $278 million in just a couple of years. In order for us to be a vibrant space nation, we need much more than that.

The Chair: Thank you very much, Dr. MacLean.

Go ahead, Mr. Wallace.

Mr. Mike Wallace: I'm going to be fairly quick because I have four questions. I'm also on the finance committee, so I'm going to challenge those numbers I heard a little bit.

The estimate we have in front of us in the budget for this coming year is $390 million, all in. You were right that it was approximately $355 million last year, in 2009-10. Then it was $378 million the year after, and then it does go down again. You're right that it goes to $312 million.

Dr. Steve MacLean: The reason it was $390 million, though, was because of reprofiling.

One of the issues that an agency has—all space agencies in the world—is that we're working on international projects, so if we have a big project that is $1 billion, as we had with space station, and it delays one year, we have to reprofile a substantial amount of money into the next year. Our budget is the $358 million, but the reprofiling adds it up for the next year—

Mr. Mike Wallace: But sir, the reprofiling would happen within the agency. If the project doesn't get off the ground and you don't spend the money that year, you have to reprofile it. Just because you were granted it, if the project doesn't happen, it doesn't mean you get to keep the money.

Dr. Steve MacLean: If we're not able to reprofile, that is true.

Mr. Mike Wallace: My point to Mr. Masse was that you're actually at $390 million this year, which is 721 FTEs. It goes up a little bit next year and then it comes down a little the year after.

Dr. Steve MacLean: Yes, and I think you'll see that in five years it will be around $280 million.

Mr. Mike Wallace: Well, I only have three years in front of me here.

I have a question for Dr. Wakata. *Konnichiwa*.

The government in Japan has changed, after 40 years. Is the new government's commitment to the space program the same as the previous government's?

Dr. Koichi Wakata: The commitment of the government is the same, and now, with Mr. Obama's proposal to extend the international space station by five years to 2020, in Japan as well as in Canada and Europe we are discussing very vividly if it's worth expanding the life of the space station.

So far we have had very supportive opinions from the public, especially last year with six of us flying in space. Right now we have one Japanese astronaut on a long-duration basis, and last month we had another Japanese female astronaut. There were two Japanese flying at the same time in space. That was the first time. Last year it was Julie and Bob flying at the same time.

However, so far we have a very supportive general public.

Mr. Mike Wallace: Did the government have a position on it when they ran for office?

Dr. Koichi Wakata: In general it is very supportive. As for the exploration, two weeks ago I was with the science minister in Japan and we had a symposium on whether we should go to the moon or to Mars. So far, in Japan the interest in the moon is very high.

Mr. Mike Wallace: Okay. *Arigatou gozaimasu*.

There has been talk about Obama and the mention of the extension and so on. We need to be somewhat frank here that the position of the financial system in the United States is very bad. Somewhere along the line they're going to have to bite the bullet and start looking at their debt and their deficit. I don't know when that will happen, but it may happen.

If the United States decides to pull back on their space spending, what does that do to Canada's space agency? Can you survive without their spending the amount of GDP they're spending now?

● (1035)

Dr. Steve MacLean: The relationship with NASA is about 70% of our budget. The relationship with ESA is about 30%. As well, although it's a small percentage, we have some very interesting projects with Japan.

We don't have acess to space. Right now we rely on Russia and the United States to get us into space. India is helping us with a couple of projects as well.

If a major partner such as the United States decides not to create a space vehicle for a number of years, it would nail us to the ground as well. One of the ways I look at our partnership in exploration is that, in a sense, we're waiting for the invitation from the United States to participate in this grand adventure into space, and if they decide not to make that grand adventure, then it would be difficult for us to contribute a major piece of it. That would be quite serious for us.

Mr. Mike Wallace: The U.S. is a big partner, obviously. Are you looking at developing further partnerships with other places just in case they do decide to pull back?

Dr. Steve MacLean: Yes, we are. In fact, our industry is talking with Turkey. You mentioned Turkey. They are an emerging nation, and they're planning on spending some money on Earth observation satellites. Our industry is talking to them, as they are with Brazil and even Dubai. Dubai is quite interested in getting observation capability up there.

Let me show you something. We all know of the financial crisis. I don't want to make it sound like a cliché, but I believe that we are not.... If we do what we're suggesting in our plan—for example, do the precision farming, look after our coastlines, work with ocean science and improve capabilities of the oceans there—not only would we contribute to solving this economic crisis, but we would also contribute to economic growth and economic renewal.

The numbers are quite compelling. The numbers in agriculture are quite compelling. The numbers in the military area for keeping the country safer by using space assets more and in a more integrated way are compelling, and I think that if we were to pursue that plan, we would help the world to get out of this financial mess it's in.

Mr. Mike Wallace: I have one last personal interest question. It's on sleeping in space. Does your sleep change in terms of now you need six or seven or eight hours? I know you have to keep your muscle mass up through exercise. Does sleeping change? Do you actually turn the lights off so that you know it's nighttime, or how do you know?

Dr. Robert Thirsk: If you're the type of person who enjoys camping, you'd enjoy being an astronaut, because a lot of the things you do when you're camping are the same. We eat freeze-dried food, we don't have running water, there's no fridge, there's no freezer, and we use sleeping bags. Typically we sleep in sleeping bags. I slept in a sleeping bag that was attached to the wall of a sleep station. When you're in a neutral weightless environment, your body goes into something like a fetal position. You're totally relaxed. There is no pressure of the mattress on your body at all. Every night I would put my iPod on; during the first song I'd be asleep, and I'd sleep very well.

On a previous flight we did some sleep studies that involved EEGs, as well, and we did find one thing. You probably know that sleep is associated with various stages. There's one stage of sleep associated with delta waves in the EEGs. We miss that phase of sleep in space, and that's the restful phase, so I would find that I'd wake up tired every day.

But falling asleep was no problem. I'd wake up tired in the morning, but then, you know, you wake up and you think, "Holy crow, I'm in space."

Voices: Oh, oh!

The Chair: Thank you very much.

Dr. Robert Thirsk: And that would reinvigorate us.

Some of the sleep studies, by the way, are Canadian, from Toronto.

The Chair: Thank you very much, Dr. Thirsk.

Go ahead, Madame Lavallée.

[*Translation*]

Mrs. Carole Lavallée: I am not a regular member of this committee—although I feel I am becoming one. As a matter of fact, I am only a substitute here. My regular committee is the Standing Committee on Canadian Heritage. I am here today because I am very interested in the Canadian Space Agency, its headquarters being in my riding of Saint-Bruno—Saint-Hubert. So, my questions will be a bit different.

I also want to apologize somewhat because I know—I am intelligent enough to know— that you are playing in the highest spheres, if I may use that expression, of space exploration rather than in politics. In Saint-Hubert, we have enormous respect for the greatness, the usefulness and the complexity of your projects. We are really very proud of you. Everyone respects you on the South Shore.

Your head is in space but, of course, your feet are in Saint-Hubert, a region people call the "aéro" region because we have an "aéroport", which we are very proud of, the École nationale d'aérotechnique, which produces aeronautics technicians, as well as Pratt & Whitney and a whole range of aerospace companies. We are very proud to have the Canadian Space Agency in our region.

That being said, the Agency has nearly no contact with the region. As an MP, I wrote to one of your predecessors—not Marc Garneau—who did not even bother to answer my letter. One day, the industry commissioner of the region, Jacques Spencer, wanted to communicate with the Canadian Space Agency. I invited him to Ottawa and introduced him to Marc Garneau who opened your door to him, Mr. McLean, for which I am very appreciative. Since then, his economic development project is running smoothly. However, you will understand that this is not a proper way to operate.

People of the region are very aware of the aerospace industry. There are all kinds of aerospace projects in the region. There are economic development projects but people would also like to have cultural development projects. We also have organizations promoting aerospace jobs, up to the job of astronaut, to our youth.

People in my riding would certainly scold me if I did not ask you a specific question. I do feel I have to ask you this: what do I have to do, as the MP for Saint-Bruno—Saint-Hubert, to improve cooperation between the region and the Canadian Space Agency so that its leaders, or their representatives, educate themselves about what is happening in the region and take the time to tell us what they do? How can we get some cooperation?

● (1040)

Mr. Steve MacLean: First of all, I have to say that the work done by the region around the Saint-Hubert Airport is quite impressive. I have been in the region for 20 years. I am from Ottawa but I have known the South Shore since 1972.

I do not have any detailed answer for you but I can tell you that being active in the region and promoting ourselves are very important mandates for the Agency. To date, we have put our material in 40,000 classrooms of 25,000 schools across the country. We do try to make ourselves known.

It is sometimes said that space is a magnet for talent and an innovation stimulator. However, we do not have a huge budget for that. I believe that our public relations budget is about $6 million per year, which is not very much compared to NASA which spends $150 million on education. So, it is hard to do.

That being said, we do try to do better. We are proud to be in Saint-Bruno, Saint-Hubert and Saint-Lambert. It is a beautiful region with its mountains. This year, we have decided to organize an exhibition which started two weeks ago. I do not know if you have visited the Agency recently but you would have seen a big tent which will act as a museum.

Mrs. Carole Lavallée: I did not even know that.

M. Steve MacLean: Yes, it's a kind of museum.

Mrs. Carole Lavallée: I was not invited, I was not informed, and there was nothing about it in the papers.

Mr. Steve MacLean: It has not yet opened its doors to the public, that will be in June.

A voice: It will be announced this week. It is not yet open.

Mr. Steve MacLean: It is not yet open but the tent is there.

What I would like to do is to open a museum in the Saint-Hubert region. We would show our work there in the medical field since we do lots of work on the cardiovascular, neurological and immune systems. We do very impressive things in those fields. We have to explain that to everyone. We want everyone to understand that is very important to invest in aerospace. That is what we will do.

The other thing I want to do is to invite you to come and visit us. You will be my special, or spatial, guest.

● (1045)

Mrs. Carole Lavallée: Mr. McLean, I had to register for a guided tour organized in relation of a conference in Saint-Hyacinthe to be able to visit the Canadian Space Agency. I will be there in August. However, if you want to send me another invitation, I will be very pleased to accept.

I just want you to understand that your neighbours are your allies in all respects. We want to collaborate with you, we want to be in contact with your people in order to do things together. As far as your museum is concerned, I am absolutely in favour of that idea. There are also other projects being talked about and we would like to share them with you.

We do not necessarily need money. It is not a matter of money, only a matter of collaboration. We should definitely talk to develop projects together so that people in the riding become more aware of who you are and vice versa.

I will give you my address so that you can put me down on your list of guests.

Thank you.

The Chair: Thank you, Mrs. Lavallée and Mr. MacLean.

Mr. Lake.

[*English*]

Mr. Mike Lake (Edmonton—Mill Woods—Beaumont, CPC): Thank you, Mr. Chair, and thank you to all the guests for coming today. It's been a really interesting meeting, for sure.

Dr. MacLean, I want to re-address the budget question, just because I do want to get a little bit of clarity, because it seems like it's a little bit confusing, as these processes tend to be. The numbers you're referring to are the base budget, I imagine, so the $110 million that we're talking about from Budget 2009 would be additional—

Dr. Steve MacLean: The numbers he has there are the totals. The $300 million is a base, and when it adds up to $358 million.... The $390 million is the reprofiling. Those are part of a stimulus budget and left over from the old project.

Mr. Mike Lake: Are the $110 million from Budget 2009 and the $397 million over five years from Budget 2010 the project funding that you were talking about, the additional funding?

Dr. Steve MacLean: Yes.

Mr. Mike Lake: Then there's an ongoing conversation; that's what this is part of, as it relates to maybe what might be in future budgets or not as we move forward.

I think you're making an argument that there are certain things that we might want to consider as we move forward, if I'm hearing you correctly.

Dr. Steve MacLean: If you want to do a first-rate job on some of these examples that I gave you—if we're discussing agriculture, if we're discussing ocean science, if we're discussing safety, sovereignty, and security, if we're discussing our possible or potential role in exploration—you are looking at an additional budget of $2 billion over five years. That will put us at the table. That will drive innovation, and the reason is that any plan cannot be a list of projects, because if it's a list of projects, you're just a list of projects.

What you have to do is have a series of programs that, when integrated together, meet a priority. For example, precision farming takes four different satellites, including one that measures precipitation, one that measures soil moisture, and one that measures the life cycle of the crop. Right now, we actually measure how fast wheat grows in the country. We give it to Agriculture Canada every week, and the Canadian Wheat Board uses those data to set the price of wheat. We also give them how fast China's wheat is growing and how fast Russia's wheat is growing. It's a very important economic driver to have those data, but to make the whole plan work, you need to merge data from several different areas, and in order to do that at a first stage, it's an extra $2 billion over five years.

Mr. Mike Lake: I want to go back to some of the comments you're making around climate change. I thought that was interesting.

It's always a little bit dangerous to go into that topic. It sounded as though what you're really saying is you're talking about the evidence base and the opportunities that exist through our efforts in space to maybe identify holes in the evidence base, in a sense, and to actually impact our decisions based on actual evidence. Maybe you could comment on the evidence base as it relates to climate change.

● (1050)

Dr. Steve MacLean: This is a fascinating area, because climate change really is an opportunity. The way I look at this is that the atmosphere is fragile, very fragile. From the pictures that Bob, Frank, and Koichi showed you, it's incredibly thin. Trace element analysis of that incredibly thin atmosphere is pretty important. We know from the ozone hole that if you just change chlorine content a little bit, you will really change how much ozone is out there and you will really change how much light comes to Earth's surface.

The important thing to do is to measure it and to measure it accurately. When China had its Olympics, we put seven optical instruments in the hills around Beijing. The Chinese would shut off a factory, and we would measure what would happen to the air. They would turn that factory on, shut off another one, and we would measure what would happen to the air. What they did was to optimize which factories had to be shut down to give the impression that the air was clean—

Some hon. members: Oh, oh!

Dr. Steve MacLean:—over Beijing for those two weeks. It's not clean air over Beijing, and you can see that from space.

There will be changes. There will be melting in the north. That is clear. There will be some sea level changes depending on what happens.

The way I look at it is twofold. First, we have to stop putting emissions into the atmosphere, because we don't know what is going to happen to the atmosphere, so we should just minimize that. We need to look for new renewable resources. It's very important to understand how to develop energy without having fossil fuel emissions.

Second, on the other hand, you need to be evidence-based so you can decide where to do your development. Canada will move up into the north over the next 30 years because of climate change. If you're evidence-based so that you understand the climate, the geology, and the infrastructure—and what I mean by infrastructure is what the soil is like—you'll know where to go up there.

My feeling is that if you build it, they will come. It's like building the railroad: it was then that we moved west. Now if we build a space infrastructure so that we have communications, weather, and climate-based evidence about what's going to happen, we'll develop the north much, much faster, and I think that's something that's not only powerful to do but also visionary.

Mr. Mike Lake: Okay.

I'm going to go back to the money question. I'm going to jump all over the place here, but I'll finish with this, because it is an interesting argument. Today you're before us, but Canadians, of course, can view this testimony, the evidence, online afterwards and see what you had to say.

You're talking about $2 billion over five years, which I think is the number you mentioned. It's a substantial amount of money. Of course, here in Canada we've been renowned around the world for our handling of this global crisis that we've gone through and the fiscal prudence of the government's handling of this over time.

What argument would you make to a regular Canadian constituent of ours sitting in their living room going over their taxes for why we should take $2 billion of their money, really, and hand it over to the Canadian Space Agency for the things you're talking about?

Dr. Steve MacLean: You know what? One of the interesting things about trying to answer questions like this is that you're always expected to answer it in a sound bite and give one sentence that describes it all. Sound bites are good for media, but they're not good for strategic planning, so the way to do it is to take an example of something that is important to Canadians and show them how space can make a difference, and then take another example that is important to Canadians and show them how space can make a difference.

Take the safety of our coastlines. Our military and our public safety people, which involves several different departments, as you know, protect the west and east maritime approaches very well. We have a black hole in the north, though. We don't have the protection that's required.

Space can only be part of the answer because it takes an integrated level of assets to make it safe for the whole country, but space, if we invest the way that we're suggesting we should invest, will let us tighten up our coastlines very well. We have a system that can see every ship in the world and what it's doing. This is something that is important not just to Canada but to the entire world. That's just on security.

I can take an example and make it resonate. We have talked all morning about agriculture. It's huge. You can change the GDP of a country just by using space assets. It's a challenge to do it, a challenge to change how people think culturally, but it will work because the data now are compelling. What the data tell you about what's happening to crops is quite compelling.

It's the same in forestry. We're losing forest—I think the number is four times the size of Prince Edward Island—every year in Canada. Space assets can see that happening sooner and can stop it. There's a propagation of bugs across the west that is killing our forests. We can identify that from space and know where to go. We can manage our assets much better.

If I take ocean science, the oceans are where the future is for the food supply in the world. I was on the advisory committee for Copenhagen and was with Galen Weston, a very interesting individual. His company, which has several billion dollars in revenue a year, is focusing on the oceans for their future food supply.

If I just take communication and the economic side of things, a simple way to say it is you can't use your credit card today in Toronto if someone else used it 10 minutes ago in Vancouver. It's our space assets that prevent that from happening. I could easily make a list of a day without space in Canada and what it would do for a Canadian, and I haven't even touched communications yet.

● (1055)

The Chair: Thank you, Dr. MacLean and Mr. Lake.

The last member for today is Mr. Masse.

Mr. Brian Masse: Thank you, Mr. Chair.

First of all, I want to publicly recognize Dr. MacLean here. I wrote you a letter from a constituent and within a couple of weeks you actually got back to the constituent, so I want to express my appreciation for that, because sometimes when we have these issues and they go to a department or an agency, they disappear for a couple of months. It was a very prompt and a very thorough response, so I want to acknowledge that, because that's important to me as a member. I'm sure other members would appreciate that too.

I'd like to talk a little bit about junk now. You mentioned there are about 300 additional satellites to go up in space. What is up there in terms of disabled equipment or objects that have no purpose that can become a hindrance to our management of this sphere and to the addition of satellites in the future? Who is responsible for cleaning that up? Is there anybody, or is it just basically a free-for-all right now in terms of leaving things behind?

Dr. Steve MacLean: This is an excellent question. I dislike using numbers because they change rapidly, but I believe that for pieces larger than 10 centimetres that NORAD tracks right now, there are 9,800 pieces. Don't quote me on the number, but the idea is that it's a large number.

Now, space is large; that doesn't mean it's crowded up there, but this is a large number.

There is a recognition that this is an issue by all spacefaring nations. For example, on the RADARSAT constellation that was just approved in Budget 2010, it is our responsibility as a country of this world to ensure that when that satellite system is finished, we can basically dismantle it, bring it back to Earth, and let it burn up in the atmosphere.

Mr. Brian Masse: Are you or the company responsible, then? It's interesting, because we actually have a study going on right now with the telco sector. They're looking at launching more satellites.

The impression I'm getting is that it's basically a junkyard up there, and they just let it go. Nobody seems to have a responsibility. Do we need to have a post-product responsibility mechanism so that, for example, if you launch a satellite and it becomes deficient or has problems, you are the one who pays to clean it up?

Dr. Steve MacLean: Let me clarify a couple of things.

Up to about 800 kilometres, the gravity of the situation self-cleans. Space is quite clean up to about 800 kilometres.

For example, on my space walk I dropped a bolt, just a tiny bolt. It was an embarrassing thing to do, but it happens. There was lots of media attention about how I was contributing to the junk in space and so on. The truth is that the bolt burns up in the atmosphere four days later, so we're not talking about junk in low Earth orbit; we're talking about the positions of our geosynchronous satellites, meaning all the Anik series that Canada has and all the other satellites that Telesat has. Once their lifetime is over, which is anywhere from 15 to 30 years, they'll stay up there a long time.

There is a recognition that we cannot do that anymore. We have to have a way to bring those satellites down and allow them to burn up in the atmosphere as well when their lifetimes are over.

● (1100)

The Chair: Thank you, Dr. MacLean.

Thank you, Mr. Masse.

Dr. Thirsk, did you have something to show us or present to us?

Dr. Robert Thirsk: Yes, I just wanted to thank the Standing Committee on Industry, Science and Technology for the invitation to be with you today. In recognition of our visit with you, I'd like to leave you with what we call a montage that celebrates Canada's involvement in Expedition 20/21 aboard the international space station. Attached to the montage is a Canadian flag that spent time with me in space. It spent six months up there and completed 3,000 orbits of the Earth.

I just ask that you post this montage in some place where your committee members will remember that Canada is a spacefaring nation that has a reputation with our partners in the space station program. We bring pragmatic and tangible benefits to Canada.

Some hon. members: Hear, hear!

The Chair: Thank you very much.

I want to thank the witnesses for their testimony.

This meeting is adjourned.

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