Campus and Cosmos

An Astronomical Walking Tour of the University of Toronto Campus Area

Led by Professor John Percy, University of Toronto

17 September 2011

Sponsored by Heritage Toronto

The tour begins on the south-east corner of Bloor Street and Devonshire Place.

Introduction: Welcome! I'm John Percy, Professor Emeritus at the University of Toronto. One of my affiliations is the Department of Astronomy and Astrophysics, which you shall see at the end of this walk. The other is across the road at the Ontario Institute for Studies in Education, 252 Bloor Street West. It was established in 1965 as a think-tank for education policy and research, and moved into this building in 1969. It now encompasses the Faculty of Education, and prepares about a thousand BEd students a year, in addition to carrying out graduate education and research. Teacher education at U of T recently celebrated its 100th birthday. *Astronomy is now a compulsory part of our elementary and secondary education curriculum.* I work with the Ministry of Education, the Science Teachers Association of Ontario, and the teacher education system here, to help prepare teachers for this challenging part of the curriculum.

This walk is a legacy of International Year of Astronomy 2009 – the 400th anniversary of Galileo's development and first use of the astronomical telescope. His observations and discoveries changed our conception of the universe, and our place in it. Based on his observations of the moons of Jupiter, the mountains on the moon, the spots on the sun, and especially the phases of Venus, it was absolutely clear that the earth was *not* the centre of the solar system, the sun was. Now we know that the sun is just one of hundreds of billions of stars in the Milky Way Galaxy, which is one of tens of billions of galaxies in the visible universe. Many stars have planets, and undoubtedly some are like the Earth. And the ingredients of life are everywhere. Most stars and planets have had more than enough time to evolve life, and intelligent life – perhaps even intelligent to go on walks like this one! But we should not feel humbled; in the words of Henri Poincaré: "astronomy is useful because it shows how small our bodies, how large our minds".

As a member of Heritage Toronto, and a member of the IYA Canada Committee, I developed this walk as one of my personal IYA projects. Half of our vision was to develop partnerships that would sustain public interest in astronomy (the other half was to provide an engaging astronomy experience for every Canadian). Celebrating and preserving our heritage was a primary objective of both the international and the Canadian IYA efforts, so I am delighted to partner with Heritage Toronto. During IYA in Canada, we organized over 3,600 events, reaching almost two million people.

The geographical order of our walk is not the historical order. Organized astronomy in Toronto began at the south part of the University of Toronto campus. The building in front of us is a later home. And today's centre of astronomy activity at the University of Toronto is at the south-west corner of campus, where we shall end our walk.

Although we now think of astronomy in terms of forefront science and technology, exploration and discovery, it also has obvious practical applications, and it is embedded in almost every culture. You will experience some of that in the places that we visit today. In fact, one of the implicit themes of this walk is the diversity of astronomy: a forefront science and technol-

ogy, with practical applications, deep cultural and historical roots, a place in our educational system, and an enjoyable interest or hobby for thousands of Canadians.

We're approaching the end of summer. If I ask a typical audience why it gets hot in the summer, what do you think they will say? Yes, because the earth is closest to the sun in the summer! Not so! It gets hot because the days get long, and especially because the sun is highest in the sky; its heating effect is most efficient.

1. **What has this building (Meteorology) got to do with astronomy? And what evidence can you see that this was an observatory?**

   Meteorological Office: 315 Bloor Street West, housed one of Toronto's first observatories. In the 19th century, most astronomy had a practical emphasis: time, or surveying and navigation, matters related to the earth's motions, interior, atmosphere, or magnetic field. In those days, time was reckoned by the earth's rotation and revolution. Now it is maintained in laboratories by atomic clocks. During the course of this walk, you will see how astronomy has evolved in Toronto, since the early 1800's.

   The Meteorological Observatory was originally located on the southern part of the campus, but relocated here in 1907 when that part of the campus over-ran the observatory. This building was designed by Burke and Horwood, and opened in 1909; it was the headquarters of the Meteorological Service of Canada until 1971. Until recently, it housed the Office of Admissions and Awards of the University of Toronto, and is now part of the Munk Centre for Global Affairs. Note the very interesting carvings, around the Canadian coat of arms, above the main door.

   There is a small building, almost hidden, on the west side of the building. This housed the transit telescope for the observatory. You can see where the main dome was, on the roof. Time was measured by the passage of stars through the field of view of this telescope.

   Next stop: east entrance (on Queen's Park) to ROM.

2. **What field of astronomy is the ROM world-famous for?**

   Royal Ontario Museum: designed by Darling and Pearson, the original (now the western) part in Byzantine style, opened in 1914, and expanded in 1933, 1984, and most famously in 2007. It descends from the work of the Royal Canadian Institute, founded in 1849, which we will hear about later. It was operated by the University of Toronto until 1968; now it is an independent, provincially supported cultural agency.

   The ROM' Mineralogy Gallery is home to one of the world's major collections of *meteorites*, especially the oldest and most pristine; this new exhibit opened in December 2008. Meteorites represent samples of cosmic material falling to earth, obtained at little or no cost to science. Some are fragments of asteroids; a rare few are material left over from the formation of the solar system, 4.5 billion years ago. An even rarer few are rocks ejected, by impacts, from the surface of the moon or even from Mars.

   Meteorites also remind us that the Earth is constantly bombarded by objects from space. In 1950, prospector Fred Chubb contacted ROM geologist Ben Meen about an unusual 3.4 km circular lake in northern Quebec. Meen, Chubb, and a photographer, supported by funds from the *Globe and Mail* and other sources, set out to explore this lake. Another expedition was mounted the next summer, with support and extensive publicity from the

National Geographic Society. It was originally called Chubb Crater. Now it is called the New Quebec Crater (though the name Pingualuit Crater is increasingly used), and is one of 29 known meteorite impact craters in Canada, the largest being the Sudbury basin, almost two billion years old. Canadian scientists have been world leaders in studying impact craters around the world, including the one in Mexico that led to the demise of the dinosaurs, 64.98 million years ago.

These large impacts have had a profound effect on life on Earth. The ROM's paleontology department has contributed to our understanding of these mass extinctions.

Also (unknown to most people) the ROM is still a major force in astronomy education, through its program of portable *Starlab* planetariums: a modest replacement for the next stop on our tour – the McLaughlin Planetarium.

Next stop: plaza in front of McLaughlin Planetarium.

3. **This was once one of the world's foremost planetariums; why did it close?**

McLaughlin Planetarium: designed by Allward and Gouinlock, was once one of the world's major planetariums. It was largely funded through a donation from Col. Sam McLaughlin, an Oshawa industrialist. The University of Toronto (which administered the ROM at the time) and the Royal Astronomical Society of Canada were strong supporters of the planetarium project. From 1968 until its closing in 1995, it educated and inspired hundreds of thousands of people each year, including schoolchildren getting their first look at a "dark sky". It also had a very impressive set of exhibits, including a 3D model of the sun's starry neighbourhood in the Milky Way galaxy.

The planetarium was closed in response to the so-called "Common Sense Revolution" of the Conservative government, ostensibly as a budget-cutting measure, even though the Planetarium was close to meeting its costs. The ROM Board thought the site could be converted into a new money-making attraction; this did not turn out to be the case. [I followed the situation closely, because I was Vice-Chair of the Board of the Ontario Science Centre – another provincial cultural agency – at the time.]

Sadly, the Planetarium closed shortly before astronomy became a compulsory topic in the elementary and secondary school science curriculum; happily, the Ontario Science Centre – one of the world's best – has become the #1 astronomy resource for teachers and their students, as well as for the public.

The Planetarium was also home to the Toronto Centre (branch) of the Royal Astronomical Society of Canada, one of the largest and oldest astronomy clubs in the world. It was founded in 1868, as the Toronto Astronomy Club, by a small group of amateur astronomers. It was incorporated in 1890, and received its royal charter in 1903; and it now has over 4,000 members in 29 centres across the country. Its balance between national activities, and local ones, is exemplary, as was its balance, in its earlier years, between amateur astronomers and professionals. It recently won Canada's highest award for excellence in science outreach – the Michael Smith Award. Since the closing of the planetarium, the RASC Toronto Centre meets bi-monthly at the Ontario Science Centre, and partners with them in offering "star parties" there, several times a year, as well as at other sites such as High Park and Bayview Village Park.

There have been a handful of attempts to arrange for a new planetarium (though not on this site), but no significant funding is in sight. The University of Toronto recently bought

the Planetarium site back from the Museum, to be used for other purposes, possibly the expansion of the Faculty of Law.

Next stop: corner of Hoskin and Queen's Park (but take note of red sandstone building with red spire roof.

4. **Where and when did university-level astronomy teaching really begin in Ontario?**

   Victoria College, founded 175 years ago, now includes several buildings, but the first was the red sandstone building that we now call "Old Vic". It was designed by William Storm in Romanesque Revival style, and was opened in 1892. It was one of several colleges (mostly theological) and professional schools that affiliated with the University starting with Knox College in 1875.

   The third floor of Old Vic is occupied by the University of Toronto's Institute for the History and Philosophy of Science and Technology. The Institute's most famous member was Galileo scholar Stillman Drake. Originally a financial consultant, he later published 131 books, book chapters, and articles about Galileo. His papers reside at the U of T Rare Book Library – a treasure trove of information in this Galileo year (the Rare Book Library is an *architectural* treasure!).

   Next year (2012), the Department of Astronomy & Astrophysics plans to partner with the Institute to mark the 2012 June 5 Transit of Venus with an exhibit, and symposium. This will be the last such transit visible for over a century.

   In 1609, the year that we celebrated in IYA, there was very little "astronomy" in Canada as we know it today, other than its use for navigation by explorers such as Cabot (1497) and Thomas James, who explored Hudson's Bay in 1633. Astronomy as such began in Atlantic Canada, and in Quebec. But Canada's Aboriginal peoples traditionally used astronomy for navigation, and for keeping track of the seasons for practical and ceremonial purposes. The Inuit were particularly skilled practical astronomers; I highly recommend the book *The Arctic Sky*, by John McDonald, published by the ROM.

   Victoria College was initially located in Cobourg, Ontario. In 1842, its first President, Egerton Ryerson (famous as the "father of free compulsory public education in Ontario", and the namesake for Ryerson University) urged the teaching of astronomy. To quote his inaugural address in 1842: *surely the knowledge of the laws of the universe, and the works of God, is of more practical advantage, socially and morally, than the knowledge of Greek and Latin.* As a result, astronomy education thrived there, and this tradition was brought to the University of Toronto when Victoria College relocated here in 1892.

   Next stop: under the tree to the south of Hart House.

5. **This is one of the most scientifically-significant buildings in Ontario!**

   The Stewart Observatory: This building was designed in 1853 in mildly Venetian style by Cumberland and Storm, who also designed University College. It was originally located further south, but was over-run by the post-1900 building boom on the south side of the campus, and not used after the Meteorological Observatory was moved to Bloor Street in 1907. It was slated for demolition at that time but, through the efforts of Louis Beaufort Stewart, a Lecturer in the Faculty of Applied Science and Engineering, it was

disassembled, and moved to this site. It was used by the Department of Surveying and Geodesy until the 1950's and, since 1953, has been the headquarters of the University of Toronto Students Union.

In 1881, a 6" refracting or lens telescope by T. Cooke and Sons was installed in the observatory, to observe the Transit of Venus (it was cloudy). It was relocated to the Meteorological Observatory when it moved to Bloor Street, but was returned to the Stewart Observatory in 1930. In 1952, it was moved to a small dome at the David Dunlap Observatory in Richmond Hill, and in 1984 it found a permanent home at the National Museum of Science and Technology in Ottawa.

If the lay of the land suggests to you that a river ran through here, you are right. It was called Taddle Creek. It ran from way north of Bloor Street, down what is now Philosopher's Walk, past here, and into the lake. There was even a pond here – until it turned into a cesspool. Now Taddle Creek is underground. If you listen down the right sewer, you may be able to hear it!

Next stop: tree to the south of University College.

6. **Who was the (co)-father of astronomy in Canada?**

University College and Clarence Augustus Chant: University College, or UC, is the most famous of the University of Toronto's buildings. King's College, as it was then called, was originally chartered in 1827, and intended to be an Anglican institution. But that was controversial, and not much came about for the first decade or two, so Bishop John Strachan established Trinity College as an Anglican college, further west. The University of Toronto finally emerged in 1850 as a non-denominational institution, centered on UC. It was men-only until 1884. This building was designed in Norman Romanesque style by Cumberland and Storm in 1859, and restored in 1892 after a disastrous fire. Further restoration and renovation was done in 1979. The round structure on the south-west was the chemistry lab, then the physics lab, until about 1900. The interior – especially East and West Halls on the second floor – is a real gem. UC also hosts the University Art Centre. By the way: the oldest surviving University building is not UC but St. Basil's Church and Odette Hall, St. Michael's College, built in 1856.

UC is reputed to be haunted by the ghost of Ivan Reznikoff, a Russian stonemason who disappeared in the course of a feud with another stonemason, Paul Diablos. Years later, after the fire of 1890, a skeleton – supposedly that of Reznikoff – was found in a shaft. You can read the whole story on the UC website. And visit Reznikoff's Cafe on St. George Street, or Diablos' Cafe in UC during the week.

Clarence Augustus Chant, father of astronomy at the University of Toronto, and of the Royal Astronomical Society of Canada, had his office here, on the 2nd floor in the 4th house of the west (formerly residence) wing for the first 15 years of his long and active career – from 1891 through his "retirement" in 1935, to his death in 1956. He was born in 1865 in Hagerman's Corners, not far from Toronto. After working as a schoolteacher for three years (par for the course in those days), he completed a BA in Physics at U of T in 1890. In 1891, he joined the Department of Physics, and soon became interested in Astronomy. He spent 1900-1901 at Harvard, completing a PhD. The next year, he introduced astrophysics at U of T – not surprising, considering that Harvard was a world centre for astronomical research then (thanks to philanthropy, not government support) as

it is now. In one decade, astronomy at U of T moved from mathematics and surveying, to mainstream and frontier science; Chant was the first instructor of general astronomy (as opposed to mathematical astronomy) at the University. A separate sub-department was created by Chant in 1905, and the Department of Astronomy and Astrophysics measures its history from this date.

Chant also founded the RASC's *Journal* and annual *Observer's Handbook*; and edited these publications for 50 years, until his death at over 90; the RASC is still known, world-wide, for its Handbook.

He was an enthusiastic and gifted communicator of astronomy. His efforts eventually led to the donation and construction of the David Dunlap Observatory in Richmond Hill, in 1935.

Chant is also considered to be the "co-father of Canadian astronomy", along with John S. Plaskett, who championed federal government involvement in astronomy, leading to the construction of the Dominion Astrophysical Observatory in Victoria in 1918. In 1935, Canada had two of the three largest telescopes in the world – a sign, I think, of Canada's optimism about its status in the 20th century!

Next stop: complex of plaques in front of Sandford Flleming Building.

7. **On this site stood a building of national significance: part of the coming-of-age of our country!**

   The Magnetic Observatory: (1840), Canada's first government observatory, was one of a series erected around the world by the British government, to try to understand why compasses tended to "wander", relative to north, on time scales ranging from hours to years. In those days, compasses were still important for navigation, and navigation was part of practical astronomy. As the plaque says: between 1840 and 1898, the direction of the magnetic pole wandered by 5 degrees! Also: scientists were developing a more "holistic" interest in planet Earth. And it was a century of scientific exploration and discovery. The astronomer Halley had first noticed the problem of the wandering compasses.

   Major Edward Sabine, of the Royal Artillery (of the mother country, not the colony), was the director of the project. "Her Majesty's Magnetical and Meteorological Observatory at Toronto" was initially two log buildings. The "wandering compasses" project was successfully completed and the results published in 1851-6. The phenomenon was partly due to the effect of sunspots, solar activity, and its effect on the Earth's magnetic field – still an important issue, as we shall note later.

   The observatory was then abandoned, and presumably to be demolished, but the colonial government was persuaded to take it over, and indeed it was upgraded. This is an important example of Canada's gradual transition from colony to self-rule – both in science, and in general. A new building (now the Stewart Observatory) was designed in 1853. From that time until 1905, when the Dominion Observatory was opened in Ottawa, it was Canada's official timekeeper. According to *Wikipedia*, it is *Canada's oldest existing scientific building.*

   Note the plaque, honouring Sir John Lefroy, who directed most of these studies of the Earth's magnetic field in Canada. Mount Lefroy, north of Lake Superior, was a favourite subject for painter Lawren Harris.

By the way: the round building to the north is Convocation Hall, where we teach the most popular astronomy courses to classes of 1300+. This is a challenge: we must find ways to engage the students, such as by making effective use of devices called personal response devices or "clickers". The lectures are supported by small-group tutorials, by presentations in our small but powerful planetarium, and by visits to our roof-top observatory.

And don't try to set your watches by the sundial, without reading the fine print: sun time is rather non-uniform during the year.

8. **This structure illustrates the concept of "local time", and is a good introduction to the importance of "standard time" that we shall meet, soon.**

   The Toronto Meridian: a north-south marker, and standard for local time as well as for direction. Until the adoption of Standard Time, noon – the instant at which the sun was due south – was different for every longitude. This marker defined the position and the north-south direction of Toronto, and therefore of Toronto time.

   As you may see from the plaques here, this little section of the campus is of special interest to the Faculty of Applied Science and Engineering which, until recently, was responsible for training surveyors. The School of Practical Science (still commonly known as Skule) was established in 1873 and joined U of T in 1889. There's a plaque across the road marking the site of the original Skule building, which stood from 1877 to 1966.

9. **This structure illustrates how surveying works, both then and now.**

   The "Official" Position of Toronto: This pier of the transit telescope defined an accurate location for this spot, to which surveys could be referred. Using the transit telescope, and a telegraphic time signal, the astronomer could time the passage or "transit" of stars across the due-south line, and determine the precise longitude of this spot, relative to Greenwich or other well-established reference point. That's because, as a result of the earth's rotation, difference in longitude between two locations is equal to difference in their local time. It was the only place in the Toronto area whose position was known with high accuracy. The longitudes of other locations could then be determined, relative to this spot.

   One of astronomy's many contributions to Canada was its role in surveying, e.g. of the Trans-Canadian Railway. The Dominion Observatory was opened in 1905 in Ottawa, as a federal centre for timekeeping and surveying.

10. **In a "ten top Canadians" contest, Sandford Fleming probably wouldn't make it, but he should be known to every Canadian, because he helped to establish our national identity!**

    The Sandford Fleming Building: was one of several buildings completed in 1905-1908, on the site of the old observatory. This one was designed by Darling and Pearson in Beaux Arts style, and opened in 1907 as a Physics building. The building was gutted by fire in 1977, then completely restored.

    Remember that, at this time, the University was growing rapidly through the accretion of colleges and professional schools. The colleges generally took responsibility for teaching

arts and humanities, but several buildings were constructed for the centralized, more cost-effective teaching of sciences and engineering, which were, of course, non-denominational.

This building would have been the home of the astronomers until 1935. When the David Dunlap Observatory opened in 1935, most of the University's astronomical activity moved there, save for a small office and classroom in this building. Only in the 1960's, when astronomical research diversified, did some activity return here. For instance: astronomer Don MacRae was one of the first users of the University's Ferranti computer, in the 1950's. As well, he was a founder of the University's interest in radio astronomy.

Sir Sandford Fleming was best known for promoting the concept of Standard Time, though he didn't invent the idea. He also designed Canada's first postage stamp, played a major role in surveying the Trans-Canada Railway, and was a founding member of the Royal Society of Canada. He was also a founder of the Royal Canadian Institute, Canada's oldest still-existing scientific society. The RCI, founded in 1849, catered to the growing interest in science among educated people. It built on the "Mechanics Institutes" movement; Toronto's first Mechanics Institute was founded in 1831. The RCI had a huge influence on the development of science in Canada from its inception, well into the 20th century. It forged strong ties with other countries, especially the US. Now, the RCI presents free Sunday afternoon science lectures in the fall and winter, in the Macleod Auditorium, Medical Sciences Building. And if you can't attend, the lectures are available for viewing in video form on the RCI website.

Next stop: east side of St. George Street, outside Galbraith Building.

11. **This building reflects many of the aspects of post-war science and education.**

The Galbraith Building: designed by architects Page and Steele in International style, was opened in 1960, and was part of the frenzy of building that accompanied the expansion of the university as the "baby boom" descended on it. Expanded programs in engineering had also been fueled by the post-war influx of veterans as students, by their children (the baby boom), and by the general growth of science and engineering in the post-war period.

As astronomical activity at the university diversified, some of the astronomers (including me) were based here, rather than at the Dunlap Observatory, until the McLennan Labs opened in 1967.

Here, the late Professor Allen Yen conducted world-renowned studies of radio astronomy science and engineering (his home in upper Cabbagetown is marked with a plaque, visible on heritage tours of that area). Radio astronomy grew out of post-war expertise in radio and radar technology. With the growth of radio astronomy in the 1950's and 1960's, small radio telescopes were built on the grounds of the David Dunlap Observatory in Richmond Hill. Later, the federal government built a major radio observatory in Algonquin Park. One of Yen's innovations was to "virtually" connect that telescope to the one in Penticton BC to create a radio telescope equivalent to one 2000 km across.

Next stop: west side of St. George Street, in front of 60 St. George Street.

12. **How many of you think that this building (and others on this strip) is ugly?**

McLennan Physical Laboratories: by Shore and Moffat, 1967, was one of a row of mostly-science buildings constructed in the 1960's. Although it is said to have some

architectural merits, I can say, as a long-time inhabitant, that it was not user-friendly; I think it's correctly referred to as "brutalist" style. On the other hand: the recent beautification of St. George Street is a definite improvement.

Nevertheless, it's been home to world leaders in physics, astronomy, and also geophysics – the latter founded by J. Tuzo Wilson, Canada's eminent geophysicist. Nowadays, his work is being continued by equally eminent earth scientists such as Dick Peltier. This work connects, in an interesting way, with the work of the Magnetic Observatory of 1840!

In the 1960's, the university grew rapidly, with the arrival of the "baby boom". It spawned York University, and then the Scarborough and Mississauga Campuses, where astronomy is also done. In fact, Professor Tom Bolton was at the Mississauga Campus when he published his famous paper announcing the discovery of the first black hole in space.

One of Sir John Cunningham McLennan's claims to fame was understanding the (normal) green colour of the northern lights, which result from sun-earth interaction. Canadians away from city lights, especially in northern and western Canada, are privileged to see nature's greatest "light show" – especially in the next few years, as sunspot numbers are increasing. And Canadian scientists have been in the forefront of understanding the northern lights, which is essential to understanding and predicting the "space weather" that affects satellites and astronauts in space.

Indeed, Canadian scientists are world leaders in space science in general. Canada was the third country to have a satellite in space – *Alouette 1* – after the USSR and the USA. Since then, we have launched dozens. Canada's "humble space telescope" called MOST – Microvariability and Oscillations of STars – is the most precise light-measuring device anywhere, and is doing the work of satellites tens of times more expensive, and is functioning way past its shelf-life. It cost $10M – mostly for the launch on an ex-Soviet missile. Right now, I'm involved in a Canada-Austria-Poland project to launch a set of nano-satellites, the size of shoeboxes. These satellites, like MOST, are all designed and built at the University's Institute for Aerospace Studies, on Dufferin Street at Steeles Avenue, and will probably be launched by the Indian Space Agency.

13. **As taxpayers supporting science, how many of you want maximum "bang for buck"?**

The Canadian Institute for Theoretical Astrophysics: (in the McLennan Labs) recently celebrated its 25th birthday; it is one of Canada's most notable but unsung success stories in science. It is supported by the Natural Sciences and Engineering Research Council, and the Canadian Institute for Advanced Research. CITA has leveraged a relatively small budget to attract some of the best young (and older) astrophysicists in the world, and to develop one of Canada's most powerful computers for their work. It is one of the foremost institutes, of its kind, in the world.

We usually think of science in terms of experiment and theory. The dominant mode of astronomy is *observation*. The modes of astrophysics also include *theory, and especially computer simulations* – of phenomena such as the evolution of stars, galaxies, and the universe. No wonder CITA and other such institutes operate some of the most powerful computers in the world.

CITA was until recently directed by Dick Bond, Canada's foremost astronomer, and one of Canada's top scientists, recent winner of the half-million dollar Gruber Prize for

Cosmology. He is especially known for determining the "vital statistics" of our universe from observations of the left-over radiation from the Big Bang – the birth of the universe.

14. **The recent history of the DDO has garnered almost as much press as the demotion of Pluto – and of the same type.**

    David Dunlap Observatory: Earlier I mentioned the David Dunlap Observatory; some of you may be interested in its history and current status. When the observatory was opened, in Richmond Hill, in 1935, it housed the second-largest telescope in the world. It was very active until the 1980's: a major centre for research, training of graduate and senior undergraduate students, and public education and outreach [I was heavily involved in all of these]. But most observational astronomical research is now done at large international facilities, either in Hawaii or Chile, or in space; by the 21st century, the DDO's research capability was greatly reduced, though some research was still done there. It played very little role in training students. And its public education programs had been eclipsed by those of the Planetarium, and later the Ontario Science Centre. The lands were sold by the University to a developer who, however, expressed a strong interest in preserving the telescope dome, administration building, and director's residence for heritage or educational use – if funds can be found to support it. As of June 2009, the DDO has been operated by the Toronto Centre of the RASC, and public programs are in full swing.

    Most of the proceeds of the sale of the lands have been used to endow a Dunlap Institute of Astronomy and Astrophysics, to support research and education in Instrumentation and in Observational Astronomy at the University. So the Dunlap name will continue to be known to astronomers around the world. This is especially true as education and public outreach are very high priorities for the Dunlap Institute.

    Next stop: a few steps south, outside 50 St. George Street.

15. **This is MY home at the University of Toronto!**

    The Department of Astronomy and Astrophysics:, for most of the last four decades, lived in the McLennan Labs, but moved, three years ago, into this – the former Nursing Building. Designed by Allward and Gouinlock Architects in 1953, 50 St. George Street was the beginning of the University's westward expansion across St. George Street. Part of our department is still in the McLennan Labs. We have colleagues in the Physics Department whose research deals with planets, and colleagues in the Geology Department who study meteorites. A block west of here, on the north side of Russell Avenue, is an un-marked, un-numbered building which is the *highbay* where we assemble balloon-borne telescopes which fly in the near-space of the stratosphere over Antarctica.

    The Department of Astronomy and Astrophysics (DAA) is one of the foremost astronomy departments in the world. The department recently celebrated its 100th birthday. Its research programs are numerous and strong, but it is especially known for its research in observational cosmology, and in the formation and evolution of stars and planets. It is a centre for post-graduate education in astronomy and astrophysics, and attracts students from all over the world. Indeed, they are one of our great strengths. Graduate studies have existed at U of T for over a century, but a separate School of Graduate Studies was not formed until 1922. It is headquartered in two historic houses, further north on St. George Street.

At the undergraduate level, the DAA educates both specialist students, and also thousands of non-specialists who take introductory courses to learn about astronomy and the nature and methods of astronomy. There is a free public tour and non-technical lecture on the first Thursday of every month, including looking through the telescope if the sky is clear. I hope some of you will come back for this opportunity.

Other ways of keeping up with astronomy are (i) through www.cascaeducation.ca website, (ii) through the meetings of the RASC, (iii) through the magazine *SkyNews*, edited by Terence Dickinson; (iv) reading any book or article by Terence Dickinson, or Dan Falk; or (v) attending our free public tour on the first Thursday of each month.

Resources:

http://www.astro.utoronto.ca/∼percy/EPOindex.htm – John Percy's outreach page

http://universe.utoronto.ca – U of T Astronomy outreach website

http://toronto.rasc.ca – Royal Astronomical Society of Canada, Toronto Centre

http://www.theDDO.ca – Dunlap Observatory public programs.