A day in the life....
Tom McElroy
Alan Brewer

Alan W. Brewer (1915–2007)

Alan Brewer

Michael McIntrye  Kiril Seminiuk  Alan Brewer

1999 50th anniversary of the Brewer-Dobson paper

July 15-19, 2013  UofT CREATE Summer School
Transport Canada

JetStar aircraft used to make NO$_2$ profile measurements published in *Nature*, November, 1973

The NO$_2$ measurements were made with an early version of the Brewer Ozone Spectrophotometer.

**Nitrogen Dioxide Concentrations in the Atmosphere**

Atlantic Canada Aviation Museum
Concorde 002 1973

Concorde 002 interior

002 landing at Fairford England

Whitey
Delivered the first Brewer to Thessaloniki, Greece and the second to Norkkoping, Sweden.
BOIC
Balloon Ozone Intercomparison Campaign
1983
Damage

UK NPL Pointing system

Former far-IR Michelson
Marc Garneau operates the AES SunPhotometer on board the Orbiter Challenger.

Note the use of sunglasses and a special UV filter on the side-hatch window to provide protection from the intense solar ultraviolet in space.

An ozone profile paper was published in the Canadian Journal of Physics in 1991 by McElroy et al.

1984: Marc Garneau. Photo courtesy of NASA.
Laser Heterodyne Spectrometer

Denver, CO, 1985-1987

Lead salt TDL
In vacuum at 38K

Spears HgCdTe
1 GHz photodiode
Central Control

Two TI 790 mini computers.

Suntracker microcomputer.
A Rat’s Nest

On the left:
A backing pump.
On rack above, two helium coolers for the lead salt TDLs.

On the right:
The wiring, plumbing and optical bench.

The system included 2 minicomputers and over 1 dozen microcomputers.
In the mid to late 1980s...

- Much pseudo-scientific debate about ozone
- Public concern but a lack of knowledge
- EC Ozone Watch and UV Index programs
- Ozone watch to let the public judge for themselves
- UV Index to increase awareness of the impact of ozone change and the need to change behaviour
1987: Progressive Conservative Environment Minister Thomas MacMillan signs the Montreal Protocol Agreement for Canada

"Perhaps the single most successful international agreement to date has been the Montreal Protocol."
-Kofi Annan, Former Secretary General of the UN

26 years ago, September, 1987
Canadian Montreal Protocol Signing Delegation 1987

Wayne Evans, Research Scientist, EC
Gordon Harris, EC comms
Georges Mezetta, EC Quebec Region

Steve Hart, EC
Jim Kerr, Research Scientist, EC
Tom McElroy, Research Scientist, EC
Vic Buxton, Chief, Chemical Controls Division, EC
Roy Begin, EC
Jon Allen, Department of Foreign Affairs (chaired drafting committee)
Peter Serafini, EC comms
Tim Leah, Chemical Controls Division, EC

Nicole Jaamin, UN Program, EC
Peter Higgins, Director General, Environmental Protection, EC
Thomas McMillan, Minister of the Environment
Clifford Lincoln, Quebec Minister of the Environment
Julyn Reid, Director General, External Relations, EC
Alex Chisholm, Director, Atmospheric Processes Research Branch, EC

Lewis Poulin, EC
Margit Doneit, EC comms
Ben Stafford, comms consultant

Lise Hyde, EC

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SPEAM-2
On STS-52 in October, 1992

EC SunPhotoSpectrometer

Steve MacLean  Photo courtesy Canadian Space Agency
Chemistry

Arctic Stratospheric Experiment revealed large variations in chemistry between the best model results and observations.

EC developed the Composition and Photodissociative Flux Measurement pod based on the SunPhotoSpectrometer Flown on STS-52.
MANTRA

[Middle Atmosphere Nitrogen Trend Assessment]

Balloon Project

Partners

• Meteorological Service of Canada
• University of Toronto
  (Strong & Drummond)
• York University
• University of Waterloo
• Service d’Aéronomie, Paris

Funding

• Canadian Space Agency
• Natural Sciences and Engineering Research Council
• Canadian Foundation for Climate and Atmospheric Science
• Meteorological Service of Canada

*It turned out to be the ‘Balloon that got Away’*

MANTRA 1998
Filling an 11 Million Cubic Foot
Jonathan Davies and a number of students nanch an Ozonesonde on a 1000,000 cu ft Raven balloon. Vanscoy, SK
Safely Landed!

After a 10-day jaunt across the main trans-Atlantic air routes pursued by Canadian F-18s, the balloon finally made a safe landing on Mariehamn Island in the Baltic Sea.

The payload was damaged but all instruments returned home in useful condition.

Our friends in the Finnish Met Service travelled to the Island, boxed up the payload and returned it to Toronto via New York.

Photo taken by Finnish journalist. Borrowed from *Canadian Geographic*. 
Borrowed from Canadian Geographic

DOWN TO EARTH: A group of Finnish children found a very large plastic bag to play with after a Canadian weather balloon went 9,000 km astray, disrupting air traffic and defying attempts by Canadian fighter jets to shoot it down. The 25-storey, helium-filled balloon was launched near Saskatoon on Aug. 24 to measure ozone levels over Canada. But after its package of scientific instruments failed to detach, it kept on floating. It began losing altitude after Canadian jets fired 1,000 cannon rounds at it over Labrador, but it only came to earth six days later on Finland's Aland Island.
MAESTRO Under Test...2003

~15 cm
Brewer Work and Workshops

July 15-19, 2013

UofT CREATE Summer School
Cosy accommodations and 30,000 litres of liquid helium during 2008 trip to the South Pole
Arriving McMurdo
Hercules LC-130
South Pole

An Environment Canada double Brewer was installed on the roof of the clean air laboratory of NOAA about 500 m from the South Pole in 2008.

The Brewer corroborated the measurements made by the NOAA Dobson at the South Pole via a completely independent calibration path.

The instrument is still running well in spite of minimal maintenance.
Survival!
MAESTRO-B
2011
CNES-CSA
CNES launch of MAESTRO-B in Kiruna, Sweden, 2011
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ASC
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The End
Thank you for your attention
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Heather Mackey
Chris McLinden
Jack McConnell
David Francis
And many others...
In Memoriam

Some of the folks listed on the previous slide passed on in the last few years -

Art Schmeltekopf   Ralph Nicholls
Alan Brewer        Clive Midwinter
Bill Gee