

APOGEE

THE CANADIAN SPACE PROGRAM NEWSBULLETIN

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Biocosmos Experiment Results Surprising

Canadian scientists studying an experiment from the Soviet *Biocosmos* satellite were so surprised by preliminary results that they are questioning the accuracy of their measurements.

The experiment involves a radiation detecting device, called a bubble detector neutron spectrometer, which contains a gel that produces bubbles in the presence of radiation. The device measured a significantly different level of radiation on *Biocosmos* than scientists expected.

Scientists are using particle accelerators, which produce radiation in known quantities and at known energies, to test radiation detecting devices identical to the ones which flew on *Biocosmos* for sensitivity to radiation. This will verify the results of similar tests carried out before *Biocosmos* was launched.

The Canadian Space Agency negotiated flight opportunities for two Canadian experiments on board *Biocosmos* September 15 to 29, one on

radiation detection and another on the decalcification of bone in microgravity. The Agency also funded and co-ordinated the experiments.

Dr. Harry Ing of Bubble Technology Industries in Chalk River, Ontario, who is conducting the radiation detection experiment, discovered the radiation-sensitive gel in 1984. Results of the *Biocosmos* tests are expected to prove very interesting as analysis progresses, and will be released in February at a symposium to be held in Moscow by Canadian and Soviet researchers. Nuclear laboratories, hospitals and

(see **Biocosmos**, p. 2)

Photo: Researchers Dr. Harry Ing and Kim Tremblay of Bubble Technology Industries in Chalk River, Ontario, test a radiation-detector similar to those carried on the Soviet Biocosmos satellite. The test tube they are observing contains a gel discovered by Dr. Ing in 1984, which produces bubbles in the presence of radiation.

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Canadian
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Space Agency Progress Report

This third issue of *APOGEE* is symbolic of the infrastructure that the Agency is gradually putting in place as it becomes autonomous. The administrative services of the National Research Council, Communications Canada, Energy, Mines and Resources and Industry, Science and Technology Canada are gradually being cut as the scientific and engineering links are strengthening.

The process will come to a head with the promulgation of the Agency Act (Bill C-16) which has now passed through the first and second readings as well as the Committee hearings. There remains third reading and then the Senate review, Royal Assent and Promulgation. There has been all-party support for the main thrust of the bill.

Meanwhile, staffing of the office in downtown Montreal is proceeding, with 11 colleagues in place including the Communications Branch, and arrangements for further space to accommodate the personnel now being recruited should be completed by February, 1990. Phase I of the St. Hubert Campus design is completed, arrangements for the

transfer of land from Transport Canada are advanced, and commercial flights from St-Hubert to and from Ottawa have begun. A meeting has been held with the heads of Montreal universities to discuss collaboration in the context of our Montreal site.

The important basic work of our programme continues uninterrupted, with new initiatives appearing more clearly on the horizon, as exemplified by the Canada-Japan Space Panel meeting November 16 and 17 and the protocol signed by the Prime Minister in Moscow November 21. Recent

meetings with the Scandinavian space agencies confirmed the desire of other countries to collaborate ever more closely with Canada in space. Details of progress in various areas are to be found throughout this issue.

A colleague who joined the Space Agency recently said to me this morning "It's so much more exciting than I imagined."

My feelings exactly.

Larkin Kerwin, C.C.
President
Canadian Space Agency

Canada, U.S.S.R. Sign Space Agreement

Canadian Prime Minister Brian Mulroney and Soviet Chairman of the Council of Ministers, Nikolai I. Ryzhkov, signed an intergovernmental agreement to increase co-operation in space research and the use of outer space for peaceful purposes November 21, during Prime Minister Mulroney's visit to the Soviet Union.

The agreement provides for co-operation in the areas of solar terrestrial physics, remote sensing, material sciences and biotechnology, space biology and medicine, space geodesy, space astronomy and other fields decided by mutual agreement.

Exchanges of scientific specialists and students are encouraged under the agreement, along with joint research, the sharing of experiment results, joint projects to design, build and launch spacecraft, and joint conferences and symposia to promote contact between Canadian and Soviet scientists.

The agreement will facilitate future meetings such as the one on Co-operation in Peaceful Uses of Space which took place in Kiev, U.S.S.R., September 11 to 15.

Delegates to the Kiev meeting, including representatives of the Canadian Space Agency and the Space Research Institute of the Soviet Academy of Sciences, agreed to increase collaboration between Canadian and Soviet scientists in the areas of space astronomy, life sciences, and space physics.

Canada and the Soviet Union co-operated recently on the Soviet *Biocosmos* satellite mission, which carried two Canadian experiments.

Ongoing collaboration in space astronomy includes participation in the Soviet RadioAstron program, which combines images from the ground and the RadioAstron satellite to produce very detailed radio images of celestial objects. Opportunities for co-operation in the life sciences include a study on bone mineral kinetics, and invitations to discuss future projects in the neurovestibular area and fly an energy expenditure experiment aboard the Soviet MIR Space Station. In space physics, Canada is considering flying plasma physics experiments on the Soviet Regatta A satellite.

APOGEE

Apogee is the term applied to the highest point above the Earth in the orbit of the Moon or an artificial satellite.

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Biocosmos (from page 1)

universities are the main users of radiation detectors sold by Bubble Technology Industries.

The second Canadian experiment on *Biocosmos*, being conducted by University of Toronto researchers Johan Heersche and Jane Aubin, involves analysis of bone marrow cultures from rodents flown on *Biocosmos* and dissected within hours of landing. The researchers are comparing control preparations with those taken from the experiment rodents to investigate changes in bone marrow cells over a

two-week period of microgravity. The results will help scientists understand the decalcification of bone in microgravity, which is a concern for astronauts as they prepare to spend longer periods in space.

Biocosmos, eight feet in diameter and semi-spherical in shape, carried more than 100 experiments from twelve countries and housed two monkeys, 10 rodents and other biological specimens during its two-week mission, which ended September 29.



Remote Sensing

Remote Sensing Conference Gets Enthusiastic Response

The 7th Thematic Conference on Remote Sensing for Exploration Geology: Methods, Integration and Solutions was held in Calgary October 2 to 6. Delegates from industries, government agencies, and institutions involved in geological exploration met at the international conference to discuss the latest developments in remote sensing.

Representatives of Energy Mines and Resources' Canada Centre for Remote Sensing (CCRS) and Geological Survey of Canada participated in conducting conference workshops and chairing sessions.

Delegates were enthusiastic about advances in remote sensing satellites, airborne sensors and related technologies being used by geologists as a new tool for mineral and petroleum exploration.

The conference, organized by the Environmental Research Institute of Michigan, also provided an opportunity for delegates to view remote sensing equipment which is available in North America, such as image analysis systems, geographic information systems and photographic equipment.



Space Station

CASI Holds Space Station Symposium

The Canadian Aeronautics and Space Institute (CASI) held a symposium on the International Space Station in Ottawa November 8 and 9 — the first dedicated to Space Station in Canada.

The symposium opened with a plenary session featuring speakers from the United States, Japan, the European Space Agency (ESA) and Canada, who described the activities of the international partners working on Space Station.

More than 40 papers were presented on Mobile Servicing System design, advanced robotics technology, expert systems for operations, materials science and processing, and the legal aspects of activities on Space Station.

Two additional plenary sessions were held. The first, chaired by Canadian Astronaut Dr. Robert Thirsk,

included mission specialists from NASA, NASDA (the Japanese Space Agency), ESA and the Canadian Space Agency, and was on astronaut activities on Space Station. The second, chaired by the Agency's Dr. Ziad Saghir, was on the "Utilization of Space Station", and allowed international speakers to discuss concepts and plans for undertaking science on Space Station.

General J-L Chretien described his flight experience on the Soviet MIR Space Station at a symposium dinner. Luncheon addresses included a long-range perspective from Dr. M. Duke of NASA on "Integrated Strategy for Exploration of Moon and Mars" and an address by Dr. Philip A. Lapp entitled "Where Now Canada?".

The symposium was organized by the Astronautics section of CASI. W.M. Evans of the Canadian Space Agency was the general chairman of the symposium. Members of the organizing committee were Frank Vigneron (chair), Fred Christie, John Beck, Roberta Rheume, Ziad Saghir and Robert Thirsk of the Canadian Space Agency; Mike Parfitt of SPAR Aerospace Ltd.; Richard Boudreault of Oerlikon Aerospace; John Saber of Concordia University, Howard Schwartz of Carleton University and A.J.S. (Tim) Timmins and Mary Rainboth of CASI.

The Canadian Space Agency's Dr. Karl Doetsch is President of the Canadian Aeronautics and Space Institute for 1989-90.

STEAR Awards Five Contracts

The Space Station Program's Strategic Technologies for Automation and Robotics (STEAR) branch awarded the last of five Phase Two contracts September 21 for "Automation of Operations" on the Space Station's Mobile Servicing System (MSS).

The STEAR Program helps Canadian industry develop advanced technology, particularly automation and robotics, for use in the design of MSS. The new technology is expected to create terrestrial spinoffs and longterm industrial benefits.

The five teams who won the \$900,000 contracts are:

- Artificial Intelligence Inc.; Atomic Energy of Canada Ltd., (B.C., Ontario)
- Softwords (Press Porcep); Alberta

Research Council (B.C., Alberta)

- Det Norske Veritas; Alberta Research Council (Alberta)
- Spectrum Engineering; Queens University (Ontario)
- Dynacon; N.B. Research and Productivity Council; CRS Plus; University of Toronto; University of Ottawa (Ontario, N.B.)

Artificial Intelligence Inc. and Softwords will develop plans involving the use of expert systems for training astronauts and technical personnel. Det Norske Veritas and Spectrum Engineering are investigating expert systems for fault diagnosis. The expert system uses a computer program which stores data about a machine's normal performance to diagnose faults in the machine by searching its memory. Dynacon is developing a sophisticated planner for operational applications.

The five contracts will be completed by 1992. Experts from the National Research Council of Canada and the Space Mechanics Group of the Canadian Space Agency will supply scientific advice and direction. "Automation of Operations" is being managed by Dr. Donald Smith of the STEAR Program.

MSS is a multi-armed robotic unit which will be used to assemble and maintain the Space Station, beginning in 1995-96.



Communications

STEM Antenna on Display at DFL

An early Canadian space program artifact called the STEM antenna is on display in the gallery at the David Florida Laboratory near Ottawa.

STEM, which stands for Storable, Tubular, Extendable Member, was developed in 1960-61 for *Alouette*, Canada's first satellite. It is sometimes referred to as the root of the Canadarm.

The antenna is a thin ribbon of prestressed steel which was rolled on a spool prior to launching and then extended to form a long tube when the satellite reached orbit. Extending up to 120 feet in length, the antenna had to be strong enough to withstand great centrifugal force, produced when a satellite spins.

(see **Communications**, p. 4)

Space Scan

Communications (from page 3)

The STEM antenna was invented by NRC researcher G.J. Klein and developed for space application by the Special Products and Applied Research Division of De Havilland Aircraft, which later split off to form SPAR Aerospace Ltd. Frank Mee, supervisor of SPAR Aerospace's Mechanical Development Laboratory, won the Canadian Aeronautics and Space Institute's Romeo Vachon award in 1984, in large part for his work on the STEM concept and manufacturing process.



Representatives of SPAR Aerospace Ltd. recently presented a STEM antenna to the David Florida Laboratory for display in its gallery. From left to right are: Dr. Rolf Mamen, DFL; Dr. Jack Chambers, Director General, Space Technologies Research (Canadian Space Agency); Peter Everett and Peter Charlton, of SPAR Aerospace Ltd.

SPAR Aerospace Ltd. has produced and exported many STEM devices, which have been used to deploy solar panels, as instrumentation booms and as antennas on rockets and satellites. Since 1960, more than 350 such devices have been flown on Canadian, European and U.S. space missions. STEM units have also been used for ground and seaborne masts and antennas.

Japanese to Invest in MSAT

An investment consortium headed by C. Itoh and Company Ltd., a Japanese trading firm, is a shareholder in Telesat Mobile Inc. (TMI), the newly formed Canadian communications company which will own and operate MSAT, the first mobile satellite communications system in North America.

Telesat Canada and Canadian Pacific Ltd. are other shareholders of TMI, which is based in Ottawa.

Telesat Canada will contribute \$50 million in equity and own 50 per cent of TMI while Canadian Pacific will contribute \$30 million and have a 30 per cent share. C. Itoh, along with three other Japanese companies, Nippon Yusen Kabushiki Kaisha, Passenger Service Co. Ltd., and Seino Transportation Co. Ltd., and Cable and Wireless of the United Kingdom, will provide \$20 million and own the remaining 20 per cent.

This is the first time in history that Canada and Japan will co-operate in the field of telecommunications services. The participation of C. Itoh may also benefit Canada by encouraging more Japanese companies to invest in Canada and opening up new business opportunities for Canadian industry in Japan.

The MSAT project originated with the Department of Communications and was expedited by the Canadian government's agreement to pre-pay for guaranteed lease services.

TMI's first satellite is expected to be operational by early 1993. The company will eventually employ up to 200 people and have regional offices across Canada.

Telesat, a world leader in satellite telecommunications, will supply engineering services associated with the design and procurement of the mobile satellites and will look after the day-to-day operations of TMI's satellite.

Olympus on track

Scientists have begun a series of tests on the *Olympus* satellite using 30/20 GHz communications payloads. The tests are being conducted using Canadian earth stations developed by Communications Canada. This is the first opportunity for Canadians to work in the new frequency band in the area of satellite communications.

Canada has been a full partner in the *Olympus* program since it was started by the European Space Agency in 1980. Final assembly, integration and testing of the satellite, which was launched July 11, were performed at the Canadian Space Agency's David Florida Laboratory. *Olympus* is the largest hybrid satellite used for civil communications launched in the western world.

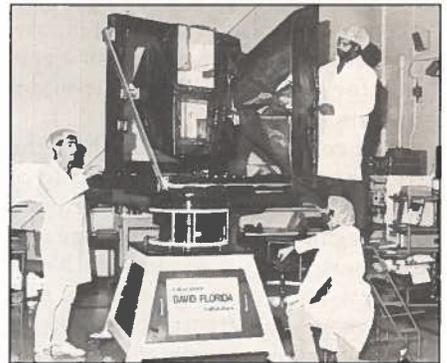
Despite a few minor anomalies that were handled quickly, *Olympus* has been performing well. For example, payload commissioning tests found a problem with one of the infrared earth sensors, caused by a reflection from a small portion of insulation that became partly detached during the launch.



Space Science

WINDII Undergoes Environmental Testing

Canada's Wind Imaging Interferometer (WINDII) is undergoing environmental testing at the Canadian Space Agency's David Florida Laboratory near Ottawa. The instrument will be launched aboard NASA's Upper Atmospheric Research Satellite in October, 1991.



Technicians at the David Florida Laboratory prepare the Wind Imaging Interferometer (WINDII) for mass properties measurements, which involve spinning the instrument to measure how long it takes to stop, and measuring its centre of gravity.

WINDII has successfully completed thermal vacuum and vibration testing, which confirms it will withstand extreme temperatures and the strain of launch. The instrument will also undergo electromagnetic interference tests to ensure it is compatible with other instruments on the satellite.

WINDII is an optical device that will measure very low-intensity light from atoms and molecules above the earth for 18 months. By measuring phase shifts and intensities in the light emission lines of successive images, scientists will be able to measure wind velocities and atmospheric temperatures and determine relationships between upper atmospheric disturbances and weather on earth.

Space Scan



Astronaut Program

Bondar, Money Continue IML-1 Training

As part of their training for the first International Microgravity Laboratory (IML-1) Space Shuttle Flight, Canadian payload specialist candidates Dr. Roberta Bondar and Dr. Ken Money continue their tour of the laboratories involved in developing experiments to be flown during the December 1990 mission.

Bondar and Money met with investigators from a dozen European countries in September and October during visits to laboratories in Belgium, England, France, Germany, Spain,

Switzerland and the Netherlands. Earlier, they visited U.S. investigators in Alabama, California, Pennsylvania and Tennessee.

Bondar and Money are being accompanied by NASA mission specialists Dr. Norman Thagard and Dr. Mary Cleave and by fellow payload specialist candidates Dr. Ulf Merbold (ESA) and Dr. Roger Crouch (NASA). At each laboratory they receive lectures on the nature of the experiment and get hands-on instruction in the operation of the apparatus.

The IML-1 payload will also include six Space Physiology Experiments developed by Canadian researchers, including University of British Columbia's Dr. Peter Wing and Dr.

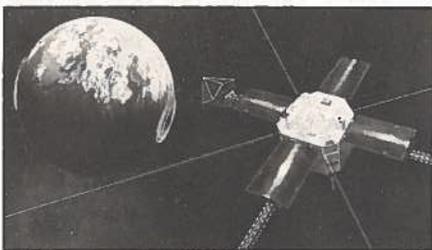
Donald Brooks, University of Calgary's Dr. Howard Parsons, McGill University's Dr. Douglas Watt, University of Western Ontario's Dr. Joseph McClure and the Canadian Space Agency's Dr. Robert Thirsk. The tour of Canadian laboratories took place in May.

Besides visiting laboratories to study experiments, the scientists spend a great deal of time at the George C. Marshall Space Flight Center in Huntsville, Alabama, participating in mission orientation sessions, and later will take part in experiment and flight simulations.

Their nine-day mission is scheduled for launch on December 6, 1990.

Scientists Study Upper Atmosphere

An instrument developed in Canada is generating data which may add to our knowledge and understanding of phenomena such as the Northern Lights. The Suprathermal Ion Mass Spectrometer (SMS), only 32 cm long and weighing 6 kg, is being used by scientists to monitor interactions between electrically charged particles in the Earth's upper atmosphere and particles from the Sun.



An artist's conception of the Japanese Akebono satellite, launched February 22, 1989 from the Kagoshima Space Centre in Japan.

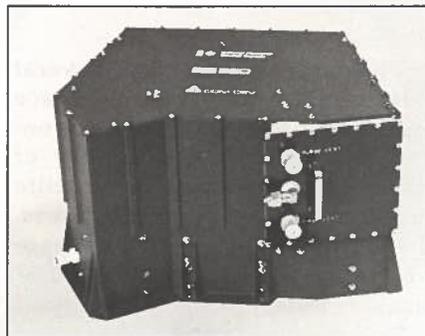
Because gases made up of these particles are major components of the Sun, stars and galaxies, better knowledge of their behaviour will be useful in understanding space as a whole.

Phenomena in the upper atmosphere, such as magnetic storms, produce effects including auroras, short-wave radio transmission problems, power outages and possibly long-term weather changes. On Earth, gases of electrically charged particles are used in fusion reactors, fluorescent lights, x-ray machines and microwave ovens.

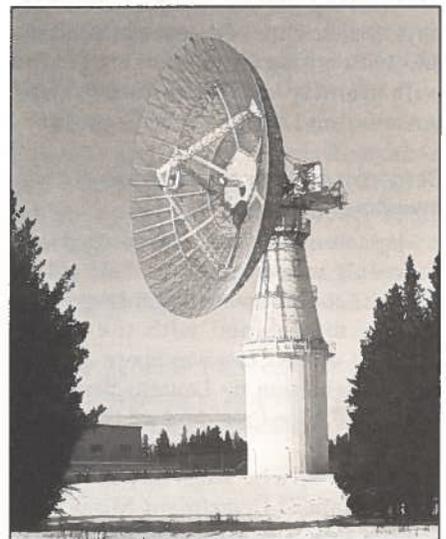
SMS was launched on board the Japanese satellite *Akebono* (formerly known as EXOS-D) February 22, 1989 and is the first Canadian scientific instrument to be flown by the Japanese.

The most interesting data from SMS is being received by a satellite facility in Prince Albert, Saskatchewan, which is far enough north to track *Akebono* as it passes through the auroral zone. Solar activity is at the height of its 11-year cycle, making this an opportune time for the satellite's mission.

SMS is one of eight instruments being carried on *Akebono* (Japanese for dawn). It measures the mass, and energy distribution of charged particles. *Akebono* has a planned lifetime of one year, but scientists expect to collect useful information from it for at least three.



The Canadian Suprathermal Ion Mass Spectrometer, designed to investigate interactions between electrically charged particles in the Earth's upper atmosphere and particles from the Sun.



Scientists are using this 26-metre antenna in Prince Albert, Saskatchewan to receive information about the upper atmosphere from *Akebono*.

The instrument's development was funded and managed by the Space Division of the NRC (now part of the Canadian Space Agency), and was a joint effort with the Japanese Communications Research Laboratory. Dr. B.A. Whalen of the NRC's Herzberg Institute of Astrophysics is the instrument's Principal Investigator. The work involved eight Co-Investigators, including a group of scientists from the NRC and the Japanese Communications Research Laboratory. The prime contractor, SED Systems Ltd. of Saskatoon, designed and built the instrument.

Space International

Canada-Japan Space Panel Meets

Canadian and Japanese delegates indicated a strong commitment to long-term co-operation in space at the inaugural meeting of the Canada-Japan Joint Space Panel in Vancouver November 16 and 17.

Dr. Jocelyn Ghent Mallett, Director, Policy and Planning for the Canadian Space Agency, co-chaired the Panel with Shinichi Nakayama, who directs the International Space Affairs Division, Research and Development Bureau of Japan's Science and Technology Agency.

The meeting dealt mainly with the formalities of the Panel's operation and its relations with the Joint Steering Committee administering the 1986 Canada-Japan Science and Technology Agreement.

The Panel set up a bilateral working group in the area of earth observation and agreed in principle to establish similar working groups dealing with solar-terrestrial science and space astronomy, and with microgravity. Working groups will identify opportunities for co-operation and develop specific projects.

Bergeron addresses Japanese Investment Mission

Japanese investors were assured that Canada's role in space and its international commitments regarding space will be maintained with the establishment of the Canadian Space Agency in a presentation by Laurent Bergeron, Executive Vice-President of the Space Agency.

Bergeron, who addressed the high-level Japanese Investment Mission to Canada October 23, went on to say that Canada believes in developing a harmo-

nious and profitable relationship with international industry.

Bergeron later attended a luncheon for the delegation in the company of Quebec Premier Robert Bourassa and a reception hosted by Montreal Mayor Jean Doré.

The investment mission was headed by Shinroku Morohashi, Vice-Chairman of the Japan Federation of Economic Organizations (Keidanren) and President and CEO of Mitsubishi Corporation. The Japanese delegation visited each of the 10 Canadian provinces from October 22 to November 2.

The Japanese Ministry of International Trade and Industry and Keidanren sponsored the mission. Its objective was to assess the Canadian business climate and its suitability as an investment destination, particularly in the context of the Canada-U.S. Free Trade Agreement.

The mission should facilitate greater commercial exchanges and collaboration in sectors such as space and advanced materials.

Canadians Contribute to IAF Congress

Canadian space activities were well-represented at the 40th International Astronautical Congress "The Next 40 Years in Space" in Malaga, Spain this fall, attended by 1,150 delegates from all over the world.

The Canadian delegation was led by Dr. Karl Doetsch, Director of the Canadian Space Agency's Space Station Program and President of the Canadian Aeronautics and Space Institute.

Several papers by Canadian space program and industry representatives were chosen from a record number of

submissions for presentation at the October 7 to 13 congress, sponsored by the International Astronautical Federation.

Mac Evans, Canadian Space Agency Vice President, presented a paper on the Space Station Mobile Servicing System and its role in the Canadian program. Dr. Doetsch co-chaired a session of the Symposium on Space Station, where the Space Agency's Parvez Kumar spoke on "Preparing for Use of the Space Station in Canada".

Representatives of CAE Electronics Ltd. in Montreal, Quebec, SPAR Aerospace Ltd. of Toronto, Ontario, Telesat Canada of Gloucester, Ontario, and MacDonald Dettwiler & Associates Ltd. of Richmond B.C. also presented papers.

The congress included 77 sessions, covering all aspects of international space activity, with more than 600 presentations being made.

Special sessions on international planetary exploration, IAF preparations for International Space Year in 1992, current U.S. space activities, 25 years of the European Space Program in science, the Soviet Energia Buran rocket/space transportation system, and space and flood management were featured.

Dr. Doetsch was appointed co-chairman of the International Program Committee for the 1991 and 1992 IAF congresses. The 1991 IAF congress will be held in Montreal, Quebec. The 1992 IAF congress will be held in Washington D.C. in conjunction with COSPAR, the Committee on Space Research.

The IAF is a non-governmental association of national societies, institutions and industrial companies, and has 106 members in 38 countries.

Space Net

Science teachers learn about space

Science educators from across Canada and speakers from around the world gathered in Ottawa for "Science Teaching — Canada's Future" October 18-21 to learn more about the subject they teach. The conference featured several sessions on the topic of space.

People came from as far away as Ghana and the Soviet Union to participate in the conference which was organized by the Science Teachers' Association of Ontario, and its Quebec counterpart l'Association des Professeurs de Sciences du Québec.

The conference featured several speakers from the Canadian Space Agency, including Ron Wilkinson, who spoke about applications of space technology, such as satellite surveillance of the Earth's environment. The technological benefits of space exploration, including the latest advances in robotics, were discussed by Paul Johnston. Robert Vaive spoke about educational requirements and training for astronauts.

Other speakers related to the Canadian Space Program included Peter Diedrich, a tutor at this year's Inter-

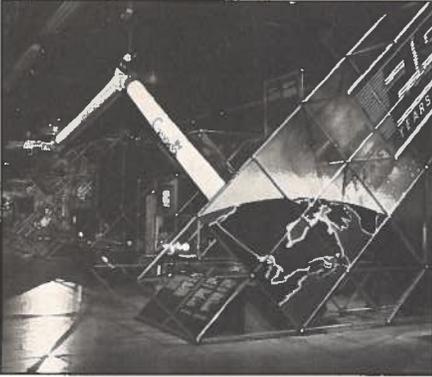
national Space University in Strasbourg, France, and Ron Thorpe, programme facilitator at Marc Garneau Collegiate Institute, who spoke about resource materials available at the Collegiate's Space Resource Centre.

The conference also featured an update on Canada's role in space, the science and teaching of astronomy, satellite communications and teaching students about space to interest them in science.

Space Net

Space Exhibition Featured at Science World

"Canada's Place in Space", an exhibition developed by the National Museum of Science and Technology and the Canadian Space Agency, was one of a group of three space exhibitions on display at Science World British Columbia until January 2.



The full scale model of Canadarm as it appeared on display at the National Museum of Science and Technology in Ottawa from September 1987 to January 1989.

"Canada's Place in Space" used descriptive panels, artifacts and models, including a full-scale replica of the Canadarm, to survey Canada's role in space exploration and applications. The exhibit was originally developed to celebrate the 25th anniversary of Canada's entry into the space age with the launch of *Alouette 1* on September 29, 1962.

"25 Years of Space Photography" developed out of the Jet Propulsion Laboratory's participation in American space exploration for NASA. The

exhibition was a collection of colour images created with a special television camera, which were transmitted from space and reassembled on Earth using computers.

A third exhibition, "The View from Space: American Astronaut Photography 1962-1972", recorded the first decade of American manned space exploration. The 80 images, taken by 16 different astronauts, were selected from the photographic record of the Mercury, Gemini and Apollo missions.

ISU Summer Plans Taking Shape

Canadian organizers are moving quickly on plans for the International Space University's Summer Session in 1990, to be held at York University in Toronto, with field trips to École Polytechnique and McGill University in Montreal and Canadian Space Agency facilities in Ottawa.

A working group to oversee the planning has been established, under the leadership of Dr. Rod Tennyson of University of Toronto's Institute for Aerospace Studies. Other members of the working group are representatives of École Polytechnique in Montreal, McGill University, University of Toronto, York University, Oerlikon Aerospace, SPAR Aerospace, the Canadian Space Agency, and the governments of Ontario and Quebec, Metropolitan Toronto, and North York, as well as CIDEM of Montreal.

The group has met twice, establishing subcommittees to fully develop and plan certain aspects of the session. For instance, in collaboration with ISU

headquarters in Boston, the academic subcommittee plans the educational shape of the session and decides on design projects for the students. They must also seek out instructors from around the world.

The university summer session will span about two months in July and August of 1990.

ISU '89 Allows Students to Specialize

The second International Space University, which took place at the Université Louis Pasteur in Strasbourg, France attracted 124 students from 25 countries for a multidisciplinary look at space science and policy and an opportunity to specialize in one of eight disciplines.

Eleven graduate students from Canadian universities were chosen for their academic performance and leadership abilities to participate in the session. Tutors for this year's session included Canadians Peter Diedrich, Chris Sallaberger, Kristiina Valter and Erik Viirre, who were students at the 1988 International Space University.

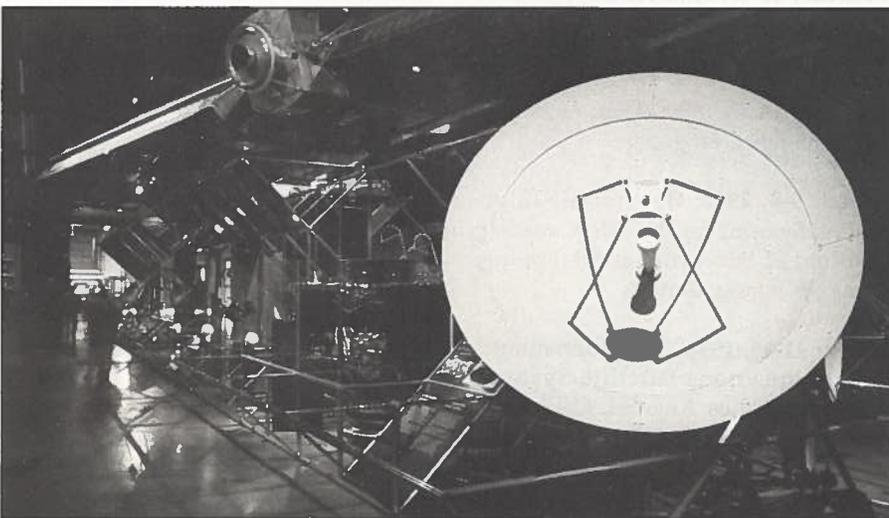
Students attended lectures on Business and Management, Resources and Manufacturing, Satellite Applications, Space Architecture, Space Engineering, Space Life Sciences, Space Policy and Law, and Space Sciences during the first half of the eight week session.

The second half of the session allowed students to take more advanced topic courses and specialize in one of the eight disciplines.

In addition, students completed two design projects, a Lunar Polar Orbiter, which could search for possible ice, gas or mineral deposits at the poles of the Moon, and a Variable Gravity Research Facility.

Students also viewed live images of Neptune as they were sent back from *Voyager 2* and were treated to a panel discussion among Bruce McAndless, who designed NASA's Manned Manoeuvring Unit, two French astronauts and Soviet cosmonaut and cardiologist Dr. Oleg Atkov, about their experiences in space.

This year's session featured Soviet faculty members for the first time. Atkov, who spent eight months in space and held the longest duration space flight record until 1984, was on the Space Life Sciences faculty for a month.



A satellite dish used with *Hermes*, an experimental communications satellite built at the David Florida Laboratory near Ottawa. The engineering model of *Hermes* appears in the background with a half-scale replica suspended overhead.

Space Resources

◆ Canadian Space Agency Resources:

- **Canadian Space Program Profiles:** Canada's Place in Space/MSS Facts (Space Station)
- **Pamphlet:** Canada in Space: 25 Years and Counting
- **Video Tapes:** Canada in Space: 25 Years and Counting/Canada's Place in Space (Space Station)/RADARSAT
- **Posters:** Canada's Place in Space/Space Station (MSS)/RADARSAT
- **Photo Cards:** Canada's Place in Space/Space Station(MSS)/Space Science (Aurora)/RADARSAT/Canadian Astronauts
- **Stickers:** Canadian Space Program Patch

◆ The David Florida Laboratory fact sheets folder

David Florida Laboratory
P.O. Box 11490, Station "H"
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tel. (613) 998-2383

Space Communications
Canadian Space Agency
1981 McGill College Avenue
BNP Tower, Suite 535
Montreal, Quebec
H3A 2X1
tel. (514) 496-4000

Space Communications
Canadian Space Agency
240 Sparks Street
Ottawa, Ontario
K1A 1A1
tel. (613) 991-0205

- ### ◆ The Space Resource Centre Catalogue, 1988, The Marc Garneau Collegiate Institute (MGCI)
- The catalogue describes materials available for duplication in areas such as aeronautics, application of satellites, space life sciences, manned space-flight, space sciences, etc.

◆ The Capsule—MGCI's newsletter.

Marc Garneau Collegiate Institute
135 Overlea Boulevard
Don Mills, Ontario
M3C 1B3
tel. (416) 429-6166

- ### ◆ The Space Resource Centre at MGCI,
- a nation-wide NASA materials distribution centre, includes video tapes from numerous Canadian agencies and businesses. Other resources available to Canadian educators include packaged audio tapes and slide presentations, teacher guides and course materials. References to sources of information related to space science and a list of speakers and contact persons in related fields can also be ordered.

- ### ◆ Directory of Publications and Audio-Visual Materials, Communications Canada
- The directory lists brochures and handbooks, fact sheets, newsletters, posters, studies, reports and audio-visual material available from DOC. Some publications are free of charge, others can be purchased from authorized bookstores or from the Canadian Government Publishing Centre. Audio-visual materials can be borrowed free of charge.

Communications Canada
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Calendar

January 8-11, 1990: American Institute of Aeronautics and Astronautics (AIAA) Aerospace Sciences Meeting, Reno, Nevada, U.S.A.

February 3-7, 1990: American Astronautical Society (AAS) Guidance and Control Conference, Keystone, Colorado, U.S.A.

February 13-15, 1990: AIAA Aerospace Engineering Conference and Show, Los Angeles, California, U.S.A.

February 14-18, 1990: Asian Aerospace '90 Conference, Singapore

March 5-8, 1990: Geographic Information Systems for the '90s, Canadian Institute of Surveying and Mapping, Ottawa, Ontario, Canada

March 11-15, 1990: 13th International Communications Satellite Systems Conference, Los Angeles, California, U.S.A.

March 13-15, 1990: 12th Aerospace Testing Seminar, "Testing for the 21st Century", Manhattan Beach, California, U.S.A.

March 26-29, 1990: Space Commerce, Montreux, Switzerland

March 28-30, 1990: 14th Annual International Mobile Communications Expo, Dallas, Texas, U.S.A.

May 1-3, 1990: First Circumpolar Symposium on Remote Sensing of Arctic Environments, Yellowknife, North West Territories, Canada

May 8-9, 1990: Second Workshop on Microgravity Experimentation, Ottawa, Ontario, Canada

May 14-15, 1990: Canadian Aeronautics and Space Institute Annual General Meeting, Toronto, Ontario, Canada

May 20-26, 1990: 17th International Symposium on Space Technology and Science, Tokyo, Japan

May 22-23, 1990: 5th Conference on Artificial Intelligence Applications for Space, Huntsville, Alabama, U.S.A.