

**Presentation by
The Canadian Coalition for Astronomy**

**To the
House of Commons
Standing Committee on Finance**

October 30, 2001

**By
Dr. Russ Taylor and Mr. Peter Janson**

Good Morning, and thank you for inviting us to present our national vision for the future of Canadian astronomy.

My name is Dr. Russ Taylor. I am the President of the Canadian Astronomical Society/Societe canadienne d'astronomie, and a Co-Chair of the Canadian Coalition for Astronomy. With me is Peter Janson, who is the Chair and CEO of AMEC and another of the Coalition's Co-Chairs.

The Coalition is well aware that the recent tragic events of September 11 have altered the priorities of this Committee and the Federal Government. However, we believe it is critical that the Government focus on its vision for innovation. To do so will be an important part of restoring the confidence of Canadians so that we can collectively get on with our lives.

The Government has stated that it wants to be among the most innovative countries in the world – increase its level of R&D investment so that we move from 15th place to 5th place. Canada's Long-Range Plan for Astronomy and Astrophysics (LRP) is one cost-effective way to move in that direction.

The LRP is a 10-year plan for astronomy developed by an expert panel. It builds on Canada's strong position globally in astronomy and will help insure that we do not slip from the third place position we now hold.¹

For a relatively modest investment, this plan provides opportunities for Canada in high technology and engineering. It will provide a training ground for scientists and technologists working on new technologies and innovations at the frontiers of human knowledge for years to come.

I would like to provide you with a very brief overview of the LRP and explain why it is important for this country's future.

Astronomical observatories are mega-projects that no single country can afford to build on its own. Groups of developed countries are working together to build the next generation of observatories, and Canada is an important player in these international efforts.

¹ The Plan reflects the consensus and support of the entire astronomical community. It has been publicly endorsed by all major stakeholders including: the Presidents of the National Research Council, the Canadian Space Agency, the National Sciences and Engineering Research Council and Presidents of all Canadian Universities engaged in astronomical research; leaders of Canadian industry, and leaders in the field of public awareness of science.

We are key players because Canadian scientists are among the most productive in the world. Canada ranks third in the world in astronomy and among Canadians scientific disciplines, Astronomy is first on the list of science exports.² Canadian astronomers and astrophysicists have accomplished great things even though Canada only invests about \$22 million annually in astronomy, a per capita investment of 98 cents per year. Our investment is several times smaller, than the United States and typically five times smaller than in European countries with similar GDPs.

In addition to the accomplishments listed in Appendix A, one of the most important factors contributing to Canada's high standing is the effective working relationship between the University sector and the National Research Council of Canada (NRC).

In keeping with its Parliamentary mandate, the NRC negotiates agreements to jointly develop new telescopes and maintains domestic telescopes and laboratories where advanced technologies are developed and young Canadians are trained. The NRC is also a partner in three major offshore facilities. Canadian engineering has literally been at the foundation of these impressive observatories.³

The total cost of the Long-Range Plan is \$264 million. The Canadian Space Agency will contribute \$100 million. The Coalition is seeking an investment of \$164 million (16.4 million per year for ten years) for the land-based components of the plan. This total may be less if our application to the Canada Foundation for Innovation (CFI) succeeds. Due to the limitations of the CFI funding criteria, the Coalition has only been able to request about \$24 million from the CFI.⁴

Canada's investment in the LRP buys the opportunity for Canadians to participate in designing, developing technology and software, building, and maintaining these facilities.

² Many Canadians know that this country is a world leader in science and technology. Across all scientific disciplines, Canada does about 5% of the world's research. The relative impact of a discipline on the international stage is measured by the number of citations to published research (i.e. use of the published results by other researchers). Within Canadian science and technology, astronomy leads all other disciplines in international impact – followed by medicine and chemistry.

³ They include:

- the twin 8 metre Gemini Telescopes; (one in Hawaii and one in Chile);
- the Canada-France-Hawaii Telescope (CFHT) (Maunaea Kea, Hawaii); and
- the James Clerk Maxwell (JCMT) radio telescope. (Maunaea Kea, Hawaii).

⁴ The CFI funds would only cover one specific part of the LRP - the Atacama Large Millimetre Array, a specialized high-speed digital electronics device to convert the faint signals received by the telescopes into images of radiation from dust and gas in the early Universe. Plans for Canadian partnership in the Atacama Large Millimetre Array have been formalized as part of an agreement between the U.S. National Science Foundation and the National Research Council. Other projects in the LRP include an innovative Canadian radio telescope concept, the Canadian Large Adaptive Reflector, to construct the world's largest telescope in Canada, as part of the technology development for the Square Kilometre Array. Canada will also develop new approaches to fabrication of optical telescopes as part of an international program to design a very large Optical Telescope on the ground that will be used to measure the properties of planets around nearby stars. All of these technology developments are carried out in partnership with Canadian industry

It also provides Canadian scientists access to new, world observatories that will help Canadians stay at the forefront as we unravel the secrets of the origin of the universe.

In the case of the Atacama Large Millimeter Array project, Canada's investment will be approximately \$50 million of the billion dollar total cost. For Canadian scientists, this investment is less than one percent of the total cost but provides us with access for up to thirty percent of the available research time in this new observatory.

Peter Janson's company – AMEC – is an excellent example of the impact astronomy investments can have on the Canadian economy. I would now like to ask him to share some of his experiences and observations with you.

Thank you Russ,

Dr. Taylor has outlined many of the reasons why, from a scientific perspective, an investment in the LRP makes sense. I would like to offer the business case.

There are a lot of reasons why an investment of this kind makes sense.

In many respects, we are at the same kind of critical crossroads that Canada faced in 1989/90 when Canada's participation in Gemini telescopes was decided.

The Canadian Government invested \$38 million to buy its partnership in the Gemini twin 8-meter telescopes. My company, AMEC Dynamic Structures (formerly known as AGRA Coast) built the Gemini domes. Our contract for the construction alone was worth \$44 million. Our ongoing work on telescopes has now resulted in gross revenue of \$150 million.

More than 80 high tech and engineering companies across Canada involved in astronomy projects would not have been eligible to compete for the work if Canada had chosen not to participate in Gemini. The Gemini telescopes demonstrate the excellent value that Canada received through this focused investment.

Because of AMEC's experience in astronomy structures, we are now placed at the forefront of another sector, the multi-billion dollar international amusement ride industry. AMEC has become the contractor of choice, providing turnkey solutions to some of North America's largest amusement park companies and international theme park builders.

Economic activity generated from the construction and operation of major astronomical facilities has a broad impact. Even a very conservative reckoning would show that for every dollar Canada invests in astronomy projects, Canadians are getting at least double their money back through the spin-offs and the work that Canadians are uniquely positioned to do.

If we fully implement the Long-Range Plan, not only will we preserve Canada's leadership position in world astronomy, but also our designs will influence and form the foundation for other countries to follow. With Gemini, we bid to construct structures to specifications. Implementing the LRP will mean Canada actually writes the specifications that others will bid to. It can be everything. Developed in Canada by Canadians for the world.

One thing is for certain, if we do not invest in the new round of projects outlined in the LRP, Canadian technology will not be a part of them. These international agreements stipulate that only companies from signatory countries may bid for contracts on these projects. Therefore, if Canada does not fund the LRP, Canadian companies will not be able to compete for the \$4 billion worth of work. More important, our students and scientists will not have access to these facilities.

Make no mistake; these projects will be built, with or without Canadian participation.

The time is fast approaching for Canada to commit funds to fulfill our part. If we are not soon at the table, Canada's potential to shape the projects outlined in the Plan will diminish, and Canadian technology and expertise may be sidelined by other countries that are ready to proceed.

As part of the North American contingent, our other partner, the United States intends to move forward by as early as the end of this year. The U.S. has just passed a Bill committing to their share of the first project in the LRP (150 million US\$) which means the international agreements to move forward will be signed in February. These agreements will go forward whether or not we are a partner.

The business members of the Coalition want to participate in these projects, and we want the opportunity to compete for these contracts, and win so that Canada can win on both the scientific and economic fronts. We ask you to share in this vision, and recommend that the LRP be funded in the upcoming Budget.

[Back to Dr. Taylor]

In addition to positive economic returns to the Canadian economy, many spin-offs from astronomical research have had an impact on our daily lives. The Internet, video cards for computers, and the precursors of the detectors that scan baggage at airports are all byproducts of astronomical research (see Appendix 2 for more examples.)

What new products will be derived from the imagination of Canadian scientists, technologists, and engineers through astronomy? That remains to be seen, but we do know there will be real and lasting benefits.

In Summary:

The LRP has two overarching goals:

- To ensure that Canada remains a leader in this new era, and
- that we reap the scientific and economic benefits of the new developments in astronomy.

It is all about innovation

The LRP will further develop the expertise that gives us a competitive advantage in high technology and returns the investment many-fold, as AMEC has shown.

The Long-Range Plan is coherent. It has broad-based support among astronomers, academia and industry. It is a goal that is both affordable and attainable.

The Canadian astronomical community has achieved great things in the past. We want to continue the tradition of Canadian excellence. We urge the Standing Committee on Finance to join with their colleagues on the Standing Committee on Industry, Science, and Technology, who have already passed a resolution endorsing the Plan and calling on the Government to make this investment, and to champion the Long-Range Plan. It is right for Canada.

Appendix 1

Canadian research and discoveries have directly contributed to moving astronomy forward to its current position. Some of the discoveries made by Canadian astronomers over the past decades include:

- The invention of techniques to measure ultra precise motions of stars now used to detect the presence of planets around other stars.
- The development of adaptive optics techniques to remove the distortions in optical images caused by the Earth's atmosphere.
- Canadian theorists have used computers to develop predictions of the structure of the Universe before the dawn of light – predictions that will be tested by the next-generation of radio telescopes.
- Canadian scientists have used measurements of the motions of galaxies in space to measure the density of the universe.
- Canadian scientists have identified the missing link in the evolution of matter from the primordial state outside galaxies to the complex state needed to form the building blocks of life.

Appendix 2

There have been many spin-offs from astronomical research that have had an impact on our daily lives. Including the following:

- The technology for the Netscape web program which was invented for computational astrophysics work.
- Image reconstruction techniques and sensitive microwave receivers developed for astronomy which are used for analysis of CAT scans and Magnetic resonance imaging (MRI) and also used for breast cancer scans.
- The precursors of the detectors that scan baggage at airports were developed for X-ray satellites.
- Synthetic aperture radar technology, used by RADARSAT to map the earth in high detail, uses the technique of aperture synthesis first developed by radio astronomers to make detailed images of the sky.
- Two students from Ecole Polytechnique started a small company Matrox in 1979 to produce electronic cards for storing images from the Observatoire Mont Megantic in Quebec. Today Matrox is a world leader in video cards for personal computers with export sales in excess of \$200 million annually.
- From the same observatory two researchers developed a computer display system for astronomical images. The software company Softimage resulted, and has grown into an industry leader in computer visualization and video production.