National Space Awareness Workshop 2008

Edited by
Steve Ulrich

CANADIAN ALUMNI OF THE INTERNATIONAL SPACE UNIVERSITY

Canadian Alumni of the
International Space University

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Preface

The National Space Awareness Workshop (NSAW) is a biannual event organized by the Canadian Alumni of the International Space University (CAISU). The workshop aims at promoting space awareness among students, young professionals and the community in general by having the participants working on topics in a space-related theme, through a very dynamic and interdisciplinary setting. The NSAW 2008 was held at McGill University, Montreal, Quebec on November 23rd, 2008. The theme for this workshop was *Canadians in Space*. The 2008 edition of the workshop attracted between 40 and 50 participants.

During the workshop, the participants first received lectures by the following worldwide experts, researchers, and professors in the space sector:

Bjarni Tryggvason	Visiting Professor, University of Western Ontario Former Astronaut, Canadian Space Agency
Viqar Abassi	Technical Manager, Canadian Space Agency
M. Lucy Stojak	President, Consultants M.L. Stojak Inc
Matthew Bamsey	PhD Candidate, University of Guelph
Robert D. Richards	Director of Space Technology, Optech Inc. Co-Founder of the International Space University

Then, some participants took the opportunity to form breakout working groups to address the conference theme and propose their own creative strategies and vision to reshape the Canadian Astronaut Program, from an interdisciplinary perceptive, with the help of experts acting as group moderators. Finally, the teams presented the results of their discussions to the other participants.

The following reports were prepared by a dedicated group of passionate and talented soon-to-be-academics and professionals people with whom it was a great pleasure to work. In the name of CAISU, I invite you to read on and discover how the next generation of space explorers envisions the future of *Canadians in Space*.

Steve Ulrich
Chair, NSAW 2008
Vice-President, CAISU

The following documents do not represent the point of view of the Canadian Alumni of the International Space University (CAISU) Association. The interpretations and opinions contained in those documents are solely those of the authors.

A Vision for the Future of Canadians in Space

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I. Introduction

ANADA needs a policy that will set the direction Cfor all agencies including Environment Canada, the Canadian Space Agency, the Ministry of Defence, and others. The need for this vision is further developed in Ref. 1. Ironically, it seems that there has been little change in the state of affairs since the publication of the so-called Chapman Report in the 1970`s [2]. Plainly, our vision for the future of *Canadians in Space* is not just two Canadian astronauts planting a flag and leaving footsteps on the Moon or Mars. Our vision is of all Canadians joining together in the space adventure, contributing to it, and benefiting from it. Specific benefits of this effort that we can see, and that all Canadians recognize the value of are:

1. pride in our country and intellectual leadership in the world;
2. the development of a highly skilled labour force, leading to a stronger economy;
3. space solar power, as a solution to the energy and environmental crisis, as dramatically and eloquently described in Gerard K. O'Neill's book [3];
4. the ability to monitor and study our environment and therefore to better protect it.

This much is generic. Where our vision is original is in its implementation and spirit. It revolves around two key concepts. First, **direct student and public involvement** and investment in this great adventure, and second, that students and the public will be motivated to become involved if becoming involved is easy, and if this involvement **involves activities that are fun and exciting**. We believe that space is not just a playground for scientists and engineers, but should involve everybody in the most direct way possible.

II. Implementing the Vision

In addition to the solutions proposed in Ref. 4, we propose the following specific structure and strategy:

1. the establishment of a Canadian Space University;
2. the establishment of a Canadian Space Theme Park network;
3. the assistance and promotion in the development of a Canadian Launch Capability;
4. the promotion of the development of an all-Canadian astronaut training program;
5. the founding of the International Astronautic Games in Canada.

This proposed strategy is illustrated in Fig. 1, in which the Canadian Space University would combine the strengths of Shad Valley, the University of North Dakota (UND) and the International Space University (ISU), all of them established, highly respected institutions. This University would be a significant contributor to the development of the Theme Parks through which the Astronautic Games would be run in Canada, and would assist in the development of the Launcher and the Canadian astronaut training program, an effort which would also be supported in large part by the theme parks.

These three components realize our vision of student and public involvement by engaging it at three levels, each of them in a way that is true to the spirit of the vision, while being matched to the level of experience and type of interest of the group involved.

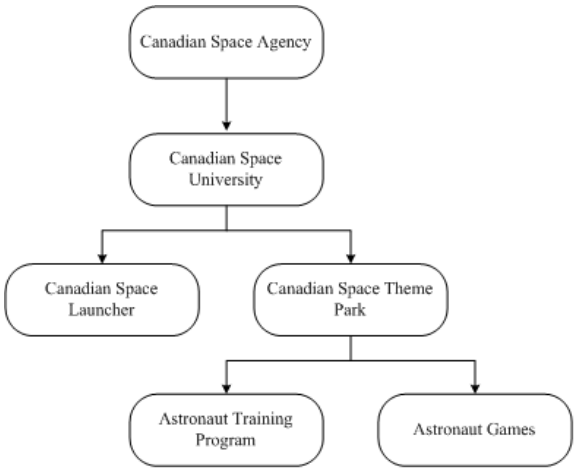

Fig. 1 Proposed Infrastructure and Strategy

III. Canadian Space Theme Park Network

The Space Theme Park Network most directly addresses the two key concepts of the vision, those of direct involvement of students and the public. The greatest challenge, and thus opportunity of the theme parks is finding the right balance of entertainment and education. The theme parks would address this balance at several levels. First, in their every day operation, it is desirable if they can offer an experience that is primarily entertaining, as that will be the best way to spread awareness of, and enthusiasm for, space exploration.

However, if the Theme Parks remain only institutions of pure entertainment they will not succeed in helping realize the vision of greater public involvement in space exploration. They must therefore offer and promote active participation in the conception, construction, and development of the Theme Park. The public will only arrive at a true appreciation of the nature of the construction and engineering behind the park if they play a role in it themselves. This participation is seen as coming in two flavors. The first is a very simple one wherein groups of participants replicate existing attractions. This generates further revenue in two ways, first, the participants pay the park for this training experience, and second, the park ends up expanded, with more to offer the public, and therefore attracting them in greater numbers. The second flavor is one in which the Canadian Space University, described in the next section, would come into the picture. This time, the participants would not replicate an existing attraction, but would perform all the process steps from conception to testing, including design and promotion. These activities would be carried out within the grounds of the theme park, over a period of a month or two or three, likely following a similar structure to that of the Shad Valley summer program, and the ISU Space Studies Program, as mentioned earlier. The net result of all this activity would be a continually expanding Theme Park paid for with profits from entertainment, alongside investment in education. Specific ideas for theme park attractions have been included as an appendix.

IV. Canadian Space University

The Canadian Space University would be the formal institution where individuals who discover their love of space through the theme parks would go to further deepen their knowledge through systematic study. It would also be these people who would play the greatest role in the further development of the parks.

The purpose of the Canadian Space University (CSU) would be to build on the existing Canadian space program by developing a launch facility and further developing and completing our astronaut training program (through the medium of the theme parks) while providing training and education in science, engineering and business (similar to the ISU). Pre-eminent experts from across Canada would be recruited as professors for this university, if only for a few weeks at a time, while the students would be responsible for the actual further development of the space program, putting in massive amounts of time and effort developing hardware and software in the context of their course-work. They would have the great privilege of learning all about science and engineering while tackling the most challenging and therefore exciting projects that can be thrown at them.

These extensions of the space program would be funded from three sources. First, as discussed above, profits from the theme parks as a result of public investment in their products and services in the domain of entertainment and technical training, second, investments in secondary and university education as a result of students deciding to receive their education from the CSU, and finally, sponsorships from industry if the theme parks and/or university decided to so partner. It is thought that the CSU would have a summer program and a bachelors and graduate program, just as the ISU has a summer and masters program. The summer program would be exactly as described previously. The bachelors program would be similar to the bachelors program at Sherbrooke; similar to the summer program, but longer and with more interesting results. All these programs would have the goal of developing

technologies and techniques to advance Canada's standing in the international space arena. To sum up, this CSU would be:

- dedicated to providing training and education in science, engineering and business. Satellite programs in universities, high¬ schools, and primary schools as described in [4] could be affiliated with the CSU, as well as the local theme park;

- specifically mandated to further develop the Canadian space program to include a space launch system and an astronaut training program, in collaboration with existing stakeholders in these fields. This effort would draw upon smaller student projects in the first two years of the program, and large-scale projects (one per team of students) in the last two years of the program, similarly to what is implemented at the Université de Sherbrooke, Quebec, Canada [5];

- such that the projects are required to be individually profitable independently of space and military applications. Suggestions include educational products/services, entertainment products/services, medical, energy and environmental products/services;

- specifically mandated to create a network of Space Based Theme Parks as the method by which the above products will be introduced to their ultimate purpose of engaging the public, generating funding for further development through educational entertainment. These products will further be the equipment with which the Astronaut Training Program will be further made possible, supporting the International Astronautic Games in Canada [6].

V. Canadian Launch Capabilities

Since the publication of the Chapman Report, the development of small launch capabilities has been a recognized priority for the Canadian space community. It is a fact that at this very moment the demand for such launch capabilities is growing at an unprecedented rate with the development of nano and pico-satellites accelerating worldwide [7]. It is also a fact that no current technology exists that can lift small payloads into their respective orbits in an efficient timely fashion. This is particularly true for Canada which must depend on the launch facilities, schedules, and regulations of other countries. The fact that Canadian satellite launches are not under Canadian control "severely limits the number, timing and type of orbital missions that Canada can undertake" says Arny Sokoloff [8].

It is important from the perspective of international relations that no such technologies currently exist, because whether or not we develop our own small launch capability, it is agreed that developing a large launch ability is likely outside our financial ability, meaning that we will still depend on other countries to launch our larger satellites and astronauts. There are those in the Canadian space community who fear that developing such a launch capability would be seen as attempting to compete with these other nations, hence introducing a stress factor in our relationship with them when it comes to negotiating for the launch of our larger satellites and astronauts, as mentioned above. However, these same experts have agreed that this would not in fact be a problem, given that no such capability currently exists (for the launch of small payloads), and such we would not be in competition internationally, but would be seen instead as providing a valuable and therefore appreciated service .

The development of a Canadian space launcher is currently a hot topic in Canadian industry, lead by the DreamSpace group and Continuum Aerospace ,and is currently on the agenda of the 2009 Canadian Space Commerce Association Annual General Meeting , March 19th. The ownership of a home-grown space launcher is a source of immense pride for any nation, Canada notwithstanding, and would provide an incredible boost to our national self-esteem if achieved.

The Space Theme parks will provide much of the initial motivation and interest in space, while the Canadian Space University will ensure that those who are interested in space will have the support and guidance they need to pursue their interests as far as they wish. The on-going development and improvement of the Canadian Launch Facilities and the Astronaut Training Program will represent the holy grail of space achievement in Canada, the assurance that with sufficient dedication and effort, the high goals that the young people of this country will be encouraged to set for themselves can actually be achieved in their lifetimes, to the benefit and enjoyment of all.

VI. The International Astronautic Game in Canada

The Apollo program truly caught the hearts of the people on this planet. Millions of hearts pounded together as Neil Armstrong set his foot on another

world and delivered his historical statement. The program ended, but the mission never ends. The dream lingers as the world continues its difficult but fascinating journey. Since the beginning of time, nearly everyone dreamed of flying. It was not a matter of prestige or complacency. It was a simple dream. It lingered in the minds of the children staring at the stars, the astronomers looking through their eyepieces, and even the housewives chatting under the cedars, until the Wright Brothers took off at Kitty Hawk. Thus society is not isolated from those who make dreams a reality.

There needs to be something marvelous to engage society again now that the Golden Ages of space have passed. People need something to talk about everyday at their dinner tables. The NewSpace phenomenon has filled this need in part, but not –everybody- is involved. Recently Canadian space activities have been quiet. We have a space program and it produces excellent results for the money it receives, but very few are taking to the streets cheering because of it. Rather, there are still those who are un-aware that we have one and many also who believe our money is better spent elsewhere.

The Canadian Space University, Theme Parks, Launch Facility, and Astronaut Training Program would all be similarly low profile infrastructure and institutions. Not so for the International Astronautic Games in Canada. This is where all the promotion, fanfare, and excitement will be.

The Astronautic Games [6] would represent a coming of age for the Space Theme Parks in Canada, the moment when, in partnership with all the exceptional institutions listed in Ref. 6, they are finally thrust into the national spotlight. The ultimate in technical extreme entertainment, combining modern technology, innovative applications of very simple technology, extreme guts, strength, physical prowess and mental acuity, the games would be a space Olympics, truly bringing home to people the full complexity of space exploration, and the immense satisfaction of being able to perform complex tasks quickly, efficiently, and effectively with equally complex technology, and a high level of creativity in the harshest of environments.

The Astronautic Games will allow the transformation of Astronautics from its perception as the occupation of distant supermen, to the high-tech sport of tomorrow, accessible to all. For the first time, youth from all over the country and the world will see fit, skilled, and tech savvy practitioners of this new extreme techno-sport perform on equipment that they themselves will then get the chance to try their own abilities on. This will serve to make them feel much closer to these people, and therefore closer to the adventure of space exploration. For the first time, people will see physical fitness ranked equally alongside technical skill in a high profile competition, and will thus be provided with role models that they did not have before, showing technology lovers how they can keep fit while still enjoying interaction with technology, and fitness lovers, how they can become tech savvy while maintaining their bodies in excellent shape. This will be truly an awakening for the nation.

With the technical programs offered by the space university, and the extreme sports equipment available in the theme parks, this new generation will have access to all the tools it needs to see its dreams through, to the benefit of themselves, the country, the exploration of space, and humanity itself.

VII. Conclusion

The most popular and therefore most financially secure Canadian space program will be one that incorporates a very high level of public awareness and involvement. If the budget of the space agency is made public at the same time as significant efforts are made to share Canadian space science, engineering and research with the public through the medium of the proposed theme park network, then Canadians will see much more clearly the real benefits and value of these investments. This needs to be done because an intellectual gap currently exists between a large portion of the population, and the experts of the space industry. The space theme park network will have the ability to educate a substantial portion of the population that would not otherwise become interested in or have access to the technologies of space exploration. This means that by using this network, this gap can be bridged in a way that is self-sustainable and even profitable, and will result in a strengthening of the space industry, and the country as a whole. The simplest, most direct way of implementing this strategy of increased public awareness, knowledge, and involvement is therefore to establish a Canadian Space University, a network of Space based Theme parks, and develop a Canadian Space Launcher and Astronaut training program. With all this infrastructure in place, along can come the Astronautic games to galvanize the nation to action.

Acknowledgments

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D. Richards for their refreshing, enlightening, and inspirational presentations, without which this report would not have been possible.

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Appendix A– Space Them Public Outreach

Some other ideas for outreach programs that could be operated by the staff of the theme parks but that would serve a different public because they would not be limited to the grounds of the theme park itself include:

Educational

- Elementary curriculums that would involve hands on space related projects for students, tying what they learn in the class room.
- Linking the student project to a space project where the students can contribute (eg: http://www.openluna.org/) .
- Create a publication. Each year, have students submit ideas for the theme park, complete with cost analysis, science involved, lessons learned, etc. The best ones will be incorporated into the theme park, and published the following year! The peer review committee could be made of teachers, scientists, engineers, community members, and other students. This would help students get valuable business skills, as well as involving them in something exciting, and bringing them into contact with many other people.

Entertainment

- Video games involving building space systems, drag and drop construction.
- Role playing games for Moon or Mars exploration.
- Movie and TV programs involving space (ex: http://www.ipxentertainment.com/).
- Racing game interactivity (eg. http://www.rocketracingleague.com/).

Participation

- Space tourism
- Lotteries
- Interaction between students and astronauts
  - through web technology
  - via amateur radio

Appendix B – Events/Attractions

Glider This part of the games is to challenge participating teams to build a very simple glider, and then fly it a certain distance. It would be designed to get airborne at jogging speed pulled by something, or gliding down a slope, flying no more than 10 feet high, for as far as you have a field to fly it in. This might take about a week or two, both to build and test fly. This project would take place in parallel with many other individual events that would last at most days or hours. Waiting a week for teams to build gliders is not particularly spectator friendly, but seeing the gliders take off at the end of a week or two would be a fitting end to the event. In the context of the theme parks, the public could

fly in pre-built gliders until such time as they decided to build their own, as discussed in the text.

Human Sling-Shot The idea of this one would be to simulate zero g in a way that is both radical, and inexpensive. The idea would be to use Bunge cords to launch people into the sky, or mock space capsules containing people. The Bunge cords would remain attached, catching the people on their arrival back at the ground. A variation would be to launch them up the side of a hill or mountain so that they land in a sea of padding. A third variation would be to build a giant net in which to catch them, but this would be much more expensive.

RC Plane Sponsored by the Rocket Racing League, rocket or propeller powered radio-controlled airplanes navigate an areal obstacle course, which is held up with helium balloons. The airplanes are equipped with autopilots that detect when an accident is about to occur, or when an airplane is seriously off-course, and take control of the airplanes in trouble, returning them to the ground. Tracers (coloured smoke) is emitted by each airplane helping the public and the competitors to spot them.

Satellite Communications The competitors could be challenged to take control of a satellite such as SEDSAT-2, perhaps via ham radio, and take a picture of the theme park with it, or the closest or most interesting region of the earth that is accessable.

Rocket Launch A fairly common activity, that would be an absolute must at an event like this. Competitors would be challenged to both build and fly their own rockets, or rockets (or rocket kits) provided to them, in a performance trial.

Pogo stick event A student at the University of Sherbrooke recently broke a Guinness World Record for the highest pogo stick jump , at 8ft. He built an entirely new kind of pogo stick to do it. The competitors would be challenged to navigate an obstacle course with the sticks, finishing with a super high jump. A trainer could be brought in for the week to help limber them up for the race, perhaps teaching them some tricks along the way. Relevance: Physical ability and endurance. Spatial orientation.

Piloting a Plane Another group here at the U of Sherbrooke has built an acrobatic airplane . The challenge would be to see how long it takes the competitors to successfully fly it.

SCUBA Challenge Treasure hunt, or race, or technical challenge underwater. Efficiency test involving physical and technical challenges. Proposal for building an in-expensive giant pool: sink an inverted hot-air balloon in the great lakes by filling it with clear fresh water. Cost of a used hot air balloon, adapted with coating so it will survive its new environment, a barge, diving equipment, and space ship mock-ups to be placed inside.

Flying Trapeze Relevance: It is hard to argue this, but it is a cool worthwhile attraction. It combines physical skill with spacial orientation skills, and you –are- briefly in free-fall. It would be a shoe-in in terms of quickly paying for itself.

Psychological Challenge Psychological test with Francine Coté (Clown from the Cirque de Soleil). Anybody who has been through this workshop can tell you that it is a physically, mentally, and emotionally exhausting experience. There is no better way of getting to know people very well, very quickly, than through this workshop. Astronauts who go to the moon and mars will have to be able to get along with each-other for long periods of time. The better they know each-other, the better. The workshop is also an excellent workout. This would be an event that would only be offered in the one off context of the games, given it's expense. Contingent on Francine's approval, this could be incorporated into a reality show style event, designed to test astronauts mentally and emotionally.

Canadians in Space: Establishing a Common Vision for Canadians

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I. Introduction

DURING the National Space Awareness Workshop 2008, the invited speakers raised several issues about *Canadians in Space*. Based on their expertise and on working group members' knowledge some weaknesses and possible solutions for the Canadian Astronaut Program have been identified. In this report, four aspects have been investigated regarding human space exploration in Canada: (1) public outreach, (2) astronaut recruitment and training, (3) Canadian launcher, and (4) the use of robotics in space.

II. Public Outreach

First, it appears that lacks of visibility and communication facilities are responsible for the image provided to Canadian in space; you'll only find the elite in these ranks. What seems, in our opinion, wrong. Moreover, it appears that the population doesn't see real impact of scientific research in space, which creates remoteness to this area. To resolve these problems, several solutions could be implemented:

- media on the accessibility of information, as used by the Canadian Armed Forces;
- sell the scientific benefits to the population;
- create a background of spatial awareness (extracurricular activity where students in primary and secondary schools where they are supervised by university students in space field);
- facilitate access to space by creating a Canadian student competition (secondary and university / college);
- sponsor launch of pico-satellites built by the universities scientist clubs.

By inviting young students to space through other persons initiated, this would lead them to consider space rather than another sphere of activity. Thereafter, by offering them a competition, they would be lead to appropriate new knowledge, and they would have tangible needs to be filled; those goals that seem outrageously missed. Moreover, this experience could lead them in a related study field, or they could try to make recognize these experiences to an employer. Finally, financing launch of pico-satellites built by universities would facilitate the creation of new scientific organizations, allowing them to become familiar with space and political laws, related to space activities.

III. Recruitment and Training

Of course, getting young people more aware of the space field will make easier the creation of a Canadian space program and will ensure that our space industry will continue to grow in the next century. That will eventually lead to the need of forming more astronauts. But is it realistic to think that we would be able to educate our astronaut exclusively in Canada, without any use of foreign facilities? After discussion, we realized that we don't have enough resources to completely form an astronaut and that it would be a major loss of money to build all the facilities required to accomplish this. In fact, we believe that it would be better for Canada to continue to use facilities in USA and all over the world to form our astronauts, but we should invest money in what we are specialized like the robotic field. For example, astronauts over the world come in Canada to get trained by our CAE simulator at the CSA. We should then invest and make these simulators a most that all astronauts, including even Japanese, cannot before going into space.

IV. Canadian Launcher

Nowadays, there are a lot of groups/societies advocating the development for a Canadian launcher (mainly for small satellites, but also for astronauts). After all, many nations already have their own launcher, so why would the situation be different for Canada? Having our own launcher would not only give Canada more launch accessibility but could also be a symbol of national pride and lead to several job creation in research and development. However, it is not believed to be a realistic avenue. Indeed, Canada has a very good and efficient partnership with the United States of America for using their launch facilities. In addition, development of a Canadian launcher involves a lot of money. Besides that, due to the geographical location of Canada (high latitude), launch costs would be higher than with platforms located near the equator. This scenario wouldn't allow us to be competitive compared to launchers used, for example, by ESA or NASA.

It is believed that it would probably be much more interesting for Canada to put energy and investments on its existing strengths, for example, space robotics.

V. Space Robotics

Although Canada is a leader in space robotics, it is believe that robots will eventually completely replace astronauts in space exploration. For sure, our participation in many robotic programs, such as *Canadarm*, has been recognized throughout the entire world, but the future of space exploration is in the hands of our astronauts and that's why our Canadian astronaut recruitment is so important. There are however, several advantages in using space robots instead of astronauts. For example, it is more difficult to maintain astronauts in health in space (food, medical and countermeasure issues, emergency procedures, entertainments, etc.). Because of this, the operational costs related to astronauts in space are larger than with robots. Indeed, robots do not get tired after 12h of continuous work and do not need to eat.

But on the other hand, seeing Canadian astronauts setting foot on another planet adds to the national pride, which is an important element of public outreach. Having an astronaut who went in space giving a speech to a young audience gives role models to them and helps promoting higher education in Canada, especially in science and technology fields. Even if it is not believe that robots will replace humans in space, we cannot get rid of our leadership in space robotics. When asked to the general public what they know about Canada is space, one of the first thing that will come to their mind is probably the name of an astronaut, but they are also likely to bring up *Canadarm*. This clearly means that visibility have succeeded on both side (human and robotics space exploration). However, when we think about the other aspects, as the training of an astronaut to deploy a tank of oxygen on the ISS versus the training of a ground controller to remotely operate *Canadarm2* to achieve the same task, the profitability of the latter options is more attractive. But again, robotics is not ready to replace humans.

Hence, it is clear he the best option is the use of robotics in support of human operations in space. Humans on Mars are not for tomorrow, and robots can reduce the cost of some missions. It is believed that Canada should continue to be a leader in this field. It should also allow better promote its robotic capabilities and training facilities in order to increase its cooperation with other countries.

VI. Conclusion

In conclusion, to justify our investment in the Canadian space program, people have to understand why we would like to inject so much money in that particular field. To achieve this population understanding, it begins with the awareness of our students and this is a major point to work on. More space awareness equals a better understanding of our goals and then, an easier justification of the investments and a constantly growing space industry. Canada can be proud of what was done in the past about space, but we have to continue running in that direction to keep Canada as a world leader in the space industry.

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